Food and Agriculture
Organization of the
United Nations

Indigenous Peoples' food systems

Insights on sustainability and resilience from the front line of climate change

Alliance
Bioversity International
CIAT
International Center for Tropical Agriculture
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Indigenous Peoples' food systems

Insights on sustainability and resilience from the front line of climate change

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Cover photo: Community member of the Tikuna-Cocama-Yagua reserve fishing on Lagos de Tarapoto Wetland Complex in Puerto Nariño, Colombia.
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ABBREVIATIONS AND ACRONYMS

A4NH	CGIAR Research Program on Agriculture for Nutrition and Health
ABS	Access and benefit-sharing
ACODERJE	Asociación para la Coordinación del Desarrollo Rural de San Juan Ermita
ANMs	Auxiliary nurse midwife
APL	Above poverty line
ASEDECHI	Asociación de Servicios y Desarrollo Socioeconómico de Chiquimula
ASHA	Accredited social healthy activist
ASORECH	Asociación Regional Campesina Ch'orti'
ATICOYA	Asociación de autoridades indígenas del resguardo Tikuna, Cocama, Yagua
AUNAP	Autoridad Nacional de Acuicultura y Pesca de Colombia
BEES	Barefoot Environment Educators
BMC	Biodiversity Management Committee
BPL	Below poverty line
CADER	Programa de Agricultura Familiar y Centros de Aprendizaje para el Desarrollo Rural
CFC	Christian Fellowship Church
CFS	Committee on World Food Security
CHINAR	Central Himalayan Institute for Nature & Applied Research
CIAT	International Center for Tropical Agriculture
CIFOR	Center for International Forestry Research
CINE	Center for Indigenous Peoples' Nutrition and Environment
COAG	Committee on Agriculture
COCODE(S)	Consejo(s) Comunitario(s) de Desarrollo Rural
COFI	Committee on Fisheries
COFO	Committee on Forestry
COMUNDICH	Coordinadora de Asociaciones y Comunidades para el Desarrollo Integral del Pueblo Ch'orti'
CONAP	Consejo Nacional de Áreas Protegidas
COVAREF	Comités de Valorisation des Ressources Fauniques
DANE	Departamento Adminstrativo Nacional de Estadística
ENAM	Energía para el Amazonas
EUR	Euro
FAO	Food and Agriculture Organization of the United Nations
FPIC	Free, prior and informed consent
GIAHS	Globally Important Agricultural Heritage Systems
GPS	Global positioning system
GTQ	Guatemalan quetzal
HACCP	Hazard Analysis and Critical Control Point
ICBF	Instituto Colombiano de Bienestar Familiar
ICDS	Integrated Child Development Scheme
INAB	Instituto Nacional de Bosques de Guatemala
INR	Indian rupee
INSTAT	Institut national de la statistique du Mali
IPCC	Intergovernmental Panel on Climate Change
IRD	French National Research Institute for Sustainable Development
ITCZ	Intertropical convergence zone
KSO	Khadar Shnong Organization
LPG	Liquefied petroleum gas
MASL	Metres above sea level
MDC	Members of Autonomous District Councils
MeECL	Meghalaya Electricity Corporation Limited
MEHRD	Ministry of Education and Human Resources and Development
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MHIS	Meghalaya Health Insurance Scheme
MLA	Members of State Legislative Assembly
MRDS	Meghalaya Rural Development Society

NEN	North East Network
NESFAS	North East Slow Food and Agrobiodiversity Society
NGO	Non-governmental organization
NGT	National Green Tribunal
NIAHS	Nationally Important Agriculture Heritage System
NORAD	Norwegian Agency for Development Cooperation
NTFP	Non-timber forest product
PAFFEC	Programa de Familiar para el Fortalecimiento de la Economia Campesina
PBR	People's Biodiversity Register
PDS	Public distribution system
PET	Polyethylene terephtalate
PGS	Participatory guarantee system
pH	Potential of hydrogen (a figure expressing the acidity or alkalimity of a solution)
PHE	Public Health Engineering Department
PINPEP	Programa de incentivos forestales para poseedores de pequeñas extensiones de tierra de vocación forestal o agroforestal
PKH	Pastoralist Knowledge Hub
REDD+	Reducing Emissions from Deforestation and Forest Degradation
ROS	Rain-on-snow
SDA	Seventh-day Adventist Church
SHG	Self-help group
SSF	Small-scale fisheries
SIMSAN	Sistema de Información Municipal de Seguridad Alimentaria y Nutricional
TD	Thematic discussions
Ticoya	Tikuna-Cocama-Yagua indigenous reserve
TIP	The Indigenous Partnership for Agrobiodiversity and Food Sovereignty
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNPFII	United Nations Permanent Forum on Indigenous Issues
UREDA	Uttarakhand Renewable Energy Development Agency
USD	United States dollar
VDC	Village Development Committee
VDMC	Village Disaster Management Committee
VEC	Village Employment Committee
VGGT	Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security
VHNSC	Village Health Nutrition and Sanitation Committee
VWSC	Village Water Sanitation Committee
XAF	Central African CFA franc

FOREWORD

Climate change has been an ongoing struggle for Indigenous Peoples. It is not a challenge that we are awaiting the consequences of, but one we are currently facing and have been facing every day. I come from a Sámi people fishing community in northern Finland. We are experiencing first hand the effects of climate change on Indigenous Peoples. Global warming is melting the ice and fish resources are diminishing, which is affecting our food system and, as a result, compromising our livelihoods. Finding solutions to climate change is not just a priority, it is an emergency.

Indigenous Peoples number 476 million persons worldwide, living in more than 90 countries and belonging to 5 000 different peoples and linguistic groups. We are amongst the most culturally diverse and traditionally unique societies on earth because of our rich history, culture, spirituality, unique ancestral links and tremendous traditional knowledge. Our ways of life, cultures and knowledge systems have been passed on for centuries.

Indigenous Peoples are amongst the longest living cultures in the world. Our land and territories are as diverse as our groups. Whilst some Indigenous Peoples live in the Amazon rainforest, others live in the Sahara Desert, and many others live in mountains, in the Arctic or on remote islands. Our territories encompass over a quarter of the world's land surface, and intersect about 35 percent of all terrestrial protected areas and ecologically intact landscapes in the world (Garnett *et al.,* 2018). We must assert and emphasize that indigenous territories preserve and sustain 80 percent of the world's remaining biodiversity (Sobrevilla, 2008).

Researchers, academia and the international community have long investigated how and why indigenous territories are home to the highest percentage of biodiversity on the planet.

The answer is simple. It is because of our profound connection to our territories and our traditional knowledge. We have learned to preserve our territories and their natural resource bases and passed this knowledge from parents to children for centuries. Our survival is a testament to Indigenous Peoples' ability to observe, adapt and incorporate traditional knowledge to ever-changing ecosystems, and harmoniously reside within the biological diversity of Mother Earth.

This all-encompassing richness in culture and traditions allows Indigenous Peoples to develop and sustain diverse and unique food systems. From reindeer herding to gathering wild plants and berries, Indigenous Peoples generate and collect food in complex, holistic and resilient ways whilst always respecting the need to preserve the biological diversity that generates and maintains harmony in nature. Eating and feeding but without destroying. Eating and feeding but maintaining biodiversity. Eating and feeding thanks to Mother Earth's generosity that needs to be nurtured, protected and respected. In nature, everything is alive and has an ultimate purpose and reason of being. This purpose, often overlooked in scientific assessments, is unfortunately better grasped when the plant or animal or berry has disappeared, and the balance is gone.

Indigenous Peoples' wisdom, traditional knowledge and ability to adapt provide lessons from which other non-indigenous societies can learn, especially when designing more sustainable food systems that mitigate climate change and environmental degradation. We are all in a race against time with the speed of events accelerating by the day.

It is crucial to recognise Indigenous Peoples as key players in achieving the 2030 Agenda and to create larger spaces for more inclusive dialogues recognising the vast lessons to be learned from them.

Although Indigenous Peoples and their ecological-based food systems have adapted and survived for centuries, pressures from extractive industries, intensive agricultural schemes, lack of access to natural resources, increasing environmental degradation, and drastic changes in climatic conditions are posing major threats to our livelihoods. Our food systems are not only relevant to us, but to the global community as well. This is why the global community must listen and join forces with Indigenous Peoples and advocate for the preservation and safeguarding of Indigenous Peoples' food systems before it is too late and the knowledge we hold, accumulated over hundreds of years, is gone forever.

Many other challenges have the potential to devastate Indigenous Peoples' food systems. These include the migration of Indigenous Peoples away from indigenous communities to urban centres, and the increased capitalization and monetization of their economies due to their increased connectivity to commercialized societies. Their traditional knowledge is also disappearing at an alarming rate. As indigenous elders, who preserve and share this knowledge, gradually pass away, much of this traditional knowledge disappears with them.

Indigenous Peoples hold internationally recognised rights for the preservation of their food systems through the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), particularly through the inherent right to self-determination and their right to food. The right to food of Indigenous Peoples was also recognised in the 2004 Voluntary Guidelines on the Right to Food, indicating how these rights are strongly linked to Indigenous Peoples' lands, resources and culture. Therefore, human-rights-based dialogue is necessary to ensure the inclusion of Indigenous Peoples in global debates on ending hunger and ensuring food security for all.

The United Nations Permanent Forum on Indigenous Issues (UNPFII) will take forth this dialogue in upcoming annual sessions.

The UNPFII welcomes the recognition of Indigenous Peoples by the Food and Agriculture Organization of the United Nations (FAO) as allies in the fight against malnutrition and food insecurity. We have accompanied FAO in all relevant work for the implementation of its Policy on Indigenous and Tribal Peoples since 2010.

The UNPFII also recognises FAO's relevant work on Indigenous Peoples' food systems, specifically the two key publications that FAO and the Center for Indigenous Peoples' Nutrition and Environment (CINE) at McGill University released in 2009 and 2013. These publications provided much-needed insights into our traditional food systems, their utilization, and changes in the dietary patterns in our communities. In 2018, the High-Level Expert Seminar on Indigenous Food Systems in Rome organised by FAO brought together countries, Indigenous Peoples and academics to share traditional and scientific knowledge to identify research and policy gaps on Indigenous Peoples' food systems.

The UNPFII celebrates and welcomes this current publication, which combines research and case studies that delve into Indigenous Peoples' food systems. This publication is an important step in creating a deeper understanding of Indigenous Peoples' food systems. In this regard, this publication maps eight diverse Indigenous Peoples' food systems, providing insights and details into their unique elements of sustainability and resilience. FAO has conducted this participatory field research in collaboration with the Alliance of Bioversity International and CIAT, engaging with Indigenous Peoples and their communities.

I would like to thank all the Indigenous Peoples and members of their communities, as well as the researchers, who have contributed to this work. We hope this publication motivates policymakers to integrate Indigenous Peoples' perspectives in the debates about sustainable food systems. We must align altogether on the path towards a more just and sustainable world, tackling climate change and accelerating solutions to humankind´s greatest challenges.

Anne Nuorgam,
Chair of the United Nations Permanent Forum on Indigenous Issues (UNPFII)

PREFACE

The Food and Agriculture Organization of the United Nations (FAO) and the Centre for Indigenous Peoples' Nutrition and Environment (CINE) at McGill University published in 2009 "Indigenous Peoples' Food Systems: the many dimensions of culture, diversity and environment for nutrition and health". This publication was the result of months of fieldwork and a collaboration between indigenous leaders, McGill University-CINE, and the FAO Food and Nutrition Division. The publication brought attention to the broad food base and consumption of nutritious and medicinal edibles by Indigenous Peoples. The food systems of the Inuit, Nuxalk and Gwich' in of Canada, the Awajun of Peru, the Ingano of Colombia, the Maasai of Kenya, the Igbo of Nigeria, the Dalit and Bhil of India, the Karen of Thailand, the Ainu of Japan, and the inhabitants of Pohnpei Micronesian island were analyzed, showing how their food systems were based on food species and varieties/cultivars that number from 35 to almost 400.

This 2009 publication was the first book published by FAO that analyzed the comparative characteristics of diverse Indigenous Peoples' food systems from across the world. The book drew the interest of experts, researchers and policymakers towards the tremendous – and often underestimated – richness of knowledge that the traditions and ancestral practices of Indigenous Peoples have maintained and nourished over centuries. The essence of Indigenous Peoples' knowledge systems is largely encapsulated in how they generate, harvest, hunt and grow such diverse foods.

In 2013, FAO and McGill University-CINE published "Indigenous Peoples' food systems & well-being: interventions & policies for healthy communities". This second publication was the result of nearly 10 years of extended research about the challenges that Indigenous Peoples' food systems are facing in a fast-changing world. The researchers analyzed the challenges of the indigenous communities presented in the 2009 publication, concentrating their findings on aspects of health and nutrition. The second publication provided policy recommendations to help protect traditional knowledge and customary governance rules, with the ultimate goal of preserving the communities' nutrition and health, with particular emphasis on children.

In 2015, the recently established FAO Indigenous Peoples Team hosted in Rome a caucus with indigenous representatives and leaders from the seven socio-cultural regions. The caucus identified priorities for their work with FAO based on the organization's technical expertise. One of the most salient requests from indigenous leaders at the plenary discussions was for FAO to create a working group on Indigenous Peoples' food systems. FAO management agreed, and ever since the FAO Indigenous Peoples Unit has been coordinating a task group on Indigenous Peoples' food systems involving other technical divisions as well as key research organizations.

In 2018, FAO joined forces with different Indigenous Peoples' organizations, research centres, the United Nations (UN) and international organizations to host the First High-Level Expert Seminar on Indigenous Food Systems at its Rome headquarters. The Expert Seminar brought together more than 200 participants including 70 speakers representing indigenous leaders, researchers, governments and FAO experts from different fields. The main result of this Expert Seminar was the agreement about the need to create a Global-Hub on Indigenous Peoples' Food Systems that would bring together universities, research centres, Indigenous Peoples and UN agencies. The Global-Hub would be dedicated to facilitating a dialogue between scientists, academics and Indigenous Peoples to co-create knowledge, reshape terminology and reexamine conceptual frameworks. The Global-Hub is expected to contribute to the ongoing global debate on sustainable food systems and climate resilience.

In past decades, the world witnessed a series of global challenges that have influenced conceptual discussions and policy debates, placing food systems at the centre of the discussion within the Committee on World Food Security (CFS) as well as FAO Technical Committees on Agriculture (COAG), Forestry (COFO) and Fisheries (COFI).

The 2007 subprime mortgage crisis spilled over into the food market and generated a spike of food prices that pushed several countries across the world into a critical food-provision shortage. In parallel, the loss of biodiversity and the degradation of the environment, exacerbated by climate change and weather variability, are increasing the extinction of species and damaging ecosystems. More and more, experts have moved from production and food availability concerns to looking more broadly through the lens of food systems. Beyond the food security pillars of availability, access, stability and utilization, this lens started to incorporate considerations such as value chains, local food production, food losses and waste, agroecology, food sovereignty, environmental externalities, biodiversity, climate, nutrition, health, energy and input balances, as well as the interrelations between the different players along the food trade and production value chain. The global conceptual debate moved from food security to food systems.

Today, food systems based on agriculture and livestock consume more than 70 percent of the water (FAO, 2017b), 30 percent of the fossil fuels (OECD, 2010) and use 38 percent of the land (FAO, 2011) in the world. The debate has been evolving towards the importance of reviewing the sustainability of production, distribution and commercialization to make recommendations that transform food systems, making them efficient, sustainable, nutritious and respectful of the environment.

Cognizant of this debate and of the different paradigms being considered, in 2017 the FAO Indigenous Peoples Unit, in an effort to develop a collaborative methodology for analyzing Indigenous Peoples' food systems, approached the Alliance of Bioversity International and CIAT, The Indigenous Partnership for Agrobiodiversity and Food Sovereignty (TIP), The French National Research Institute for Sustainable Development (IRD), the Center for International Forestry Research (CIFOR), FAO's Pastoralist Knowledge Hub (PKH), FAO Fisheries Division, FAO Food and Nutrition Division, and the Mountain Partnership Secretariat. Inspired by the Self-evaluation and Holistic Assessment of climate Resilience of Farmers and Pastoralists (SHARP)[1] and other participatory research methods, this new methodology could be used to profile the status and trends of Indigenous Peoples' food systems across the world and continue the work started by FAO in 2009.

[1] For further information, see http://www.fao.org/in-action/sharp/sharp-application/en/

The book you are about to read constitutes the third volume on Indigenous Peoples' food systems. The objective of this publication is to (1) acknowledge the contributions that Indigenous Peoples can make to achieve the 2030 Sustainable Development Goals (SDGs); and to (2) advocate for these contributions and associated food systems to be taken into consideration in ongoing discussions about sustainable and efficient food systems that could support better nutrition and health.

Co-published by FAO and the Alliance of Bioversity International and CIAT, this publication builds on the analysis by a Scientific Editorial Committee of field research carried out with the involvement of participating Indigenous Peoples' communities. Their rich discussions, their interest in the work and their level of participation, often setting aside their chores to talk to the researchers and local organizations, made the difference and informed the content of this book. The Indigenous Peoples participating in the profiling of the Indigenous Peoples' food systems are eager to share with the rest of the world the fundamental aspects of their ancestral knowledge that may contribute to better understandings of what makes food systems sustainable and resilient.

This book makes valuable contribution to global food system debates, including, but not limited to, the ability to generate food without depleting the natural resource base but rather preserving and enhancing the biodiversity and health of the ecosystems, the use of renewable energy sourced from within the food system, the importance of customary governance mechanisms and institutions, and the role that traditional knowledge plays in climate resilience.

At the same time, the research has revealed the tremendous forces and pressures that Indigenous Peoples across the world withstand to maintain their livelihoods and food systems. Rural-urban migration, food aid schemes that are not culturally appropriate, transition towards a more monetized economy, abandonment of traditional practices, loss of knowledge and languages, land grabbing and encroachment of Indigenous Peoples' territories, influx of highly processed imported foods, pollution of waters, lands and resources, inexorable deforestation, forced displacement, and increasing rates of suicide and self-harm amongst indigenous youth are some of the most acute issues threatening the future of Indigenous Peoples' food systems.

Chaired by the FAO Indigenous Peoples Unit, the Scientific Editorial Committee, composed of the Alliance of Bioversity International and CIAT, TIP, IRD, Massey University, the PKH, and the FAO Food and Nutrition Division, reviewed all the materials from the field, selecting 8 profiles out of the 12 initially prepared by the local indigenous organizations and field researchers. The 8 profiles presented in this book correspond to the food systems of: the Baka in Cameroon, the Inari Sámi in Finland, the Khasi in India, the Melanesians[SI][2] in Solomon Islands, the Kel Tamasheq in Mali, the Bhotia and Anwal in India, the Tikuna, Cocama and Yagua in Colombia, and the Maya Ch'orti' in Guatemala.

We hope that the present volume will encourage researchers to learn more about Indigenous Peoples' food systems, policymakers to incorporate new knowledges and values, country representatives to respect other forms of knowledge, and practitioners to influence the global debate with stronger field-basedgrounded evidence.

We hope that the present volume will encourage countries to include Indigenous Peoples' representatives in policy discussions that affect humankind.

Rome, March 2021.

[2] Note from the editors: Melanesia region, inhabited by the Melanesian people, covers an important area that includes Papua New Guinea Island, Solomon Islands, Vanuatu and Fiji. There is hence an important cultural diversity amongst the Melanesians, who can locally belong to subgroups. The referencing to Melanesian[Solomon Islands], noted afterwards Melanesian[SI], indicates that the authors are referring to the Melanesians inhabiting Solomon Islands, in absence of indication of any further specific identification.

Milpa bordering a diverse multiuse forest in Jocotán.

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The overall guidance and direction of the publication was carried out by Yon Fernández-de-Larrinoa (Indigenous Peoples Unit, FAO) and Anne Brunel (Indigenous Peoples Unit, FAO), supported by a Scientific Editorial Committee composed[3] of: Barbara Burlingame (Massey University), Edmond Dounias (the French National Research Institute for Sustainable Development-IRD), Serena Ferrari (Pastoralist Knowledge Hub-PKH, FAO), Danny Hunter (Alliance of Bioversity International and CIAT), Ana Islas Ramos (Food and Nutrition Division, FAO), Gennifer Meldrum (Alliance of Bioversity International and CIAT), Stefano Padulosi (Alliance of Bioversity International and CIAT), Phrang Roy (The Indigenous Partnership for Agrobiodivesrity and Food Sovereignty-TIP), Florence Tartanac (Food and Nutrition Division, FAO), Gregorio Velasco Gil (PKH, FAO) and Maria Xipsiti (Food and Nutrition Division, FAO), which provided scientific and technical edits to the case studies.

Edmond Dounias (IRD) prepared the Executive Summary and Yon Fernández-de-Larrinoa (FAO) wrote the Policy Recommendations section, with technical inputs from Anne Brunel (FAO), Luisa Castañeda (FAO), Gennifer Meldrum (Alliance of Bioversity International and CIAT) and Ida Strømsø (FAO). The circular calendars for each chapter were prepared by Yanto Wahyantono (IRD). The species index was prepared by Ida Strømsø (FAO). The final layout of the publication was guided by Mariana Estrada (FAO) and realized by Carlos de la Fuente González and Carlos Matilla (Isla Gráfica) with the editorial support of the FAO Publishing Group (OCCP). The final stages of the editing and publication process benefited from the inputs and contributions by Luisa Castañeda (FAO), Mariana Estrada (FAO), Sara Sheibani (FAO), Ida Strømsø (FAO) and Mikaila Way (FAO). Final comments, clearances and technical contributions were received from Beth Bechdol (FAO), Máximo Torero Cullén (FAO), Marcela Villarreal (FAO), Anna Lartey (FAO), Benjamin Davis (FAO), Jamie Morrison (FAO), Maria Xipsiti (FAO), Ramani Wijesinha Bettoni (FAO), Tomas Buendia (FAO), Nicole Franz (FAO), Benjamin Siegelman (FAO), Guido Agostinucci (FAO) and Mariana Estrada (FAO).

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Out of the 12 Indigenous Peoples' communities involved in the fieldwork, after the review, analysis

[3] Organised by last names in alphabetical order.

and validation by the Scientific Editorial Committee, 8 were included in this publication, portraying the food systems of 11 different Indigenous Peoples. Our sincere thanks and acknowledgment to the remaining four Indigenous Peoples and their communities, whose members put time apart from their daily chores to support the research and fieldwork towards this initiative.

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• **Chapter 1: Hunting, gathering and food sharing in Africa's rainforests.**
The forest-based food system of the Baka Indigenous People in South-eastern Cameroon was prepared by Masaaki Hirai (Center for African Area Studies, Kyoto University), Towa Olivier William Kamgaing (Center for African Area Studies, Kyoto University) and Gennifer Meldrum (Alliance of Bioversity International and CIAT). Abouli Jean, Mbokamba Germi, Adjomo Jean, Konga Mathurin, Kakouar Janvier, Mbossi Jean, Mbossi Felix, Mepongo Daniel, Mbossi Felix Fils, Assolo Jean, Djema André, Lengo Jean Paul, Egoulou Matin, Pkasselé, Bonawe Germi, Souka Daniel, Essouma Brigitte, Ama Guilaine, Adjo Vigini, Bototo Odette, Ebeni Marie, Kabili Pauline, Kopayo Lidy, Massala Jeanine, Sangale, Apkagui Pauline, Amedji Janne, Sema Odette, Ama Jacqueline, Galla Rosette, Mandeya Jacqueline, Djamie Juliene, Wena Delfine and Dagoma Marie, Chaude Jonas, Manganba Fedjina, Douma Denis, Dangouma Odette, Kundu Delfine, Andjouba Ilem, Madema Mari, Avanda Remi and Mbosssi Michel participated in the profiling of the food system. Bongo Bongo Alain, Assolo Mesaba Rodin and Atia Yvette were the facilitators. Nkoul Messaba Marius, Azam Jean Paul, Moamie Nathan, Lemidjeng Kenis and Tamdo Florence were responsible for taking notes. Zouom Sylvain, Medjinandjo Bertrand, Onana Syprian and Kani Célestin were the translators. Alidou Lytti and Timothée Kamgaing, the staff of Gribe research station, Akiyo Shioya (Kyoto University) and Gaia Lochetti (Alliance of Bioversity International and CIAT) provided valuable support to this case study.

• **Chapter 2: Voices from Arctic nomads: an ancestral system facing global warming.**
Reindeer herding food system of the Inari Sámi people in Nellim, Finland was prepared by Inka Saara Arttijeff (Sámi Parliament in Finland), Elle Maarit Arttijeff (Sámi Parliament in Finland) and Tero Mustonen (Snowchange Cooperative).

• **Chapter 3: Treasures from shifting cultivation in the Himalayan's evergreen forest.**
***Jhum*, fishing and gathering food system of the Khasi people in Meghalaya, India** was prepared by Bhogtoram Mawroh (North East Slow Food and Agrobiodiversity Society-NESFAS), Ruth Sohtun (NESFAS), Pius Ranee (NESFAS), Melari Nongrum (NESFAS), Phrang Roy (TIP) and Gennifer Meldrum (Alliance of Bioversity International and CIAT). Asteshon Diengdoh, Carius Ranee, Angelbert Dohling, Edmund Khonglam, Carmelus Ranee, Horno Dohling, Richard Ranee, Jilius Riahtam, Roisius Khongsit, Pynsuklang Khongsit, Jasinta Ranee, Agnes Khonglam, Lista Khonglam, Martina Rani, Suklin Dohling, Bibiana Ranee, Makrina Ranee, Ioana Khongsit, Patrisha Riahtam and Sweetsila Ranee participated in the profiling of the food system. The Martin Luther Christian University Research Ethics Committee reviewed and approved the methodology.

• **Chapter 4: From the ocean to the mountains: storytelling in the Pacific Islands.**
Fishing and agroforestry food system of the Melanesians[SI] people in Solomon Islands was prepared by Chris Vogliano (Massey University), Jessica E. Raneri (Alliance of Bioversity International and CIAT) and Shane Tutua (SPE Consulting), with the support of Carol Offer (Solomon Islands National University) and Joe Hagabore (Solomon Islands National University). The Massey University Human Ethics Review Board and the Solomon Islands Ministry of Education and Human Resources and Development (MEHRD) approved the methodologies and research. The participating institutions, communities, networks and individuals provided important inputs to this case study. The following participants provided valuable support to this case study: The Women – Elders: Liza Tambe, Audrey Havea, Nelly Tony, Hetigula Lulu, Rose. R, Mizipa. G, Judith. G, Renny. O, Ruth, Margaret Piko; Adults: Sabe Kenwick, Vicka Devis, Eving Pita, Kokena Mockson, Jenny Erick, Carolyn Tope, Tare Isaac, Elizabeth James, Dorida Elson, Jane Taki, Melisa K., Loren Z., Mirraim B., Libe P., Ilian V., Elis J., Lynmah G., Ester H., Elisa D., Anna, Freda, Zizalia, Aristio, Wati, Jenny M., Vaelyn, Tema, Jerolyn, Betty. Children: Eugene Qua, Kemasi I., Rosly H., Amalan P., Maristio V., Silivina V., Mayoth J.; Men – Elders: Benjamin Kavi, John Sigoto, James D., Samuel Rove, Elijah Nole, Mockson J., Manoka H.; Adults: Eric Sapa, Kalepo Newzom, Frank Langa, Joseph Terry,

Scaou B., Hosea R., Moses Bulekolo, James Dimmy, Hosea Reo, Skann Baki, Jimmy R., Devesi M., Tom T., Nickson P. Children: Douglas L., Batolo R., Robino V., Clifford G., Douglas B., Frances O., Dilo E., John T.

• **Chapter 5: Surviving in the desert: the resilience of nomadic herders.**
Pastoralist food system of the Kel Tamasheq people in Aratène, Mali was prepared by Aboubacrine Ag Mohamed Mitta (Réseau des Peuples Pasteurs du Sahel-RPPS), Ouayara Kone (RPPS), Ahmed Ag Hamama (RPPS) and François-Xavier Cherdo (Independent). Moctar Ag Mohamed Aly (village chief), Mohamed El moctar Ag Abdoulahi (notable), Mohamed Aly Ag Abdoulahi (retired teacher), Maya Walet Mohamed Aly (Women's Association), Fadimata Walet Hamama (Women's Association), Mohamed Attaher Ag Mohamed (notable), Mohamedoun Ag Mohamed Elmoctar (notable), Mohamed Aly Ag Mohamed (village adviser), llama Walet Alhousseyni (Women's Association), Aïchata Walet Mohamadoune (Women's Association), Aicha Walet Mohamed, (Women's Association), Mohamed Ag Abdoulahi (village adviser), Maya Walet Mohamed (Women's Association), Taya Walet Mohamed Elmoctar (Women's Association) and Erhant Ag Mohamed (village adviser) provided valuable contributions to the organization of this case study. The community participants, youth and children provided a key role in the thematic discussions. They included: Men – Moctar Ag Mohamed Ali, Aboubacrine Ag Mohamed Mitta, Zinoreyni Ag Mohamed Ali, Balti Ag Mohamed Ali, Mohamed Ag Adeg, Menkou Ag Ballo, Mihdi Ag Amidi, Hamel Ag Abdolaye, Hamel Ag Mossa, Mohamedoun Ag Hamama, Hamet Ag Ehya, Mamatal Ag Abdolahi, Igbey Ag Zouaya, Irahim Ag Mohamed Ali, Mohamed Elmoctar Ag Hamada, Ebey Ag Aya; Women – Tabosate Wallet Mohamed, Tikertan Wallet Abdolahi, Fati Walet Abdoulsalam, Niktete Walet Abdolhi, Almidinet Walet Moctar, Maya Walet Mohemmed Ali, Tifinit Walet Mosa, Fadimoutou Walet Alhassane, Aramet Walet Mohamed Ibrahim, Aminoutou Walet Khandi, Kani Walet Alkaussi, Zimilaye Walet Ibrahim, Safia Walet Ibrahim, Tassa Walet Mohamed Ahmad, Kadidjatou Walet Mohamed; Boys – Inine Ag Tchin, Mohamed Ag Mohamed Ousmane, Morab Ag Anim, Mohamed Ah Mohamed Amed, Anafa Ag Acheik, Mohamed Ahmad Ag Ahmad, Mohamed Ahmad Hamé, Amidi Ag Mohamed Ibrahim, Ousmane Ag Mohamed; Girls – Mariam Wallet Mohamed Ahmad, Janati Walet Mohamed Ahmed, Talla Walet Habahi, Tébébete Walet Ibrahim, Aicha Walet Ibrahim, Mariama Walet Ismael, Zeina Walet Ibrahim, Aoudou Ag Mohamed Ousmane, Fadi Walet Mohamed, Oumaissa Walet Mohamed. Mariam Wallet Aboubacrine provided support in the review of the terms in Tamasheq.

• **Chapter 6: Ancestral nomadism and farming in the mountains.**
Agro-pastoralism and gathering food system of the Bhotia and Anwal peoples in Uttarakhand, India was prepared by Pradeep Mehta (Central Himalayan Institute for Nature and Applied Research-CHINAR) and Ghanshyam Kalki Pande (CHINAR). The Namik community provided valuable support to the development of this case study. Ghanshyam Kalki Pande and Ram Singh were responsible for facilitating, collecting data and taking notes.

• **Chapter 7: Following the flooding cycles in the Amazon rainforest.**
Fishing, *chagra* and forest food system of the Tikuna, Cocama and Yagua peoples in Puerto Nariño, Colombia was prepared by Liseth Johanna Escobar Aucu (Fundación Omacha) and Fernando Trujillo González (Fundación Omacha). The communities of Puerto Esperanza, 20 de Julio, Santa Clara de Tarapoto, Nuevo Paraíso, San Francisco, Comunidad Ticoya and the urban area of the municipality of Puerto Nariño participated in the characterisation of the food system. The artisanal fisherfolk and watchmen of the Lakes of Tarapoto, women, children and elder knowledge holders shared valuable knowledge in the discussions. Lilia Java and Sara Peña supported the fieldwork. Jean-Pierre Goulard provided support in the review of the terms in Tikuna.

• **Chapter 8: The maize people in the Mesoamerican dry corridor.**
***Milpa* food system of the Maya Ch'orti' people in Chiquimula, Guatemala** was prepared by Carlos Lira (Alliance of Bioversity International and CIAT), Rose Robitaille (Alliance of Bioversity International and CIAT), and Juan Carlos Argueta (Mancomunidad Copan Ch'orti') and Carlos Cerna (Mancomunidad Copan Ch'orti'). Ninety-five men, 178 women and 30 children participated in the thematic discussions. Roberta García (Pitahaya, Camotán, COCODES leader), Alfredo Amador (Chaguiton, Camotán, COCODES leader), Cecilio Shashente Roque (La Ceiba Tunuco Arriba, Jocotán, COCODES leader), Juan Díaz Gonzales (Chatuncito, Jocotán, Leader of the "Tunuco Arriba" group), Aurelio Reyes Vásquez (Agua Blanca, Olopa, Mayor) and Reyna Luz Sánchez (Rodeo, Camotán, Group Leader) provided valuable support to this case study. Juan Antonio

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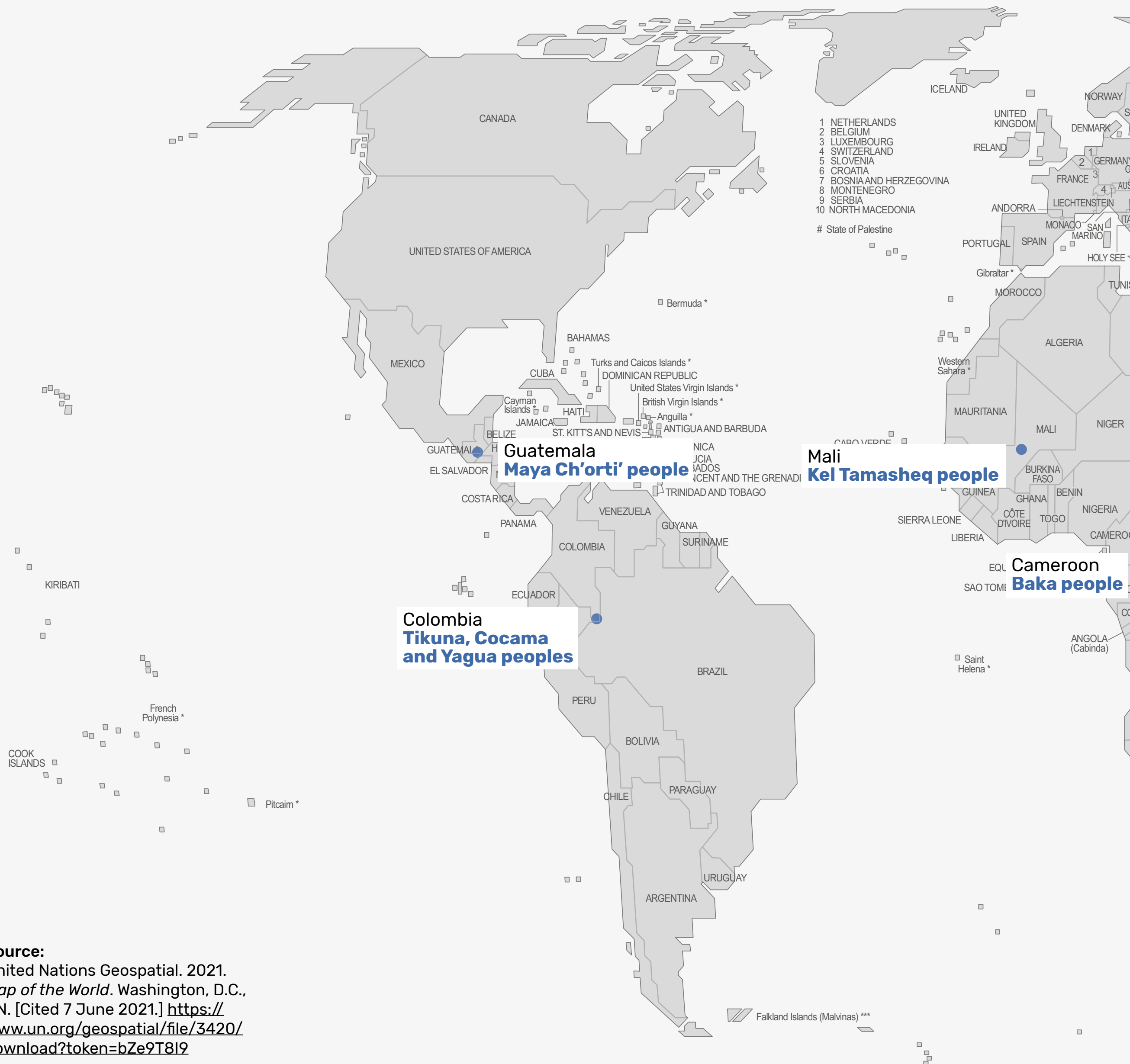
SUMMARY OF THE EIGHT PROFILED INDIGENOUS PEOPLES' FOOD SYSTEMS

Community members in Baniata playing soccer.

© Massey University/Chris Vogliano.

FIGURE 0.1. Location of the eight Indigenous Peoples’ food systems

The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country,territory, city or any area or of its authorities, or concerning the delimitation of its frontiers or boundaries.
*A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).
** Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.
*** Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.



Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9


Finland
Inari Sámi people
India
Bhotia and Anwal peoples
India
Khasi people
Solomon Islands
Melanesians[SI] people
FINLAND
RUSSIAN FEDERATION
ESTONIA
LATVIA
LITHUANIA
POLAND
BELARUS
UKRAINE
SLOVAKIA
HUNGARY
REP. OF MOLDOVA
ROMANIA
BULGARIA
ALBANIA
GREECE
MALTA
TURKEY
GEORGIA
ARMENIA
AZERBAIJAN
KAZAKHSTAN
UZBEKISTAN
KYRGYZSTAN
TURKMENISTAN
TAJIKISTAN
MONGOLIA
DEM. PEOPLE'S REP. OF KOREA
REP. OF KOREA
JAPAN
CHINA
Jammu and Kashmir **
AFGHANISTAN
ISLAMIC REPUBLIC OF IRAN
IRAQ
SYRIAN ARAB REP.
CYPRUS
LEBANON
ISRAEL
JORDAN
KUWAIT
BAHRAIN
SAUDI ARABIA
EMIRATES
OMAN
YEMEN
NEPAL
BHUTAN
BANGLADESH
INDIA
MYANMAR
LAO PEOPLE'S DEM. REP.
THAILAND
CAMBODIA
VIET NAM
PHILIPPINES
SRI LANKA
MALDIVES
BRUNEI DARUSSALAM
MALAYSIA
SINGAPORE
I N D O N E S I A
TIMOR-LESTE
PAPUA NEW GUINEA
SOLOMON ISLANDS
PALAU
Guam *
FEDERATED STATES OF MICRONESIA
MARSHALL ISLANDS
NAURU
KIRIBATI
TUVALU
Tokelau *
SAMOA
FIJI
TONGA
New Caledonia *
AUSTRALIA
NEW ZEALAND
LIBYA
EGYPT
CHAD
SUDAN
ERITREA
DJIBOUTI
SOMALIA
ETHIOPIA
SOUTH SUDAN
CENTRAL AFRICAN REPUBLIC
UGANDA
KENYA
DEMOCRATIC REPUBLIC OF THE CONGO
RWANDA
BURUNDI
UNITED REP. OF TANZANIA
SEYCHELLES
COMOROS
ANGOLA
ZAMBIA
MALAWI
MOZAMBIQUE
MADAGASCAR
MAURITIUS
NAMIBIA
ZIMBABWE
BOTSWANA
ESWATINI
SOUTH AFRICA
LESOTHO

TABLE 0.1. Overview of the main characteristics of the eight Indigenous Peoples' food systems

	Baka	Inari Sámi	Khasi	Melanesians[SI]
Biome and natural elements in the land- and seascape	Tropical rainforest, rivers	Sub-boreal forest, fells and wetland	Subtropical evergreen forest, water streams	Tropical rainforest, mountain, inland water, ocean
Main activities and livelihoods in the food system	Hunting, gathering, fishing, cultivation, exchange of Non-Timber Forest Products (NTFPs)	Hunting, gathering, livestock, cultivation	Cultivation, gathering, hunting, fishing, cash crops	Fishing, gathering, agroforestry, hunting, fishing, cash crops
Mobile practices: Nomadic/ semi-nomadic/ transhumant /shifting/ hunting/fishing	Shifting cultivation and mobile hunting	Semi-nomadic/ transhumant	Shifting cultivation	Traditional shifting gardens, now evolved into agro-forestry
Origin of the food in percentages: Food produced and generated in territories/ Food obtained from the market	81%/19%	70%/30%	55%/45%	75%/25%
Number of species provided by the food system and used as edibles, food, medicines, spiritual, construction, etc.	179 foods, 5 construction, 23 cosmetic, accessories, lighting and other non-food uses, 4 stimulants, 3 cash crops	26 foods, 1 medicine	150 foods 2 cash crops, 2 construction, 10 medicine, 5 other non-food uses	132 foods, 2 cash crops, 7 construction, 1 stimulant, 4 medicine
Barter exchange in the food system	Yes ⟶	-	No, Disappeared	Yes ↘

Legend:

- ⟶ Trend maintained over time
- ↘ Decreasing trend over time
- \- No information available

TABLE 0.1. Overview of the main characteristics of the eight Indigenous Peoples' food systems

	Kel Tamasheq	Bhotia and Anwal	Tikuna, Cocama and Yagua	Maya Ch'orti'
Biome and natural elements in the land- and seascape	Desert, shrubs and thorn bushes, lacustrine plain	Forest, mountain	Tropical rainforest, lakes, rivers	Tropical temperate rainforest, subtropical humid forest, subtropical dry forest, and subtropical thorn bush, water pools
Main activities and livelihoods in the food system	Livestock, gathering, cultivation	Cultivation, livestock, gathering	Fishing, cultivation, hunting	Cultivation, gathering, fishing, hunting
Mobile practices: Nomadic/ semi-nomadic/ transhumant /shifting/ hunting/fishing	Nomadic/ transhumant	Semi-nomadic/ transhumant	Shifting cultivation, mobile fishing and mobile hunting	Traditional shifting ***milpa*** system, now evolved into settle non-mobile ***milpa***
Origin of the food in percentages: Food produced and generated in territories/ Food obtained from the market	65%/35%	70%/30%	75%/25%	55% /45%
Number of species provided by the food system and used as edibles, food, medicines, spiritual, construction, etc.	25 foods, 3 medicine, 1 fodder	29 foods, 7 fodder, 2 construction, 6 medicine, 6 other non-food uses	153 foods[4], 2 cash crops, 5 medicine, 14 construction, 16 cosmetic, accessories, lighting, utensils and other uses	143 foods, 1 construction, 7 dye, poison medicine, and other uses, 6 fodder, 1 stimulant
Barter exchange in the food system	Yes	Yes ↘	-	Yes ⟶

[4] Includes data from literature.

WHAT IS AT STAKE?

To endure the effects of climate change and to address the challenges that humankind (indigenous or non-indigenous) will face as a result of unsustainable food production practices, Indigenous Peoples' food systems are probably amongst the best placed to provide insights, lessons and empirical evidence that could facilitate the transition towards more sustainable food systems. The analysis of the eight food systems[5] provides nine salient insights whilst identifying obstacles that need to be considered.

1. The recognition of Indigenous Peoples within the countries they inhabit is important and enables them access to basic public services. Although Indigenous Peoples and their food systems have existed for thousands of years, with the creation of today's modern states, several Indigenous Peoples across the world see their existence unacknowledged in national legislation and normative frameworks, despite the adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007 in the United Nations (UN) General Assembly and the endorsement by the countries.

Ten out of the 11 Indigenous Peoples considered in these eight profiles live in countries where they are explicitly recognised in the Constitution. These are: Cameroon, Colombia, Finland, Guatemala, India and Solomon Islands. The recognition of Indigenous Peoples in the Constitution and laws in the countries facilitates their access to essential public services. However, and as the analysis showed for the Melanesians[SI], the Baka, and the Tikuna, Cocama and Yagua, legal recognition does not resolve the need for interculturality in public services and social protection measures for them to be effective and benefit Indigenous Peoples. Evidence from many of the profiles here demonstrates communities' lack of satisfaction with development programmes, agriculture plans, school meals and education plans in which, apparently, they did not participate in the design and scope.

2. Indigenous Peoples have valid and tested contributions to make to sustainability. There are examples of: energy use, territorial management, waste included as inputs in the system, fallow practices and ecological management associated with culture and tradition to enable replenishment of the natural resource base, etc. The territorial management practices of Indigenous Peoples are carefully attuned to the ecosystems in which they live and has been able to successfully preserve biodiversity and create sophisticated food systems that generate food for communities for generations. Scientists are starting to acknowledge this whilst policymakers have not yet been able to translate this growing awareness into effective policy measures that protect Indigenous Peoples' practices. There is potential to draw lessons on sustainability from Indigenous Peoples that can be extrapolated to other contexts and communities.

At the same time, despite their undeniable qualities, strengths and capacities of sustainability and resilience, in the last 50 years, Indigenous Peoples' food systems are undergoing profound changes, motivated by both internal and external drivers, that are transforming some of the ancestral practices at an unprecedented speed and rapidly altering their food systems, with some of them resorting to unsustainable practices whilst others are being abandoned. The threats to indigenous territories from external actors have drastically reduced indigenous lands, thus increasing the vulnerability of ancestral and orally transmitted knowledge that has persisted until recently.

3. Indigenous Peoples hold immense knowledge about wild and semi-domesticated plants. The vast knowledge of Indigenous Peoples on a huge diversity of wild, semi-domesticated and domesticated species of plants used for food and medicine in their diets and health systems is the best known to humankind. In some cases,

[5] Note from the editors: All references to the Indigenous Peoples in this section refer to the communities that took part in the fieldwork unless otherwise specified. These are: Baka in Gribe; Inari Sámi in Nellim; Khasi in Nongtraw; Melanesians[SI] in Baniata; Kel Tamasheq in Aratène; Botia and Anwal in Namik; Tikuna, Cocama and Yagua in Puerto Nariño; and Maya Ch'orti' in Chiquimula.

pharmaceutical companies, in collaborative agreements with Indigenous Peoples, have developed new medicines that today are sold over the counter throughout the world. In other instances, Indigenous Peoples denounced biopiracy and lack of respect of their intellectual rights over their knowledge of plants used for medicines and foods. The respect, or lack thereof, of Indigenous Peoples' intellectual property rights over their knowledge of plants has been one of the major constraints for Indigenous Peoples to share their knowledge about sustainability with non-indigenous scientists. The international community needs to address this issue guaranteeing Indigenous Peoples' rights. Otherwise, important segments of knowledge and understanding of how nature and biodiversity works, accumulated over generations of observation of the natural cycles and interactions in the ecosystems, will be lost with the passing of the elders and the migration of youth to urban centres.

4. The importance of nomadism, mobile livelihoods and shifting practices to maintain biodiversity. Indigenous Peoples remind us that many of today's livelihoods are mobile, itinerant, semi-mobile and nomadic. Often not well understood by practitioners and policymakers, the relationship between nomadic livelihoods and biodiversity conservation is an area of research that merits more dedicated analysis. Indigenous Peoples' territorial management practices have not been well understood by non-indigenous scientists. Practices like shifting cultivation have been criticized for years as responsible for deforestation. However, areas subjected to shifting cultivation practices are still forested today whilst surrounding areas have been logged and the forest eliminated. More research is needed about the cycles of shifting cultivation. Evidence suggests that in almost all communities, reducing the period of time to complete the cycle caused by external actors' pressures and increased demography has negatively impacted sustainability.

Relatively recent new drivers related to globalization, monetization, markets, migration, climate change and extractive pressures over the natural resources are either impairing, limiting or forbidding mobile and nomadic practices. In some cases, the mobile livelihoods will be irreversibly lost. Climate change is posing an insurmountable challenge in some cases, given the severity of reported climatic variability in some of the ecosystems. It is important to have more dedicated research to inform policies that today either do not support mobility or go against it altogether. The disappearance of mobile practices will have an effect on Indigenous Peoples' food systems and sustainability.

5. Indigenous Peoples' food systems are dynamic in time and subject to changes but today they are changing at an unprecedented speed. Whilst in the past, the dynamism of their territorial management techniques allowed them to adjust to changing migratory patterns and climate variations, the current situation and pressures are placing Indigenous Peoples in difficult conditions to counteract. They see how their territories and livelihoods are suffering a profound impact from migrants in and out of the communities, extractive industries, commercial agriculture schemes, youth's changing habits and tastes, and climate change. These, coupled with the changes introduced by the monetization of the economy and the growing interest in selling foods and handicrafts in markets to acquire cash, are rapidly introducing new habits and tastes, and reshaping the Indigenous Peoples' food systems from within.

The rapid monetization of barter-subsistence traditional economies is shifting preferences and changing habits, whilst redirecting livelihood efforts towards market-oriented activities. The traditional accumulation of capital in the environment and ecosystems is now shifting more and more towards cash accumulation to access a new plethora of available goods and services that are no longer transacted by barter exchange but through cash. This is having an impact on many of the ancestral collective forms of reciprocity and circular solidarity that have constituted their safety nets for centuries. Today, important practices rooted in the indigenous values of reciprocity and collective solidarity are being abandoned. Individualism is growing. This creates a real risk that several Indigenous Peoples' food systems will disappear and become unsustainable by being detached from their natural resource base and the cosmogony and traditional knowledge that informed them for years.

6. The acceleration in the adoption of market-oriented activities for cash is profoundly transforming Indigenous Peoples' food systems. Whilst access to markets and the monetization of the Indigenous Peoples' food systems is neither negative nor positive *per se*, in the context of ongoing globalization, the improved access to markets is having a direct impact on the socio-economy of the indigenous communities. These positive and negative impacts affect the environment, the social fabric, and the transmission of traditional knowledge. The accumulation impetus has become a negative driver to maintain the food system's sustainability, changing a basic principle of Indigenous Peoples' food systems: Previously, the system accumulated capital in the environment in the form of natural resources that, when properly managed, generated foods, medicines and by-products. Now, the accumulation of capital has moved away from the ecosystem and into private hands, enabling cash generation to purchase externally manufactured goods. This shift towards the extraction of resources from the system affects the future sustainability of some of the Indigenous Peoples' food systems that were analyzed, with community members already observing new extraction rates to cater to the market that go beyond the threshold limit that allows the regeneration of resources.

7. Indigenous Peoples' food systems risk disappearance. Indigenous Peoples' food systems are today at a juncture in time where, unless properly analyzed and supported by the right policy interventions, risk disappearance or full assimilation by the dominant cultures mainstreamed in the globalization process.

Markets, along with climate change effects and pressures from external actors encroaching indigenous territories and ancestral lands, are probably the factors that are transforming Indigenous Peoples' food systems at the fastest rate. These circumstances are causing the largest, long-lasting and, in some cases, irreversible effects on the continuity and sustainability of the Indigenous Peoples' food systems.

An important open question remains as to how the transmission of knowledge is going to be maintained and ensure the continuation of some of the practices that support the territorial management and food systems. This concern was made evident during interviews with the communities.

8. The future of Indigenous Peoples' food systems depends largely on the decisions indigenous youth are making. Indigenous youth face an unprecedented divide: on the one hand, they want to access education and pursue a professional life that allows them to participate in an urbanized and globalized economy. On the other hand, if they do not continue some of the traditional practices in their communities, the food systems and associated territorial management practices threaten to disappear.

New formulas are needed to allow indigenous youth to participate in both the globalized world and the local community. The importance of governments developing educational programmes with interculturality cannot be overemphasized. Initiatives and programmes discussed with elders and youth that blend traditional knowledge with new technologies could be the solution.

The future will largely depend on indigenous youths' ability to reconcile traditionally sustainable and self-consumption food systems with the growing preference towards market-oriented food systems whilst maintaining elements of ancestral knowledge and sustainability. This reconciliation remains an open question and is directly linked to the preservation of ancestral languages and traditions, whose disappearance will hamper the survival and continuation of these ancestral food systems.

9. Free, Prior and Informed Consent (FPIC) is more than a principle – it brings success. Free, Prior and Informed Constent is not only a right that Indigenous Peoples have in the UNDRIP, it is actually **essential to ensure the success and performance** of different governmental development and social protection programmes aimed at improving the well-being of Indigenous Peoples. From agricultural support programmes to education, all interventions benefit when there is consultation and consent by Indigenous Peoples.

WAY FORWARD

In order to fully ascertain the way forward, deeper understanding of the many existing Indigenous Peoples' food systems is needed to learn from them and inform many of their valuable contributions into the worldwide debate on sustainable food systems.

Further research is required to undertake a more complete and systematic inventory of the diversity of strategies and territorial management techniques elaborated by culturally diverse Indigenous Peoples in their relations with the diverse ecosystems they live in across the world.

> **A sustainability science approach** should help better achieve this incorporation. Sustainability science seeks to examine the interactions between human, environmental and engineered systems to understand and contribute to solutions for complex challenges – climate change, biodiversity loss, pollution, and land and

water degradation – that threaten the integrity of the life support systems (Lang *et al.,* 2012). Most importantly, sustainability science is defined by the problems it addresses, not by the disciplines it employs. Contemporary research remains indeed too fragmented, too discipline-focussed, and singularly lacking in articulation between the results it proposes and the scale of the problems to be solved.

Along these lines, there is an urgent need to develop **new collaborative research frameworks** that bring together experts from different scientific disciplines but also from different cultures to co-create knowledge. This equates to promoting transdisciplinary, transcultural and co-constructed knowledge between scientists and key actors in society, with Indigenous Peoples at the centre of these efforts.

Further research is needed to highlight the role that Indigenous Peoples' food systems can play in ensuring food security and nutrition security, mobilizing political support, sharing knowledge and good practices, discussing successes and challenges, and working to promote and preserve Indigenous Peoples' food systems and the foods and services generated by them, with the ultimate objective of improving food systems, diets and nutrition for all. **These interrelated interventions require the setting of a dedicated body** that would carry them forward in a coordinated manner.

In this regard, a major outcome of the High-Level Expert Seminar on Indigenous Food Systems held in November 2018 at FAO to introduce the preliminary findings of the profiling was the creation in 2020 of a **Global-Hub on Indigenous Peoples' Food Systems.**

Launched at the 27th session of the Technical Committee on Agriculture (COAG) of FAO, the Global-Hub brings together universities, research centres, Indigenous Peoples, UN agencies and other interested stakeholders to co-create evidence that builds on scientific and traditional knowledge systems of Indigenous Peoples, in order to influence policy discussions on sustainable and climate-resilient food systems in the context of the UN Decade of Action on Nutrition (2016-2025) and the 2030 Agenda for the Sustainable Development Goals (SDGs).

The overarching objective of the Global-Hub is to facilitate an exchange of evidence that aligns research and indigenous agendas for a more concerted implication in the food systems debate. The Global-Hub will concentrate on four activities pertaining to Indigenous Peoples' food systems, their sustainability and climate resilience:

- a knowledge-bearers' platform, creating a space for sharing ideas and knowledge;
- a knowledge platform; designed as a knowledge repository, it will be an online staple source of information;
- advice in policy dialogues, providing reliable inputs to ongoing policy discussions;
- creation of synergies to drive the design of multidisciplinary and collaborative research to fill the gap of knowledge and understanding of Indigenous Peoples' food systems and to prioritize studies to be carried out.

These four activities together form a coherent global programme with the intention to continue **learning** from Indigenous Peoples' food systems, **prolonging** data gathering and reframing methodologies adequately, **promoting them** through carefully targeted advocacy, and **preserving** them through the provision of legal and technical assistance when needed. Lastly, the institutional support to self-certification or other labelling mechanisms is essential.

KEY MESSAGES ORGANISED AS PER THE FIVE FAO PRINCIPLES OF SUSTAINABLE FOOD SYSTEMS

1. Provision of livelihoods, equity and social well-being:

Indigenous Peoples' food systems have been providing food, livelihoods and well-being to Indigenous Peoples for centuries. Their sophisticated territorial and natural resource management practices stems from their close relationships and profound understanding of the environment and its biodiversity. This relationship is based on reciprocity, respect, the observation of the natural cycles and the interactions between the different elements in the ecosystem.

The governance systems, cultures, languages, beliefs and cosmogonies in Indigenous Peoples' food systems are embedded in this connection with nature.

When the food systems are well functioning, biodiversity is maintained, social cohesion and well-being are achieved through customary governance practices, and equity is ensured through reciprocity and solidarity circular mechanisms.

1.1. The world cannot feed itself sustainably without listening to Indigenous Peoples. Indigenous Peoples' food systems are multifunctional and holistic, generating food, medicines, shelter and energy, and supporting culture, social and spiritual manifestations. This multifunctionality is rooted in understanding and engagement in the food systems in their totality, giving special attention to the relationships between the different elements in the ecosystem. The very existence of Indigenous Peoples' food systems today and their capacity to preserve 80 percent of the remaining biodiversity in the planet (Sobrevilla, 2008) constitutes two of the most important contributions made to the world´s sustainability.

1.2. Indigenous Peoples' elaborate territorial management includes mobile and semi-mobile practices. Gathering, hunting, fishing and farming are integral to Indigenous Peoples' food systems. Such activities are dependent upon their collective rights and access to communal resources including lakes, lands, forests and seas. However, lack of access to their ancestral territories and natural resources and governmental restrictions directly threatens the continuity of Indigenous Peoples' food systems. For Indigenous Peoples' food systems with mobile or semimobile practices, revitalizing and protecting this mobility is fundamental. There is a direct linkage between these mobile practices, the health of communal resources, the sustainability and the biodiversity of their food systems that needs more understanding, dedicated research and better policies.

1.3. Indigenous Peoples' food systems are changing at an unprecedented rate. Indigenous Peoples' food systems are changing profoundly and are rapidly influenced by internal and external drivers (market and monetization; climate change; biodiversity loss; pressures from external actors; decay of traditional knowledge transmission; youth migration; mechanization; prospects and tastes changes; new technologies and inputs in agriculture and fisheries). These drivers are transforming some of the ancestral practices and rapidly altering the food systems, with some Indigenous Peoples' resorting to unsustainable practices in their food systems whilst others are being abandoned. A major threat comes from external actors encroaching upon Indigenous Peoples' territories and reducing their lands' size.

1.4. Market is the fastest modifier of Indigenous Peoples' food systems. In the eight food systems, market dependency for food needs oscillates from around 20 percent to 45 percent. Markets are one of the largest factors transforming Indigenous Peoples' food systems at an incredible speed. Fuelled by improved communications, markets are bringing new opportunities in terms of cash generation, new services and goods, and new tastes and foods.

1.5. Monetization has changed Indigenous Peoples' circular solidarity and reciprocity mechanisms. The increasing monetization is leading many indigenous communities to move away from barter, food sharing and communal works as traditional forms of solidarity and reciprocity. Engaging with the cash economy enables communities to access additional sources of food, inputs for food generation and health services. However, this tendency has also been seen to weaken sustainability and resilience of traditional practices of resource sharing and weaken ancestral forms of social cohesion.

1.6. Highly processed and imported foods have arrived, yet Indigenous Peoples prefer their foods. Although many Indigenous Peoples are consuming more highly processed and imported commercial foods, traditional foods are still preferred in the communities. Indigenous Peoples' preference for traditional crops and breeds ensures the maintenance of the genetic diversity and biodiversity of traditional seed varieties, as well as wild and semi-domesticated edible species.

1.7. Food composition is also fundamental to improve Indigenous Peoples' food and nutrition security. Food composition, particularly on micronutrients, enables research and policies to be put in place to protect key foods that are being abandoned due to changes in preferences, sometimes jeopardizing the food and nutrition security of the communities. Dedicated food composition efforts would lead to political support and sharing of knowledge and good practices before the disappearance of certain food items.

2. Resource use efficiency:

Indigenous Peoples' food systems rely primarily on renewable energy and resources within their territories. From the environment, Indigenous Peoples acquire the materials and foods to cater for shelter, tools, fibres, medicines and meals. With sunlight, water, fire, wind and other renewable energies, they process, build and consume the acquired natural materials and food items. Until more recently, waste was an unknown concept in their systems.

Intact Indigenous Peoples' food systems have practices to use and regenerate resources efficiently, whilst effectively reintegrating waste materials.

External factors are compromising the efficient processes of Indigenous Peoples' food systems, including the arrival of materials that generate inorganic waste, increased dependence on fossil fuels, and use of inorganic fertilizers and chemical pesticides. Further, the compounding impacts of climate change are affecting Indigenous Peoples' resource availability and efficiencies.

2.1. Climate change and natural disasters are negatively impacting Indigenous Peoples and their food systems. Indigenous Peoples' food systems are increasingly vulnerable to the amplifying realities of climate change. Historically, their food systems were resilient by aligning with the cycles of natural resources. As these cycles are disrupted by climate change, so too are their food systems and food security. Furthermore, seasonal eating habits were a strength of their food systems and nutritionally diverse diets. Now such habits pose potential risks as the variability in weather patterns affects the seasonal cycles and availability of food sources.

2.2. Indigenous Peoples' food systems maximise innate energy, but external inputs are also increasingly required. In the field research undertaken, it was observed that Indigenous Peoples cover the majority of their energy demands for processing, heating and cooking with sunlight, wind, water and firewood – renewable energy sources available within their territories. However, dependency on fossil fuels increases exponentially for mobility (transport by boat, car) and cooking (gas stoves). Their systems have the potential to incorporate more renewable energy sources. There are good examples of solar panels for boreholes, home appliances and small hydroelectric schemes.

2.3. Shifting cultivation is a sustainable practice and lifestyle. Shifting cultivation within Indigenous Peoples' territories is crucial to ensure the preservation of the environment and biodiversity whilst also generating diverse food sources. The practice effectively blends resource management and production techniques to generate renewed growth of semi-domesticated and domesticated species, creating a broad, diverse base for food security and dietary diversity from wild foods in local fields, forests, pastures and waterways. Shifting practices are essential in territorial management of many Indigenous Peoples' food system. However, in the last 40-50 years, obstacles and rules against shifting practices have increased exponentially. Such obstacles have negatively affected Indigenous Peoples' food systems and territories reliant on these techniques, diminishing their food security and surrounding biodiversity.

3. Conservation, protection and enhancement of natural resources:

Indigenous Peoples have been conserving, protecting and enhancing natural resources for thousands of years. Currently, 80 percent of the world's remaining biodiversity is located in Indigenous Peoples' territories (Sobrevilla, 2008), an undeniable testament of their ability to generate food whilst preserving and enhancing biodiversity. Indigenous Peoples' diverse management practices span across terrestrial and aquatic ecosystems of the globe. Despite the clear evidence and wide scientific recognition, many governments and external non-governmental organizations (NGOs) are not following the science, gaining consent or respecting Indigenous Peoples' capacities to enhance biodiversity whilst practising their livelihoods.

Many Indigenous Peoples subjected to environmental protection laws and natural protected areas have experienced restrictions to their livelihoods.

When Indigenous Peoples are consulted and their consent is gained by governments and NGOs, the outcomes of conservation agendas and legislature are enhanced.

3.1. Indigenous Peoples' approaches to conservation are key. Indigenous Peoples' approach to ecosystem conservation recognises the interdependent health of the food system, the local ecosystem and humans. Indigenous Peoples conserve biodiversity through ancestral practices emanating from traditional knowledge passed on orally from generation to generation.

3.2. Indigenous Peoples depend on intact biodiversity for food security and nutritional diversity. Indigenous Peoples maintain biodiversity of native species and often enhance the richness of domesticated species. Food systems are often comprised of wild, semi-domesticated and domesticated plants and animals. Their relationships with diverse local species contributes to maintaining the biodiversity of their surrounding ecosystems. The loss of biodiversity in Indigenous Peoples' territories can be attributed to multiple factors. These include pressures from external actors, and replacement of sustainable practices with unsustainable and extractive ones, such as overfishing, overhunting, reduction of fallow periods, and increased numbers of animal heads in the herds. These human-induced factors are compounded by the effects of climate change, including reduction of water points, desertification, loss of wildlife, the disappearance of wild plants, melting of ice, changes in rainfall and seasons, climate variability, and changing migration patterns.

3.3. Impacts of globalization are affecting Indigenous Peoples' territorial management. The economic drivers of globalization promote unsustainable practices and demands that exhaust environmental resources. This crowds out management practices that are regenerative for ecosystems. Often, the extraction rate exceeds the regeneration rate. Pressures from external actors, including national parks, extractive industries, expansion of commercial agriculture and livestock operations are factors causing the size of Indigenous Peoples' territories to be reduced.

4. Responsible and effective governance mechanisms:

Indigenous Peoples' governance mechanisms are integral to their home territories and livelihoods.

The respect for elders and their leadership, generational transmission of traditional knowledge and their collective rights are pillars of their complex governance systems. Furthermore, the core values of solidarity, reciprocity and communal works serve to inform their societal organization and leadership. Conflicts are commonly resolved within the community as per widely understood and followed unwritten codes of conduct. Orality remains the main form of transmission of traditional knowledge.

When Free, Prior and Informed Consent (FPIC) is followed in new administrative institutions, the support and involvement of Indigenous Peoples results in more community engagement and better accountability in management.

Increasing intercultural education and programmes for indigenous youth is critical for the future of Indigenous Peoples and the health of their communities.

4.1 Nation states must recognise Indigenous Peoples and their rights and ensure access to basic public services. Although Indigenous Peoples' societies have existed for thousands of years, several Indigenous Peoples across the world have not been recognised within national legislation and normative frameworks. This is despite the adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). in 2007. This lack of recognition is a direct threat to Indigenous Peoples' rights, in particular their rights to land, natural resources and self-determination.

4.2. Indigenous governance practices should be recognised and strengthened at all levels. Indigenous Peoples have developed safety nets and solidarity mechanisms based on social organization and customary governance systems. These systems are mobilized especially during times of food scarcity, in which food sharing within and between neighbouring communities is common practice. Communities that have maintained their traditional governance institutions manage to strengthen social cohesion through collective decision-making processes.

4.3. Natural resource management decisions need to involve Indigenous Peoples. Several of the governance and customary mechanisms developed by Indigenous Peoples are in place to ensure proper, sustainable management of natural resources. This helps them guarantee the regeneration of ecosystems and their food security. Therefore, it is crucial to integrate Indigenous Peoples' perspectives into conservation strategies and follow the principle of FPIC. Such practice will help guarantee conservation measures ensure Indigenous Peoples maintain their guardianship, culture, sacred sites and livelihoods.

4.4. Development programmes do not work without FPIC. Some of these programmes have improved access to electricity, petrol, schools, health dispensaries and roads. Others have brought new varieties of seeds and new animal breeds. Field research findings indicate these positive impacts are more significant when the community was part of the initiative or consulted before the intervention. However, some programmes, initiatives and social protection schemes are introduced in the communities without consultation, resulting in a low level of success. In some cases, these initiatives have created new challenges for the communities and other environmental issues related to the introduction of new plant varieties and animal breeds.

4.5. Indigenous languages must be sustained. About 4 000 of approximately 6 700 languages currently spoken in the world are indigenous languages (UNDPI, 2018). When an indigenous language starts to deteriorate, so does the traditional knowledge of the community, resulting in community members forgetting the names of plants, herbs and practices. This can lead to Indigenous Peoples' food systems and associated territorial management practices vanishing. A point of concern is that Indigenous Peoples' traditional knowledge remains largely undocumented globally, with many cultures relying mainly on oral transmission in their indigenous language. Another matter of concern is indigenous youth who do not know the language or are uninterested in learning the traditional teachings. Such circumstances threaten the continuation of Indigenous Peoples' knowledge systems, languages, cultures and cosmogonies. Indigenous language revitalization efforts and intergenerational learning are key to sustaining indigenous languages.

4.6. Intercultural education is fundamental for indigenous youth. Intercultural education is critical in academic curricula and in feeding programmes to preserve Indigenous Peoples' languages, food systems, nutritional health, cultural identities and traditional knowledge. In the majority of cases, schooling has had a detrimental impact on Indigenous Peoples' customary systems and transmission of traditional knowledge, further transforming prospects, roles, tastes, traditional knowledge and belief systems. Education and school feeding programmes can play key roles in regenerating indigenous language and cultural identities for indigenous youth, addressing the loss of their language and changes in food habits, such as moving away from their traditional foods towards highly processed and unhealthy foods. As a response, intercultural educational plans and mobilizing traditional knowledge within school programmes is crucial to ensuring that food systems, livelihoods and indigenous languages are preserved and carried forward into future generations.

5. Resilience of people, communities and ecosystems:

Indigenous Peoples and their food systems have prevailed for thousands of years, adapting to changes in the environment and developing new practices and techniques. Their beliefs, cosmogonies, value systems and principles constitute core elements of their cultural resiliency. Common values such as reciprocity, solidarity, co-responsibility and community are seen throughout Indigenous Peoples globally. These core elements and common values are expressed in the dynamism of their Indigenous Peoples' food systems, resulting in resilient systems and strong communities.

Today, the expansive loss of biodiversity, along with the compounding effects of climate change, is taking a heavy toll on Indigenous Peoples and their food systems.

New, growing interest and dependence on external markets is changing the principles, core values and dynamics within Indigenous Peoples' communities. Collective rights and communal work is being abandoned in favour of more individualistic livelihoods.

5.1. Indigenous Peoples are custodians of intergenerational traditional knowledge. Indigenous Peoples hold unique and rich traditional knowledge on local resources that support the communities' resilience and adaptive capacity. In particular, indigenous women not only play a key role in Indigenous Peoples' food systems, they are also guardians of ancestral, dynamic and specific traditional knowledge that they, along with the elders, transmit to younger generations. In the field research, this intergenerational transmission of traditional knowledge stood out as a fundamental element of Indigenous Peoples' resilience.

5.2. Indigenous Peoples have adapted their food systems over time. Indigenous Peoples with their food systems and traditions have survived for centuries through climate variations, periods of colonization and displacement. Far from frozen in an idealized past, Indigenous Peoples are constantly adapting, incorporating observations, open to recombination, and receptive to new ideas and practices to borrow and adjust to their local specificities. Rather than exhaust the environment for their needs, Indigenous Peoples adapt their food generation and production to the seasonality and natural cycles observed in their surrounding ecosystems. This delicate balance between change and dynamism, and traditional knowledge through observation of the environment makes Indigenous Peoples and their food systems unique and diverse.

5.3. Indigenous Peoples' cultures depend on the preservation and transmission of traditional knowledge. The future of Indigenous Peoples' food systems will be affected by the decisions that indigenous youth are making today. Namely, their ability to reconcile traditionally sustainable and self-consumption food systems with the growing preference towards market-oriented food systems. The future of Indigenous Peoples' cultures and traditional knowledge will be determined by how indigenous youth choose to maintain elements of their ancestral knowledge and livelihoods. The transmission of traditional knowledge from older to younger generations is changing rapidly, parallel to the new interests and prospects of indigenous youth. In addition to the rural-urban migration, the attractiveness of new technologies, professions and more education opportunities often hinders the transmission of traditional knowledge. Amidst the change, elders and youth are aware their languages, cultures and food systems will vanish without their generational stewardship of traditional knowledge.

POLICY RECOMMENDATIONS

The analysis from the field research shows how each food system is **unique** in terms of the pressures they are exposed to, as well as the diverse territorial management practices, climates, flora, fauna, culture, spirituality and traditional knowledge upon which the system is based. This richness and variety also showed certain **commonalities** between food systems that need to be understood and further analyzed. In the framework of these commonalities, **several drivers emerged** as having a direct impact on the health, sustainability and ability to generate food and income in the food systems. Without being intrinsically "good" or "bad", these drivers – some external and others internal – affect either positively or negatively the continuity, resilience and sustainability of the food systems. Some systems are more sustainable than others. Some are changing rapidly to adapt to the market. Others have seen their traditional knowledge weaken. The scope of this publication is not to judge which changes are good or bad, but to analyze the resilience and sustainability of Indigenous Peoples' food systems. Therefore, this objective has guided the organization of the drivers and their categorisation as positive in terms of contributing to the resilience and sustainability, and negative in terms of undermining them. These drivers have been clustered in groups as shown in Table 0.2.

TABLE 0.2. Drivers of sustainability identified through the profiling of eight Indigenous Peoples' food systems

Clusters	Drivers	
	Positive	Negative
Rights to land, territories, natural resources and nomadism	**+ Internal:** Collective rights over communal resources **+ Internal:** Nomadism and mobile livelihoods **+ External:** Involvement of Indigenous Peoples in governmental institutions	**- External:** Lack of security of access to the ancestral territories and use of natural resources
Biodiversity, multifunctionality of the systems, and self-sufficiency	**+ Internal:** Biodiversity conservation as the basis for the food system **+ Internal:** Multifunctionality of the food systems **+ Internal:** Governance informed by ancestral spiritual beliefs and cosmogony embedded in nature **+ Internal:** Food self-sufficiency from territorial management that integrates seasonality **+ Internal:** Low energy dependence from external sources and use of renewable energy	**- External:** Biodiversity reduction from external pressures
Continuity of traditional practices, adaptation and innovation	**+ Internal:** Adaptive capacity to change **+ Internal:** Continuity in the use of traditional practices and techniques **+ Internal:** Preference for traditional foods **+ External:** New techniques and innovations adopted	**- External:** Introduction of new seeds and breeds **- External:** Climate change and natural catastrophes
Governance, Free, Prior and Informed	**+ Internal**: Traditional Indigenous Peoples' governance systems and strong social cohesion	**- External:** Development programmes needing consultation and consent
Consent, and development programmes	**+ External:** Development interventions supporting the communities	**- External:** Expansion of infrastructure bringing external actors

TABLE 0.2. Drivers of sustainability identified through the profiling of eight Indigenous Peoples' food systems

Clusters	Drivers	
	Positive	Negative
Youth, education systems, interculturality, indigenous languages and traditional knowledge	**+ Internal:** Indigenous languages essential for traditional knowledge and food systems **+ Internal:** Preservation of traditional knowledge	**- Internal:** Globalization decreasing youth's interests in traditional practices and knowledge **- Internal:** Difficulties for intra- & intergenerational transmission of language and knowledge **- External:** School feeding changing tastes of indigenous youth **- External:** Lack of access to education and the need for culturally appropriate education
Globalization, income, barter, trade, processed foods, waste	**+ Internal:** Indigenous Peoples' food systems and cash income **+ External:** Relevance of sharing, barter and trading practices **+ External:** Improved infrastructure and better access to markets and information	**- Internal:** Markets and cash-generation reshape food systems, affects biodiversity and health **- External:** Processed foods bring inorganic waste

The policy recommendations at the end of each cluster of drivers seek to provide responses to address these drivers, indicating institutions and groups that could play a key role in improving the situation.

All policy recommendations are made under the overall framework of the UNDRIP, and the right to FPIC. Their aim is to advance the learning, preservation and promotion of Indigenous Peoples' food systems within the framework of the UN Decade of Action on Nutrition (2016-2025) and the Agenda 2030 for the SDGs.

RIGHTS TO LAND, TERRITORIES, NATURAL RESOURCES AND NOMADISM

Internal positive driver - Collective rights over communal resources

The 11 Indigenous Peoples present in the eight participating indigenous communities rely heavily for their livelihoods on the collective rights and access to communal resources such as lakes, lands, forests and seas. The levels of respect and recognition of these collective rights to communal resources varies greatly from country to country and within different communities. For instance, the Constitution of Colombia recognises the rights of Indigenous Peoples, including the Tikuna, Cocama and Yagua, and their territorial autonomy. In several cases, such as the Baka, the Khasi and the Inari Sámi, external pressures over the communal resources and restraint in exercising their collective rights had a direct impact on their food systems. The Baka, despite being aware of their collective rights to forest resources, are now constrained by a zoning policy that establishes areas for hunting, gathering and fishing. In the Maya Ch'orti' food system, recent episodes of injustice and violence have led to insufficient access to farmland and forests, impairing food security and diet quality. Most communities rely on ***astilleros***, or communal forest areas between villages, for firewood and wild edibles to complement their diet.

There is need for more dedicated research to better understand the relationship between biodiversity preservation and Indigenous Peoples' collective use of communal resources. In the eight food systems analyzed, there are few examples of policies supporting Indigenous Peoples' collective access to communal natural resources. However, evidence strongly suggests that the use of communal resources by Indigenous Peoples is directly related to the health of their food system and the level of conservation of biodiversity.

Internal positive driver - Nomadism and mobile livelihoods

Nomadic, semi-nomadic and mobile activities like shifting cultivation, hunting, fishing and pastoralism are common territorial management practices in the analyzed food systems. Those Indigenous Peoples whose traditional food systems include mobile activities refer to the importance of revitalizing and protecting this mobility to ensure the sustainability of the food system. Mobility has also transformed over time. Several of the governance and customary mechanisms were developed to regulate the shifting cycles with the purpose of ensuring proper management of the natural resources and its replenishment.

The Inari Sámi, the Baka, the Kel Tamasheq, the Khasi, the Tikuna, Cocama and Yagua, the Bothia and Anwal, and the Melanesians[SI] all report the importance of their different mobile activities within their territories to ensure environmental and biodiversity conservation and food generation. The Khasi practise ***jhum*** or shifting cultivation, obtaining significant numbers of species for food through this rotating practice in the forest. The Baka food system depends largely on mobility within forests for sourcing animals, mushrooms, herbs and wild tubers. The Kel Tamasheq have been nomadic people for hundreds of years, following water and pasture availability for their flocks. The Tikuna, Cocama and Yagua follow the flooding cycles of their ecosystem, shifting their fishing areas and their home gardens. The Inari Sámi combine reindeer nomadic herding with gathering and fishing. The food system of the Bothia and Anwal depends on the balance between the settled farming by some communities and the transhumance of others.

From the analysis of the profiles, those shifting cultivation patterns that have reduced either their shifting period or area could manifest signs of unsustainability. This is particularly the case of the Melanesians[SI] and the Khasi, who reduced their fallow period as a consequence of increased demography, leading to reduced soil fertility. The Maya Ch'orti' have seen their mobile practices significantly reduced, and their hunting and insect gathering have almost been abandoned.

All the communities using mobility, nomadism and shifting practices as essential territorial management of their food system have stated that in recent years, in particular in the last 40-50 years, obstacles and rules against mobile practices have increased exponentially, negatively affecting their food systems and the area's biodiversity. The recognition, respect and legislation to protect nomadism and mobile livelihoods vary significantly across countries. A positive case from the countries where food systems were analyzed is Mali. The Pastoral Charter (Law n° 01-004 of 27 February 2001) recognises the rights to pastoralists to carry their mobile livelihoods' and activities and the Law on Agricultural Orientation (Law n° 06-045 of 5 September 2006) acknowledges the environmental benefits of transhumance. However, mobile activities and livelihoods in most other cases where the research took place are either not protected or discouraged, with policies favouring settlement, sometimes forcefully, of Indigenous Peoples. In addition, policies are in place that either give concessions to private mining and agriculture firms or promote the settlement of colonists on indigenous lands and territories, directly compromising Indigenous Peoples' mobile livelihoods. Mobile livelihoods often clash with the interests and practices of settled communities who have historically benefited from legislated protection of rights in most countries. There is need for further research to understand how these legislations and policy measures have contributed to environmental degradation.

External positive driver - Involvement of Indigenous Peoples in governmental institutions

There have been positive developments to include Indigenous Peoples in new institutions, both at the grassroots level and in top-down processes, involving them in policy and normative discussions about collective rights to land, territory and natural resources. The Maya Ch'orti' have organised groups at various levels for their participatory decision-making regarding natural resources in their communities. They are participating in national programmes and initiatives on agriculture and to regenerate and protect forests. The Khasi in Nongtraw, thanks to support from the Government and NGOs, participate in recently created community institutions to discuss the governance of natural resources. The Khasi participate in the village council, in the Biodiversity Management Committee (BMC) and in the Village Disaster Management Committee (VDMC). The Inari Sámi leverage Article 9 of the Act of the Sámi Parliament on the "Obligation to negotiate" to force negotiations and stop the logging in their traditional lands by Metsähallitus, the Department of Forest Management.

When Indigenous Peoples are included in governmental institutions' discussions about natural resource management, they bring to the table their vast experience with biodiversity conservation and environmental management. This active engagement and participation is a positive driver to greatly expand collaborations.

External negative driver - Lack of security of access to the ancestral territories and use of natural resources

From the Amazonian jungles to the taiga in Sámi land in the Arctic, from the forests in Cameroon to the Himalayan hills, the increased insecurity surrounding indigenous territories is negatively affecting Indigenous Peoples' food systems and their sustainability. This is further exacerbated when the ownership of the land by Indigenous Peoples is not recognised by the State, for example through titling. This leads to concessions to extractive industries, commercial agriculture and logging companies. In 2002, the Inari Sámi started a legal process due to a land-use conflict with the Finnish State Forestry Enterprise "Metsähallitus" to secure and protect their traditional pasture and forest lands from logging activities in the Kippalrova area. The Sámi presented the case to the UN Human Rights Committee, resulting in a moratorium on the logging activities for the next 20 years, explicitly recognising the Sámi people's right to enjoy their own culture enshrined in Article 27 of the International Covenant on Civil and Political Rights, which in this case secured the Sámi's land-use rights. Lack of security to exercise collective rights applies directly to the use of natural resources. Since 2016, the Government of Meghalaya has intervened in the functioning of the Khasi community of Nongtraw, restricting ***jhum*** or shifting cultivation and requiring a written document from the Government for land transactions within the community.

In some cases, the State's conservation policies over Indigenous Peoples' lands can create conflicts, even when these policies are well intended. Several cases are highlighted throughout this publication. The Bothia and Anwal faced the effects of the 1972 Wildlife Protection Act and the 2002 Biodiversity Act, resulting in the banning of their hunting and most of their ancestral gathering practices in their forests. This reduced the availability of foods in the food system, increasing dependency on the market for meat, eggs and other items, and favouring the domestication of animals. The Baka suffered from the rapid expansion of logging activities that began in 1960, which reduced their forest resources. The creation in 2005 of the Boumba-Bek National Park further limited their access to forest areas for food and medicine.

This driver is identified as one of the main external drivers outside of the system that most affects the present and future of Indigenous Peoples' food systems. If it is not addressed, it will seriously compromise the viability of these ancestral knowledge systems. Looking at the results in terms of land degradation, biodiversity loss, impact on human well-being and other externalities generated, the success and sustainability of these governmental conservation and environmental measures is sometimes questionable. More dedicated research is needed to analyze the effects on biodiversity when States' conservation measures are put in place over Indigenous Peoples' ancestral management of their territories.

POLICY RECOMMENDATIONS FOR GOVERNMENTS:

- **Implement the Voluntary Guidelines on the Responsible Governance of Tenure of land, fisheries and forests in the context of National Food Security** (VGGT) (FAO, 2012) and sector-specific guidelines such as the **Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries** (SFF Guidelines) (FAO, 2015) whilst continuing to involve Indigenous Peoples and their representatives in institutions and legislative settings.

- **Set up a multi-actors committee at the national level to look at biodiversity conservation.** This committee should involve indigenous leaders and the Ministries in charge of environment, land planning and reform, and agriculture and management. If Indigenous Peoples can organise themselves at the national level into an umbrella coordination mechanism, this should be part of the Committee. The Committee will come up with a National Plan that identifies obstacles to exercising collective rights and mobility, proposing alternatives that guarantee customary rights of Indigenous Peoples and promoting nomadism and mobile livelihoods. Special attention will be given to the continuity of ancestral indigenous practices that have generated and maintained ecosystems of high biodiversity value.

- Follow the recommendations of this multi-actor committee **by legislative legitimacy at the parliamentary level.** In particular, land titling or schemes that guarantee the exercising of collective rights by Indigenous Peoples would be key activities to follow.

- **Issue a specific permit or identification to Indigenous Peoples that are nomadic/ mobile to enable them to move freely in their territories, ensuring that their ancestral rights to movement and their associated livelihoods can be exercised.** This identification or permit will grant governmental recognition and de facto protection of mobile and nomadic ways of living within the country and across borders.

- **Together with the UN and NGOs, rethink their approach to biodiversity conservation when considering the creation of national parks and natural reserves in territories previously belonging to Indigenous Peoples. Governments should collaborate with Indigenous Peoples in protected areas, benefiting from their knowledge to manage and restore biodiversity whilst they can still practise their traditional livelihoods.** These biodiverse-rich areas are the result of their ancestral management practices.

POLICY RECOMMENDATIONS FOR THE UN:

- Together with governments and research institutions, **host a routine technical seminar followed by a statement about the need to protect rights to customary land and natural resources, collective rights, and nomadic livelihoods, avoiding concessions to the private sector, and stopping licenses for deforestation, mining, and intensive agriculture and livestock schemes,** in the frame of the VGGT (FAO, 2012) and the SFF Guidelines (FAO, 2015).

- **Mediate between Indigenous Peoples and the states, through the UN country teams in the countries and at the global level, to reach moratoriums about interventions on indigenous and nomadic territories** that have not followed the principles and process of FPIC with the Indigenous Peoples living from those resources. This will reduce tensions and violence and enable a period of revision of the policies adopted.

- **Issue a statement recommending an international moratorium about displacing Indigenous Peoples from their ancestral lands to have conservation areas set up.**

POLICY RECOMMENDATIONS FOR RESEARCH CENTRES AND ACADEMIC INSTITUTIONS:

- **Undertake further dedicated research on three important areas:** the linkages between ecosystem services and collective management of the environment and nomadic livelihoods; the impact of resettlement policies on the environment and biodiversity for those areas previously subjected to nomadic or mobile livelihoods; and an environmental impact analysis for nomadic livelihoods that have shortened their cycles or reduced their areas.

It is recommended that the **Global-Hub on Indigenous Peoples' Food Systems,** hosted by FAO, UN specialized agencies and indigenous organizations, **undertake dedicated work about certifying Indigenous Peoples' foods generated through nomadic and mobile livelihoods,** highlighting the ecosystem services they provide and analyzing mobile territorial management practices such as shifting cultivation, nomadism and transhumance.

BIODIVERSITY, MULTIFUNCTIONALITY OF THE SYSTEMS AND SELF-SUFFICIENCY

Internal positive driver – Biodiversity conservation as basis for the food system

Indigenous Peoples are the custodians of 80 percent of the remaining world's biodiversity (Sobrevilla, 2008). This conservation of biodiversity occurs in territories they manage through ancestral practices emanating from traditional knowledge transmitted orally from one generation to the next. Indigenous Peoples have a specific approach to biodiversity conservation where the health of the food system, local ecosystem and humans are all intertwined. The management of the natural resources follows a biocentric approach rooted in their cosmogony, beliefs and in the understanding that all living being are important and deserve consideration. Humans are not at the centre of the system, but rather are responsible for ensuring the maintenance of the balance between the different elements in the ecosystem. Indigenous storytelling and collective practices reinforce these beliefs and apply them in the territory.

The richness of biodiversity is the heart of healthy Indigenous Peoples' food systems. This biodiversity generates a broad food base, which in some cases exceeds 250 edibles for food and medicinal purposes, consisting of different species, varieties and breeds consisting of wild, semi-domesticated and domesticated species of plants, animals and fish. For instance, the Khasi, thanks to their shifting cultivation or ***jhum***, generate 60 species, with their food systems providing a total of 150 food species. The system of the Melanesians[SI] obtained over 238 foods from about 132 food-providing species, out of which 51 are aquatic species. The forest food system of the Baka consists of over 179 food species coming from animals and edible species and varieties of plants, many of which are wild tubers extracted whilst hunting and gathering. The Baka are renowned for their knowledge of more than 500 plants for medicinal uses. The food system of the Tikuna, Cocama and Yagua generates 153 food species used for food, of which 116 are from the wild and 68 are species of fish. Through their ancestral ***milpa*** system, the Maya Ch'orti' cultivate 101 species that are edible, out of the 143 that the food system generates. The Sámi diet is rich in seasonal wild berries. The majority of the profiled food systems depend on the biodiversity present in healthy ecosystems in the indigenous territories to provide such a broad food base.

Besides the wild edibles, these food systems also show an important intra-specific diversity, resulting from the management of the community members. For instance, the Baka food system presents 28 varieties of plantain and 18 varieties of cassava, which appeared over the years. The food system of the Khasi counts 13 varieties of potato, 7 varieties of cocoyam, and 7 varieties of sweet potato.

The extended acceptance by scientists and policymakers of the vast knowledge that Indigenous Peoples have over wild, semi-domesticated and domesticated species contrasts sharply with the lack of dedicated policies in place to protect this knowledge.

Internal positive driver - Multifunctionality of the food systems

The eight analyzed Indigenous Peoples' food systems are multifunctional, generating food, medicines, shelter and energy, and supporting culture, social and spiritual manifestations. By-products of food crops and animals are used for packaging and conservation of foods. Leaves, lianas, vines, roots, barks, animal hives, skins and animal parts are used for utensils, tools, housing, dressing and packaging.

Multifunctionality is to be understood with a cyclical approach, where leftovers of by-products are reintegrated into the system mirroring the processes observed in nature. Multifunctionality is observed at two levels: a single species can support various uses, and one or more ecosystems can provide a diversity of services, foods and products. For example, the food system of the Bhotia and Anwal is based on various interlinked ecosystems that generate a plethora of ecosystems services, and where the forest plays an essential role in the spirituality of the community. The forest provides firewood, timber for construction and tool making, medicinal plants, and leaves used in farming. Since all of these materials are biodegradable, organic garbage and waste was not considered a problem. Instead it is seen as a resource that is recycled into biomass for fertilization or as bio-pesticide. The Tikuna, Cocama and Yagua also consider organic waste an important resource used as organic fertilizer.

Another example of the multifunctionality of these systems by the Tikuna, Cocama and Yagua is the myriad uses of palm trees for food, crafts, medicines, construction, fibre, rituals and kitchen utensils. This multifunctionality is rooted in understanding the food system in its totality, giving special attention to the relationships between the different elements.

Internal positive drivers - Governance informed by ancestral spiritual beliefs and cosmogony embedded in nature

The traditional governance systems in each community integrate advanced ecological protection and management measures within their traditions and customs that are kept alive through storytelling and tales informed by their beliefs. These governance systems have been in place for generations, much before the conceptual framing of ecology and environmental protection. Six out of the eight profiled food systems rely heavily on deep ancestral spiritual beliefs and a cosmogony that sees all elements in nature as alive and worthy of respect and protection. The maintenance of biodiversity and natural resources could be seen as an unconscious result of communities' activities and norms influenced by their cosmovision entailing that water, land, forests and wildlife are worshipped and protected as sacred elements with their own spirituality. The Khasi and Melanesians[SI] have sacred areas in their territories where it is taboo to enter, entailing a traditional and incidental form of ecosystem protection. The Tikuna, Cocama and Yagua believe that the mother of the lake, represented by a large snake or anaconda, protects the Tarapoto lakes and surrounding flooded forests, providing a dimension of sacredness and respect for the natural environment. Before being colonized, animism and shamanism were openly practised as the primarily belief of the Inari Sámi, respecting the divinity of all-natural objects. The Baka recognised the role of a forest spirit called ***jengi*** in defining resource availability, whilst their food taboos and implicit rules maintain home ranges for different residential groups that have likely contributed to prevent overharvesting.

When dreaming, the Baka receive the knowledge about their forests and resources thanks to visits from the forest spirits. The Bothia and Anwal worship ***Bhumiya Dev***, the God of jungle, which makes them protect forest areas for five years to restore them in his name.

The connection between Indigenous Peoples' cosmogony and biodiversity protection through traditional knowledge and customary governance practices is a fundamental element of the sustainability of these food systems. The lack of dedicated research and policies that, through interculturality, support the continuation of these governance practices is a matter of concern.

Internal positive driver - Food self-sufficiency from territorial management that integrates seasonality

Despite the reported weather variability associated with climate change, the integration of seasonality in their food practices is an important characteristic of Indigenous Peoples' food systems. This seasonality contributes to their resilience and self-sufficiency, ensuring numerous foods that guarantee dietary diversity. These systems generate foods consisting of animals, fish, plants and fruits – wild, semi-domesticated and domesticated – obtained through gathering, hunting, fishing and farming. The blend of territorial management and production techniques results in food systems capable of generating a broad base of foods from local fields, forests, pastures and waterways.

The eight communities show a high level of self-sufficiency, with food provisioning ranging from 55 to about 80 percent, whilst the market supplements foods to varying degrees. The food system of the Baka has important counts of foods from hunting, gathering, fishing and farming, with some foods sourced from the market primarily for interest and novelty. On the contrary, the Maya Ch'orti' depend on the market, which has provided a lifeline for food security that has bolstered the local production of maize and beans. The Kel Tamasheq depend on the market to complement their diet, otherwise consisting of dairy, meat and meat products. Out of the eight food systems, the Kel Tamasheq, the Inari Sámi and the Bhotia and Anwal are the ones with the lowest food count, with 25, 26 and 29, respectively. The remaining six systems oscillate between 130 and 180 food species. The Tikuna, Cocama and Yagua generate their food following the flooding cycles in the Amazon watershed, combining hunting, harvesting, fishing and ***chagra*** cultivation plots. This territorial management practice consists of a variety of foods, such as fruits and vegetables, hunted wild animals, household small livestock, and purchased foods like frozen chicken, with 81 percent of their protein intake coming from their fisheries. The food system of the Melanesians[SI] generates a wide diversity within many food groups, such as 30 fruits, 18 vegetables, 28 leafy greens, 17 legumes, 12 eggs, 51 types of seafood, and 14 other animals. The ***jhum*** system of the Khasi had a total of 60 species, including 22 species of fruits, 17 species of vegetables, and 9 species of cereals and other starches.

The fact that eating habits follow seasonality has been a strength of the various food systems, enhancing food diversification, self-sufficiency, resilience and dietary diversity. However, lately this seasonality is also becoming a weakness due to the effects of weather variability from climate change on food generation and production.

Internal positive drivers - Low energy dependence from external sources and use of renewable energy

The eight Indigenous Peoples' food systems reveal a low use of energy sources external to the system. These systems rely on the sun, firewood, wind and water for most of their energy needs, especially for processing, heating and cooking. Aside from solar energy, human labour and wood for cooking are the main sources of energy from within the communities and across the sites. Daily tasks rely on the labour force from families, with men and women holding distinct responsibilities. Communal and collective work involving different groups in the community are essential in most food systems and help to reduce drudgery, especially when combined with celebrations and storytelling. However, all communities indicate a constant rise in the use of non-renewable and externally sourced energies that is expected to increase.

The use of energy sources, such as gas, petrol and electricity, from outside the food systems is increasing, reducing drudgery, increasing mobility and improving efficiency in the work. The role of fossil fuels is mainly for transportation, such as the motorized boats used by the Melanesians[SI] and the Tikuna, Cocama and Yagua for fishing and reaching the markets, or vehicles used by the Maya Ch'orti' to access markets, along with fuel for tractors in their ***milpa*** plots. The Inari Sámi use snowmobiles to lead the herd during the round-up process. The use of gas and kerosene kitchens is increasing in the Tikuna, Cocama and Yagua communities. Meanwhile, the micro-hydel power plant established by the Uttarakhand Renewable Energy Development Agency (UREDA) in the Namik village and managed by the Village Urja Committee is a good example of adapted low-cost technologies that could be managed by the community to increase the energy supply of Indigenous Peoples in isolated areas. Along with the increased demand for fossil fuels and electricity, the dependency on cash to purchase these relatively new forms of energy is also increasing.

External negative driver - Biodiversity reduction from external pressures

Overall, the participating Indigenous Peoples have stated a progressive reduction of the biodiversity in their territories. From the Tikuna, Cocama and Yagua in the Amazon basin to the Sámi in the Arctic region and the Kel Tamasheq in the arid Sahel areas, this is a matter of concern. For instance, the cutting of forest on Inari Sámi ancestral lands has shrunk and degraded the remaining habitat of hanging lichen and species of birds and mammals. Since the 1980s, the population of wild species, such as taiga bean goose, has drastically declined, and mountain hare and willow grouse have also declined. This collapse has created room for other species to increase their population, like small predators. Similarly, the Khasi observed, along with the loss of dense forest, the disappearance of many of the large animals that the community once hunted, such as deer and Chinese pangolin. This process started in the 1980s and has consequently forced community members to reduce their hunting and gathering activities. In the Sahel, the degradation of the environment in Aratène has increased due to the different climate shocks and disturbances experienced since the 1970s, as well as the advance of the desert. Large parts of the wild flora have already disappeared, limiting the gathering of wild edibles. Hunting activities completely stopped about 20 years ago with the progressive extermination of the wild fauna by armed groups. Due to deforestation and the advance of the agricultural frontier at the national level, the forest area where the Maya Ch'orti' used to hunt has progressively been reduced. Populations of wild edible plants and animals have declined over time, to the point that community members do not perceive hunting as a viable food source anymore. The analysis of the eight food systems did not found evidence of any community where biodiversity has been maintained. In all instances, the environment has deteriorated and biodiversity declined. Climate change seems to be an important culprit, going hand-in-hand with deforestation and extractive activities from external actors.

POLICY RECOMMENDATIONS FOR GOVERNMENTS:

- **Create an inter-ministerial body with representatives from Indigenous Peoples and the Ministries** of Agriculture, Fisheries, Forestry, Environment and Culture that could have an integrated look at food systems.

- **At the global level, together with the UN, recognise that as of today, Indigenous Peoples across the world are amongst the best experts in preserving biodiversity,** having proved this consistently over time as research gathers more evidence about it.

- **Design at the national level, and in agreement with indigenous representatives, mechanisms of retribution for Indigenous Peoples** under the United Nations Framework Convention on Climate Change (UNFCCC) discussions for the payment of carbon dioxide sequestration and for ecosystem services.

- **Recruit Indigenous Peoples as parks personnel** to allow them to continue with their ancestral practices whenever parks and protected areas overlap with their territories.

- **Start a dialogue process with Indigenous Peoples with the aim of issuing legislation that protects wild foods in their territories,** restricting consumption and illegal harvesting by external actors.

- **Through ministries of energy, increase access to renewable energy technologies for Indigenous Peoples** without resorting to importing technologies from far-away non-renewable sources whilst respecting FPIC principles.

- **Consider biodiversity conservation and schemes for ecosystem services that build upon Indigenous Peoples' governance and traditional knowledge systems** to support their inclusion as main actors in the management of natural resources and biodiversity conservation.

POLICY RECOMMENDATIONS FOR THE UN:

- **Issue a statement that recognises** that, as of today, Indigenous Peoples across the world are amongst the best experts in preserving biodiversity, **through a UN declaration supporting Indigenous Peoples, their livelihoods and territorial management practices** that made possible the preservation of biodiversity across the planet.

- **Issue a statement to request the end of violence and displacement of Indigenous Peoples from their ancestral lands, territories and natural resources.**

- **Recognise Indigenous Peoples' traditional knowledge and their customary governance** in relation to biodiversity conservation as the world´s intangible heritage.

- **Together with research institutions and governments, increase their analysis of the use of renewable and non-renewable sources of energy in Indigenous Peoples' communities,** making recommendations under SDG 7 and 13.

- **Together with foundations and NGOs, consider funding and supporting renewable and community-managed energy supply schemes,** particularly for indigenous communities living in isolated areas.

POLICY RECOMMENDATIONS FOR RESEARCH CENTRES AND ACADEMIC INSTITUTIONS:

- **Undertake dedicated work to understand the multifunctionality of Indigenous Peoples' food systems,** in particular: the complex territorial management systems sustaining and enhancing biodiversity and Indigenous Peoples' food systems, the linkages between indigenous cosmogony and environmental and biodiversity conservation, and the capacity to generate by-products that are organic in nature and therefore biodegradable.

- Upon agreement with the Indigenous Peoples and their communities, **undertake micro- and macro-nutrient analysis of the traditional food items consumed by Indigenous Peoples** to understand nutrient composition of food items.

CONTINUITY OF TRADITIONAL PRACTICES, ADAPTATION AND INNOVATION

Internal positive driver - Adaptive capacity to change

Indigenous Peoples' food systems have survived for centuries, some for millennia, having adapted over time to climate variations, colonization and displacements. They have shown incredible ingenuity and adaptive capacity that has made them resilient through change and dynamism, whilst maintaining traditional wisdom and practices. This delicate balance between change and dynamism, and traditional knowledge through observation, is shared across all eight analyzed Indigenous Peoples' food systems. For instance, the Melanesians[SI] have adapted their socio-economic and food patterns to the availability of petrol and motorized boats, which have taken the place of their traditional sailing boats. The Inari Sámi have adapted their traditional migratory and nomadic reindeer patterns to new legislation on cooperatives, creating a hybrid system that enables them to continue with their reindeer herding methods. Indigenous Peoples have been eager to adopt new livelihoods, practices and tools that improve their lives. Since the 1990s, the Baka in Cameroon have adapted their hunting practices in response to the intensification of bushmeat hunting and displacement of animal populations deeper in the forest. They tend to restrain their trapping activities as soon as a decrease in game capture is observed, hence facilitating the recovery of the animals' populations.

Internal positive driver - Continuity in the use of traditional practices and techniques

The use of inputs from outside their territory is limited in the eight food systems, should it be seeds, agrochemicals, fuel, mechanization or electricity. Noticeably, only the Maya Ch'orti' explicitly mentioned applying agrochemicals on the ***milpa*** production plots, and the Bothia and Anwal have started applying inorganic fertilizers and pesticides. On the contrary, the Baka, the Tikuna, Cocama and Yagua, the Khasi, and the Melanesians[SI] choose not to use them. Fallow and use of organic matter as compost is the primary strategy for nurturing soil. Households often save kitchen scraps and crop residues to use on crops in several sites. Kitchen gardens flourish from grey water and the manure of roaming chickens amongst the Khasi, the Bothia and Anwal, and the Maya Ch'orti'. Several of the communities continue practising shifting cultivation, although the fallow period that enabled the soil and vegetation to regenerate has generally reduced over time due to demography and external actors' pressure on the territories. Livestock often graze freely or are fed local products. The Inari Sámi and the Kel Tamasheq sometimes resort to purchasing feed and forage. Although new tools, machinery and techniques are being incorporated more and more, human labour and tools from materials sourced in the surroundings are still predominant. The Khasi use traditional machetes, iron cups and spades for farming, and the Bhotia and Anwal build tools from materials in their forests, with their blacksmiths building their traditional tools. The expected trend is a progressive increase in the use of new tools, techniques and inputs from outside of the territory as mobility increases thanks to the growing demand for petrol fuels for transportation.

Internal positive driver - Preference for traditional foods

The participating communities agreed that despite the irruption and increasing consumption of highly processed and imported commercial foods, they prefer their traditional foods. Bushmeat is the preferred food of the Baka and the Inari Sámi prefer their traditional foods, with children especially favouring reindeer stew and fish. These preferences motivate the Baka and the Inari Sámi to continue their traditional food sourcing activities despite the growing presence of alternative food sources. For those Indigenous Peoples practising agriculture to produce their food, this means a preference for their traditional crops and breeds. For the Maya Ch'orti', taste is the primary factor in their choice and maintenance of local maize varieties. The Bothia and Anwal continue producing their local varieties of amaranth, potato, finger millet and beans. The Khasi interplant in their ***jhum*** plots in forest areas several of their traditional seed varieties. The preference for traditional crops and breeds ensures the maintenance of the genetic pool of traditional seed varieties that, together with the wild and semi-domesticated species existing in the surrounding lands and forests, contribute to the maintenance of the overall biodiversity and to the preservation in situ of the genetic pool.

External positive drivers - New techniques and innovations adopted

Different innovations and new techniques have increased efficiency in food production, sourcing and processing for some of the profiled food systems. For example, snowmobiles have reduced labour for herding amongst the Inari Sámi. The use of wire cables replacing vegetal ropes has increased hunting efficiency for the Baka. An electric mill was introduced by the Khasi, reducing the drudgery in processing finger millet and enabling the production of products with increased value-add for the market. Often these innovations increased dependence on external sources of energy (electricity, petrol) but not exclusively, as seen in the case of bicycle-powered machines that were introduced for producing crafts by a Maya Ch'orti' community in Chiquimula. Some of the new techniques incorporated also carry implicit new effects in the ecosystem that need to be researched. For instance, the Tikuna, Cocama and Yagua saw fish stocks in their rivers deplete due to their increased use of nylon nets. They resorted to asking the elders to design a community management fishing plan that would ensure the replenishment of the fish stocks before they were decimated.

External negative driver - Introduction of new seeds and breeds

New seed varieties have been arriving to the indigenous communities through different routes. In some cases, they come from barter and trade with neighbouring communities and non-indigenous populations. In other instances, new seeds are purchased in local markets, which may be local or introduced varieties. These seeds sometimes introduce a new crop that successfully adapts to the local environment. For example, the Baka in Cameroon mainly obtained varieties of plantain and cassava by sharing amongst local communities, whilst a few were brought by external organizations and integrated in their production systems. Sometimes, new seeds and crops are part of development packages promoted by the extension services of the different countries where Indigenous Peoples live. Regarding these agricultural extension packages, it has been observed that sometimes there is not sufficient discussion, consultation or consent by the Indigenous Peoples benefiting from these assistance programmes, resulting in failure. For example, the Tikuna, Cocama and Yagua peoples explained how ***sacha inchi*** (*Plukenetia volubilis* L., Euphorbiaceae, Inca peanut), introduced by the Ministry of Agriculture, has not been adopted by the indigenous community.

Introduced seeds and breeds in several cases contributed to displacing local ones. The Khasi reported that they have lost many traditional varieties as new crops have been introduced. Eight varieties of potato have disappeared in the last few decades, whilst three have been introduced in their place. The same is the case for sweet potato, where five traditional varieties have been replaced by only two over time. Some other species, such as millet, are still grown but varietal diversity has decreased over time, and they are planted on smaller areas. Equally, the introduction of a new breed of pig has led to abandonment of the local breed. This phenomenon has also occurred with the Bothia and Anwal, where the traditional crop amaranth is produced less than it was in the past. In the case of the Melanesians[SI], the reliance on local, traditional animal breeds, as well as plant species and varieties, has also decreased over time. The Bougainville banana, introduced in 1992, had the advantage of growing easily, which contributed to its expansion to the detriment of the rich plantain and banana biodiversity that exists in the territory. This has affected, amongst others, the Vitamin-A-rich Fei banana, which used to be a nutritious staple for breakfast. Whilst the introduction of new seed varieties and crops is not bad per se, and in most cases is well intentioned, some of the negative effects seem to be related to a lack of discussion with the Indigenous Peoples and the lack of measures in place to support traditional breeds and varieties. The varietal reduction is a concern.

External negative driver - Climate change and natural catastrophes

The high dependency of Indigenous Peoples' food systems on natural resources and its cycles that made these food systems resilient over time is now making them vulnerable to the effects of climate change. The high adaptive capacity of Indigenous Peoples' foods systems has met an insurmountable challenge posed by climate change. Climate change, along with increased recurrence of natural catastrophes, is negatively affecting Indigenous Peoples and their food systems. Climate change and climatic variability has altered the arrival, length and stability of seasonal weather patterns, affecting wild edibles and vegetation that are depleting at an alarming rate. The scientific evidence has been corroborated by the observations of the Indigenous Peoples participating in the profiling and detailing the recent changes in the environment. For instance, the Kel Tamasheq have seen their mobile patterns change due to a shortage of water sources since the Sahel droughts in 1973. This has affected the livelihoods of the Kel Tamasheq through loss of livestock, migration to neighbours' countries, and loss of pastures and wild plants. The Inari Sámi are witnessing how the increased melting of the ice that later freezes now hampers reindeers' ability to find the grass under the snow. The Bothia and Anwal have seen a reduction in the number of pollinators in the Himalaya region, as well as early flowering of wild plants like rhododendron. Climate change and the increase of natural calamities come across as one of the drivers most affecting the present and future of Indigenous Peoples' food systems, testing its resilience and sustainability.

POLICY RECOMMENDATIONS FOR GOVERNMENTS:

- **Enact legislation that protects Indigenous Peoples' food systems legacy and traditional crops,** ensuring that Indigenous Peoples and their knowledge is respected and taken into account as part of the cultural and environmental heritage of the countries.

- **Have a section of extensionists dedicated to Indigenous Peoples' food systems within the ministries of agriculture.** They will speak the indigenous languages, understand the food systems, and be able to provide technical advice to the Indigenous Peoples on how to improve their production as well as incorporate some new techniques, varieties and practices. It is recommended that the Ministries of Agriculture and Environment incorporate, amongst their extensionists and agents, the principle of FPIC when working in indigenous territories.

- In respect of the UNDRIP, through the different ministries, **stop any development and interventions in indigenous territories that have not received the consent of Indigenous Peoples** following the process of FPIC.

POLICY RECOMMENDATIONS FOR THE UN:

- **Discuss with the member countries, through the UN country teams, the policy and scientific recommendations made at the global level** by the UNFCCC and the Intergovernmental Panel of Experts on Climate Change (IPCC) and how they can be implemented locally in relation to Indigenous Peoples and climate change.

- **Establish voluntary guidelines to protect native local seeds and recommend that the introduction of new seeds should be decided by the Indigenous Peoples' communities** at the local level following localized testing and adaptation that can be supported by the relevant Ministries of Environment and Agriculture.

GOVERNANCE, FREE, PRIOR AND INFORMED CONSENT, AND DEVELOPMENT PROGRAMMES

Internal positive driver - Traditional Indigenous Peoples' governance systems and strong social cohesion

Despite the different drivers and factors negatively affecting Indigenous Peoples' food systems, the research showed that all the participating communities manage to maintain a solid social bond and solidarity within their communities. This is even more so for those communities that have maintained their traditional governance and customary institutions, which reinforce social cohesion as everyone participates in the decisions for the betterment of the community. For example, the Khasi have maintained the ***Durbar Shnong***, their village council, which is an ancient system linked to other villages and sites since ancient times and has been embedded within the formal system of State governance. The Maya Ch'orti' maintain respected local leaders linked to a confederation of Maya Ch'orti' municipalities in Chiquimula dedicated to sustainable development. Since 1996, the Sámi have established a parliament dedicated to plan and implement the self-government of the Sámi as an independent legal entity of public law. The Kel Tamasheq governance system is based on Village Councils acting as advisory bodies to the communal authority. Whenever the communities do not have specific governance institutions in place, they still show strong social binding and organization systems often linked to celebrations, rituals and communal work. For example, amongst the Khasi, representatives from all families gather once a year and, combined with festivities, prepare the ***jhum*** field. They can also hire people from the village to help carry out the activities. The Tikuna, Cocama and Yagua call the ***minga***, gathering friends and family members together to help carry out different work activities during a full day of work. The Maya Ch'orti' cosmogony includes the concept of "mística de servicio" or being of service to others and the community. This is a key element of their governance, providing services that are free, voluntary and permanent for the benefit of the community. The Inari Sámi keep alive the tradition of collective and communal work by bringing together different cooperatives during the round-up process of the herds.

The relationships between communal works, social cohesion, functioning institutions and customary governance with the transmission of traditional knowledge, culture and the preservation of biodiversity are a research area meriting more attention. This would enable the design of support programmes that build upon this intangible but extremely valuable capital that indigenous societies have.

External positive driver - Development interventions supporting the communities

There are examples of development programmes initiated by the government, NGOs and institutes that have benefited the communities, reduced the drudgery, and brought about positive impacts. Some of these programmes have improved access to electricity, petrol, schools, health dispensaries and roads, whilst others have brought new varieties of seeds and new animal breeds. These positive impacts seem to be greater when the community had a say and was part of the initiative managing to provide their consent prior to the intervention. The Kel Tamasheq and the Bhotia and Anwal developed vegetables via gardening to complement their diets thanks to the support of governmental agencies and NGOs. Several of the participating communities benefited from infrastructure facilitating water access. For instance, the construction of pipelines increased greatly the quality of life of the Khasi, the Bhotia and Anwal, and the Melanesians[SI], whilst boreholes facilitated access to water for the Kel Tamasheq. Despite an increase of inorganic waste in the communities, a result of the increased consumption of allopathic medicines, batteries and processed foods, some of the participating communities have managed to keep the burden of waste and garbage low thanks to state-run recycling initiatives. The Inari Sámi benefited from an efficient state-run recycling system and managed to recycle all waste. The Khasi had recently been included in a state-run recycling system. Lastly, the access to government-subsidized food rations for the Khasi, and Bhotia and Anwal benefit the communities and are welcomed initiatives.

External negative driver - Development programmes needing consultation and consent

In most of the eight analyzed food systems, government interventions aim to support the well-being of the community. Whilst some of these governmental programmes have obtained positive outcomes, others have been mentioned by the communities as an important source of stress and dissatisfaction. In most of the food systems analyzed, there are examples of well-intended governmental programmes that had a negative impact on the Indigenous Peoples' food systems and diets. The participating communities mentioned that they have not been consulted properly, which could perhaps indicate that in some cases the process of FPIC has not been duly respected. In these instances, the combination of the fact that the indigenous leaders and the community were not properly consulted, and that the State authorities did not follow the process of FPIC, resulted in the failure of the programmes.

Despite some positive examples found during the research, in most profiled food systems the local administration and the national institutions did not consider the existing Indigenous Peoples' governance systems when developing new policies and development programmes. This could be one of the reasons for the low level of success for some development programmes, initiatives and social protection schemes introduced in these communities. In some cases, these initiatives created new challenges for the communities and in others environmental issues related to the introduction of new plant varieties and animal breeds. The Bhotia and Anwal are progressively increasing the use of inorganic fertilizers and pesticides with the introduction of new crops. The Khasi saw a loss of food diversity as a consequence of the introduction of rice varieties through state-run programmes in the 1980s. For the Melanesians[SI], both with the arrival of missionaries in 1915 and later with development interventions, the introduction of new foods and the establishment of commercial coconut plantations influenced food production and consumption and negatively affected the health of the people. The adoption of the Lagos de Tarapoto Wetlands Complex as the first Ramsar site in the Colombian Amazonian area is a positive example that shows that conservation policies can be successful with the consent of the indigenous communities. Comprising areas destined for production, conservation and restoration initiatives under the Reducing

Emissions from Deforestation and Forest Degradation (REDD+) the site received the support of the Tikuna, Cocama and Yagua, who wished to engage in the process of protection and recovery of their ecosystems. The Free, Prior and Informed Constent cannot be sufficiently emphasized.

The research has shown that minor adjustments during the design, discussion and implementation phases of assistance programmes can greatly improve their impact and sustainability.

External negative driver - Expansion of infrastructure bringing external actors

Infrastructures are reported as welcomed and beneficial to the participating indigenous communities. However, the expansion of infrastructure also brings new actors that sometimes entail new challenges. For instance, the construction of roads in Nellim has resulted in the arrival of alcohol and narcotics. Improved accesses for the Inari Sámi has also brought tourists, leading to environmental degradation and eutrophication of lakes. The construction of roads and the opening of ferry services around Gribe resulted in more logging that has progressively reduced the size of the Baka forest and increased trade in bushmeat, adding pressures on the biodiversity. In Puerto Nariño, the arrival of highly processed and imported food to the market is associated with the development of the urban area. The remote location of Namik village of the Bhotia and the Anwal in the Himalayan mountains has slowed down the arrival of external actors. Likewise, for the Kel Tamasheq in Mali, the road conditions make it difficult to reach the Aratène village.

POLICY RECOMMENDATIONS FOR ALL ORGANIZATIONS, AGENCIES OR GOVERNMENTS UNDERTAKING ANY ACTIVITIES, DEVELOPMENT OR INTERVENTIONS IN INDIGENOUS TERRITORIES AND LANDS:

- Ensure that Indigenous Peoples in their country are informed about FPIC, and on how they can request its application.

- **Respect the principle of FPIC.** The respect of the process of principle of FPIC is a guarantee of respect of the right to self-determined development of Indigenous Peoples, which contributes directly to the success of any proposed development interventions.

POLICY RECOMMENDATIONS FOR GOVERNMENTS:

- In respect of the UNDRIP, through the different ministries, **stop any development and interventions in indigenous territories until they receive consent from Indigenous Peoples** following the process of FPIC.

- **On a local level, together with indigenous leaders, create mixed committees to analyze the proposed Central Government interventions** from Line Ministries, ensuring that those proposals clashing with the views and cosmogony of the Indigenous Peoples can either be adapted or rejected.

- **Both nationally and locally, have the Principle of FPIC inform all programmes, decisions and policies affecting Indigenous Peoples and their communities,** including development and conservation policies.

- In this context, **include Indigenous Peoples in the steering committees implementing these programmes,** decisions and policies.

YOUTH, EDUCATION SYSTEMS, INTERCULTURALITY, INDIGENOUS LANGUAGES AND TRADITIONAL KNOWLEDGE

Internal positive driver – Indigenous languages essential for traditional knowledge and food systems

About 4 000 out of the approximately 6 700 spoken languages today in the world are indigenous languages (UNDPI, 2018). The research has shown that indigenous languages are key in sustaining the food system and knowledge of the environment. The participating communities were aware of the importance of their languages to maintain their culture and livelihoods. Indigenous Peoples' languages are particularly rich in naming plants and wild and semi-domesticated animals, describing the biodiversity and ecosystems and their interactions and behaviours within the ecosystem. For the Inari Sámi, their observations and relationship with the surrounding biodiversity is reflected in their traditional knowledge and language such that they have different words and terminology to characterise whitefish and their behaviour. The Sámi Education Institute is a positive example of intercultural education that integrates and teaches Sámi language, Finnish and traditional skills. It was noted, by many examples in the case studies, that when these indigenous languages disappear, so too does the body of knowledge that was generated through the use of this language. This is especially true for the cultures founded on orality, as are the majority of the indigenous languages in the world. The International Decade of Indigenous Languages (2022-2032) stresses that these are the languages at the highest risk of extinction. It is fundamental to come up with intercultural education programmes that support the ongoing efforts in Indigenous Peoples' communities to keep their languages alive.

Internal positive drivers - Preservation of traditional knowledge

The eight participating communities hold unique and rich traditional knowledge on local resources that supports their resilience and adaptive capacity. One of the key factors that has helped them maintain this knowledge is their respect for elders, who are responsible for passing on this knowledge to younger generations. This intergenerational transmission of traditional knowledge stood out as a fundamental element of resilience across all eight food systems. This is particularly the case for the Kel Tamasheq, who perceive their food system and diet based on meat, meat products and dairy as part of their identity, which depends on the transmission of their traditional knowledge. Interestingly, for the Melanesians[SI], the profiling exercise catalysed their awareness about the need to revive their traditional knowledge and its transmission from the elders to the youth. The Tikuna, Cocama and Yagua perceive mothers as the guardians of the knowledge system of the ***chagras***, where this knowledge is passed on to the youth during different activities. The Fishing Conservation Guidelines was prepared by artisanal fisherfolk and elderly knowledge holders in the context of the Community Fisheries Agreement, and it was used to carry out educational work with the younger generations. The Maya Ch'orti' women specialized in wild mushroom harvesting, maintaining rich knowledge of the place and time when fruiting occurs.

Several of the profiled food systems indicate that despite migration of the youth from the community and decreasing interest for traditional practices, some youth still take great interest in the traditions, culture and production systems. In Nellim, the Inari Sámi youth are important actors in maintaining the cultural subsistence fisheries. The Melanesians[SI] youth in Baniata village compose electronic music to pass on the knowledge of traditional recipes. In the village of Nongtraw, a group of 16 Khasi youth have formed a cooperative society for marketing the traditional millet, selling both raw and processed millet to cater to the market.

Language and traditional knowledge are in essence adaptive and dynamic, whilst at the same time, as the Melanesians[SI] mentioned, fragile if not properly used, maintained and transmitted.

Internal negative drivers - Globalization decreasing youth's interests in traditional practices and knowledge

Migration is affecting all eight indigenous communities. Youth are increasingly migrating away from the communities, usually to urban areas. The youth expressed their wish to leave the community and learn a profession following the attraction and calling to participate in the market economy and urban culture. Often, this phenomenon is catalysed by the attendance in school, where kids develop aspirations and change their cultural and food habits. This phenomenon is leading to a decreasing interest in ancestral practices, less capacity to maintain and carry forward Indigenous Peoples' food systems, and, sometimes, an abandonment of the land, as is the case for the Bhotia and Anwal. In Nellim, when an Inari Sámi moves outside the Sámi homeland area, their legal right to use nature in certain areas is lost, thus young people lose their connection to their traditional fishing areas. Baka women anticipate that their children will no longer forage in the forest as their parents did in the past. In Mali, the situation is more dramatic, where some youth migrate to cities to learn a profession, but sometimes end up getting involved in armed groups.

There is an overall consensus that, if not addressed in a multifaceted and coordinated way, the transmission of traditional knowledge within many Indigenous Peoples will deteriorate drastically, resulting in some cases in the loss of rich oral traditions that will disappear with the passing away of the elders. Whilst migration, particularly to the cities by the indigenous youth, seems unstoppable, the transmission of traditional knowledge could be preserved through different initiatives.

Internal negative driver - Difficulties for intra- and inter-generational transmission of language and knowledge

In all eight food systems except in the Tikuna, Cocama and Yagua food system, Indigenous Peoples' traditional knowledge systems remain undocumented and depend on oral transmission to be preserved. The language, culture, beliefs and cosmogony of entire Indigenous Peoples' nations depend on the ability to effectively transmit oral knowledge. Many of the case studies exposed current vulnerabilities and risk factors compromising the traditional oral knowledge systems. One such factor is when indigenous languages are forgotten by a community. As depicted in the food system profile of the Tikuna, Cocama and Yagua, when an indigenous language starts to deteriorate and the community forgets the names of plants, herbs and practices, the Indigenous Peoples' food system, its associated territorial management practices and their traditional knowledge is weakened, and in some cases condemned to disappear and vanish. The wealth of knowledge that Indigenous Peoples across the world have about the environment and biodiversity is codified in the use of indigenous languages that are maintained almost exclusively through orality.

Another related and influential factor found is that as some indigenous youth become less interested in traditional knowledge, a large threat exists regarding the future of these oral knowledge systems as their elders pass. This dynamic can generate frustration within the community, as for the Melanesians[SI], where the elders perceive that the youth are not interested. School and education seem to play an influential role in this occurrence. It is reported that when attending school, Melanesians[SI] kids have a higher desire to leave the community and learn a profession than when they participate in their community's livelihoods' activities. Similar trends were seen for the Tikuna, Cocama and Yagua, whose children attend school and spend less time with their parents learning fishing techniques. The effects of schooling that lacks intercultural education can be understood as a negative internal and external driver that is affecting the future resilience and sustainability of Indigenous Peoples' cultures, languages, knowledge and food systems.

External negative driver - School feeding changing the tastes of indigenous youth

In various ways, all profiles have shown indications of weakened ties between indigenous youth and their indigenous customs and traditions. There are several emerging factors when examining youth's decreasing interest for traditional practices. One of them is linked to the impact of school feeding and access to new imported and often highly processed foods that reshape indigenous youth' food tastes away from their traditional foods. School meals are part of the schooling and education in several countries. This is the case for the Tikuna, Cocama and Yagua's kids, who have acquired increased preference for highly processed food as a result of their participation in school feeding programmes. In Solomon Islands, one quarter of the Melanesians[SI] kids interviewed declared their preference for processed foods over traditional ones. Paradoxically, youth and the elders agree that their indigenous traditional food systems, meals, livelihoods and ways of life are healthier, tastier and preferred to the new imported habits. However, they see themselves caught up in the divide between the need for education to access better prospects for the future or continuing their lives without education.

All the Indigenous Peoples participating in the research saw the education of their children as positive, yet they were concerned about the open question of how to ensure traditional knowledge transmission that guarantees the continuation of their ancestral food and knowledge systems.

External negative driver - Lack of access to education and the need for culturally appropriate education

All indigenous communities have mentioned the effects that education programmes and missionaries have had on their livelihoods. Often these interventions not only denied the beliefs and customs of the Indigenous Peoples, but also created assimilation and reeducation programmes that undermined the essential role of ancestral beliefs, culture, spirituality, languages, habits, customs and, very importantly, foods within the system.

The eight examined food systems suffer the absence of education programmes integrating and building on indigenous values, beliefs and traditions. There was either no access to schooling services or, when they did arrive, interculturality was not considered.

Despite this, education is seen as essential by most of the parents interviewed, who want their children to attend school whenever possible. At the same time, parents reported that where it was available, schooling has had a detrimental impact on their customary systems and the transmission of traditional knowledge, advancing the loss of their language and a change of food habits and tastes in the youth towards highly processed and unhealthy foods.

Schools have been mentioned by most communities as one of the main entry points affecting their food habits, beliefs, self-esteem and traditions.

The lack of consideration of indigenous knowledge seems to have also been the norm when missionaries arrived, converting the communities into other religions and denying Indigenous Peoples' notion of holiness embedded in nature and the environment. For instance, the Inari Sámi and Khasi beliefs based on animism and shamanism were substituted by Christianism. The Inari Sámi as well as the Tikuna, Cocama and Yagua were denied from using their native languages or engaging in their cultural practices. As a result, it is now rare that indigenous languages are the dominant languages within a community; worse, they can be nearly extinct, such as for the Inari Sámi. These educational and religious assimilation processes have also created a sense of inferiority, guilt and embarrassment when exercising their customs and traditions, and speaking their languages.

The reconciliation of school and education with the maintenance of traditional knowledge is fundamental to ensure not only the transmission of ancestral territorial practices, but also for the survival of indigenous languages, culture, beliefs and cosmogonies. Intercultural schemes of schooling and education are possible and there have been some positive examples mentioned during the field research.

This includes some of the experts providing assistance to other Indigenous Peoples through cooperation arrangements. Another example, as mentioned with the indigenous language programmes, is the Sámi Education Institute, which offers unique vocational upper secondary education along with short courses in Finnish and Sámi. The Institute promotes traditional knowledge and practices such as herding, fishing, handicrafts and cooking in Sámi languages.

It is important to undertake policy interventions to ensure that education is not seen as a zero-sum game. Instead, schooling should be able to reinforce the cultural heritage of the communities whilst providing youth with the needed skills for professional lives. Interculturality is essential in education programmes with Indigenous Peoples.

Dedicated research and new policies discussed with Indigenous Peoples to support the schooling of Indigenous Peoples without condemning their indigenous language, culture and foods are more needed than ever.

POLICY RECOMMENDATIONS FOR GOVERNMENTS:

- **Set up national committees composed of experts from ministries of education and indigenous leaders who can discuss and design intercultural education plans in Indigenous Peoples' territories.** These intercultural educational plans should blend mainstream education along with traditional knowledge, ensuring that the indigenous languages are preserved and, along with them, the food systems and livelihoods. Ideally, interculturality should inform all educational plans and curricula in more than 90 countries where Indigenous Peoples live in the world.

- **Through this national committee on intercultural education, analyze the time and frequency of the classes and the schooling.** It should not collide with the traditional calendar for livelihood activities that follows nature's seasonality and cycles. Rather, it is important to reach a schedule of lectures that does not clash with the transmission of traditional knowledge that takes place in association with many livelihood-related activities. The classes and lectures can be taught with the support of parents in the indigenous language as well as in the language spoken by the professors.

- Through the Ministries of Education and the governmental agencies responsible for the school feeding programmes, **set up a mixed committee with the indigenous elders, women and representatives to jointly decide which foods will be part of the school menus.** The recipes and foods should come from the community by involving the parents in the school meal programmes, ideally purchasing their local production of indigenous foods.

- Together with universities and indigenous organizations, **within the overall context of the International Decade of Indigenous Languages (2022-2032), undertake a mapping of the indigenous languages spoken and characterise their importance to maintain Indigenous Peoples' food systems,** identifying centres that can document and support these languages to avoid their disappearance.

POLICY RECOMMENDATIONS FOR THE UN:

- **Promote that interculturality informs all educational plans and curricula** in more than 90 countries where Indigenous Peoples live in the world.

• **Through the United Nations Permanent Forum on Indigenous Issues (UNPFII), take up the issue of school feeding and analyze the impact** it is having on Indigenous Peoples' health, food taste, habits and culture.

• **Through FAO, together with research institutions, undertake a study on the impact of school feeding programmes** on the nutrition status of indigenous youth.

• **Through FAO, together with research and academic institutions, develop guidelines with indigenous organizations** that can inform governments on how to preserve traditional knowledge and food systems.

• **Together with governments, support initiatives driven by the community and Indigenous Peoples on documenting traditional knowledge** with funding and mechanisms to ensure that the traditional knowledge and languages are not lost. Many Indigenous Peoples have started to document their traditional knowledge into participatory encyclopedias and compendiums of documents such as the Matsé people encyclopedia of indigenous medicine.[6]

POLICY RECOMMENDATIONS FOR RESEARCH CENTRES AND ACADEMIC INSTITUTIONS:

• **Engage with documentation of indigenous languages** to ensure their survival.

• **Co-create curricula for protecting and preserving traditional knowledge, together with indigenous organizations.** Museums, libraries and almost all forms of transmission of knowledge through written means have an associated university degree that ensures that the knowledge is preserved. In the case of traditional oral knowledge, this is lacking, and within the International Decade of Indigenous Languages (2022-2032), it is important to have important academic institutions come up with a curriculum and a methodology discussed and approved by Indigenous Peoples.

POLICY RECOMMENDATIONS FOR INDIGENOUS PEOPLES:

• At the national level, through the national commission of Indigenous Peoples and indigenous leaders, **create a working committee that analyzes how to preserve indigenous languages and traditional knowledge** both inter- and intra-generational.

• **Blend oral traditional knowledge with written codified guidelines.** The examples of the drafting of traditional knowledge encyclopedias, such as the ones initiated in the Amazon region, could be expanded to other areas of knowledge. The new forms of technology and data management can assist but should be assessed by indigenous youth to ensure the respect of FPIC and guarantee the safety and restricted access, in some cases, of the codified information and knowledge.

[6] For further information, see https://news.mongabay.com/2015/06/amazon-tribe-creates-500-page-traditional-medicine-encyclopedia/

GLOBALIZATION, INCOME, BARTER, TRADE, PROCESSED FOODS, WASTE

Internal positive driver - Indigenous Peoples' food systems and cash income generation

All participating indigenous communities sell items to generate income. The Melanesians[SI] harvest the wild ***ngali*** nut that they market at the international level, mostly to New Caledonia. The Maya Ch'orti' sell various handicrafts made of palm at the market. The Khasi sell bamboo baskets and crops, which contribute around 40 percent of household income. The Bhotia and Anwal base their income on the selling of their crops, sheep and goats to nearby villages. They also sell wood and bamboo handicrafts. The Kel Tamasheq and the Inari Sámi obtain the majority of their income from the selling of their animals or animal products in local and national markets. The Tikuna, Cocama and Yagua mainly sell the surplus from their ***chagra*** plots to the urban area of Puerto Nariño. In the case of the Maya Ch'orti', the main source of income comes from off-farm labour.

In the eight communities, in addition to food and inputs for the food system, cash incomes were primarily used to meet the needs for allopathic medicines, education, transportation and communication. However, cash incomes were not always considered adequate. That is particularly the case for the Baka, who reported not getting a fair price for the selling of their forest products. Due to the remoteness of the Nongtraw and Namik villages, the vegetables sold by the Khasi, and the Bhotia and Anwal are often less fresh and start to rot when they reach the markets, which affects price. The degree of dependency on the market by the different communities to sell and buy foods played a role in the prices obtained. For instance, the Maya Ch'orti' and the Kel Tamasheq rely on the market to meet their food security, whilst the Tikuna Cocama and Yagua are self-sufficient in food and sell their surplus in the market.

Internal positive driver - Relevance of sharing, barter and trading practices

Trade, barter and sharing are practised to different degrees in all eight food systems. The Melanesians[SI] have been trading with different islands to fetch items that were not sourced locally. Similarly, the Tikuna, Cocama and Yagua, and the Inari Sámi have been trading fish, meat and fruits with other non-indigenous and Indigenous Peoples. For instance, the Baka hunter-gatherers have been bartering and trading with the neighbouring Bantu farmers to maintain their livelihoods for generations. They collect several wild edibles such as *Irvingia* kernels, *Aframomum* pods and *Ricinodendron* nuts, for instance, that they exchange with the Bantu. For the Baka, food sharing is common; when one family has more food than necessary, they share it rather than store it. The barter system is also strong amongst the Kel Tamasheq, the Maya Ch'orti', and the Bhotia and Anwal, making these food systems locally interdependent. All participating communities have traditionally practised barter and food sharing as a form of solidarity based on the reciprocal practices common amongst Indigenous Peoples' societies. However, the monetization of the economy is progressively leading several communities away from these ancestral safety nets and communal practices, favouring selling for cash versus in-kind exchanges.

Internal negative driver - Markets and cash-generation reshapes food systems, affects biodiversity and health

In all eight communities, trade has been occurring for hundreds of years. Whist trade has traditionally taken place through barter, the recent improved access to markets by traditionally isolated indigenous communities has brought along several new elements into their economies. In the eight cases, this increasing interest in the market for income generation is reinforcing the importance of cash and accelerating the monetization of these traditional economies. The cash and monetization of the transactions has led to an interest in accumulation in the form of products or cash to purchase manufactured goods (motorbikes, fishing nets, improved tools, snowmobiles, boats). This trend is accompanied in some of the profiles by the intensification of cultivation, harvesting, fishing and hunting geared to cover the demands of the market. The differential shifting of the eight food systems towards markets, cash and monetization is accompanied by the learning of some of the effects of this new impetus. This relatively recent focus on the market, occurring during the past hundred years, is reshaping profoundly these food systems that for centuries have come up with sophisticated territorial management practices to ensure self-sufficiency and based on barter, exchange, reciprocity and solidarity. This is affecting environmental biodiversity, sustainability and the diversity of foods within the system, as well as the social fabric, traditions, and the health and nutrition of the community. The selling at the market of nutritious foods generated by the Indigenous Peoples' food system occurs at the same time new highly processed and imported foods are purchased for consumption. This increasing consumption of highly processed and imported foods has had a direct impact on preferences and tastes, affecting traditional knowledge and deteriorating the health in the communities. The interest in cash generation has altered relationships amongst villagers in some of the communities, with evidence of individualistic behaviours growing and abandonment of collective tasks and communal work. Competition for selling goods has risen.

For the Melanesians[SI], the arrival of missionaries marked the starting point of the conversion from a self-sufficient system towards a monetized economy. With the introduction of income, the dependence on cash increased over time. Today, incomes within the community are increasing as community members sell more home garden products, handmade crafts and goods to the markets. The community is working on achieving certification for the selling of the ***ngali*** nuts that they collect from the wild. Since the 1990s, the Melanesians[SI] have increased their consumption of highly processed and imported commercial foods, whilst their consumption of fresh and traditional foods has decreased. Now, their freshly gathered and produced food items are sold in the market to pay their children´s school fees. This market-induced shift in the Melanesians[SI] diet has resulted in poor health outcomes, such as high blood pressure, high blood glucose, and increasing rates of obesity and people being overweight.

Between 1960 and 1970, the Tikuna, Cocama and Yagua increasingly engaged in fishing, hunting and gathering of wild fish, animals and plant species for commercial use. This included the ***pirarucú*** (*Arapaima gigas* Schinz, Osteoglossidae), the black caiman (*Melanosuchus niger* Spix, Alligatoridae), the jaguar (*Panthera onca* L., Felidae) and otters (*Pteronura brasiliensis* Gmelin, Mustelidae and *Lontra longicaudis* Olfers, Mustelidae). This was rendered possible thanks to the adoption of nylon nets, which negatively impacted the biodiversity in the natural ecosystem. Once the level of the damage was understood, community members engaged in protecting the biodiversity in their territories, adhering to the Ramsar Convention and starting a sustainable community fisheries programme to reverse the reduction in catches of certain species.

In Namik where the Bhotia and Anwal live, the few families that receive cash from their relatives working in urban areas rely less on the barter system, consequently affecting the social bonds within the community. Community members are now more interested in getting maximum return from their production system, when previously they offered each other gifts without expectation of reciprocity. The Khasi have abandoned barter altogether now that their income has increased thanks to markets, with community members exonerated from their traditional tasks so they can dedicate their time to produce handicrafts to be sold at the market. The Maya Ch'orti have seen their traditional weaven textiles displaced by the arrival of cheap manufactured cloths at the market.

Cash-generation in communities that until recently have a low level of monetization and little access to markets has become one of the major drivers reshaping at once the preferences, tastes, social bonds, safety nets and traditional solidarity mechanisms. There is no doubt that this will continue in the near future and has raised the question of how much will the resilience and sustainability of traditional practices be compromised to meet market demand.

External positive driver - Improved infrastructure and better access to markets and information

With globalization, the communities have seen improved infrastructure, offering better marketing prospects for indigenous foods. The Melanesians[SI], for example, rely on a 90-minute petrol-powered boat ride to reach the market and sell their foods. The Khasi still lack proper infrastructure and have to carry their products from the village up 3 000 steps to reach the road. If they reach the market late, they face a problem in getting a good price for their goods. A road to the village would greatly enhance their income opportunities. A similar situation exists for the Bhotia and Anwal, who suffer from remoteness and minimal road access to sell fresh food on the market. All participating communities expressed their interest in accessing better infrastructure that improves their mobility and access to markets following the principle of FPIC.

External negative driver - Processed foods bringing inorganic waste

The eight communities have a long-lasting tradition and knowledge about integrating organic by-products and waste generated back into the system as inputs. But inorganic waste is a different issue with the introduction of processed foods, bringing a new profusion of packaging materials, plastics and bags into the communities. Batteries and allopathic medicines have also become sources of waste. For most communities, this is a relatively new phenomenon. The lack of waste management plans, facilities and awareness has further compounded the effect of inorganic waste in otherwise pristine areas. The Bothia and Anwal throw inorganic waste from marketed products outside their houses. This practice pollutes the local landscape and water streams. It is interesting to compare this practice with other traditional behaviours, such as educating through tales about not urinating in water streams to keep them clean and drinkable, reaffirming the community values about their environment.

With respect to inorganic and organic waste, this situation affects non-indigenous and Indigenous Peoples alike in both developed and developing countries. However, there is need for better understanding about the use of biodegradable materials for packaging, clothes and construction materials. Many of the biodegradable and organic products used by Indigenous Peoples are available locally and should be promoted through local legislation. In some instances, the environmental legislation in some countries, although well-intended, can be counterproductive to the harvesting and use of natural by-products from the forest that traditionally have been used sustainably by Indigenous Peoples for centuries.

During the fieldwork, there were reports of some positive experiences of recycling inorganic waste that could pave the way for the adoption of these schemes at the community level in other parts of the world.

POLICY RECOMMENDATIONS FOR GOVERNMENTS:

• **Discuss with indigenous leaders about environmental legislation hampering or restricting the use of by-products from the forest in their areas.** Their suggestions should be incorporated to allow Indigenous Peoples to exercise their livelihoods whilst protecting the environment.

• **Include in national school curriculums education programmes that are culturally sensitive and that will reinforce traditional knowledge and healthy eating practices.**

• **Through the Ministries of Health, Agriculture, Environment, Commerce and Development, jointly analyze in specific commissions the importance of reducing or eliminating inorganic materials in the bottling, wrapping and packaging of processed and commercial foods.** The experience of some countries in banning plastic bags[7] has been exemplary policymaking for the rest of the world that could be expanded in the case of processed foods.

POLICY RECOMMENDATIONS FOR THE UN:

• **Within the UNPFII establish dedicated expert sessions to discuss how to facilitate the development of labelling and certification schemes for Indigenous Peoples' foods** generated by healthy and sustainable food systems that protect the environment. These sessions should also address how to access the market with a preferential rate that guarantees that the added value along the chain is redistributed as much as possible to the community.

• **Undertake a coordinated effort through several of its main agencies to issue a statement that can help governments tackle the problem of highly processed and imported commercial foods with regards to Indigenous Peoples' health and environment.**

POLICY RECOMMENDATIONS FOR RESEARCH CENTRES AND ACADEMIC INSTITUTIONS:

• **Together with the UN undertake studies on the thresholds of wild edibles in response to market demand.** It is questionable that without domestication, wild edibles, dependent on the health of the ecosystem in which they thrive, can sustain the markets' demand without being depleted. More dedicated research is needed.

POLICY RECOMMENDATIONS FOR INDIGENOUS PEOPLES:

• Through indigenous organizations, together with NGOs and research centres, **train communities on how to market their produce without losing their culture and values along the process.** There are some good examples of certification and labelling. The reindeer meat marketed by the Inari Sámi is a good starting point.

• **Through indigenous youth, carry out an analysis on how new technologies could help Indigenous Peoples access urban markets, bypassing intermediaries.**

[7] For further information, see https://www.unenvironment.org/interactive/beat-plastic-pollution/

SUMMARY TABLE OF THE DRIVERS OF SUSTAINABILITY FOR THE EIGHT INDIGENOUS PEOPLES' FOOD SYSTEMS

Principles of sustainable food systems. L: Provision of livelihoods, equity and social well-being; R1: Resource use efficiency; C: Conservation, protection and enhancement of natural resources; G: Responsible and effective governance mechanisms; R2: Resilience of people, communities and ecosystems. **Indicators of resilience (SHARP).** 1. Exposed to disturbance; 2. Globally autonomous and locally interdependent; 3. Appropriately connected; 4. Socially self-organised; 5. Reflective and shared learning; 6. Honours legacy; 7. Builds human capital; 8. Coupled with local natural capital; 9. Ecologically self-regulated; 10. Functional diversity; 11. Optimally redundant; 12. Spatial and temporal heterogeneity; 13. Reasonably profitable.

TABLE 0.3. Identification, effects and future trends of the drivers identified for the eight Indigenous Peoples' food systems, organised by clusters and linked to the five principles of sustainable food systems (FAO, 2014) and the Self-evaluation and Holistic Assessment of climate Resilience of Farmers and Pastoralists (SHARP) indicators (Choptiany *et al.*, 2015)

Cluster	Driver	Main principles of sustainable food systems and resilience indicator affected by the driver					Baka	Inari Sámi	Khasi	Melanesians[SI]	Kel Tamasheq	Bhotia and Anwal	Tikuna, Cocama and Yagua	Maya Ch'orti'
		L	R1	C	G	R2								
Rights to land, territories, natural resources and nomadism	Collective rights over communal resources				■		Not recognised	Rights over the resources recognised	Rights of the resources recognised	Rights over the land and resources recognised	Rights over the resources recognised	Rights over the resources recognised	Rights over the land and resources recognised	Rights over the resources recognised
	Nomadism and mobile livelihoods	■				■ 8,9 12	Yes ↘	Yes, but under threat	Yes, but under threat	No	Yes, but under threat	Yes ↘	Yes	No
	Involvement of Indigenous Peoples in governmental institutions			■	■	■ 4	No →	Yes ↗	Yes ↗	-	Yes	Yes ↗	Yes, but needs improvements	Yes ↗
	Lack of security of access to the ancestral territories and use of natural resources	■	■		■	■ 12	Yes ↗	Yes ↗	Yes ↘	No	Yes ↗ ↗	Yes	No	Yes
Biodiversity, multifunctionality of the systems, and self-sufficiency	Biodiversity conservation as the basis for the food system	■	■	■		■ 1,2 8,9 10 11	Yes →	Yes	Yes ↗	Yes ↘	Yes ↗	Yes	Yes ↗	Yes
	Multifunctionality of the food systems		■			■ 8 10	Yes	Yes	Yes ↘	Yes ↘	Yes ↘	Yes →	Yes ↘	Yes ↘

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		L	R1	C	G	R2								
Biodi-versity, multifunc-tionality of the sys-tems, and self-suffi-ciency	Governance informed by ancestral spiritual beliefs and cosmogony embedded in nature	■		■	■		Yes →	Yes ↘	No	Yes ↘	No	Yes →	Yes	Yes
	Food self-suffi-ciency from territorial manage-ment that integrates seasonality	■		■		■ 1,2 8,9 10 11 12	Yes ↘	Yes, but under threat	Yes ↘	Yes ↘ ↘	Yes ↘	Yes ↘	Yes ↘	Yes ↘
	Low energy dependence from external sources and use of renew-able energy		■	■		■ 8	Yes	Yes	Yes	Yes ↘	Yes ↘	Yes →	No ↘	Yes ↘
	Biodiversity reduction from external pressures	■		■		■ 1,8 11	Yes ↗	Yes ↗	Yes ↘	Yes ↗	Yes ↗	-	Yes	Yes
Conti-nuity of traditional practices, adaptation and inno-vation	Adaptive capacity to change		■	■		■ 5 6	Yes	Yes ↗	Yes ↗	Yes, but more is needed	Yes ↗	Yes	Yes →	Yes ↗
	Continuity in the use of traditional practices and techniques	■	■	■		■ 1 6	Yes	Yes, but more is needed	Yes →	Yes ↘	Yes →	Yes ↘	Yes, but hybrid system and under threat	Yes ↘
	Preference for traditional foods	■					Yes ↘	Yes, but under threats	Yes	Yes ↘	Yes ↘	Yes ↘	Yes ↘	Yes

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		L	R1	C	G	R2								
Continuity of traditional practices, adaptation and innovation	New techniques and innovations adopted		■			■ 5	Yes	Yes	Yes	Yes ↘	Yes	-	Yes	Yes
	Introduction of new seeds and breeds	■		■			No	-	Yes – pros and cons	Yes ↗	-	Yes – pros and cons	Yes	-
	Climate change and natural catastrophes	■	■			■ 1 8	Little threat perceived	Yes ↗ ↗	Yes	Yes ↗ ↗	Yes ↗ ↗	Yes ↗	Yes ↗	Yes ↗ ↗
Governance, Free, Prior and Informed Consent, and development programmes	Traditional Indigenous Peoples' governance systems and strong social cohesion	■	■	■	■	■ 4	Yes →	Yes →	Yes ↗	Yes ↘	Yes →	Yes	Yes, but challenges	Yes ↗
	Development interventions supporting the communities	■	■	■	■	■ 7	Yes	-	Yes ↗	Yes	Yes	Yes	Yes, but challenges	Yes ↘
	Development programmes needing consultation and consent	■	■	■	■		Yes →	Yes ↗ ↗	-	Yes	Yes	-	Yes	Yes ↗
	Expansion of infrastructure bringing external actors			■		■ 3	Yes ↗	Yes ↗	-	-	-	-	-	-
Youth, education systems, interculturality, indigenous languages and traditional knowledge	Indigenous languages essential for traditional knowledge and food systems				■	■ 6	Yes →	Yes, but challenges	Yes ↘	Yes ↘	Yes	-	Yes, but under threat	Yes ↘ ↘
	Preservation of traditional knowledge			■		■ 6 7	Yes →	Yes, but challenges	Yes	Yes ↘	Yes, but under threat	Yes	Yes, but under threat	Yes, but under threat

TABLE 0.3. Identification, effects and future trends of the drivers identified for the eight Indigenous Peoples' food systems, organised by clusters and linked to the five principles of sustainable food systems (FAO, 2014) and the Self-evaluation and Holistic Assessment of climate Resilience of Farmers and Pastoralists (SHARP) indicators (Choptiany *et al.*, 2015)

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		L	R1	C	G	R2								
Youth, education systems, interculturality, indigenous languages and traditional knowledge	Globalization decreasing youth's interests in traditional practices and knowledge					■ 6	Yes ↗	Yes ↗ ↗	-	Yes ↗	Yes ↗	Yes ↗	Yes ↗	-
	Difficulties for intra- & inter-generational transmission of language and knowledge				■	■ 7	No ↗	No	Yes	Yes	-	-	Yes	-
	School feeding changing tastes of indigenous youth	■					-	-	-	-	-	-	Yes	-
	Lack of access to education and the need for culturally appropriate education				■		Yes	Yes ↘	Yes	Yes	-	Yes	Yes	Yes
Globalization, income, barter, trade, processed foods, waste	Indigenous Peoples' food systems and cash income	■	■			■ 13	Yes	Yes	Yes ↗	Yes ↗	Yes ↗	Yes ↗	Yes	Yes
	Relevance of sharing, barter and trading practices	■				■ 2,4	Yes ⟶	No - Disappeared	No - Disappeared	Yes ↘	Yes ⟶	Yes ↘	-	Yes ⟶

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		L	R1	C	G	R2								
	Improved infrastructure and better access to markets and information	■				■ 3	No	Yes	-	Yes ↗	Yes ↗	Yes	-	No
	Markets and cash generation reshape food systems, affects bio-diversity and health	■	■	■		■ 7 10	Yes ↗	Yes ↗	Yes, but trade-offs	Yes ↗	-	Yes, but trade-offs	Yes ↗	Yes ↗
	Processed food bring inorganic waste		■	■			Yes ↗	Yes	Yes ↗	Yes ↗	Yes ↗	Yes ↗	Yes ↗	Yes ↗

Legend:

- The driver has a strong positive effect on the sustainability of the food system
- The driver has a slight to moderate positive effect on the sustainability of the food system
- The driver has a strong negative effect on the sustainability of the food system
- The driver has a slight to moderate negative effect on the sustainability of the food system

- \- No information available
- ↗↗ Important increase of the effect of the driver on the sustainability and climate resilience of the food system in future trends
- ↗ Slight to moderate increase of the effect of the driver on the sustainability and climate resilience of the food system in future trends
- → Effect of the driver on the sustainability and climate resilience of the food system is perceived as constant in future trends
- ↘ Slight to moderate decrease of the effect of the driver on the sustainability and climate resilience of the food system in future trends
- ↘↘ Important decrease of the effect of the driver on the sustainability and climate resilience of the food system in future trends

EXECUTIVE SUMMARY

This is the third FAO publication on Indigenous Peoples' food systems. The first one, "Indigenous Peoples' Food Systems: The many dimensions of culture, diversity and environment for nutrition and health", emphasized in 2009 the broad food base of nutritious and medicinal edibles by Indigenous Peoples. The second one, "Indigenous Peoples' food systems & well-being: interventions & policies for healthy communities", released in 2013 focussed on the communities' health and nutrition, with particular emphasis on children. Both books were co-published by FAO and McGill University-CINE.

The objective of this third publication, co-published by FAO and the Alliance of Bioversity International and CIAT, is to acknowledge the contributions that Indigenous Peoples make to achieve the 2030 Sustainable Development Goals, and to advocate for these contributions and their associated food systems to be taken into consideration in ongoing discussions about sustainable and efficient food systems that could support better nutrition and health.

To achieve this objective, the focus of the research methodology, the subsequent fieldwork and the analysis has been to identify elements that make Indigenous Peoples' food systems sustainable and resilient, signalling drivers affecting these two characteristics positively or negatively.

This book presents evidence that demonstrates the potential of Indigenous Peoples' food systems to inform ongoing global debates about sustainability, climate resilience, territorial management, food systems and intercultural education, amongst others. The implementation of the same methodology in eight Indigenous Peoples' communities, following months of participatory field research and data analysis, allows comparison across different food systems.

The analysis confirms the need for more systemized research at all levels on Indigenous Peoples' food systems. There is still much to learn with respect to the different solutions that these food systems can provide.

At the same time, the findings highlight the heterogeneity and richness of Indigenous Peoples' food systems and their unique territorial management techniques, whilst bringing upfront their concerns, threats and unique practices, many at risk of disappearing. The eight cases analyzed have helped identify four salient characteristics across Indigenous Peoples' food systems:

- Indigenous Peoples preserve and enrich their ecosystems through their food systems;
- Indigenous Peoples' food systems are resilient and adaptive;
- Indigenous Peoples' food systems can broaden the existing food base with nutritious foods;
- Indigenous Peoples' food systems are interdependent with language, traditional knowledge, governance and cultural heritage.

Whilst the evidence gathered confirms that Indigenous Peoples' food systems preserve biodiversity whilst providing foods, livelihoods, nutrition and by-products for the eight communities, it also indicates that these systems are subject to globalization, trade, markets, monetization, regulations and mass media like any other food system. These global trends are modifying Indigenous Peoples' food systems by introducing new opportunities, new products, new technologies and new livelihoods that are modeling the priorities, preferences and tastes of the members in the communities. Without entering into subjective affirmations on whether some changes are good or bad, it is widely observed that changes within the food systems have accelerated significantly in recent years.

Moving beyond the assumption that Indigenous Peoples' food systems are sustainable and climate resilient under all circumstances, it is important to avoid preconceived ideas and pre-empted approaches. Indigenous Peoples' food systems are highly dynamic and adaptive and should therefore not be romanticized.

The appearance of new actors along with globalization has led to the emergence of multiple interconnected drivers that need more dedicated research to fully grasp their effects on Indigenous Peoples' food systems. However, it is important to recall that in keeping the focus with the scope of this research, the drivers affecting Indigenous Peoples' food systems identified during the fieldwork have been analyzed in terms of their contribution or damage to the sustainability and resilience of the eight Indigenous Peoples' food systems analyzed.

This publication invites the reader to learn from the unique and common elements that make Indigenous Peoples' food systems resilient and sustainable, how they can inform global debates, why they deserve respect and dignity, and what could be the consequences of the disappearance of these ancestral food and knowledge systems.

CHAPTER 1: HUNTING, GATHERING AND FOOD SHARING IN AFRICA'S RAINFORESTS

Forest food system of Baka people in South-eastern Cameroon

The Baka living in the tropical rainforest of South-eastern Cameroon are one out of a dozen groups of Congo Basin hunter-gatherers often referred to as "Pygmies". The food system of the Baka is entirely dependent on the forest. An estimated 81 percent of their food is obtained through hunting, gathering and fishing activities, practised during incursions and movements in the forest, combined with shifting cultivation. Exchanges with other communities and the market provide about 19 percent of their diet. In total, the Baka use around 179 species for food. Outstandingly, the Baka are renowned for their knowledge of about 500 species of wild or ruderal plants used for medicinal, material, and spiritual purposes.

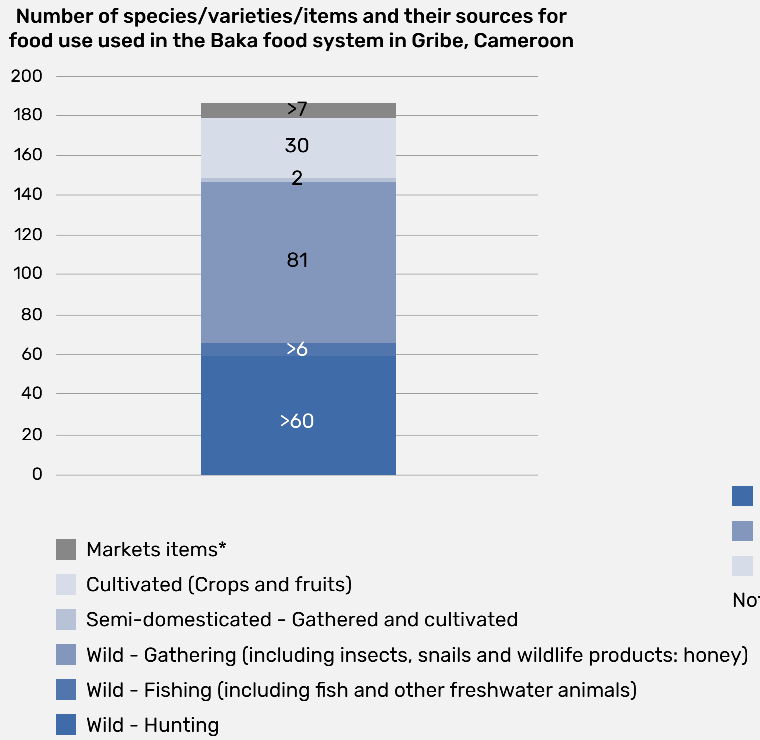
The livelihood of the Baka primarily consists of an alternation between seasonal excursions into the forest and sedentary activities carried out in permanent villages along the road. In Gribe, where the study was carried out, the Baka are engaged in a transitional post-forager lifestyle affected by an increasingly constrained access to the forest. Long-distance stays in the forest in search for food items (bushmeat, freshwater resources, insects, wild tubers, honey, leaves, fruits, nuts and all sorts of spices) and non-food products (medicinal plants, various materials for building and carving) are becoming increasingly challenging and diminishing, whilst sedentary activities in the village are increasing. Shifting cultivation to produce starches and Non-Timber Forest Products (NTFPs), home gardening, and agroforest plantations to produce cash crops (cocoa, coffee), as well as off-farm activities (labouring in exchange for crops, and salaried jobs in logging and safari companies) are all important activities.

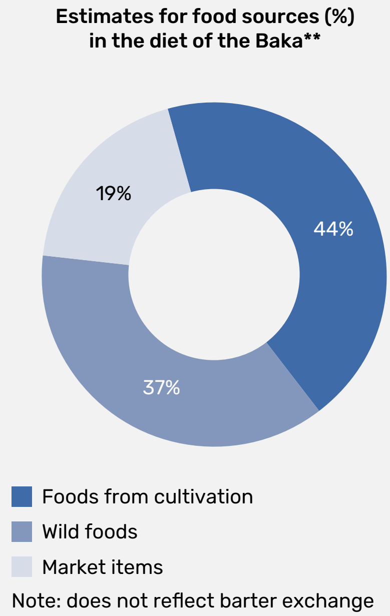
The relationships between the Baka and their farming neighbours are based on complementarity. Through the adoption of a lifestyle that mimics that of their neighbours and under constant incentives by governmental agencies to abandon their age-old forager way of life, the Baka are now exposed to an acute risk of losing their expertise of the forest and their rich animist culture based on a connivance with the supra-natural forces who are the masters of forest resources. At the same time, Baka interest in NTFPs for the market is developing a new relationship with neighbours that goes beyond the traditional exchanges and barter. Despite this, the Baka are increasingly ostracized since they rarely have a voice in negotiations with the various stakeholders (authorities, private companies, protected areas managers) who meet and discuss, which in the end results in progressively reducing the Baka's access to their ancestral forests.

Major changes occurring in recent years

- Increased constraints in accessing the forest (creation of a national park, presence of logging and safari companies);
- Progressive abandonment of hunter-gatherer mobile lifestyle and shift into more sedentary lifestyle with only seasonal expeditions in the forest;

FIGURE 0.2. Estimates for food sources (%) and number of species/varieties/items for food use used in the Baka food system in Gribe, Cameroon





Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed foods. **Estimates based on data available.

- Adoption of agriculture;
- Improved road infrastructures and development of local markets with merchants coming from outside;
- Increased demand for NTFPs, becoming a source of cash income.

Trends expected by the Baka in future years

- Balanced livelihood between seasonal incursions into the forest and shifting cultivation in permanent settlements along the road;
- Reduced dependence on the forest products and greater reliance on food and agroforestry products;
- Loss of traditional knowledge regarding the forest and rising concerns about health implications (degradation of diet quality and loss of traditional healing practices);
- Marginalization and no voice in the negotiations with other forest users (farmers groups, conservation NGOs, logging companies, safari owners);
- Youth manifesting contradictory aspirations.

TABLE 0.4. Estimates for food sources (%) and number of species/varieties/items for food use used in the Baka food system in Gribe, Cameroon

	Cultivated species	Semi-domesticated species (cultivated and gathering)	Wild species			Barter exchange	Market items
Species count and market items* used for food	30 species (about 60 varieties in 6 crops)	2	Gathering^	Fishing^^	Hunting	Unknown	>7
			60	>6	>60		
Unidentified species/varieties/ breeds			21				
Food sources in the diet** (%)	44		37			Practised	19

Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed foods. **Estimates based on data available. ^Includes insects, snails and wildlife product: honey ^^Includes fish and other freshwater animals.

CHAPTER 2: VOICES FROM ARCTIC NOMADS: AN ANCESTRAL FOOD SYSTEM FACING GLOBAL WARMING

Reindeer herding food system of the Inari Sámi people in Nellim, Finland

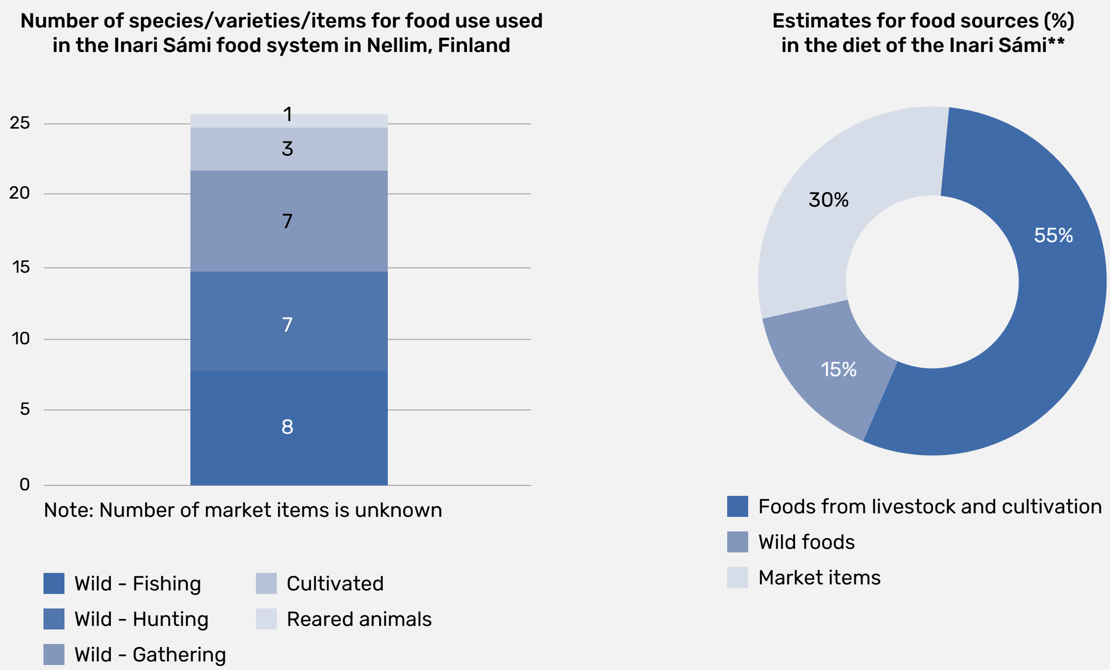
This food system is practised by the Inari Sámi, the smallest group of the Sámi people, who inhabit the northern part of the Fennoscandia peninsula. The Inari Sámi live in the extreme North of Finland and the community that took part in this study is located in Nellim village. What characterises these inhabitants of the Arctic region is their lifestyle as traditional mobile reindeer herders, governed by seasonal transhumance to grazing lands. The food system of the Inari Sámi traditionally relies on fishing, hunting and wild edibles gathering. The reindeer is a keystone species that is central to the culture of the Sámi. Fishing, hunting and wild berry picking for sale are other salient traits of the Inari Sámi food system. Depending on the season, these activities are more or less prominent throughout the year. There are 26 species in their food system used for food, and one species has been identified for medicinal uses. Additionally, 30 percent of the food consumed by Inari Sámi comes from the market.

As revealed by their transitioning food system, the Inari Sámi community has passed through drastic historical episodes and regulations that have profoundly modified their daily life. State law regarding the regulation of reindeer herding, changing sources of feed and forage for reindeer, decreasing demography in Inari Sámi villages, the encroachment of processed food items, and new extractive activities in the region that are impacting wildlife habitats are some of the drivers modifying their territorial management and livelihoods. This is resulting in the weakening of the food system and traditional lifestyle of the Inari Sámi. Furthermore, the Arctic is amongst the areas of the world most exposed to climate change, which has significantly affected seasons, natural cycles and the related herding activities.

Major changes occurring in recent years

- increased sourcing of food from the market in their diet, especially processed meat;
- visible effect of climate change on the diet (new wild mushrooms);
- reduced and limited access to land and pastures;

FIGURE 0.3. Estimates for food sources (%) and number of species/varieties/items for food use used in the Inari Sámi food system in Nellim, Finland



Species count does not include stimulants. ** Estimates based on data available. No practice of barter exchange has been reported.

TABLE 0.5. Estimates for food sources (%) and number of species/varieties/items for food use used in the Inari Sámi food system in Nellim, Finland

	Reared and cultivated species		Wild species			Barter exchange	Market items
Species count and market items used for food	4		22			Unknown	Unknown
	Reared	Cultivated	Hunting	Fishing	Gathering		
	1	3	7	8	7		
Food sources in the diet** (%)	55		15				30

Species count does not include stimulants. ** Estimates based on data available. No practice of barter exchange has been reported.

- youth migration to cities;

- damaging policies of acculturation and assimilation.

Trends expected by the Inari Sámi in future years

- expected increase of forest exploitation leading to drop in reindeer herding and rarefaction of wild edibles (berries, mushrooms, etc.);

- increasing soil degradation and lake eutrophication;

- reducing populations of wild game and fish;

- youth losing interest in reindeer herding;

- persistence of traditional activities, but less prevalent;

- increased dependency on the market for their diet.

CHAPTER 3: TREASURES FROM SHIFTING CULTIVATION IN THE HIMALAYAN'S EVERGREEN FOREST

Jhum, fishing and gathering food system of Khasi people in Meghalaya, India

The Khasi are a group of Indigenous Peoples that predominate in the eastern part of the hilly State of Meghalaya in northeastern India. Meghalaya is known to be the wettest region of India, and it is also recognised as a singular subtropical forest ecoregion that hosts a remarkable biodiversity. The village of Nongtraw, where the research took place, is inhabited solely by Khasi people. The food system of this matrilineal and Christian society relies on shifting cultivation in ***jhum*** fields, home gardening, livestock rearing (poultry and pigs), beekeeping and, to a lesser extent, on fishing, trapping and the gathering of wild edibles from the forest. In spite of its remoteness, the village of Nongtraw for a long time has taken part in the weekly market in the adjoining villages. These markets allow for important social interactions and are places where local produce, goods and services are bartered and traded. The Khasi have been traditionally open to contacts and marriage with other groups. This interdependent and open socio-economic approach is one of the reasons why the Nongtraw inhabitants obtain an important share of their diet from the market. In total, the food system of the Khasi people is based on 150 species and varieties of plants and animals used for food. In addition, there are at least 17 prominent species used for construction and materials, and medicinal purposes.

Daily wage labour and artisanal activities (especially basketry) are the main sources of cash income along with broom grass cultivation as a cash crop. Since the 1970s, the accession of Meghalaya to statehood and the related improvements in governmental facilities (electricity, pipes and storage tanks for water supply) and services (public transport, market, waste management) have improved the livelihoods of the Khasi, easing access to the cash economy and reducing uncertainty in the food supply, without damaging the traditional diet of the Khasi. Increased conservation initiatives have come up with regulations and responsible awareness to mitigate the pressure on agricultural lands and natural resources. The resilience of the Khasi food system has gotten stronger over time and this positive observation seems to stem from the strength of the self-governance and customary institutions in the community.

Major changes occurring in recent years

- India's overall public distribution system has changed the local subsistence system;

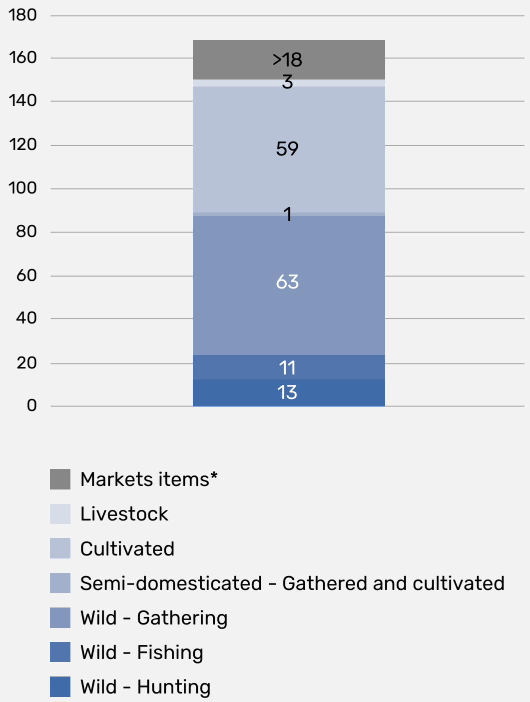
- rice has supplanted local staples (millet and pulses);

- reduced presence of wild foods in the diet;

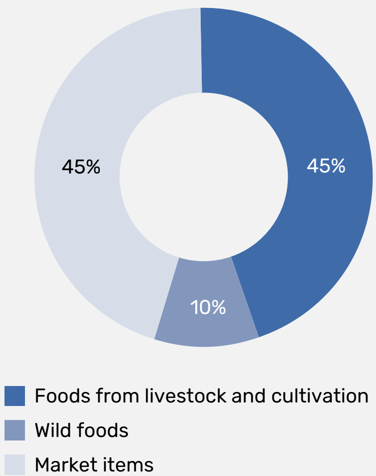
- increased cash income economy;

FIGURE 0.4. Estimates for food sources (%) and number of species/varieties/items for food use used in the Khasi food system in Nongtraw, India

Number of species/varieties/items and their sources for food use used in the Khasi food system in Nongtraw, India



Estimates for food sources (%) in the diet of the Khasi**



Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available. Barter exchange is not practiced anymore in the food system.

TABLE 0.6. Estimates for food sources (%) and number of species/varieties/items for food use used in the Khasi food system in Nongtraw, India

	Livestock species	Cultivated species	Semi-domesticated species (cultivated and gathered)	Wild species			Barter exchange	Market items
Species count and market items* used for food	62		1	87			No	>18
				Gathering	Fishing	Hunting		
	3 species (2 breeds in 1 species)	55 (about 42 varieties in 9 species)		26	4	10		
Unidentified species/varieties/ breeds		4		37	7	3		
Food sources in the diet** (%)	45			10			No	45

Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available. Barter exchange is not practiced anymore in the food system.

• loss of food sharing and barter practices;

• emergence of cash crop production (broom grass).

Trends expected by the Khasi in future years

• no expected changes by the Khasi, who trust the resilience of their food system supported by the solid self-governance of their community.

CHAPTER 4: FROM THE OCEANS TO THE MOUNTAINS: STORYTELLING IN THE PACIFIC ISLANDS

Fishing and agroforestry food systems of the Melanesians[SI] people in Solomon Islands

The term Melanesian federates a diversity of tribes that are now organised according to their followed Christian movements. The Melanesians[SI] inhabiting the Baniata village live in remote conditions in Rendova Island located in the Solomon Islands archipelago in the Pacific Ocean. Their food system relies primarily on the cultivation of tuber crops and banana in fields and home gardens. Inland agroforests of fruit trees and ***ngali*** nut trees as well as coconut plantations along the shoreline for the production of copra are prominent components of the food system generating cash income. In addition, the food system relies on bushmeat and fish. Hunting and fishing are fundamental activities embedded with cultural and traditional importance, despite becoming progressively less prominent within the food system. One fourth of the food resources are sourced from markets and local stores, where handicrafts and garden products are sold and highly processed and imported foods purchased. The Melanesian food system in Baniata consists of 132 species used as food, out of which 51 are aquatic species. In addition, multiple other species are used for non-food purposes, such as for clothing, construction and materials, medicine, or fuel.

Excessive logging and reliance on the market have been the major drivers of change for the food system in Baniata over the second half of the past century, resulting in natural resource degradation and a greater dependency and consumption of imported and highly processed foods. The reduction of the period for land fallowing and the intensification of agriculture have reached their limits. Increased pests and diseases along with climate change have impaired the health of the food system, resulting in further accentuating the dependency of imported highly processed foods. All of these factors are severely impairing the Melanesians[SI] agri-food system in Baniata village.

Major changes occurring in recent years

• colonization has impacted cultural and religious beliefs and encouraged introduction of new foods and crops;

• monetization of the local economy and abandonment of traditional barter and exchange practices;

• increased import of highly processed foods and health deterioration with increase of non-communicable diseases;

• reduced yields for crops and increased crop damage by pests;

• loss of traditional knowledge, in particular regarding hunting;

• declining stock of marine fish.

Trends expected by the Melanesians[SI] in future years:

• concerns about their increased demography in a context of limited land resources and damaged natural resources;

• imported rice anticipated to replace traditional tuber staple foods;

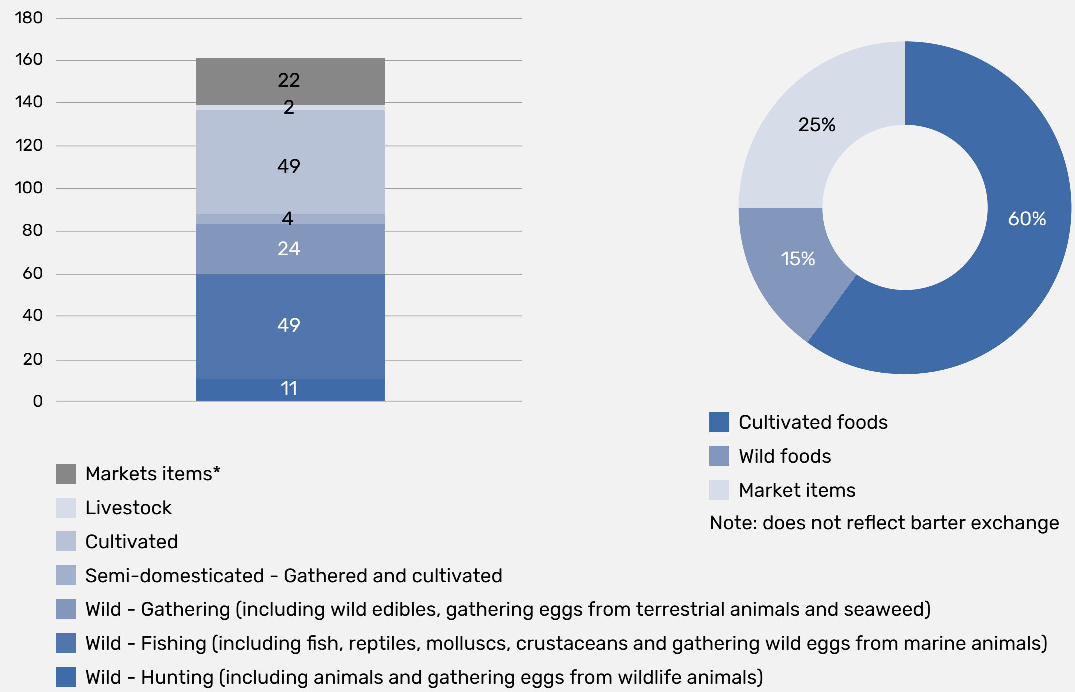
• climate change is feared to negatively impact agricultural yields;

• dependence on the market is expected to increase.

FIGURE 0.5. Estimates for food sources (%) and number of species/varieties/items for food use used in the Melanesians[SI] food system, Baniata, Solomon Islands

Number of species/varieties/items and their sources for food use used in the Melanesians[SI] food system in Baniata, Solomon Islands

Estimates for food sources (%) in the diet of the Melanesians[SI]



Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food.

TABLE 0.7. Estimates for food sources (%) and number of species/varieties/items for food use used in the Melanesians[SI] food system, Baniata, Solomon Islands

	Cultivated and raised species		Semi-domesticated species (cultivated and gathered)	Wild species			Barter exchange	Market items
Species count and market items* used for food	Livestock	Cultivation	4	Gathering^	Fishing^^	Hunting	Unknown	22
	2	49 (about 141 varieties in 29 crops)		19	49	11		
Unidentified species/ varieties/breeds				5				
Food sources in the diet (%)	60			15			Practised	25

Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. ^Includes wild edibles, gathering eggs from terrestrial animals, and seaweed ^^Includes fish, molluscs and crustaceans, and gathering eggs from marine animals.

CHAPTER 5: SURVIVING IN THE DESERT: THE RESILIENCE OF THE NOMADIC HERDERS

Pastoralist and nomadic food system of the Kel Tamasheq people in Aratène, Mali

The Kel Tamasheq are traditionally nomadic and Muslim pastoralists, part of an extensive ethnic confederation known as Tuareg people who inhabit vast arid areas of the Sahara and surrounding Sahel. The research for the analysis of the Kel Tamasheq food system was carried out in the village of Aratène, located in the region of Goundam Circle in the northern part of Mali. Besides the activities of rearing livestock, the Kel Tamasheq in Aratène also gather wild edibles from the surrounding dry vegetation and at least four species are used for fodder, medicine or construction. To a lesser extent, they also practise small-scale cultivation and vegetable gardening for food uses. The Kel Tamasheq source 35 percent of their food needs from the market.

The Sahelo-Saharian climate imposes strong ecological constraints and guides the seasonal activities in the food system, which alternates between moving with the livestock during the dry season, and dedicating the rainy season to sales, stocking of cereals and gardening for the market. Mobile pastoralism is the fundamental activity of the Kel Tamasheq. It shapes their culture and their way of perceiving and interacting with the natural surrounding environment. Livestock is diversified and aggregates sheep, goats, bovids, donkeys, camels and poultry. Their overall economy depends on the management and sale of livestock. Whilst men manage and sell the animals, women take care of the transformation and selling of livestock-derived products such as dairy products, meat and leather. Recent political disorders, like the rebellion in the 1990s, affected the daily life of the Kel Tamasheq, causing massive migration abroad, crumbling the economy, and creating insecurity and cattle rustling. The recurrence of droughts, mass flooding and sandstorms has increased, indicating more climate variability and uncertainty and affecting the availability of water as the most critical resource. This is translating into recurrent and severe losses of livestock. Therefore, hydro-climatic whims are the main threat to the resilience of the Kel Tamasheq food system. The increased rarefaction of emblematic flora and fauna are clear indicators of a dramatic climatic trend in the Sahelo-Saharian ecosystems, affecting arable and pasture lands alike.

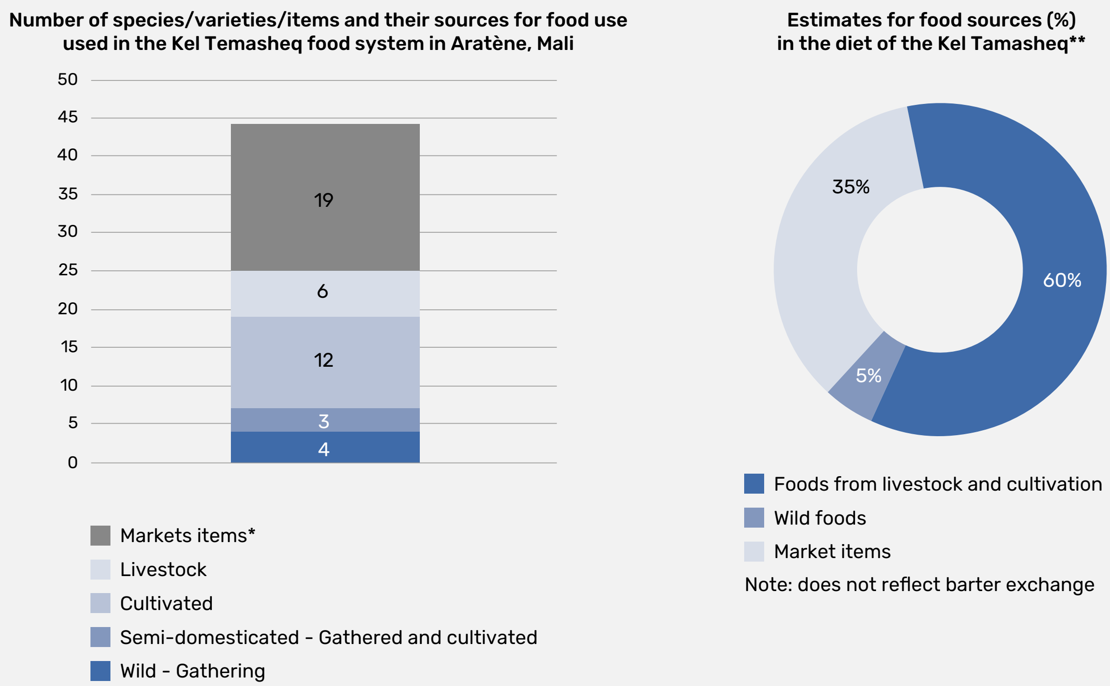
Major changes occurring in recent years

- drying up of water bodies, ponds, lakes and aquifers, causing severe water scarcity;
- significant depletion of wild plants and wild game from successive climate shocks and decimation by armed groups;
- land grabbing and land tenure insecurity;
- increased reliance on markets for food and cash income.

Trends expected by the Kel Tamasheq in future years

- increased uncertainty caused by climate change, droughts and political instability;
- intensified exploitation of land for agriculture: concern about soil degradation and competing use of water sources and reserves;
- increased reliance on "new foods" and gradual abandonment of certain traditional foods;
- youth aspirations not to pursue the pastoralist lifestyle and induced loss of traditional knowledge.

FIGURE 0.6. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Kel Tamasheq, Aratène, Mali



Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available.

TABLE 0.8. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Kel Tamasheq, Aratène, Mali

	Cultivated and reared species		Semi-domesticated (gathered and cultivated)	Gathered species	Barter exchange	Market items
Species count and market items* used for food	18		3	4	Unknown	19
	Cultivated	Livestock				
	15	6				
Food sources in the diet** (%)	60			5	Practised	35

Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available.

CHAPTER 6: ANCESTRAL NOMADISM AND FARMING IN THE MOUNTAINS

Agro-pastoralist and gathering food system of the Bhotia and Anwal people in Uttarakhand, India

The Bhotia and Anwal are two native Hindu tribes co-inhabiting the Namik Valley of Uttarakhand, a state in northern India crossed by the Himalayas. The Bhotia are greater in number and are distributed over the Trans-Himalayan belt, whilst the Anwal are solely found in the hilly forested and remote area of Uttarakhand. Traditionally, the Anwal are mobile migrating shepherds, whilst the Bhotia were primarily involved in the Indo-Tibet trading route. Currently, the two groups collaborate through an integrated agro-pastoral food system in which the Anwal continue being migrating shepherds amongst Bhotia cultivators. Traditionally, the Bhotia and Anwal have always practised hunting and gathering of wild game and edibles. However, conservation policies have prohibited hunting activities and progressively restricted their access to forests, thus reducing their access to wild edibles species. In total, the food system relies on 29 species used for food. An additional 20 species are dedicated to non-food uses for fodder, construction and materials, and medicine. Today, the market covers an estimated 30 percent of the food needs.

Pulses, in association with maize and potato, are the major staples cultivated by the Bhotia, who also keep bees, poultry, cattle and buffalo. The Anwal take care of sheep and goat herds. Whereas fishing and hunting have always remained marginal activities, the inhabitants of Namik still devote great importance to the gathering of wild plants used as foods, medicines and raw materials for craft. Women are the main actors in the food system, as they carry most of the farming and gathering activities. The natural ecosystems provide fodder and grazing lands for livestock whose dejections serve as manure for the traditional cropping system. In this diverse system based on complementarity, barter is a relevant mode of exchange for the resilient circulation of goods. Yet the market remains necessary for enabling access to food items not generated within the system, especially rice, wheat, salt, sugar and cooking oils. Activities are paced along five distinct seasons, including the monsoon, which heavily affects the activities during the annual cycle. Road construction, protection of wildlife and access to markets have been the major drivers of change. The abandonment of foraging in the wild has accompanied a greater demand for marketed goods and a slow dismissal of lesser-used crops, reducing the diversity of the local dietary regime. As high-altitude ecosystems are more exposed to climate change, remote villages are increasingly sensitive to more occurring natural calamities, which now bring about stress and uncertainty.

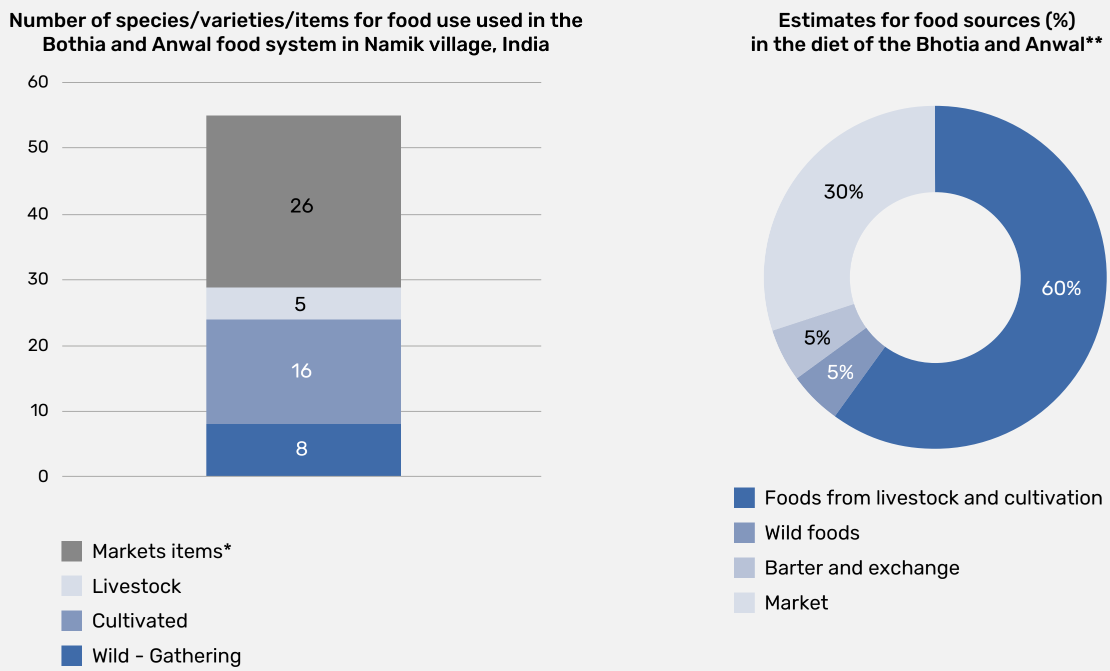
Major changes occurring in recent years

- reduced access to wild edibles imposed by national conservation laws;
- diminished reliance on traditional medicine;
- land degradation induced by climate change;
- road construction increased connectivity that has been associated with migration to urban areas, introduction of new crops, and easier access to markets.

Trends expected by the Bhotia and Anwal in future years

- increasing aspirations by youth to leave the villages;
- concern about maintaining the transmission of traditional knowledge;
- awareness of pros and cons of adopting new practices from modern agriculture: opportunities to test new crops along with concerns about increased utilization of chemical inputs;
- progressive disinterest for livestock rearing;
- increased consumption of highly processed food, meat and eggs in the diet.

FIGURE 0.7. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Bhotia and Anwal, Namik, India



Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food.

TABLE 0.9. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Bhotia and Anwal, Namik, India

	Cultivated and reared species		Gathered species	Barter exchange	Market items
Species count and market items* used for food	21		8	Unknown	26
	Cultivated	Reared			
	16	5 (4 breeds in 2 species)			
Food sources in the diet (%)	60		5	5	30

Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food.

CHAPTER 7: FOLLOWING THE FLOODING CYCLES IN THE AMAZON RAINFOREST

Fishing, *chagra* and forest food system of the Tikuna, Cocama and Yagua peoples in Puerto Nariño, Colombia

The Tikuna, the Cocama and the Yagua are three Indigenous Peoples fishers-groups living in the Colombian part of the Amazon Basin who are also present in other countries in the region. The three groups are not equally represented: the Tikuna are by far more numerous than the Cocama and the Yagua. The research took place in Puerto Nariño, the second largest municipality of the department of Amazonas situated at the confluence of the Loretoyacu and Amazon rivers. A major political feature in the Amazonian Colombia is the organization of the villagers into administrative indigenous communities, which retain a legal collective property right over their land. In this tropical rainforest ecosystem, seasons are delineated according to the flooding cycles, which are determined by the fluvial water level, flux and quality. The territorial management system that informs this food system is extremely elaborate and adapts to the flooding patterns and uniqueness of the environment. Fishing is a prominent activity in this food system and is practised in close articulation with the use — through cultivation, hunting and foraging activities — of forest lands that are not exposed to flooding (***terra firma***) and floodplain forests that are seasonally inundated (***varzéa***). To complement fish catches, these fishers seasonally hunt a great diversity of mammals, birds and reptiles. The ***chagra*** is their fundamental cropping and shifting cultivation system, which combines a great diversity of crops with maize and cassava as staples, but also other cereals, tubers, vegetables, spices, fruits and cash crops. The knowledge system related to the ***chagra*** is maintained and transmitted by the women. The food system of the Tikuna, Cocama and Yagua peoples counts at least 153 species used for food, of which 68 are species of fish. Plantations of several multipurpose palm tree species (28 identified) provide a wide range of products used as foods and drinks, medicines, construction materials, and handicraft. Markets are essential for selling produce and buying goods, ensuring a good balance between the preservation of traditional dietary habits and the adoption of new exotic food products, many of them highly processed and imported foods. Today, the market caters to an estimated 25 percent of food needs. The present standardization of formal schooling exclusively in Spanish seems to be inducing a regression of the indigenous maternal languages and creating a perception of threat through acculturation.

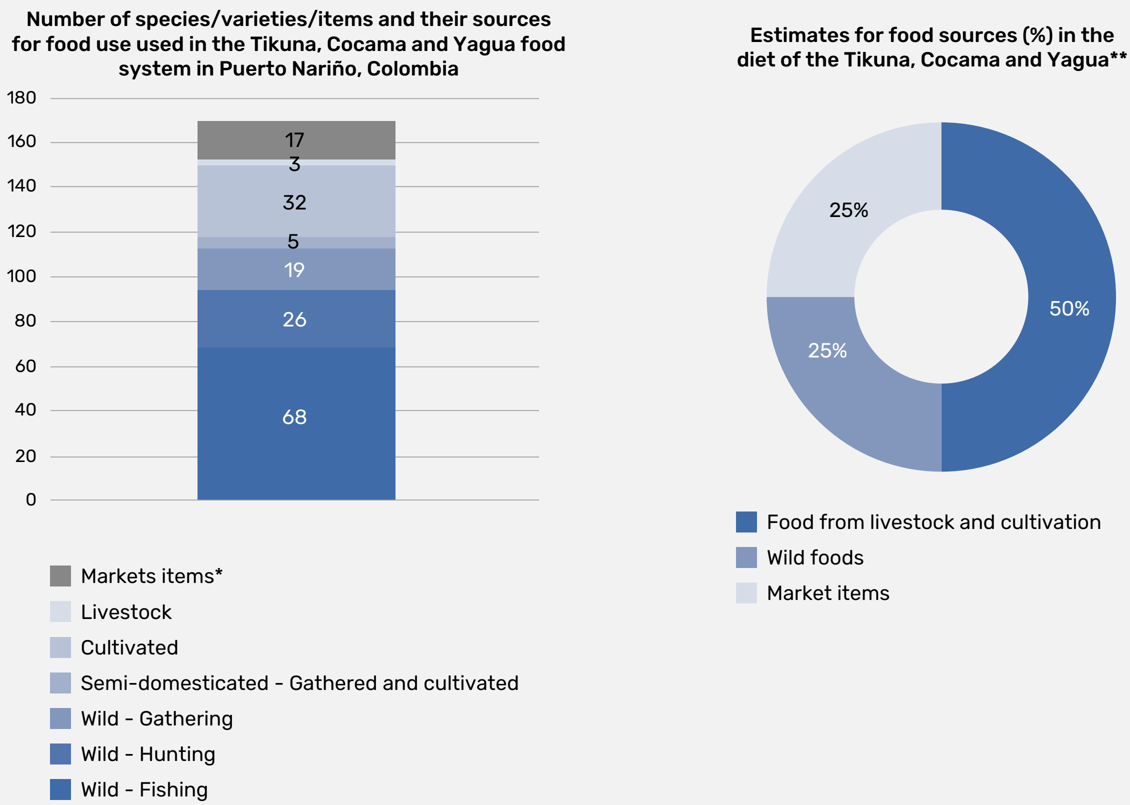
Major changes occurring in recent years

- increased presence and consumption of highly processed and imported foods fueled by the development of urban areas;
- adoption of new, modern and less sustainable hunting and fishing techniques;
- failed successive agricultural governmental development programmes based on new crops;
- education and schooling have generated damaging policies of acculturation and assimilation;
- children and youth now prefer processed foods, with the school feeding programme having played a role in this change of dietary habits.

Trends expected by the Tikuna, Cocama and Yagua in future years

- reviving the production and consumption of traditional foods;
- involving children in food production activities, especially fishing;
- being proactive in rehabilitating government programmes;
- making school meals more adequate and including Indigenous Peoples' foods and traditional diets.

FIGURE 0.8. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Tikuna, Cocama and Yagua peoples, Puerto Nariño, Colombia



Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available.

TABLE 0.10. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Tikuna, Cocama and Yagua peoples, Puerto Nariño, Colombia

	Cultivated and raised species		Semi-domesticated species (gathered and cultivated)	Wild species			Barter exchange	Market items
Species count and market items* used for food	35		5	113			-	17
	Livestock	Cultivated		Gathering	Fishing	Hunting		
	3	32		19	68	25		
Unidentified species/varieties/breeds						1		
Food sources in the diet** (%)	50			25			-	25

Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available.

CHAPTER 8: THE MAIZE PEOPLE IN THE MESOAMERICAN DRY CORRIDOR

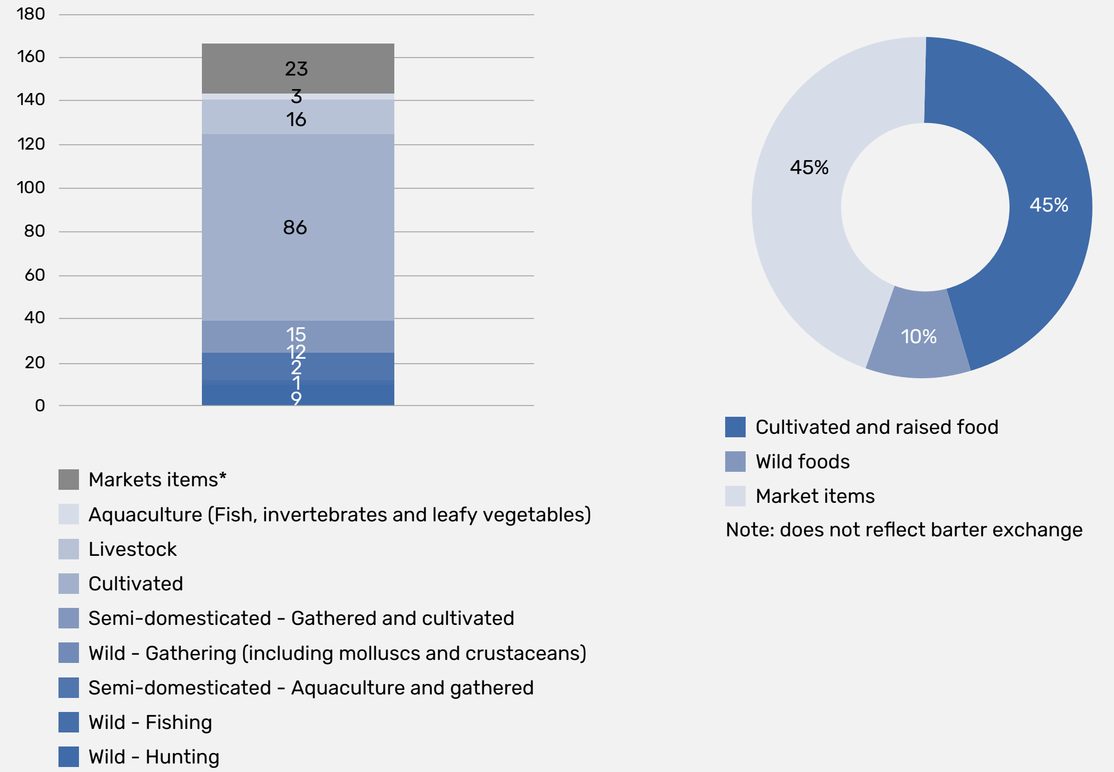
Milpa food system of the Maya Ch'orti' people in Chiquimula, Guatemala

The food system profile of the Maya Ch'orti' involved the communities in six villages in the department of Chiquimula, in the dry corridor in Guatemala, in the eastern part of the country. The Ch'orti' are part of the ancestral Maya civilization whose cosmogony remains vivid amid their adoption of Christianity. Their diet is primarily ensured by a mix of agricultural production, an agroforestry system, home gardens, and the ***milpa***, a cropping system emblematic of Mesoamerica that combines the production of maize, beans and squash. Livestock rearing, stingless beekeeping, aquaculture (a combination of fish, gastropod and aquatic

FIGURE 0.9. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Maya Ch'orti', Chiquimula, Guatemala

Number of species/varieties/items and their sources for food use used in the Maya Ch'orti' in Chiquimula, Guatemala

Estimates for food sources (%) in the diet of the Maya Ch'orti'**



Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available.

TABLE 0.11. Estimates for food sources (%) and number of species/varieties/items for food use used in the food system of the Maya Ch'orti', Chiquimula, Guatemala

	Cultivated and raised species			Semi-domesticated species (gathered and cultivated)	Semi-domesticated species (aquaculture and gathered)	Wild species			Barter exchange	Market items
Species count and market items* used for food	105			15	2	22			Unknown	23
	Cultivated	Livestock	Aquaculture^			Hunting	Fishing	Gathering^^		
	86	16	3			9	1	12		
Food sources in the diet** (%)	45					10			Practised	45

Species count does not include stimulants. *Includes plant and animal species, condiments, seasonings, and processed food. **Estimates based on data available. ^Includes fish, invertebrates and leafy vegetables ^^Includes molluscs and crustaceans.

edible plant production), and the gathering of a broad range of wild edible plants efficiently complement the food system. Bushmeat and insects, which were non-negligible resources in the past, are eaten only occasionally today. As a result of limited land access and productivity issues, food production does not fulfill all the basic food needs and the market provides the missing goods, an estimated 45 percent of the food needs. In total, the food system of the Ch'orti' is based on 143 species used for food of plants, mostly cultivated, and animal species. Fourteen species were additionally mentioned as having prominent uses for construction, fodder, dye, poison or medicinal remedies.

Their weather is characterised by contrasting wet and dry seasons with a small dry season in the middle of the rainy season, which constitutes a factor of climatic uncertainty and recurrent stress. The country's chaotic political history throughout the 20th century and its associated episodes of violence, often targeting Indigenous Peoples, have heavily reduced access to land, degraded the natural resources, and impaired the self-sufficiency of the Maya Ch'orti' food system. The rise of industrial production and export markets has decreased income opportunities based on local produce and value chains. The replacement of handicrafts by manufactured goods, and the abandonment of natural dyes by industrial chemical dyes, have deprived the community of their usual sources of incomes, reducing their purchasing power.

Major changes occurring in recent years

- cheap and low-quality highly processed and imported foods have flooded markets;
- agrochemicals introduced into the ancestral ***milpa*** cropping system;
- decrease of animal-sourced foods (bushmeat, molluscs and crustaceans, insects), resulting in a less diversified diet.

Trends expected by the Maya Ch'orti'

- optimism that the community will foster traditional food production and slow down the reliance on imported goods;
- reinforcement of trade and barter within communities through local markets and to reset a virtuous local and self-sufficient economy.

CLUSTERING OF THE MAIN OBSERVATIONS

From the analysis of the eight Indigenous Peoples' food systems, a series of observations can be cross-referenced to inform researchers, practitioners and policymakers. Some of these observations can be summarized into the following clusters, which are further expanded in the key messages section and in the policy recommendations section, which follows an analysis of the drivers affecting the eight food systems.

Rights to land, territories, natural resources and mobile livelihoods

• The way Indigenous Peoples consider natural resources, human needs and wildlife is unique. As much as possible in their territories, Indigenous Peoples mirror the processes they observe in nature.

• Indigenous Peoples' food systems result from sophisticated territorial management practices that often incorporate an assortment of livelihood activities, such as gathering, hunting, fishing and farming. The recognition and respect of Indigenous Peoples' rights, in particular rights to access land and natural resources, is critical to ensure sustainable livelihoods for Indigenous Peoples.

• Mobility and mobile livelihoods comprise different territorial management practices such as shifting cultivation, mobile fishing, hunting, gathering, transhumance and nomadism. There is not sufficient understanding about the relevance of these territorial management practices in terms of biodiversity conservation. Most mobile and semimobile livelihoods depend in most cases on collective rights to communal natural resources, referred to as commons. There is also a need to better understand how collective rights to communal resources contributes to biodiversity and food generation in order to rethink public policies around mobility.

Biodiversity, multifunctionality of the system, energy and self-sufficiency

• Indigenous Peoples' food systems both depend on and contribute to the biodiversity present in healthy ecosystems within Indigenous Peoples' territories.

• Rather than tame the environment to their needs, notably through external inputs, Indigenous Peoples adjust their food generation and production to seasonal cycles and other natural patterns observed in the ecosystems.

• Their food systems obtain a broad base of edibles that combine wild, semi-domesticated and domesticated plants, fish and animals that all together represent a vast biodiversity that is maintained and managed by Indigenous Peoples.

• Indigenous Peoples' food systems generate many nutrient-rich food items eaten in diversified diets. The food count of many Indigenous Peoples' food systems can exceed 250 species used for food and non-food purposes (medicines, construction materials, handicrafts, clothing, dyes, fuel, traps, etc.).

• Indigenous Peoples' food systems present different levels of food self-sufficiency for the communities, with the market complementing remaining food needs and diets. The relevance of the market in terms of providing food is increasing, whilst levels of self-sufficiency in some of the communities are reducing. The level of food self-sufficiency in the food systems oscillated from about 55 percent to about 80 percent.

• Indigenous Peoples' food systems reveal a low use of energy sources external from the system as they rely on the sun, wind, water and firewood for most of their energy needs, especially for processing, heating and cooking.

Continuity of traditional practices, adaptation and innovation

• Indigenous Peoples maintain their native biodiversity and often enhance their domestic richness through an insatiable curiosity to test and acclimatize new resources.

• Indigenous Peoples' food systems are dynamic. Far from being frozen in an immutable and idealized past, they are in constant movement and have adapted over time to the environment through observation, recombining new ideas, and borrowing practices that they adapt to the local specificities.

• The communities have all integrated the market to some degree in their food systems. The market supplied from about 20 percent to about 45 percent of community food needs in some cases and market dependency seems to be increasing for most communities. Despite the rise of highly processed and imported foods, traditional foods remain the preferred ones in the communities.

• Different innovations and new techniques have increased efficiency in food production, sourcing and processing for some of the participating communities.

• The delicate balance between change and dynamism, and traditional knowledge through observation of the environment makes Indigenous Peoples' food systems unique and different.

• Despite the arrival of highly processed and imported foods and the change of food taste by indigenous youth, traditional foods generated within their food systems seemed to be the preferred foods.

Governance, Free, Prior and Informed Consent, and development programmes

• Indigenous Peoples have developed safety nets and solidarity mechanisms based on social organization and customary governance systems.

• Traditional indigenous governance institutions and more novel community-based institutions support the continuity of the Indigenous Peoples' food system and its natural resource base by delineating use of areas in the territory, enabling knowledge transmission, and strengthening the voice of the community in negotiations, amongst other means.

• Communities capable of maintaining their traditional indigenous governance systems and institutions are better placed to maintain their social cohesion, allowing for the participation of community members in decision-making.

• Development programmes, interventions and social protection measures seem to work when FPIC has been followed and the indigenous communities are involved. On the contrary, lack of FPIC results in unadapted proposals and low impact, with Indigenous Peoples tending to abandon the programmes.

Youth, education systems, interculturality, indigenous languages and traditional knowledge

• The sustainability of Indigenous Peoples' food systems lies in their foundation in ancestral heritage, frequently exercised through the transmission of traditional knowledge and their cosmogony and belief systems.

• Indigenous women not only play a key role in Indigenous Peoples' food systems, they are guardians of ancestral, dynamic and specific traditional knowledge that they transmit to young generations.

• Indigenous Peoples are custodians of traditional and ancestral knowledge transmitted from generation to generation, in most cases through orality that is associated with celebrations, rituals and communal work.

• Indigenous languages are essential to maintain the traditional knowledge systems and thus the food systems.

• The current schooling and education is opening indigenous youth to new opportunities and preferences whilst altering oral transmission of knowledge and, in some cases, leading to aculturization and loss of their mother indigenous language.

• School has been mentioned as having a direct effect on the food systems and diet of indigenous youth.

Globalization, income, barter, trade, processed foods and waste

• Circular mechanisms based on solidarity and reciprocity such as barter, exchanges, collective work and sharing continue in some of the food systems despite having been abandoned in other food systems in favour of cash arrangements.

• Indigenous communities sell items at the market to generate income and meet their demand of items not produced by their food systems such as allopathic medicines, education, transportation and communication.

• Waste in the form of inorganic garbage was unknown in most indigenous communities until recently. The arrival of processed foods and consumer goods has created the problem of waste.

METHODOLOGY

Defining and conceptualizing food systems is an active topic of discussion with many approaches (HLPE, 2014). As an example, the scientific committee of the 2021 United Nations Food Systems Summit is working on a definition for food systems that will bring diverse actors together around a common understanding to foster the transformation towards healthier, more sustainable and equitable food systems (Von Braun *et al.,* 2020).

In this publication, the editors and Scientific Editorial Committee were specifically focussed on highlighting the resilient and sustainable dimensions of Indigenous Peoples' food systems, so as to better inform the ongoing global debates. Indigenous Peoples' food systems have been conceptualized in these ways:

> "Traditional livelihood practices [which] include small-scale farming, pastoralism, shifting cultivation, fishing, hunting, gathering and other forms of wild harvesting, or a combination of such practices. Such traditional livelihoods provide for sustainable management of resources, biodiversity and ecosystems, and are based on traditional knowledge, reciprocal labour and traditional agricultural calendars" (modified from FAO TERM).

> "Indigenous Peoples' food systems are the result of harmonious relationships with Mother Earth. These are holistic relationships that integrate the identity, agricultural calendar and spirituality of a people, and have implications for both physical and spiritual well-being" (María Eugenia Choque Quispe, Member of the UNPFII, Plurinational State of Bolivia).

These holistic and relational views are implemented through Indigenous Peoples' biocentric approach to their food systems. Instead of humankind or market production being the central focus, Indigenous Peoples' food systems prioritize maintaining equilibrium within the ecosystem. As such, resources tend to be managed sustainably, with consideration given to all forms and inherent spirituality of life.

This is significantly different from other food systems, which place the food production at the centre through a more anthropocentric approach (FAO, 2017a; Kuhnlein, Eme and Fernández-de-Larrinoa, 2019).

For the purpose of this publication, the editors deliberately did not define Indigenous Peoples' food systems but rather provided a set of elements commonly featured. The sum of these characteristics can be summarized as follows:

"Indigenous Peoples' food systems are dynamic and changing and comprise a series of elaborated territorial management techniques that, rooted in unique cosmogonies and beliefs, have helped develop intricate bodies of traditional knowledge. This traditional knowledge depends on the oral transmission ensured through the use of Indigenous Peoples' languages. These languages are key in ensuring intra- and inter-generational transmission of knowledge. They also inform ancestral institutions and customary governance systems that see ecosystems and the environment through a biocentric lens. The biocentrism in Indigenous Peoples' food systems looks at all living beings in the ecosystem with spiritual importance and gives attention to the relations between the different elements that maintain the balance in the ecosystem. Indigenous Peoples' food systems often include mobile livelihoods, which rely on collective rights to communal resources. Food generation is as important as food production, with activities that are productive, such as farming, aquaculture and rearing, and others that are not, such as fishing,

hunting, harvesting and gathering. The broad food base of Indigenous Peoples' food systems can consist of up to hundreds of species for food and non-food uses of wild, semi-domesticated and domesticated animals and plants. Indigenous Peoples' food systems have been providing foods for indigenous communities for hundreds of years, yet they have also managed to preserve 80 percent of the world's remaining biodiversity (Sobrevilla, 2008). The social fabric and cohesion in Indigenous Peoples' communities is intrinsically linked to communal practices and mechanisms that are based on the concepts of reciprocity, circularity and solidarity."

Field research was conducted with eight diverse Indigenous Peoples' communities to develop case studies, which helped to illustrate these commonly featured elements and characteristics of their food systems. The field research methodology followed a participatory approach that, at the community level, engaged and empowered Indigenous Peoples to share their experiences and points of view. This methodological approach was fundamental in pursuing the research goals that allowed for the blending of scientific and local knowledge (Lang *et al.,* 2012). The details, methodology and approach followed during the fieldwork are described in the following section.

The communities and Indigenous Peoples' food systems were selected for unique territorial management practices in different ecosystems and climatic zones. The research partners were selected for their capacity to carry out detailed documentation of the participatory field research with the Indigenous Peoples' communities. The partners were mainly Indigenous Peoples' organizations and community groups involved in other studies and research of these food systems.

Data collection

Field research activities were carried out in 2018 with the eight participating Indigenous Peoples' communities. Prior to starting the research process, the Free, Prior and Informed Consent (FPIC) principle was followed with each Indigenous Peoples' community. To begin, the whole community was invited to an opening meeting where the background and objectives of the initiative were presented. After which, the research partners requested the community's consent. With the consent of the community, the participatory research process began.

Each case study was developed through a series of seven discussions with community members on different themes (Table 0.12), complemented by semi-structured key informant interviews. Both types of dialogue were conducted by experienced facilitators familiar to the communities. The thematic discussions considered all the seasonal food sources used by community members, as well as the practices and issues community members faced in producing, wild sourcing, exchanging and obtaining food from the market. Whilst focussing on the details of the current-day food system, the discussions also explored how the food system has been changing over time. Details on the location, dates and number of participants by gender and age in the thematic discussions are presented in Table 0.13.

Whilst the general approach was consistent across all sites, the methods were tailored to local circumstances, priorities and values. Six of the thematic discussions (TD1-6) were held with gender-specific mixed-age groups. One discussion (TD7) was held with groups of youth (ages 13-15) and children (ages 7-12). Gender-segregated groups ensured representation of the knowledge of women and men. Including a range of ages, and especially elders, in the discussions was emphasized to document historical trends and provide opportunity for knowledge sharing across generations. The facilitators encouraged active and meaningful engagement. They worked to ensure that all participants were included, creating an atmosphere in which people felt free to express their opinions and experiences. Facilitators were careful not to dominate the discussions or add their own opinions.

Once the thematic discussions were complete, a closing meeting open to all community members was called to present the preliminary results and openly discuss reflections on the process and outcomes.

TABLE 0.12. Overview of thematic discussions (TD) held for the Indigenous Peoples' food system profiling

#	Topic
Opening meeting	Introduction to the initiative and FPIC
TD1	Traditions and trends in the food system
TD2	Sustainable natural resources use
TD3	Exchange, trade and marketing
TD4	Seasons, climate shocks and change
TD5	Food system institutions and governance
TD6	Diversity in the diet and production system
TD7	Young peoples' knowledge and perceptions
Closing meeting	Food system sustainability, climate change resilience, adaptation and the future

Analysis

Based on the qualitative information collected in the thematic discussions, additional information from research partners' longer-term data and broader literature, the case study authors analyzed the sustainability of the Indigenous Peoples' food systems through five principles of sustainable food systems (FAO, 2014): (1) Provision of livelihoods, equity and social well-being; (2) Resource use efficiency; (3) Conservation, protection and enhancement of natural resources; (4) Responsible and effective governance mechanisms; and (5) Resilience of people, communities and ecosystems.

The first principle of sustainability,"provision of livelihoods, equity and social well-being", was explored with particular attention to food security, diet quality and opportunities for income generation. The food insecurity experiences scale (FIES; Saint Ville *et al.*, 2019) and the minimum dietary diversity score for women (MDD-W; FAO and FHI 360, 2016) were applied to explore food security and diet quality, following a modified approach. The discussion groups reflected on how often people in the community consume different food groups (Box 1), and whether community members had experienced different conditions of food insecurity in the past year (Box 2). Challenges and local practices for ensuring food security and diet diversity were discussed with a focus on seasonal resources use and food storage practices. Reflections on the adequacy of income-earning opportunities were developed in consideration of occupations, sources of income, and agri-food value chains in which the community participates.

Aspects of the second principle of sustainability, "resource use efficiency", were considered with a focus on soil, water, energy and waste. The analysis sought to identify practices that maximise food obtention per input, recycle resources in the system, and minimise waste. The use and dependence on external inputs for maintaining soil quality and meeting water and energy demands was considered. Energy inputs to agroecosystems consist of ecological energy (from the sun) and cultural energy, including biological sources (human labour, animal labour, manure, etc.) and industrial sources, such as fossil fuels, hydrological power, etc. (Gliessman, 2007). The evaluation focussed on cultural energy and the role of tools in supporting productivity and minimising drudgery in food production and sourcing.

The third principle of sustainability, "conservation, protection and enhancement of natural resources", was reviewed with attention to cultivated biodiversity, wild-sourced plants and animals, and natural areas in the landscape. The presence and area devoted to traditional varieties and breeds as compared to introduced ones was examined, along with motivations for maintaining these resources. Practices followed in sourcing wild foods to ensure their continued supply were highlighted, as well as activities to protect and restore natural areas in the landscape.

TABLE 0.13. Dates, location and participants of the thematic discussions held for each profile

Participating communities	When	Where	Who
Baka	July-August 2018	Gribe village (residential group of Dimgba), South-eastern Cameroon	18 women, 16 men and 21 children
Inari Sámi	September-December 2018	Nellim community in the municipality of Inari, Finland	Over 25 community members were involved, including elders, women, men and children. Most of the discussions were held with small groups with a few persons as it was challenging to assemble larger groups during the herding period.
Khasi	April-September 2018	Nongtraw village, Meghalaya, India	10 women, 10 men and children
Melanesians[SI]	July 2018	Baniata village in Rendova Island, Western Province of Solomon Islands	45 women, 29 men and children
Kel Tamasheq	September-October 2018	Two native Kel Tamasheq communities of Aratène village in the region of Goundam circle, Mali	90 women, 132 men and 19 children
Bhotia and Anwal	June-October 2018	Namik village in the Bageshwar district of Uttarakhand, India	20 women, 8 men and 9 children
Tikuna, Cocama and Yagua	August-November 2018	Six communities and settlements in the Tikuna-Cocama-Yagua (Ticoya) indigenous reserve in the municipality of Puerto Nariño, Amazonas Department, Colombia: Puerto Esperanza, 20 de Julio, Santa Clara de Tarapoto, Nuevo Paraíso, San Francisco, Comunidad Ticoya, and the urban area of the municipality of Puerto Nariño	12 women, 17 men and 12 children
Maya Ch'orti'	September-November 2018	Six communities situated in Camotán, Jocotán, and Olopa municipalities of the department of Chiquimula, Guatemala: Caserío Pitahaya, Nearar; Caserío Chagüitón, Dos Quebradas; Caserío Chantiago, El Rodeo; Caserío Chatuncito, Tunucó Arriba; Caserío La Ceiba, Tunucó Arriba; Agua Blanca	178 women, 95 men and 30 children

Building on these themes, the assessment of the fourth principle of sustainability, "responsible and effective governance mechanisms", went further in reviewing the traditional and novel institutions guiding natural resource access and use. The communities' empowerment in decision-making regarding resources they depend upon was in focus, as well as equitability in opportunities for participation for women and men, and all persons within the community.

The initiative devoted special attention to assessing the fifth principle of sustainability, which is the "resilience of people, communities and ecosystems". Within a food system, resilience is the capacity to ensure food provisioning by preventing, mitigating or coping with risks, adapting to change, and recovering from shocks (FAO, 2014). Resilience was evaluated with reference to a set of 13 behaviour-based indicators that link core aspects of social-ecological systems (Cabell and Oelofse, 2012 - Box 3). The presence of these indicators in an agroecosystem "suggest that it is resilient and endowed with the capacity for adaptation and transformation" (Cabell and Oelofse, 2012). The assessment included some aspects of the participatory assessment of Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes (Bergamini *et al.*,

BOX 1. Food groups considered in the food system profiles

- Starches (cereals and tubers)
- Pulses
- Nuts and seeds
- Dark green leafy vegetables
- Orange-/red-fleshed fruits and vegetables (Vitamin-A-rich)
- Other vegetables
- Other fruits
- Meat, poultry, and fish
- Eggs
- Milk and milk products
- Insects and other small protein foods

Source: FAO and FHI 360, 2016.

BOX 2. Conditions of food insecurity evaluated in the food system profiles

- Worrying that you would not have enough food to eat
- Not having access to healthy and nutritious food
- Eating only a few kinds of foods
- Skipping meals
- Eating less than you thought you should
- Not having enough food in the household
- Feeling hungry but not eating

Source: Saint Ville *et al.*, 2019.

2014), in which community members score their own system on a scale of 0 to 5. Inputs were also taken from FAO's Self-evaluation and Holistic Assessment of climate Resilience of Farmers and Pastoralists (SHARP), which assesses the 13 indicators defined by Cabell and Oelofse (2012) following a more quantitative approach (FAO, 2014). Here, a qualitative evaluation of the elements, practices and processes that confer resilience in the focal food systems explored multiple topics. These included experiences with climate shocks, levels of self-sufficiency in food production, accessibility of the community, knowledge generation and transmission, land use diversity, food group diversity, and redundancy in food provisioning through the presence of multiple species, varieties and sources for nutritionally distinct food groups (Box 3).

The analysis involved identifying all foods by their scientific names to enable assessments of the diversity in the food systems and increase accessibility of this information to a wider audience. During the thematic discussions, foods were typically listed in the local language. The researchers were familiar with the translation of most local names to scientific names or to the name in a more widely spoken language. Ethnobotanical literature was also consulted to support the translation of local names. In cases where the identification was unknown, community members were asked to gather specimens or to describe the features of the food to support its identification. The identifications were verified by the Editorial Committee and controlled for synonyms with reference to *The Plant List (2013)* for plants and *Catalogue of Life* (Roskov *et al.*, 2019) for animals and fungi. Unless otherwise specified, the lists of foods presented throughout this book reflect the results of this process. As specimens were not examined in all cases, it is acknowledged that some degree of error is possible in the identifications. It was thought relevant to highlight indigenous and local names with a specific formatting, in bold, italic and minuscule, in an attempt to give the adequate recognition to indigenous and local terms in this publication.

Case study format

Each of the eight Indigenous Peoples' food systems profiles in this book is the result of the analysis of the thematic discussions held with the communities in the field, complemented by additional knowledge from the literature and author observations. Each case study first presents the Indigenous Peoples' community and describes the current status of their food system and major changes that have occurred over time (Section I). It then provides an analysis of the sustainability principles of the food system and how they have changed over time, considering interlinkage between elements and processes that contribute to these potential changes (Section II). Finally, major highlights of the food system are summarized and community reflections on the sustainability and climate resilience of their food systems are presented along with their future perspectives (Section III). Given the great scope of topics, the complexity of socio-ecological interactions in Indigenous Peoples' food systems, and the limited time for developing the case studies, the results of these case studies can be seen as a start point to be followed up by more in-depth studies.

BOX 3. Indicators of resilience considered in the food system profiles

1. **Exposed to disturbance:** The system is exposed to discrete, low-level events that cause disruptions without pushing the system beyond a critical threshold.
2. **Globally autonomous and locally interdependent:** The system has relative autonomy from exogenous (global) control and influences and exhibits a high level of cooperation between individuals and institutions at the more local level.
3. **Appropriately connected:** Connectedness describes the quantity and quality of relationships between system elements.
4. **Socially self-organised:** The social components of the agroecosystem are able to form their own configuration based on their needs and desires.
5. **Reflective and shared learning:** Individuals and institutions learn from past experiences and present experimentation to anticipate change and create desirable futures.
6. **Honours legacy:** The current configuration and future trajectories of systems are influenced and informed by past conditions and experience.
7. **Builds human capital:** The system takes advantage of and builds "resources that can be mobilized through social relationships and membership in social networks".
8. **Coupled with local natural capital:** The system functions as much as possible within the means of the bio-regionally available natural resource base and ecosystem services.
9. **Ecologically self-regulated:** Ecological components self-regulate via stabilizing feedback mechanisms that send information back to the controlling element.
10. **Functional diversity:** Functional diversity is the variety of ecosystem services that components provide to the system.
11. **Optimally redundant:** Critical components and relationships within the system are duplicated in case of failure.
12. **Spatial and temporal heterogeneity:** Patchiness across the landscape and changes through time.
13. **Reasonably profitable:** The segments of society involved in agriculture are able to make a livelihood from the work they do without relying too heavily on subsidies or secondary employment.

Source: Campbell and Oelafse, 2012; Choptiany *et al.,* 2015

CHAPTER 1

Hunting, gathering and food sharing in Africa's rainforests

The forest-based food system of the Baka Indigenous People in South-eastern Cameroon

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Baka people from Gribe village collecting forest resources.

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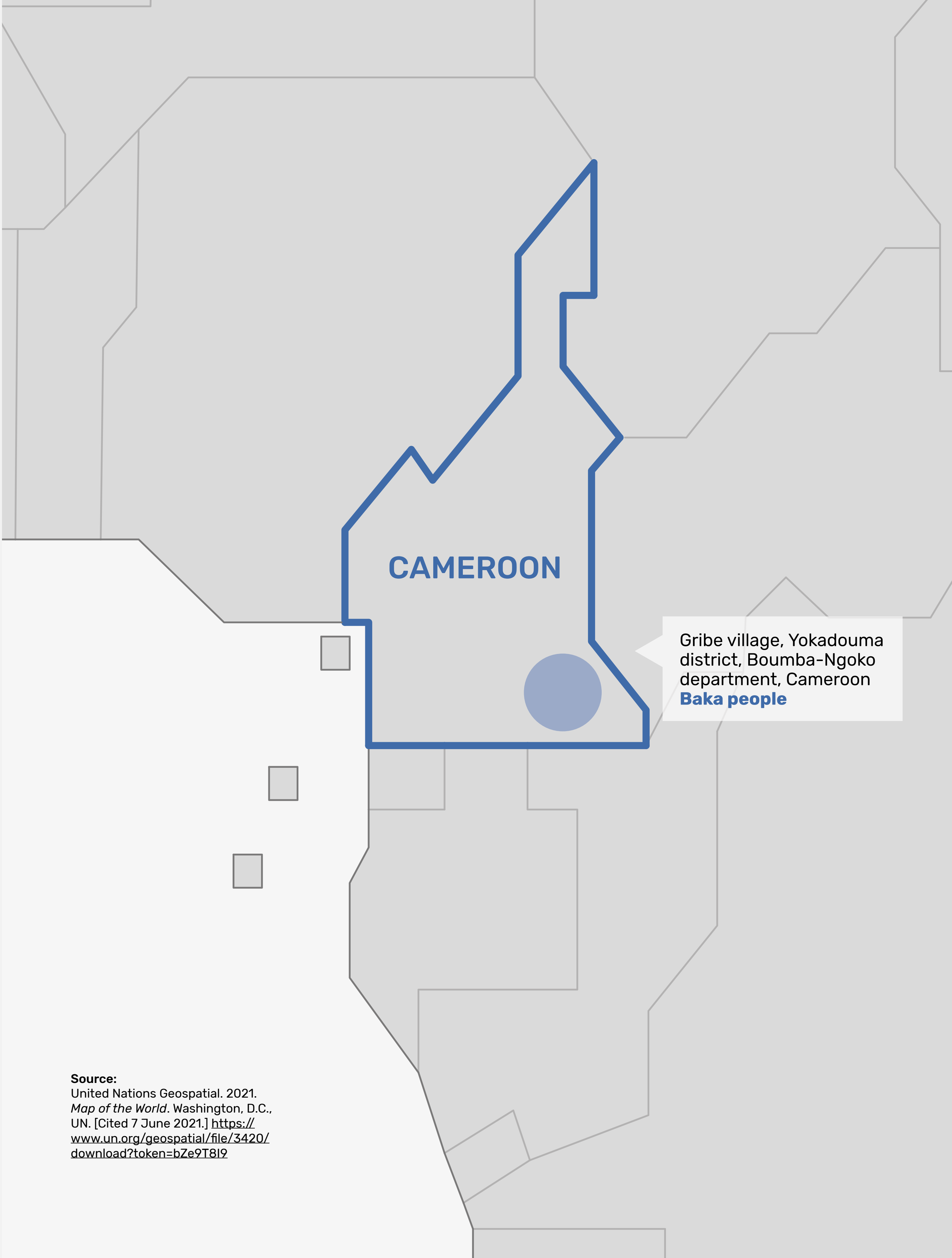

Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

"Individual independence in food sourcing is important to eat well and share food with everyone."

Saying of the Baka from Dimgba.

AT A GLANCE

The Baka are one group of"Pygmy"hunter-gatherers who live in the rainforest of the Congo Basin. They have depended entirely on forest resources for their life and culture through hunting, gathering and fishing. The most distinct and basic features of their livelihoods are characterized by (1) the frequent and extensive moves in the forest searching for major food resources, including wild yams, animals and fruits, have strong seasonality and are distributed in low density areas; (2) the minimised labour input considering they move extensively but spend only two to five hours a day collecting food; (3) the food sharing, by which uncertainty in food procurement is mitigated and the Baka's value for collective wealth over accumulation of individual property is reproduced; and (4) the exchange with neighbouring groups for crops as the forest is full of biodiversity and biomass, but food resources are not always sufficient. Over recent decades, the Baka's livelihoods have been influenced by changes in the macro environment, including a settlement policy and a zoning policy that has affected their extensive moves from forest to forest, as well as timber exploitation, the market economy, increased bushmeat trade and animal decline. Ultimately, such conditions are affecting food sharing amongst the Baka and the relationship between the Baka and their neighbours.

Note from the editors: Baka terms are mentioned using the International Phonetic Alphabet. Baka language is a three-level tonal tongue. By convention, high and low tons are symbolized by ´ and `, respectively, and medium is expressed by the absence of a symbol. ˆ and ˇ express descending and ascending inflections, respectively.

SECTION 1 COMMUNITY AND FOOD SYSTEM PROFILE

1. GEOGRAPHIC CONTEXT

Gribe village is located in the Yokadouma district of Boumba-Ngoko department in the East region of Cameroon, 75 km southwest of the city of Yokadouma. Aside from the existing administrative boundaries, Gribe together with 20 neighbouring villages constitutes the Konabembe canton that was formed before or during the German colonial period. The village is immediately surrounded by a mix of evergreen and semi-deciduous forest with a canopy stratum culminating 40 m to 50 m above ground (Tajeukem *et al.*, 2014). The topography is characterized by scattered gently rolling hills isolated from each other by a dense hydrographic network.

The climate of the East region is classified as tropical monsoon by the Köppen climate classification. The mean daily temperature is stable at around 24 °C throughout the year and mean annual rainfall is approximately 1 600 mm. The rainfall regime is primarily governed by the Intertropical Convergence Zone (ITCZ) and is divided into four seasons in a year (Figure 1.2).

The East region of Cameroon has the largest area (109 000 km^2) of all districts in the country, but the population has always been one of the smallest. Infrastructure, comprising transportation, electricity, telecommunications and water supply, is hardly advanced. Investments were made in infrastructures that support extractive activities such as timber logging and mining.

2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

Around 20 ethnic groups are found in the East region of Cameroon, among which the majority speak Bantu languages. The Baka, who speak an Ubanguian language, are found throughout the southern part within a mosaic of 17 languages, which predominantly belong to the Niger-Congo phylum of Bantu languages.

A great majority of villages in the southern part of East region, where Gribe village is located, are constituted by (1) a dominant Bantu or Ubanguian speaking group; (2) individuals originating from a diversity of other ethnic or language groups from South-eastern Cameroon who have matrimonial ties with a native of the region; and (3) Baka. In Gribe, the Konabembe – speakers of the Mpumpong language – constitute the dominant group with a population of around 300 residing in around 55 households. Approximately 25 residents speak other Bantu languages, including Kako, Mpiemo and Koonzime (Mpumpong). Additionally, about 10 households are merchants, who have recently migrated from Yokadouma city or from outside the region or country. The Baka in Gribe have a population of approximately 400 residing in 95 households.

The Baka and Bantu speakers have mutually bonded through social relations and material and immaterial exchanges. The Baka almost all speak or understand the Mpumpong spoken by the Konabembe, and a large part of non-Baka people understand Baka, whereas each group speaks their mother tongue. In Gribe and the surrounding area, Baka collectively call different groups of Bantu speakers as ***bantu*** or ***kàkà***, and so do Bantu speakers. We accordingly refer to the Konabembe and other Bantu speakers as "Bantu" or "neighbours" (Toda, 2014). Nevertheless, some precautions should be stated here to avoid confusion: First, the term Bantu basically refers to linguistic classifications and does not make sense without contextualization. "Pygmies groups" are commonly segregated from "Bantu" groups despite the fact that the majority of them speak a Bantu language. Second, packaging the different groups into a single "Bantu" – or "farmers", "villagers" or "non-Pygmies" – category tends to overshadow the great diversity of livelihoods that exist amongst Bantu-speaking groups. Third, this homogenization misleadingly caricatures the binary opposition between the Baka and their neighbours, and tends to squander the diversified facets of their interrelationships (Rupp, 2003).

The Baka form residential groups composed of 5 to 20 households tied through patrilineal kinship. The members of each residential group have close mutual relationships through daily processes of sourcing, consuming and sharing food, as well as through rituals. At the same time, most groups include households from different residential origins belonging to different patrilineal entities. Notably, many cases are found where a spouse's parents and their relatives move in and share their livelihoods. The wide range of membership in resident groups expands the range of accessible resources.

One of the major factors that has increased membership is matrilocal residence. Whereas the Baka follow virilocal residence in principle, matrilocal residence is usually followed until the husband completes payment of the bride wealth to his wife's parents or relatives. Through this custom, the relationship between different resident groups becomes more intimate. The unit of exogamy is the clan ***ye***, which is the largest boundary of the patrilineal descent group. Whilst the genealogical relationship between clan members is seldom remembered, spouses are strictly selected from different clans (Tsuru, 1998). There is strong tendency to search for spouses in clans that live farther away: half of the spouses of the Baka males originating in Gribe have spouses from outside the village and some men who have married local women may come from areas situated up to 200 km away. The wide distribution of patrilineal descent groups across the area has likely resulted from these processes of conjugal ties over long distances.

There are approximately 20 residential groups in Gribe, amongst which this study focused on one – the Dimgba. They established ***gba*** (semi-residential settlements) around the central area of the village that is resided by the Bantu (Figure 1.1 left). Residential group members move seasonally to the forest altogether or in smaller bundles of households, where they establish ***bala*** (forest camps). As the population size of the Dimgba group is large, they tend to form separated camps in the forest and members visit each other to share food and discuss various matters. Gender roles are relatively clear: in general, women are in charge of gathering, fishing, harvesting crops, weeding, procuring water and firewood, and cooking. Men are involved in hunting, honey gathering, clearing fields, and negotiating with the Bantu for exchange. In regards to decision-making on social issues and livelihood activities, there is no leader with specific authority. When facing problems or having to make joint decisions, concerned parties have to engage in slow and long-lasting negotiations.

The Baka believe in many kinds of ***me*** (forest spirits), which shape their religious system that is not built on a systematic precept. They segregate ***me*** from the God of Christians to which they were evangelized by foreign missionaries. Like humans, the spirits are said to live in camps in the forest, and occasionally visit Baka settlements to dance and sing with the people. On these occasions, the spirits are embodied in anthropomorphic masks. During ritual events with dancing and ***be*** (singing), men depict the visiting spirits through dances that are sustained by a chorus of women. The Baka have a rich repertoire of ***lìkànɔ̀*** (tales) in which they set spirits into stage. It is mainly through dreams that the spirits communicate with the Baka and impart humans with knowledge about the forest and its resources.

3. LOCAL FOOD PRODUCTION

Current livelihood and land classification

The livelihood means currently practised by the Baka in Gribe are hunting, gathering, fishing, shifting agriculture, material and labour exchanges with the Bantu, and extractivism through the harvesting for sale of Non-Timber Forest Products (NTFPs). Amongst the Baka, agriculture has increased over recent decades. The Bantu of Gribe depend mainly on

Baka community.

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agriculture, whereas they also earnestly practise hunting and gathering for subsistence, and cacao cultivation and trading NTFPs for cash income (Hirai, 2014).

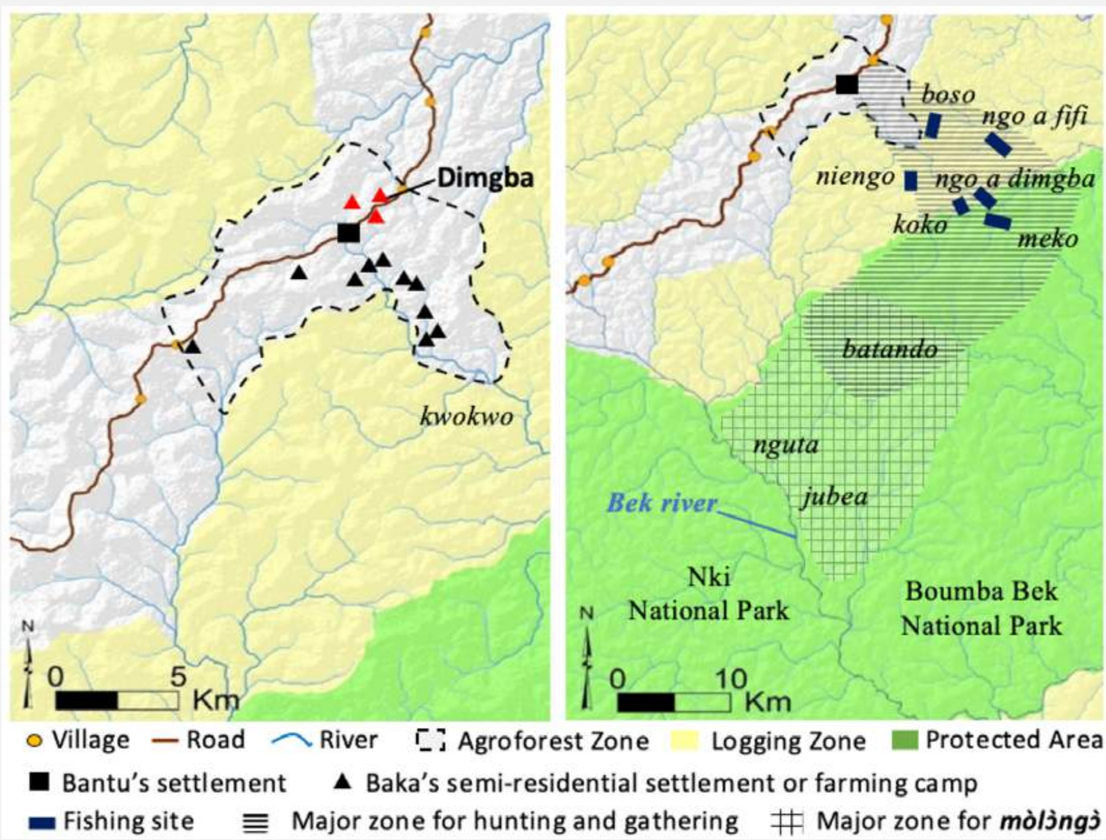
There are many restrictions on forest use connected with the zoning policy implemented by the Government in the 1990s and wildlife management by the protected areas. The zoning policy divided the forest that had been used so far by local people into non-permanent forest and permanent forest. The former constitutes the agroforest zone, expanding approximately 3 km on both sides of the road that passes through the village. The latter includes concession areas for timber logging (logging zone) and protected areas. Farming is only authorised in the agroforest zone. Gathering and hunting for subsistence, and fishing are possible in the agroforest zone and logging zone. In the protected areas, hunting is totally banned, whereas NTFP collection is tolerated under the condition that it is specified in the protected area management plan (Tegomo Njounan, Defo and Usongo, 2013). Further regulations are imposed for hunting in terms of target species, captive numbers and methods.

Hunting and trapping

All Baka in Gribe are involved in hunting (Yasuoka *et al.*, 2015). Hunting activities are roughly categorised into three types: ***maka***, ***mumbato*** and ***sendo***. The term ***maka*** refers to large-scale expeditions to track big animals such as red river hog and elephant (Table 1.1). These expeditions are carried out in groups of about 5 to 10 men who journey around the forest for more than a week. The ***mumbato*** type of hunting involves a group of two to three men for about one week. Oftentimes, these groups are based in forest camps from where they go to trap animals and collect NTFPs. The ***sendo*** type is day hunting, which is a shorter outing from a semi-residential settlement or a forest camp. In addition, the Baka use a special trap called ***mὲndàmbà*** to capture mice and rats and slingshots to shoot small birds around the farming camp. Whilst men are the primary actors capturing animals, women are also involved in hunting by checking traps set by men and guarding men's absent camps.

More than 50 mammal species inhabit the forest around Gribe (Table 1.1). Amongst these species, the most captured are the blue duiker, red duikers and brush-tailed porcupine. The Bantu also delegate the Baka to hunt for their consumption. Some primate species are captured when the Bantu give the Baka a shotgun. Bushmeat to exchange with Bantu or merchants is usually smoked for storage. About half of the captured animals are traded and the other half are used for self-consumption.

FIGURE 1.1. Landscape of Gribe (elaborated by the authors, 2019)



Source: World Resources Institute, 2011, modified by Masaaki Hirai and the Baka of Dimgba, 2018.

TABLE 1.1. List of wildlife and major captured species used as food

Groups	Baka name	Scientific name	English name	Major captured species
Birds and poultry	***kàmbi***	*Caprimulgus* sp. L., Caprimulgidae	Nightjar	
	kukuakèmbè	*Centropus* sp. Illiger, Cuculidae	Cuckoo	
	kpùngbùlù	*Circaetus spectabilis* Schlegel, Accipitridae	Congo serpent eagle	
	kanga	*Guttera plumifera* Cassin, Numididae	Crested guinea fowl	•
	kembè	*Himantornis haematopus* Hartlaub, Rallidae	Nkulengu rail	
	sɛsɛ	*Nectarinia* sp. Illiger, Nectariniidae	Souimanga	•
Mammals				
Afrosoricida	***lìnje***	*Potamogale velox* Du Chaillu, Tenrecidae	Giant otter-shrew	
Artiodactyls	***ngɛ̀ndì***	*Cephalophus callipygus* Peters, Bovidae	Peter's duiker	•
	ngbɔmù	*Cephalophus dorsalis* Gray, Bovidae	Bay duiker	•
	mie	*Cephalophus leucogaster* Gray, Bovidae	White-bellied duiker	
	mònjombe	*Cephalophus nigrifrons* Gray, Bovidae	Black-fronted duiker	
	bèmbà	*Cephalophus silvicultor* Afzelius, Bovidae	Yellow-back duiker	
	gɛkɛ	*Hyemoschus aquaticus* Ogilby, Tragulidae	Water chevrotain	•
	bea	*Hylochoerus meinertzhageni* Thomas, Suidae	Giant forest hog	
	buwele	*Neotragus batesi* de Winton, Bovidae	Bate's dwarf antelope	
	dɛ̀ngbɛ̀	*Philantomba monticola* Thunberg, Bovidae	Blue duiker	•
	pame	*Potamochoerus porcus* L., Suidae	Red river hog	•
	mbɔ̀kɔ	*Syncerus caffer* Sparrman, Bovidae	African buffalo	
	mbɔ̀ngɔ̀	*Tragelaphus eurycerus* Ogilby, Bovidae	Bongo	
	mbùlì	*Tragelaphus spekii* Speke, Bovidae	Sitatunga	
Carnivores	***lòndò***	*Aonyx capensis congicus* Lönnberg, Mustelidae	Zaire clawless otter	
	nganda	*Atilax paludinosus* G. Cuvier, Herpsestidae	Marsh mongoose	
	busɛ	*Bdeogale nigripes* Pucheran, Herpsestidae	Black-footed mongoose	
	jàmà	*Genetta servalina* Pucheran, Viverridae	Servaline genet	
	kpòkoto	*Herpestes naso* de Winton, Herpestidae	Long-nosed mongoose	
	ndìmɛ	*Mellivora capensis* Schreber, Mustelidae	Honey badger	
	mboka	*Nandinia binotata* Gray, Nandiniidae	African palm civet	•
	sùà	*Panthera pardus* L. Felidae	African leopard	
	lòngɛ	*Poiana richardsonii* Thomson, Viverridae	Central African oyan	
Chiroptera	***lìkpɔngɔlɔ***	*Rousettus aegyptiacus* E. Geoffroy, Pteropodidae	Egyptian fruit bat	
	lìèmbè	*Megaloglossus woermanni* Pagenstecher, Pteropodidae	Woermann's bat	

TABLE 1.1. List of wildlife and major captured species used as food

Groups	Baka name	Scientific name	English name	Major captured species
Hyracoidea	*yòka*	*Dendrohyrax arboreus* A. Smith, Procaviidae	Southern tree hyrax	
Pholidotes	*kokòlo*	*Phataginus* spp. Rafinesque, Manidae	Tree pangolins	
	kelepa	*Smutsia gigantea* Illiger, Manidae	Giant pangolin	
Primates	*tamba*	*Cercocebus agilis* A. Milne-Edwards, Cercopithecidae	Agile mangabey	
	mòngɛ̀njɔ	*Cercopithecus cephus* L., Cercopithecidae	Moustached monkey	
	kɔyì	*Cercopithecus nictitans* L., Cercopithecidae	Putty-nosed monkey	
	màmbè	*Cercopithecus pogonias* Bennett, Cercopithecidae	Crowned monkey	
	ʔèbobo	*Gorilla gorilla gorilla* Savage and Wyman, Hominidae	Western lowland gorilla	
	ngàdà	*Lophocebus albigena* Gray, Cercopithecidae	Grey-cheeked mangabey	
	seko	*Pan troglodytes* Blumenbach, Hominidae	Chimpanzee	
	katu	*Perodicticus potto* Müller, Lorisidae	Potto	
Proboscidea	*yà*	*Loxodonta africana* Blumenbach, Elephantidae	Forest elephant	
Rodents	*ʔìkùyà*	*Anomalurus* spp. Waterhouse, Anomaluridae	Scaly-tailed squirrels	
	mbòke	*Atherurus africanus* Gray, Hystricidaes	African brush-tailed porcupine	•
	gbè	*Cricetomys emini* Wroughton, Nesomyidae	Forest giant pouched rat	•
	sende	*Funisciurus* sp. Trouessart, Sciuridae	African striped squirrel	•
	bíʔì	*Oenomys* sp. Thomas, Muridae	African rodent	•
	bòko	*Protoxerus stangeri* Waterhouse, Sciuridae	Forest giant squirrel	
	pìa	*Thryonomys swinderianus* Temminck, Thryonomyidae	Greater cane rat	•
Tubuliden-tata	*kpìnyà*	*Orycteropus afer* Pallas, Orycteropodidae	Aardvark	
Reptiles				
Crocodilia	*mòkòàkèlè*	*Osteolaemus tetraspis* Cope, Crocodylidae	Dwarf crocodile	
	ngàndo	unknown, Crocodylidae	African crocodile	
Sauria	*bambè*	*Varanus niloticus* L., Varanidae	Nile monitor	•
Squamata	*mbùmà*	*Bitis gabonica* Duméril, Bibron & Duméril, Viperidae	Gaboon viper	•
	díàkò	*Bitis nasicornis* Shaw, Viperidae	Butterfly viper	
	ngɛkɛ̀	*Naja melanoleuca* Hallowell, Elapidae	Bblack cobra	
	meke	*Python sebae* Gmelin, Pythonidae	African rock python	
Testudines	*kùnda*	*Kinixys erosa* Schweiger, Testudinidae	Forest hinge-back tortoise	•
	lende	*Pelusios* sp. Wagler, Pelomedusidae	African side-necked turtle	

Wild edibles

A variety of plants, mushrooms and other wild edibles are collected by the Baka for subsistence and household economy. Table 1.2 shows the major wild edibles collected by food group, with specification of their scientific and Baka names. Eight species of wild yams (*Dioscorea* spp.) are notably important for subsistence. Out of the eight, two species of yam renew their tubers annually and are spread in large patches within the forest area. During the major dry season, the Baka undertake long-term harvesting expeditions for these two species to ensure their food security. By contrast, all the other yams species have perennial tubers and are more randomly distributed throughout the forest (Yasuoka, 2013). About 30 species of wild fruits are collected and consumed as oil, oily condiments, seasonings and snacks. Amongst them, kernels of ***kanà*** (*Panda oleosa*), seeds of ***màɓè*** (*Baillonella toxisperma*), and kernels of several species of Irvingiaceae trees are most frequently used. In addition, kernels of ***pɛ́kɛ*** (*Irvingia gabonensis*) are of particular importance for local diets and cash income. This species is available only in the minor dry season, at which time most Baka move to the forest and camp for two to three months to collect the kernels together with other forest resources. This seasonal camp is accordingly called ***bàlà pɛ́kɛ*** (*Irvingia* camp). Other major wild edibles collected primarily for income are fruits of *Aframomum* spp., ***ngìmbà*** (*Afrostyrax lepidophyllus*), and ***gɔbɔ*** (*Ricinodendron heudelotii*, njangsang), which are commonly sold as seasonings. As vegetables, the leaves of five species are collected, amongst which ***kɔ̀kɔ*** (*Gnetum africanum*) is the most frequently consumed and easy to gather. Mushrooms are highly valued and the Baka have a wealth of knowledge regarding their diversity, edibility and ecologies. They eat around 20 species with different seasons of occurrence. The largest forest mushrooms are the *Termitomyces* species that grow on mounds of *Macrotermes* termites. Monospecific forest patches of ***bèmba*** (*Gilbertiodendron dewevrei*) are known for their incredible diversity of symbiotic mushrooms.

Invertebrates are also important components in Baka diets. The most popular are caterpillars, which are highly seasonal. Each species receives the name of the host tree on which they feed exclusively. ***Sùsu*** (winged termite imagos), which emerge from the ground, mounds or aerial nests around the end of the minor dry season, are highly favoured. As emergence time approaches, children and adults observe termite mounds and nests almost every day. Imagos of ***mbìle*** species emerging from the ground are captured and immediately eaten by children. For ***bàndi*** termites, adult men will dig out soldiers from the mounds and cook them as a soup ingredient. Weevil larvae are extracted from the trunk of Raffia palms (*Raphia* spp.) that they parasitize in swampy forests. Large *Achatina* snails are coveted by children and women and are easy to catch. Sting bees (Apidae) and stingless bees (a dozen species of Melliponinae) produce a diversity of honey made from different flowers throughout the year. Honey gathering is one of the most culturally important activities amongst the Baka and embeds a set of knowledge, expertise and physical skill: bee nests are often found in hollow tall trees, sometimes very high above the ground. Finding bees from the ground requires the ability to perceive the slight appearance, sound and particular atmosphere of bees. ***Lìɓɛnjì*** (insect detritus) discharged by the bee workers and accumulated at the base of the tree are indirect clues for localizing a nest. *Apis* nests require the gatherer to climb the tree, while cutting it down is necessary to access stingless bee nests.

TABLE 1.2. List of wild edibles and their seasonal availability

D: major dry season; r: minor rainy season; d: minor dry season; R: major rainy season

Group	Baka name	Scientific name	English name or generic description	Seasonal availability				Trend in use	
				D	r	d	R	Not used recently for sub-sistence	Use started recently as cash value raised
Condiments, seasonings, snacks and sweeteners	***ngìmbà***	*Afrostyrax lepidophyllus* Mildbr., Huaceae				■			●
	mòbàkòsò	*Beilschmiedia louisii* Robyns & Wilczek, Lauraceae		■			■		●
	pandàkò	*Calpocalyx dinklagei* Harms, Fabaceae		unknown					
	tokombòlì	*Chytranthus atroviolaceus* E.G.Baker ex Hutchinson & Dalziel, Sapindaceae		unknown					
	ngbí (fruit)	*Dioscoreophyllum cumminsii* (Stapf) Diels, Menispermaceae		unknown					
	mbílà	*Elaeis guineensis* Jacq., Arecaceae	Oil palm	■	■	■	■		
	bèmba	*Gilbertiodendron dewevrei* (De Wild.) J.Leonard, Fabaceae	Limbali (commercial wood name)	unknown					
	kpàsɛlɛ	*Haumania danckelmaniana* (J.Braun & K.Schum) Milne-Redh., Marantaceae				■			
	ngàngɛ̀ndì	*Irvingia excelsa* Mildbr., Irvingiaceae		■	■	■	■		
	pɛ́kɛ	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., Irvingiaceae				■			●
	sɔ́ɔ̀lìà	*Irvingia grandifolia* (Engl.) Engl., Irvingiaceae				■			
	kòmbèlè	*Irvingia robur* Mildbr., Irvingiaceae		■	■	■	■		
	mobɔlu	*Irvingia tenuinucleata* Tiegh., Irvingiaceae		■					
	ɓòkɔ̀kɔ̀	*Klainedoxa gabonensis* Pierre, Irvingiaceae		■	■	■	■		
	bùndúlú	*Klainedoxa trillesii* Pierre ex Tiegh., Irvingiaceae		■			■		
	kanà	*Panda oleosa* Pierre, Pandaceae		■	■	■	■		
	kaso	*Plukenetia conophora,* Müll.Arg., Euphorbiaceae				■			
	gɔbɔ̀	*Ricinodendron heudelotii* (Baill.) Heckel, Euphorbiaceae	Njangsang	■			■		

TABLE 1.2. List of wild edibles and their seasonal availability
D: major dry season; r: minor rainy season; d: minor dry season; R: major rainy season

Group	Baka name	Scientific name	English name or generic description	Seasonal availability				Trend in use	
				D	r	d	R	Not used recently for sub-sistence	Use started recently as cash value raised
Condiments, seasonings, snacks and sweeteners	***mìmgɛ̀nyɛ̀***	*Scorodophloeus zenkeri* Harms, Fabaceae				■			●
	ʔègboyo	*Sterculia oblonga* Mast. Malvaceae				■			
	mótumbèlumbè	*Telfairia occidentalis* Hook.f., Cucurbitaceae	Fluted gourd			■			
	djàgà	*Tetrapleura tetraptera* (Schumach. & Thonn.) Taub., Fabaceae				■			●
Extrativism	***tóndo à súà***	*Aframomum* sp. K.Schum, Zingiberaceae	alligator pepper		■	■	■		●
	báyɔ̀kɔ̀	*Aframomum* sp. K.Schum, Zingiberaceae	alligator pepper		■	■	■		●
	tóndo	*Aframomum* sp. K.Schum, Zingiberaceae	alligator pepper		■	■	■		●
	kpɔkɔmbɔ̀lɔ̀	*Piper guineense* Schumach. & Thonn. Piperaceae	wild pepper	■	■	■	■		●
Fruits and juices	***múngámbà***	*Aframomum* sp. K.Schum, Zingiberaceae			■	■	■		
	kànja	*Amphimas pterocarpoides* Harms, Fabaceae		unknown					
	ngbé	*Anonidium mannii* Oliv., Annonaceae				■			
	màbè	*Baillonella toxisperma* Pierre, Sapotaceae	moabi (commercial wood name)			■			
	bámbu	*Chrysophyllum lacourtianum* De Wild., Sapotaceae				■			
	mondɔ̀ngɛ	*Chrysophyllum* sp. L., Sapotaceae		unknown					
	ngóngó	*Drypetes ituriensis* Pax & K.Hoffm., Putranjivaceae				■			
	tembo	*Drypetes* sp. Vahl, Putranjivaeae		unknown					
	pékɛ	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., Irvingiaceae				■			
	mákpá	*Landolphia* sp. P.Beauv., Apocynaceae				■			
	ngàta	*Myrianthus arboreus* P.Beauv., Urticaceae				■			●
	mɔsɛ́	*Nauclea pobeguinii* (Pellegr.) Merr. L., Rubiaceae				■			
	ngɔ́yɔ	*Trichoscypha acuminata* Engl., Anacardiaceae				■			

TABLE 1.2. List of wild edibles and their seasonal availability
D: major dry season; r: minor rainy season; d: minor dry season; R: major rainy season

Group	Baka name	Scientific name	English name or generic description	Seasonal availability				Trend in use	
				D	r	d	R	Not used recently for sub-sistence	Use started recently as cash value raised
Fruits and juices	***púlu***	*Vitex doniana* Sweet, Lamiaceae	Black plum			■			
Insects and insects products (honey)	***tàku***	*Anaphe* sp. Walker, Notodontidae	caterpillar			■			
	gbàdɔ̀	*Anaphe venata* Butler, Notodontidae	caterpillar			■			
	tòngíà	*Apis mellifera adansonii* Latreille, Apidae	sting bee		■	■	■		
	pusu	*Elaphrodes lactea* Gaede, Notodontidae	caterpillar			■			
	ngúlúmá	*Imbrasia epimethea* Drury, Saturniidae	caterpillar			■			
	bòyo	*Imbrasia oyemensis* Rougeot, Saturniidae	caterpillar			■			●
	bàndi	*Macrotermes* sp. Holmgren, Termitidae	winged imagos of termites			■			
	dàndù	Meliponini sp., Apidae	stingless bee	unknown					
	Njénje	Meliponini sp., Apidae	stingless bee	unknown					
	ɓɔ̀lɔ	Meliponini sp. Apidae	stingless bee	unknown					
	pɛ̀ndɛ̀	Meliponini sp. Apidae	stingless bee	unknown					
	molɛ̀ngì	Meliponini sp. Apidae	stingless bee	unknown					
	kàngà	*Pseudantheraea discrepans* Butler, Saturniidae	caterpillar			■			
	pɔsè	*Rhynchophorus phoenicis* Fabricius, Dryophthoridae	palm weevil			■			
Mushrooms	***mòsɛlɛ̀lɛ̀***	*Termitomyces* sp. R.Heim, Lyophillaceae		■			■		
	dedele	Unknown		■	■	■	■		
	kútù	Unknown		■			■		●
	sámɔ̀ni	Unknown				■	■		
	bòtoto	Unknown				■	■		
	jokàbukà	Unknown				■	■		
	jókàlànù	Unknown				■	■		
	kòtomòlesèko	Unknown				■	■		
	màwɔ̀luwɔ́lù	Unknown				■	■		
	mòmbùjàmbùnjà	Unknown				■	■		
	dɛ̀ngbɛ̀	Unknown				■	■		
	sákùsa	Unknown				■	■		
	tókpolì	Unknown				■	■		
	túlúkàngò	Unknown				■	■		

TABLE 1.2. List of wild edibles and their seasonal availability
D: major dry season; r: minor rainy season; d: minor dry season; R: major rainy season

Group	Baka name	Scientific name	English name or generic description	Seasonal availability				Trend in use	
				D	r	d	R	Not used recently for sub-sistence	Use started recently as cash value raised
Mushrooms	***túlútìmi***	Unknown					■		
	mundungùlà	Unknown					■		
Oils	***màbè*** (nut)	*Baillonella toxisperma* Pierre, Sapotaceae	moabi (commercial wood name)			■			●
	mbílà (nut)	*Elaeis guineensis* Jacq., Arecaceae	oil palm	■	■	■	■		
	mbalaka (nut)	*Pentaclethra macrophylla* Benth., Fabaceae			■	■		●	●
Saline matters	***kpàsɛlɛ*** (leave)	*Haumania danckelmaniana* (J.Braun & K.Schum) Milne-Redh., Marantaceae		■	■	■	■	●	
	gbado (wood)	*Triplochiton scleroxylon* K.Schum., Malvaceae	ayous (commercial wood name)	■	■	■	■	●	
Snails	***mbɛ̀mbɛ***	*Achatina fulica* Férussac, Achatinidae	giant African snail		■	■	■		●
Starches (Tubers and Piths)	***kɛ́kɛ***	*Dioscorea burkilliana* Miège, Dioscoreaceae	wild yam	■	■	■	■		
	ba	*Dioscorea mangenotiana* J. Miège, Dioscoreaceae	wild yam	■	■	■	■		
	kuku	*Dioscorea minutiflora* Engler, Dioscoreaceae	wild yam	■	■	■	■		
	sapà	*Dioscorea praehensilis* Benth, Dioscoreaceae	wild yam	■			■		
	ʔèsùmà	*Dioscorea semperflorens* Uline, Dioscoreaceae	wild yam	■			■		
	balɔ̀kɔ̀	*Dioscorea smilacifolia* De Wild. & T.Durand, Dioscoreaceae	wild yam	■	■	■	■		
	njàkàkà	*Dioscorea* sp. L., Dioscoreaceae	wild yam	■	■	■	■		
	ngbí	*Dioscoreophyllum cumminsii* (Stapf) Diels, Menispermaceae	wild yam	■	■	■	■		
	mbílà	*Elaeis guineensis* Jacq. Arecaceae	oil palm	■	■	■	■	●	
	ʔèsíé	*Raphia hookeri* G.Mann & H.Wendl., Arecaceae	raffia palm	■	■	■	■	●	
	pèke	*Raphia monbuttorum* Drude, Arecaceae	raffia palm	■	■	■	■	●	

TABLE 1.2. List of wild edibles and their seasonal availability
D: major dry season; r: minor rainy season; d: minor dry season; R: major rainy season

Group	Baka name	Scientific name	English name or generic description	Seasonal availability				Trend in use	
				D	r	d	R	Not used recently for sub-sistence	Use started recently as cash value raised
Stimulants	***lìgɔ***	*Cola acuminata (P.Beauv.)* Schott & Endl., Malvaceae	cola nut			■			●
	mɛ̀kɔ̀ɔ̀	*Cola rostrata* K.Schum, Malvaceae	cola nut	unknown					
	bànga	*Cola* sp. Schott & Endl., Malvaceae	cola nut			■			
Sweet drinks	***lɔkɔlɔkɔ à lum***	*Elaeis guineensis* Jacq., Arecaceae	oil plam	■	■	■	■		
	lɔkɔlɔkɔ à pèke	*Raphia monbuttorum* Drude, Arecaceae	raffia palm	■	■	■	■		
Vegetables	***kata***	*Dewevrea bilabiata* Micheli, Fabaceae		■	■	■	■		
	kɔ̀kɔ̀	*Gnetum africanum* Welw., Gnetaceae	eru	■	■	■	■		●
	súmba	*Hilleria latifolia* (Lam.) H.Walt., Phytolaccaceae		■	■	■	■		
	dúndu	*Sloetiopsis usambarensis* Engl., Moraceae		■	■	■	■		
	pandɔ̀	*Tabernaemontana* sp. Plum. Ex L., Apocynaceae		■	■	■	■		

Fishing

Amongst a vast range of fishing methods reported from the East region, the Baka most frequently practise ***ngúma*** (dam fishing), hand-gathering, ***njɛ́ɛ̀njɛ̀*** (angling) and ***mátìndì*** (trapping). As the Baka of Gribe more often fish in small rivers, dam fishing is one of their favourites, during which they bank up fallen trees and soil vertically with the flow of the river. Two weirs are made at intervals of about 10 metres. After water accumulates, it is raked out with big leaves of specific Marantaceae species. As the water decreases, fish – especially carp (Cyprinidae) and catfish (Siluridae) – shrimps, crabs and tadpoles can be caught by hand. Dam fishing is regarded as women's work, and they usually do it collectively since it requires heavy work and collaboration. This practice is limited to the major and minor dry season when the water level decreases. Hand-gathering is also a woman's job. Women introduce a hand into a hole in the soft soil of the riverbank and catch small catfish and ***mbɔ̀sɛ̀*** (*Gnathonemus* sp., Mormyridae, elephant fish) hidden there. Angling is practised by men. Finally, night trapping is a way to catch a relatively large catfish, which is done by an adult male. Fish caught are predominantly destined to domestic consumption.

Crops

All Baka in Gribe are involved in shifting cultivation with a medium-term fallowing period of more than 10 years, mixed cropping and low labour input. The clearing scale is small, about 0.1 ha per household per year. Main food crops are plantain, banana, cassava, cocoyam, sweet potato, maize, yam, taro, okra and chili pepper. Peanuts and cowpeas are grown more occasionally, when seeds are

Cropping field with a high agrobiodiversity.

© Kyoto University/ Masaki Hirai

available. Cocoa, the sole cash crop, is sometimes produced in small plantations, accounting for only about 5 percent of the total cultivated area. A limited amount of plantain is occasionally sold on request. Apart from the fields, plantain, banana, cocoyam and papaya are also planted around the farming camp. Food crops are integrally destined to domestic consumption, yet some plantain bunches produced in excess might punctually be sold. The Baka also cultivate tobacco, but production rarely meets their own heavy consumption.

Thirty-three crops were recorded in total (Table 1.3). Of these, plantain, banana, cassava, cocoyam and okra are cultivated by almost all the households. Peanut is very popular as an oily condiment yet few households can procure seeds. Only a few fruit trees are planted around the settlement, whilst others, such as papaya, occur spontaneously. Crops with multiple varieties are plantain (28), banana (5), cassava (18), cocoyam (3), peanut (4) and maize (2).

With 28 and 18 varieties, respectively, plantain and cassava count notably more varieties than other crops. Five varieties of plantain and three of cassava predominate. All of these varieties are recognized as local and ancient. All varieties are kept stable for several reasons. The first reason is Baka's perspective that "there is no need to abandon the varieties left by parents." They do not intend to exclude existing varieties. The second reason is related to the cropping system. For establishing new plots, suckers of plantain and sticks of cassava are procured from existing plots. As a result, a similar variety composition is inherited in the new plots. The third reason is that the Baka look for particular characteristics of each variety. The originality of each variety stimulates the Baka, which brings joy in their cultivation. The fourth reason is that consumption of plantain and cassava should be shared amongst the whole community and that cultivars should circulate beyond the boundaries of individual ownership. Similarly to wild resources, sharing is also put forward as a principle for maintaining homogenous and collectively owned diversity in cultivars. Accordingly, taking crops from a field belonging to someone else is not assimilated to stealing, and only a few persons condemn it. The Baka assume that all of them equally cultivate all the varieties, even though that is unlikely to be true.

TABLE 1.3. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Baka name	Scientific name	English name	Edible part
Condiments, seasonings, snacks and sweeteners	***alamba***	*Capsicum* sp. L., Solanaceae	Chili pepper	Fruit
	gangulu	*Saccharum officinarum* L., Poaceae	Sugar cane	Stick
Fruits and juices	***keli***	*Ananas comosus* (L.) Merr., Bromeliaceae	Pineapple	Fruit
	kalasol	*Annona muricata* L., Annonaceae	Soursop	Fruit
	papay	*Carica papaya* L., Caricaceae	Papaya	Fruit
	pampulumus	*Citrus paradisi* Macfad., Rutaceae	Grapefruit	Fruit
	mandarin	*Citrus reticulata* Blanco, Rutaceae	Mandarin	Fruit
	fumbu	*Citrus sinensis* (L.) Osbeck, Rutaceae	Orange	Fruit
	kokotye	*Cocos nucifera* L., Arecaceae	Coconut	Fruit
	mangolo	*Mangifera indica* L., Anacardiaceae	Mango	Fruit
	tota	*Musa acuminata* Colla, Musaceae	Banana	Fruit
	fíyo	*Persea americana* Mill., Lauraceae	Avocado	Fruit
	goyav	*Psidium guajava* L., Myrtaceae	Guava	Fruit
	casamane	*Spondias dulcis* Soland. ex Forst. fil., Anacardiaceae	Golden apple	Fruit
	kakao	*Theobroma cacao* L., Malvaceae	Cacao	Fruit
Nuts and seeds	***ngɔ̀ndɔ***	*Cucumeropsis mannii* Naudin, Cucurbitaceae	Egusi melon	Seed
	sàkà mbílà	*Elaeis guineensis* Jacq., Arecaceae	Oil palm	Seed
Pulses	***wòndò***	*Arachis hypogaea* L., Fabaceae	Peanut	Seed
	ariko	*Vigna unguiculata* (L.) Walp, Fabaceae	Cowpea	Seed
Starches	***kpɔ́ɔ̀ngbò***	*Colocasia esculenta* (L.) Schott, Araceae	Taro	Tuber
	ndóndó à bà	*Dioscorea* sp. L., Dioscoreaceae	Yam	Tuber
	mebuta	*Ipomoea batatas* (L.) Lam, Convolvulaceae	Sweet potato	Tuber
	bómà	*Manihot esculenta* Crantz, Euphorbiaceae	Cassava	Tuber, leaf
	ndo	*Musa* sp. L., Musaceae	Plantain	Fruit
	lánga	*Xanthosoma sagittifolium* (L.) Schott, Araceae	Macabo cocoyam	Tuber, leaf
	mbómbò	*Zea mays* L., Poaceae	Maize	Seed
Stimulants	***ndako***	*Nicotiana tabacum* L., Solanaceae	Tabacco	Leaf
Vegetables	***membyolo***	*Abelmoschus esculentus* (L.) Moench, Malvaceae	Okra	Fruit, leaf
	folom	*Amaranthus* sp. L., Amaranthaceae	Amaranth	Leaf
	kelenkelen	*Corchorus olitorius* L., Malvaceae	Mulukhiya	Leaf
	melon	*Cucurbita maxima* Duchesne, Cucurbitaceae	Pumpkin	Fruit
	ndaka	*Solanum aethiopicum* L., Solanaceae	Jiló	Fruit
	tomato	*Solanum lycopersicum* L. Solanaceae	Tomato	Fruit

4. OTHER LAND-BASED PRODUCTIVE ACTIVITIES

The Baka are renowned for using an extensive range of nearly 500 wild or ruderal plant species for material and spiritual purposes, and which in many ways support the food system. This section evokes only the most commonly used ones.

Some plants and soil provide basic materials for house and hut building. For the ***móngulu*** (dome-shaped hut) that the Baka build for forest camping, ***lìngɔ̀mbɛ*** (*Hypselodelphys zenkeriana* (K.Schum.) Milne-Redh., vines of Marantaceae) are frequently used as a frame. The roof and walls are made from leaves of three species of Marantaceae. For houses built in the farming camp, hard trees growing in the surroundings are used as pillars and leaves of Raffia palm serve for roofing, whilst ***lìngɔ̀mbɛ*** and soil provide wall material. Furniture used by the Baka includes beds, chairs, mats and shelves for drying products and placing food vessels. Beds are mainly made of the petioles of Raffia palm. Specific tree bark is used for bed sheets. Chairs are made of hard and thin shade-tolerant trees. Mats are knitted with the epidermis of the stem of ***mbili*** (*Marantochloa congensis* (K.Schum.) J.Léonard & Mullend., Marantaceae) and of ***ngòngò*** (*Megaphrynium macrostachyum* (K.Schum.) Milne-Redh., Marantaceae).

As cooking utensils, mortars and pestles are made from hard woods such as ***bòyo*** (*Entandrophragma cylindricum* (Sprague) Sprague, Meliaceae, sapelli). The buttress roots of ***ngɔlu*** (*Terminalia superba* Engl. & Diels, Combretaceae) are used to make mortars to grind nuts and other solids. To grind, the spherical and hard fruit of ***bùkú*** (*Strychnos aculeata* Soler., Loganiaceae) is used as a pestle. Leaves of several Marantaceae plants are frequently used as containers for carrying honey and as cooking sheets (Hattori, 2006). Rough leaves of ***sòmbɛm*** (*Grewia* sp. L., Malvaceae) serve for washing food vessels. Carriers are made from the hard bark of vines of ***kpongo*** (*Eremospatha haullevilleana* Mann & H.Wendl., Arecaceae), ***kàò*** (*Laccosperma secundiflorum* (P.Beauv.) Kuntze, Arecaceae) and ***kiyɔ*** (*Cleistopholis patens* (Benth.) Engl. & Diels, Annonaceae). In particular, several types of baskets and frame packs are woven to carry bushmeat and plants gathered by women. Vines such as ***kusa*** (*Manniophyton fulvum* Müll. Arg., Euphorbiaceae), ***kpongo*** (*Eremospatha haullevilleana* Mann & H.Wendl., Arecaceae), and ***púlu*** (*Adenia tricostata* Wilde., Passifloraceae) are used as rope.

Various plants are sources of cosmetics and accessories. ***Lὲsà*** (*Bixa orellana* L., Bixaceae), ***ligɔ̀mbɛ*** (*Ficus* sp. L., Moraceae), ***mboloa*** (*Diospyros canaliculata* De Wild., Ebenaceae), ***nalé*** (unknown), ***ɓɔ̀njìngà*** (unknown) and ***ngɛlɛ*** (*Pterocarpus soyauxii* Hooker, Fabaceae) are applied as red or black make-up. Leaves of ***musébé*** (*Pleiocarpa bicarpellata* Stapf., Apocynaceae) are put on the waist as an accessory. Knowledge regarding daily use of medicinal plants is broadly shared amongst many people. However, remedies for specific diseases, especially those related to witchcraft or originating from spiritual forces, are exclusively carried out by expert healers. Their expertise of these renowned ***ngàngà*** is voiced far beyond the village surroundings: they regularly receive visits from urban patients, or perhaps travel to the country head city of Yaoundé to cure rich urban citizens or politicians.

5. EXCHANGE AND TRADE

The Baka source some of their food through exchanges with their neighbours, or in local shops and a weekly market that was created in 2017. The shops are owned by a few local Bantu households, and mostly by merchants coming from the nearest Yokadouma city or farther away. Most of the food found in local shops is processed, whilst stalls in the weekly market mainly provide food from the forest and fields. Most frequently purchased foods are rice, spaghetti, cassava flour, maize, sardines in cans, dry fish, frozen fish, salt, chemical seasonings, refined oil, peanuts, alcoholic drinks, juice, sugar and candy. Purchasing frequency is high only for seasonings and alcoholic drinks. Salt and stock cubes are a regular feature of the diet. Whiskey in a sachet, at a price of XAF

100 per sachet,[1] is purchased almost every day. Nevertheless, the quantity of food bought in shops remains much lower than what they produce in their swiddens or gather in the forest. The Baka exchange their forest products and labour with the Bantu throughout the year for food, daily commodities and cash (Table 1.4) (Kitanishi, 2006). The most common example of barter between the Baka and the Bantu is kernels of ***péke*** (*Irvingia gabonensis*) in exchange for cassava flour. Payment from the Bantu for the kernels is equivalent to XAF 500[2] per 1.5 kg of dried kernel. In addition to food and labour exchanges, the Baka craft furniture and carriers and exchange them upon request with food or other items. Food sharing is common and is a natural norm amongst the Baka. If a certain household obtained food that cannot be eaten all at once, they do not store it and instead share it with others for immediate consumption.

[1] Equivalent to USD 0.18. Applying the UN Operational Rate of Exchange of 1 August 2018 (1 USD = 560.455 XAF). This rate will apply throughout the entire chapter.

[2] Equivalent to USD 0.9.

6. LOCAL CALENDAR

The Baka in Gribe classify a year into four seasons based on various changes in the environment and the occurrence of phenological events determining the availability of key resources and the related tasks and division of labour (Figure 1.2). Socio-economic circumstances occurring at the village like exchange opportunities or wage labour for the neighbours are also driving forces influencing the local calendar of activities.

The onset of the major dry season is recognized by reduction of rainfall, hardening of the soil, falling of leaves of semi-deciduous species as well as the appearance of ***mòsɛlɛ̀*** or ***mòsɛlɛ̀lɛ̀*** (a specific mushroom), ***njùmbu*** (bird), and butterflies. One of the most important activities is land clearance for cropping. At the beginning of the season, people start cutting trees to make plots and drying them to burn. Food resources are scarcer at this time of year, and hard ground makes it more difficult to set up traps, thus

TABLE 1.4. Goods, place, rate and period of exchange between Baka and Bantu

From Baka to Bantu	Place	From Bantu to Baka	Rate	Period
Kernels of *Irvingia gabonensis*	Forest	• Cassava flour • Plantain • Alcoholic drink • Daily commodities such as salt, seasoning, radio, lamp, clothes, etc. • Medicine	Food or daily commodity equivalent to XAF 500-700/1.5kg of dried nut	Minor dry season
Other NTFPs	Forest	• Crops, daily commodities	Depending on the NTFP species	Through the year
	Village	• Money		
Blue duiker	Forest	• Crops, daily commodities, wire cable	Equivalent to 500-1 000 XAF/half body	Through the year
	Village	• Money		
Red duikers	Forest	• Crops, daily commodities, wire cable	Equivalent to 1 000-1 500 XAF/half body	Through the year
	Village	• Money		
Honey	Village	• Money	200 XAF/pack (amount unknown)	Minor dry season
Labour for farming, transportation of crops, firewood collection, etc.	Village	• Money, crops, daily commodities	Equivalent to 250 XAF/ 20 kg of baggage or 2-3 hours of work	Through the year

Equivalent to: USD 0.9-1.25 (XAF 500-700); USD 0.9-1.8 (XAF 500-1 000); USD 1.8-2.67 (XAF 1 000-1 500); USD 0.35 (XAF 200); USD 0.44 (XAF 250).

lowering bushmeat catches. However, the availability of annual wild yams such as ***sapà*** (*Dioscorea praehensilis*) and ***ʔèsùmà*** (*Dioscorea semperflorens*) is highest and dam fishing becomes easier to implement due to lower water levels in the rivers. During ***mòlɔ̀ngɔ̀*** (past long-term expedition), which were regularly conducted until the 1980s, the Baka depended greatly on annual wild yams and fish. Nowadays, fishing camps do not last longer than one month during this period. Subsequently, incomes increase from wage labour with the Bantu who hire Baka for land clearance.

The onset of the minor rainy season is marked by a gradual increase in rainfall and leaf flushing. In agriculture, this season corresponds to the time of planting suckers of plantain, banana, cocoyam, sweet potato, domesticated yams and sticks of cassava. They also seed egusi melon, maize, okra and peanut. Taking advantage of the low water levels in rivers, the Baka establish medium-term forest camps for fishing. Trapping and gathering *Aframomum* spp. with high cash value are also conducted at this time. During this season, which is marked by synchronic tree blooming, honey is also more abundant.

The minor dry season is the period of mast flowering and fruiting of specific trees such as African padauk ***ngɛlɛ*** (*Pterocarpus soyauxii* Hooker, Fabaceae) and ***bɔ̀sɔ*** (*Petersianthus macrocarpus* P.Beauv. Liben, Lecythidaceae). Contrary to the major dry season, food becomes abundant. Despite the need to perform agricultural tasks, including weeding, re-dissemination, transplantation and harvesting groundnuts, most Baka prefer to move to the forest and dedicate this season to hunting, fishing and gathering of wild edibles. The kernels of ***pékɛ*** (*Irvingia gabonensis*) are the major targets of their gathering efforts.

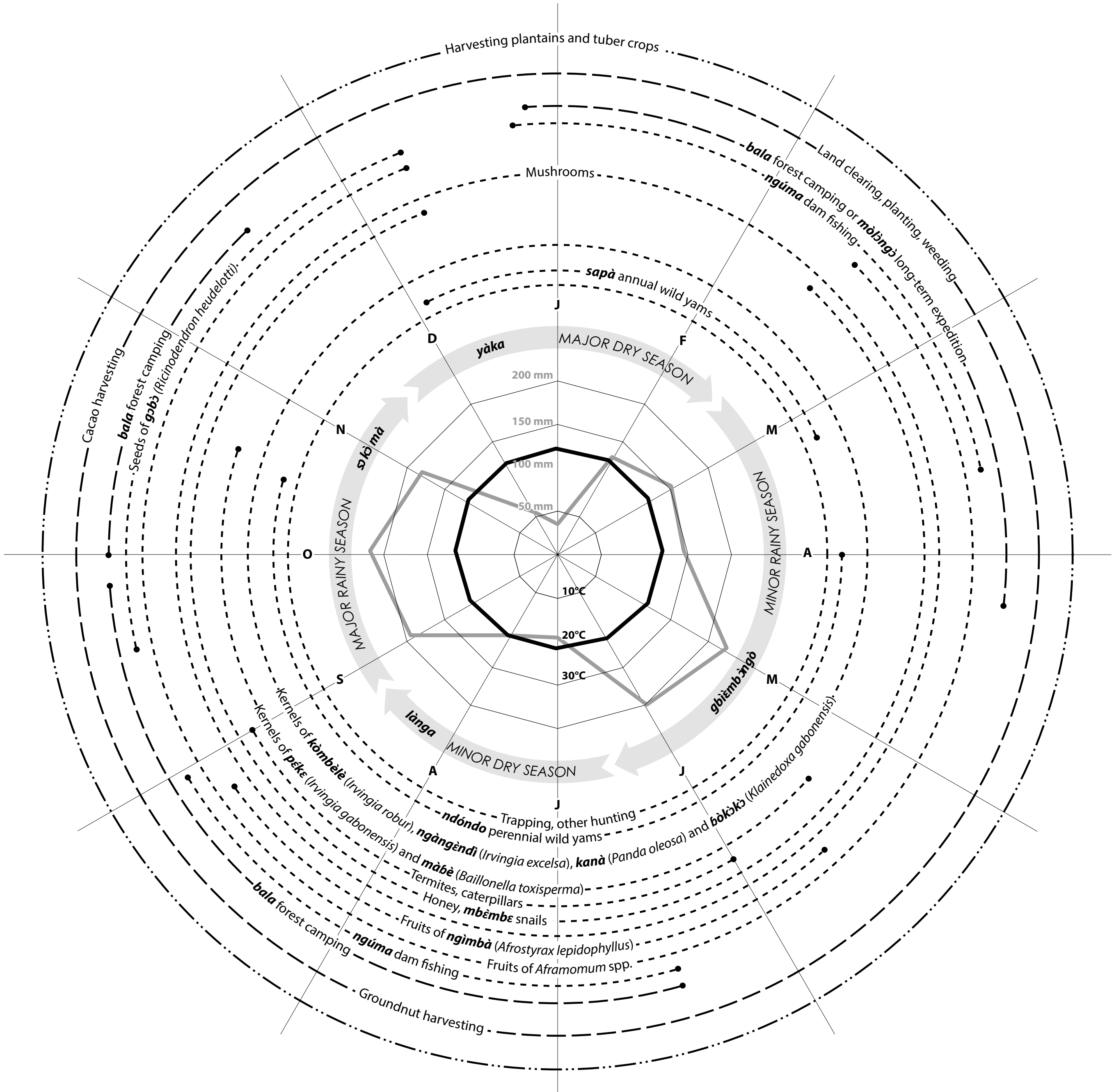
A ***lùngu*** (strong wind), heavy rainfall, flooding and the occurrence of many tree seedlings, as well as rotten fruits, being washed away from the forest floor by the rain and river water are signs of the onset of the major rainy season. After October, women engage in weeding, transplanting plantain shoots and reseeding egusi melon. Time for harvesting cacao beans comes to those who have mature cacao plantations. Villagers rebuild their houses and consolidate lateritic walls that are softened by repeated rain. Baka trappers become very active now that wildlife is constantly moving in the forest understory. *Aframomum* spp. are still plentiful and some collectors extend their stay in the forest camp to collect *Irvingia* kernels, at the expense of the maintenance of their swiddens. Those who have decided to stay in the village start exploring the agroforest zone to collect *Ricinodendron* fruits and barter them with the Bantu.

7. COMMUNITY HISTORY

Gribe was founded in the 1890s when the six major clans of Konabembe moved to the area from different parts of the East region of Cameroon. Nearly half of the Baka of Gribe aged 50 and above state that their ancestors already lived in the area of Gribe before its foundation, whilst ancestors of the other half moved to Gribe from Messok – located about 150 km west of Gribe – and Mikel – located 35 km east – during the 1930s and 1940s. Subsequently, many Baka were living along the Kwokwo River (Figure 1.1 right).

In 1954, an elementary school and church were constructed in Gribe, probably under the incentive of the French colonial Government (Kitanishi, 2003). Following the independency of Cameroon in 1960, timber logging suddenly expanded. In 1978, the national road connected Yaoundé and Yokadouma, attracting a flow of wage labourers from the western part of the Boumba-Ngoko department, including some villages around Gribe, to the eastern part of the department for logging. In the early 1980s, merchants from Yokadouma city started to visit Gribe by foot in search of cacao beans, ivory and seeds of ***nèà*** (*Strophanthus gratus* (Wall. & Hook.) Baill., Apocynaceae), which produce strophantin, an alkaloid with cardiotonic properties that has been coveted by chemistry. In times of molecular synthesis by the chemical industry, the market for *Strophantus* seeds has now vanished, but the Baka persist

FIGURE 1.2. Average annual rainfall (mm) and temperature (°C) in South-eastern Cameroon, and seasonal activities by the Baka of Gribe village (elaborated by Yanto Wahyantono, IRD, 2020)



Key:

- Activities related to cultivation
- Activities related to wild food (gathering, fishing, hunting)
- Other activities related to livelihood

in harvesting them as a key ingredient of poison for ***mbànɔ*** (crossbow arrows). Regular merchants started retailing daily commodities, including salt, sugar and soap. Around 1985, the Baka of Dimgba and their ancestors engaged in small-scale farming. At the same time, the practice of long-term foraging began to drop.

From 1997 to 2001, three timber logging companies started full-scale activities around Gribe. The road from Yokadouma city to Gribe was opened in 1997 to support these activities. In 1998, a ferry was installed to cross the Boumba River half-way between Yokadouma and Gribe. In 2001, the road was further extended beyond Gribe and ultimately reconnected with the road of the neighbouring Haut-Nyong department. These communication improvements abruptly eased the access to the district, increasing the flow of all sorts of outsiders, such as logging company workers, itinerant merchants and speculators. At the same time, the Baka started establishing semi-residential settlements in the near vicinity of Gribe.

In the late 1990s, the Government put the zoning policy into effect for all lands in the East region. In 2005, Boumba-Bek National Park was founded 16 km southwest from Gribe. A hunting zone, for licenced hunting, and a community-based management hunting zone, for licenced hunting managed by the semi-public organizations called "Comités de Valorisation des Ressources Fauniques" (COVAREF), have additionally defined the range between the agroforest zone and logging zone.

Merchant visiting Gribe village.

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SECTION 2 SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM

1. PROVISION OF LIVELIHOODS, EQUITY AND SOCIAL WELL-BEING

Adequacy of income opportunities

Major sources of cash income come from (1) sales to merchants of NTFPs, crafts and, for a few households, cacao beans, and (2) daily wage labour for the Bantu to clear swiddens, transport harvested crops and maintain cacao plantations. Some men may occasionally be employed by logging companies or safari organisers, but opportunities are limited and cause social tension locally. The cash obtained serves to buy kitchen utensils, clothing, machetes, flashlights and batteries, wire cable for snares, lamps and petrol, alcoholic drinks, tobacco, food items (primarily salt, sugar and oil), manufactured medicine, and school furniture. Occasionally money may be shared with other community members in need of cash.

As primary producers, the Baka poorly participate in and benefit from the value chains of the forest products. Most NTFPs collected by the Baka are exchanged with the Bantu. The Bantu then sell these products to local shop vendors who will resell them to regional vendors. Only cacao and a few wild edibles like *Irvingia* kernels, *Aframomum* pods and *Ricinodendron* nuts will enter national and international markets. Although transformed *Irvingia* kernels, into condiment paste, and *Baillonella* seeds, into oil, may generate more income, most products are basically sold either fresh or dried.

The Baka unanimously feel that they get unfair prices for NTFPs in their exchanges with their neighbours or with outsiders. They are poorly skilled in negotiating directly with merchants and the prices they are offered are significantly lower compared to those obtained by the Bantu. It takes about three hours for the Baka to collect and process kernels of ***péke*** (*Irvingia gabonensis*), for which the Bantu will pay approximately XAF 500[3] per kg. When the Bantu sells them to merchants, they obtain a price ranging between roughly XAF 1 000 to XAF 2 000,[4] making their margin roughly from XAF 500 to XAF 1 500[5] with a considerably lower investment of labour compared to the Baka, who are the primary producers. These margins are lower at the beginning and peak of the fruiting season, from July to September. They reach three times the Baka's benefits when the season comes to an end in October. In the minor dry season, many Bantu visit the Baka's forest camps to exchange kernels for food supplies, alcoholic drinks, and daily commodities such as clothes, radio, music player, flashlight, battery, tobacco and so on. Although they rarely feel like this exchange is equitable, many Baka succumb to the attractiveness of these goods. Merchants from the cities sometimes offer higher prices than the local merchants but they are often discouraged by poor road conditions that globally affect connectivity to market. Furthermore, the Baka fail to coordinate any form of collective action that would leverage their access to the market economy, although they fully admit the advantage they would gain in structuring their efforts. Such incapacity is chronic amongst egalitarian hunter-gatherer societies, which hinders any leadership initiative needed to change the associative dynamics. This intrinsic obstacle makes it difficult for the Baka to organise as an association for marketing. Collective or group sales are seldom or never done amongst the Baka, although they are aware of the potential contribution that it could have for raising the prices they obtain.

When asked about income sourced from agriculture and from the wild, opinion amongst the Baka are mitigated. Whereas it is difficult to purchase all they hope, the Baka consider that their earnings are sufficient to ensure their food supply, but far from enough to cover school and medical expenses.

Adequacy of diets

For the Baka in Gribe, a ***pani a djô*** (typical meal) is a combination of a staple and ***mòsùkà*** (a sauce). The staples are plantain, cassava, cocoyam, sweet potato, maize and wild yams, whilst rice and spaghetti may be purchased occasionally. The sauce is usually composed of bushmeat, fish, caterpillars, snails, termites, a leafy vegetable or mushrooms, which may be mixed. Depending on availability, the sauce may include oil or a fatty condiment and be seasoned with salt, chemical seasoning, chili pepper, tomato paste, and the bark and fruit of ***ngìmbà*** (*Afrostyrax lepidophyllus*) tree, which has a garlic flavour and is renowned for its deworming properties.

In consuming two to three such meals per day, the Baka tend to maintain a diversified diet. Starches are typically eaten several times a day. Meat or fish are eaten several days per week and nearly every day during the minor dry season. Leafy vegetables and other vegetal foods are eaten several times per week. Fruits and nuts are eaten several times per week, whilst wild eggs from reptiles and birds, insects, pulses, and honey are consumed at reasonably high frequency during the minor dry season, yet more rarely in other seasons. A few Vitamin-A-rich fruits such as mango, guava and papaya are occasionally found in home gardens, and chili pepper is moderately consumed. Milk is totally absent from the Baka diet.

Food scarcity occurs occasionally. Around 40 percent of the male participants felt that food supply was not totally adequate over the past year. Both men and women recounted not having enough food in the household and having felt hungry. All reported having gone to sleep without eating at least once. Apart from general hunger caused by lack of ***pòte*** (food), the Baka also express by the word ***pɛnɛ*** a form of acute hunger felt when the consumption of bushmeat

[3] Equivalent to USD 0.9.

[4] Equivalent to USD 1.8 to 3.5.

[5] Equivalent to USD 0.9-2.7.

is insufficient. These forms of hunger both occur primarily in the major dry season, when encounters with mammals are rare and hunting conditions are less favourable. In this season, the availability of many major wild edibles and crops also declines (Table 1.2).

The Baka evoke a few ways to cope with food insecurity. One of these is "sleeping without eating." When food is temporarily scarce, the Baka may accept the situation with philosophy and will not let the obsession of finding food take over control of their actions. This apparent passivity is backed by the Baka's trust in the forest: "food is always available somewhere". "Sleeping without eating" is strongly associated with a conviction that they belong to the forest. It mitigates the stress originated from punctual hunger, and the feeling of insecurity is compensanted by the acceptance that "we sleep hungry tonight but we will eat tomorrow". Going to bed with an empty stomach occurs more frequently during the minor dry season, when they eat animal skins and intestines discarded around camp to get through that time.

Frequent movement between the forest and the village and the flexibility to shift between foraging and farming activities also greatly sustain Baka's food security. Throughout the year, the Baka undertake food generation and production activities both in the village and the forest (Figure 1.2). During the minor dry season, which is dedicated to gathering *Irvingia* kernels in forest camps, regular trips are carried out back to the village for groundnut harvests. Kernel production from *Irvingia* species fluctuates strongly from year to year. In years of poor production, the majority of the Baka will remain in the village and more will engage in farming and wage labour by weeding the cacao plantations of the Bantu, whilst the few who entered the forest will focus on hunting and gathering *Aframomum* fruits. During the major rainy season, some will continue these activities in the forest, whilst others will opt to stay in the village and participate in cacao harvests for their neighbours. From the major dry season to the minor rainy season, the majority of the Baka of Gribe are engaged in slashing and burning new swiddens for the Bantu or for their own use, whereas others will prefer long stays in the forest for fishing, hunting and gathering. Although the major dry season is known to offer less diversity in food resources, the availability of annual wild yams and non-seasonal fruits is worth enough for a stay in the forest. Fish is an abundant resource during this major dry season and intervenes as a valuable safety net (Dounias and Oishi, 2016), although bushmeat remains the preferred food.

Storing, which is a common way to secure access to food, is not meaningful amongst hunter-gatherers as it would drastically impede their mobility. In immediate-return societies, which are known to process and consume food immediately after procurement, sharing becomes fundamental and is an efficient response to food insecurity. The Baka praise sharing as a prominent feature of their cultural identity, be it for food or non-food resources. When it comes to food, sharing occurs twice: a first round of sharing occurs for the food items before being processed, and a second round intervenes once the food is cooked and ready for consumption. Sharing is in full coherence with the egalitarian political system of the Baka, in which no distinction should be tolerated between those who have and those who have not.

Exchanges with the Bantu and NTFPs sales contribute to moderating food shortage. In case of low food procurement from the wild or from farming activities, income-generating activities provide access to foods sold by merchants and small shop retailers, and afford punctual opportunity to enjoy the exotic taste of rice, noodles and manufactured snacks. Baka women lament, however, that the entirety of the money they earn is spent on food and basic necessities, leaving them with no possibility to buy less necessary little extras.

The Baka may occasionally borrow money from their neighbours but contracting such a loan has its drawback. Obligation to work for the Bantu to reimburse the loan may in turn restrict the indebted Baka from entering the forest or cultivating his own swidden, and consequently contribute to experiences of food insecurity.

Confined access to the forest is a factor seriously compromising the food security of the Baka of Gribe. Restrictions to penetrate the logging zone, the national parks and the portions of forest conceded to sport-hunting entrepreneurs generates tensions as they drastically reduce access to the forest resources, which are of prior importance, especially during the major dry season (Sayer *et al.,* 2017).

Changes in the provision of livelihoods and social well-being over time

Diets and incomes of the Baka have changed over the past three decades. The Baka have increased their consumption of crops, whilst reliance on forest foods has declined due to reduced access to the forest and an abrupt increase in market demand for forest products that drives the Baka to sell rather than keep them for their own consumption.

Amongst the various forest foods, wild yams providing annual tubers such as ***sapà*** (*Dioscorea praehensilis*) and ***ʔèsùmà*** (*Dioscoera semperflorens*) used to constitute the major source of staples during the major dry season. Nowadays, reduced access to the distant forest hinders long-term expeditions and consequently lowered the contribution of wild yam tubers to the diet. With declining access to the forest, the Baka increasingly rely on labour exchange with the Bantu to obtain food in the major dry season. The highly nutritious edible caterpillars of ***bòyo*** (*Imbrasia* species), one of the Baka's favourites, have also become rare, a consequence of the over-logging of the host tree *Entandrophragma cylindricum* (Sprague) Sprague, Meliaceae (also called ***bòyo***).

The need for cash income in the community has increased considerably, along with the facilitated arrival of merchants as the result of improved road infrastructures in the late 1990s. Since the road and ferry to cross Boumba River were opened in 1997 and 1998, merchants began selling a variety of daily commodities and foods. The rise of the cacao market in the early 2000s drastically increased the cash income of the Bantu in Gribe, which permitted them to purchase new items such as bikes and new homes. Influenced by this new longing for introduced commodities, the Baka started increasing their cash incomes through intensified wage labour with the Bantu and sales of NTFPs.

Although reliance on the forest decreased in favour of agriculture and purchased food, the Baka do not consider that their self-sufficiency has been affected that much, arguing that their reliance on the market economy remains minimal. Nevertheless, the prominence of starches in their diet and declining consumption of forest foods reveals their increased investment in farming at the expense of forest explorations. This shift in their diet may be a factor contributing to trends. The Baka estimate that they are more likely than in the past to fall sick and blame their change in diet, evoking for instance their increased consumption of manufactured snacks, rich in additives like monosodium glutamate.

2. RESOURCE USE EFFICIENCY

Land and soil

In general, the soil quality is considered good, although there is some heterogeneity. The Baka recognize two main types of soil in their landscape: sandy soils known as ***muséké***, and red soils known as ***ngàò***. In practice, the Baka recognize soil quality based on observation of crop growth. Although rare, gray soils are considered better for cultivation. Soils are judged better in forests called ***manjà***, characterized by low presence of bushes or thicket in the understory, like in very old fallows or mature forests. Places where the tree species ***gbado*** (*Triplochiton scleroxylon*) grows are considered good for cultivating, since this species prefer fertile, well-drained ferruginous soils. By contrast, the Baka avoid farming in areas with the tree species ***mὲndì*** (*Sclerocroton cornutus* (Pax) Kruijt & Roebers, Euphorbiaceae) because its toxic litter inhibits the growth of other plants, including crops. When signs of crop withering

Pέkε (*Irvingia gabonensis*) kernels collected by the Baka for use as a condiment and for sale.

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are observed in the first year after planting, the Baka will abandon the swidden and seek another place.

As a principle for shifting cultivation, an ecosystem's sustained fertility requires short-term cropping alternating with long-term forest fallow. Cassava, peanut, okra and plantain, for instance, are mixed cropped. In the first year, peanut, okra and cassava are harvested, and in the second and third year, plantain and banana are harvested. After the third year, the field is set aside to allow fertility restoration by post-agricultural forest regrowth.

Labour and fuel energy

The food system of the Baka of Gribe is exclusively based on locally sourced renewable energy, mainly firewood and human labour. Firewood is used for cooking, processing and heating, and its availability is sufficient. In their semi-residential settlements, the Baka gather logs driven from clearing fields for crops, whereas in the forest, branches are collected from the forest floor.

Farming is the most demanding activity in human labour. Yet, the Baka invest much less labour input into farming than their Bantu neighbours. The plots are left nearly derelict when they leave their residential settlements to join their seasonal forest camps. A male participant explained that "plantain bunches are mature when returning from the forest," showing how the Baka approach agriculture in a similar fashion to wild edible gathering; they prefer to feed on ripened fruits rather than invest too much time and effort in increasing and stabilizing crop yields. The Baka follow an approach of "less managed is management" in their agriculture, wherein the yield per area – land productivity – is generally low, but the yield per labour – labour productivity – becomes high. This low management agriculture with minimal weeding allows the concomitant growth of numerous spontaneous wild edible plants such as *Gnetum*, wild yams, oil palm trees, *Aframomum* shoots and mushrooms, which purposely contribute to diet and income. For their cacao production, the Baka selectively decide whether to carry out maintenance according to the market and the amount of labour available at the time. Regardless of maintenance, cacao seedlings usually do not die. ***Biya biya*** or ***soya*** (mutual aid), a common seasonal practice to mitigate drudgery amongst the Bantu cacao growers, is less frequent amongst the Baka, who only have a few cacao growers and possess much smaller plantations.

Some fuel and batteries are used for lighting, such as kerosene lamps and flashlights. Locally sourced resins extracted from ***pàkà*** (*Guibourtia demeusei* L., Fabaceae), ***sɛnɛ*** (*Canarium schweinfurthii* Engl., Burseraceae), ***mòndùmbà*** (*Copaifera mildbraedii* Harms, Caesalpiniaceae) and ***ngámbè*** (*Pentadesma butyracea* Sabine, Clusiaceae) are also burned as a light source. ***Paka na bàle*** (old and hard bee wax) is also valued for the same purpose. The Baka occasionally use motorbikes owned by the Bantu as a means to visit distant relatives. Such punctual and minimal use of non-renewable and external energy sources is seldom linked to food-system-related activities.

Water

Water is plentifully available at any time of the year. Drinking water is sourced from the many rivers in the area that are always found within a few hundred metres of the Baka's use areas. Clear water is also available from some springs. River water and rainwater are used for washing clothes and dishes, which, along with cooking, are the greatest water demands. Swidden fields, plantations and home gardens are totally rainfed. Women and young girls are responsible for water collection, which requires approximately one hour per trip, two to three times per day. No specific practices of water capture and storage are used. In order to maintain clean ponds, Baka women regularly remove accumulated vegetal debris. Standing in the water source is considered bad manner.

Waste

The main waste products are residues of crop and forest products and plastic packages. Organic wastes are abandoned around the camp. Amongst the wastes, animal hides are sometimes used for making drums or vine-framed backpacks. Non-biodegradable wastes include spaghetti packages, plastic whiskey sachets, empty cans, polyethylene terephthalate (PET) bottles, and batteries. Most of these are burned or abandoned, whereas some are reused and repurposed into tools, which reduces drudgery and time investments. For instance, empty sardine cans are transformed into graters for grinding hard cakes made from *Irvingia* kernels. Sardine cans are also used to make toy cars for children. Occasionally, vinyl sachets are used to produce small baskets by weaving different colours together with plant material. Plastic whiskey sachets and rubber slippers are sometimes used as material for ignition when newly lighting a bonfire. Polyethylene terephthalate bottles from juices are reused as water flasks and bottles for decoction. Overall, the generation of non-biodegradable waste in the food system has increased as the market has brought in many products with metal and plastic packaging.

Changes in resource use efficiency over time

The tools used by the Baka for daily life have not changed greatly over time. Nonetheless, the introduction of some new tools has contributed to changes in fuel and labour inputs into food-system-related activities. Introduction of battery-powered flashlights and kerosene lamps have increased the dependency on external fuel energy. Although the Baka rarely use vehicles, increasing trade with visiting merchants is indirectly associated with a greater use of fossil fuels. The adoption in the 1970s of wire cables for trapping, which replaced vegetal ropes, has made animal capture much more efficient. Yet, in contrast with professional hunters and poachers, the Baka have taken advantage of this novelty to reduce time and effort in trapping without modifying the average number of traps that they usually set. Nonetheless, hunting efficiency – labour or time per catch – has decreased compared to before because the animal populations are negatively impacted by the proliferation throughout the region of non-Baka trappers and firearm hunters, to satisfy the booming bushmeat demand in cities.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

Protecting and conserving the forest are notions that are not conceptualized as such by the Baka and thus are not translated into measurable control and regulation practices. Declines in resource availability and difficulty procuring food are recognized as "a state in which the forest is closed by a forest spirit called ***jengi***". Nevertheless, Baka's resource use embeds a corpus of social and cultural mechanisms contributing indirectly to forest conservation and to the enhancement of natural resource availability and livelihood quality.

Food taboos are a good illustration of existing socio-cultural regulations. Many foods should not be eaten, depending on individual, gender, social status and clan affiliation. For instance, whilst processing extraction of oil from ***màɓè*** seeds, women avoid eating any bushmeat. When conducting dam fishing, women will not eat red river hog, monkey or honey, as a means to prevent misfortune in catching large fish. When the forest spirit called ***kòse*** gets angry, men will interrupt hunting and share with the spirit tubers of ***ba*** (*Dioscorea mangenotiana*, wild yam), along with honey and cooked cassava flour, to calm it down. Having dozens of food prohibitions of this type is not meant primarily to sustain conservation goals. Rather, what is at stake is to gather food resources successfully and to ensure a healthy livelihood. This requires maintaining a balanced relationship with the supra-natural forces, which are the custodians of natural resources. Moderation dictates the humble attitude of the Baka *vis-à-vis* forest resources. Food proscriptions participate in this moderation and, incidentally, contribute to mitigating excessive exploitation of resources.

Between different residential groups tied by limited kinship, not entering an area already occupied by another group is somewhat implicit. Trails and ranges for gathering food resources tend to be formally differentiated.

When the ranges used by different groups overlap, slight litigations may arise, particularly in the logging zone where the Baka collect forest resources more intensively. Although kinship is so conceived that it provides a broad range of shared exploitable forest between and within residential groups, access is not totally open and can become an acute concern. In the wake of extended familial and matrimonial ties, it is usual practice amongst the Baka to join other groups that occupy areas with higher resource availability. Gently differentiated access to the forest can defuse tensions and competition over resources, whilst preserving margins for permissiveness and tolerance in accessing resources and ensuring good citizenship between residential groups.

Interaction with forest resources

Forest uses by the Baka do not hinder natural regeneration dynamics and may even contribute to an increase in the availability of useful plants. Many wild yam tubers, fruits and nuts are collected over a wide range of the forest patches and brought to the campsites where some are cast out in a specific place to deposit as waste. Such circulation of plant material driven by the Baka's seasonal mobility has likely contributed to regeneration of useful plants and expansion of their dispersal range. Small-scale disturbance of vegetation through honey gathering and forest camp building likewise facilitates regeneration and dispersal of light-demanding useful plants and incidentally creates favourable niches for wildlife. The non-random distribution of these plants along regularly used forest trails and in old residential settlements suggests that over generations, the Baka have extensively co-influenced, along with natural ecosystem engineers, the mosaic assemblage of forest patches.

Changes in resource availability over time

In the 1990s, along with the opening of the road, the Baka started full-scaled agriculture. At that time, the crops that they adopted had already been cultivated by the Bantu of Gribe for a long time. Since then, the Baka have introduced additional varieties on their own: five for plantain, as well as five for cassava. In addition, two plantain varieties and three cassava varieties were brought around the year 2000 by a local non-governmental organization (NGO).

Since the 1990s, bushmeat hunting has intensified. With the opening of the logging road, many merchants have come to visit the village in search of forest products. Demand from urban dwellers is high and supply is not sustainable. Merchants began selling more robust wire cables and guns to the Bantu to hunt more animals. The Bantu deliver those tools to the Baka and ask for intensive hunting in exchange for money, food and daily commodities. Animal populations seem to have declined in the early 2000s. This concern, known as the bushmeat crisis, has led to the empty forest syndrome. Nevertheless, many Baka state that "animals are not decreasing, rather, deep in the forest, there are still many". For those who believe in this statement, animals temporarily move away to distant areas in response to increased trapping, but they eventually return. It is well confirmed by many Baka that the number of catches is high during the first week of trapping and decreases subsequently. Therefore, as soon as the Baka perceive a decrease in game captures, they tend to remove their traps. By restraining their trapping activities, the Baka may facilitate the populations of some mammal species, for instance the mostly preyed blue duiker, to recover.

The intensity of NTFP gathering of *Irvingia* kernels and *Aframomum* fruits with cash value has clearly increased in response to exploding demand. However, in contrast to animal population dynamics, regeneration of NTFPs is facilitated or even expanded by human activities, and may not be negatively impacted by increasing demand.

Since the 1990s, the Baka recognized that ***bier a toto*** (new fields) and ***wùndɔ*** (young fallow) areas increased in the agroforest zone, whilst ***bele*** (mature forest) regressed at the same time. Fields in production cover less than 3 percent of the total area of the agroforest zone and, during forest clearing to create a new swidden field, 30 percent of the trees are maintained uncut. With the extension of swiddening, the agroforest zone is constantly enriched in NTFPs, especially

Gnetum and *Piper* vines, *Aframomum* shrubs, and *Ricinodendron* trees. Long fallowing rotations and a scattered distribution of swiddens within the agroforest zone contribute to create forest micro-patches at different stages of regeneration. This forest mosaic is favourable to many small mammals, which tolerate proximity with humans, such as rodents, blue duikers and Bates dwarf antelopes. They remain abundant in the zone and constitute a reliable source of meat. Although the Baka do not have explicit conservation practices, their poorly intrusive agricultural system participates in maintaining a rich biological diversity within the agroforest zone.

By contrast, in the logging zone, the Baka deplore the decline of resources obtained from logged trees, like the oil obtained from ***màɓè*** (*Baillonella toxisperma*) seeds or the popular ***bòyo*** (*Imbrasia oyemensis*, caterpillar) that feeds exclusively on *Entandrophragma cylindricum* leaves. Many sites suitable for establishing forest camps have been destroyed. It has generated serious litigation amongst various residential groups of Baka, which have lost their home range.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of forest resources

The Baka and Bantu in Gribe have no structured endogenous institution related to forest management, nor do they have explicit rules aimed at restricting access to and use of their resources. Their extensive exploitation of forest resources has shaped a loose "local commons" principle characterized by mutual resource property and social interactions, leading to a consensual management. Through establishing fields, anyone can use a vacant place. Once occupied by someone, the land may be perceived as owned by that person, but in reality, property is not defined by a specific ownership system and erodes with time, after being retroceded to clan and lineage broader levels, especially if effective use of the land is dropped. This trend is more applicable for the forest camps. The preferable campsite for the Baka is a flat place located near a relatively large river where many useful plants grow. Such places are not that numerous in the landscape. Therefore, once such a spot is found, they claim their occupancy by planting some items such as oil palm. In the absence of the owner, anyone may temporarily occupy the site. Nevertheless, this tolerance is fading, especially with Baka from another village. For example, when one of the participants went trapping in a village located 50 km south of Gribe, he was threatened by a local Baka, "I will notify the ranger that there are poachers." The "local commons" principle seems increasingly fragile and loses its ability to prevent resource depletion in a context of increased market economy and zonation of forest accessibility by local people.

As many red-listed animal species inhabit the forest surrounding Gribe, several forest management and livelihood improvement projects have been conducted since the 1990s. Most of these projects were implemented top-down, even though some adopted a community-based approach. Alternate activities to hunting were promoted as a means to reduce the threats on the most endangered species. There were improved agriculture, livestock raising, NTFPs promotion and so on, as well as the creation of community institutions. They were aiming to foster a sustainable use of fauna through licensed hunting – managed by COVAREF – and legalized logging – managed by "Forêt Communautaire" – with profits to be shared with the villagers. In many cases, the proposed initiatives do not meet people's aspirations and are eventually poorly accepted, notably by the Baka, who are chronically marginalized and not included in any decision-making processes.

Changes in governance of forest resources over time

Forest governance in Cameroon has experienced tremendous changes since the 1990s. In 1989, the Government decided to stimulate timber exports with the support of the World Bank, in an attempt to recover from the economic crisis of the 1980s. In 1994, the CFA Franc (XAF) currency was devaluated by half, benefiting foreign logging companies, which intensified timber exports. Induced acceleration of deforestation led major international NGOs for nature conservation to intervene in the East region, including the area around Gribe. In 1994, prohibitions and regulations regarding hunting activities entered the Forest Code (Law n° 94-01 of 20 January 1994), with specific statements on protected species, bushmeat trade, hunting seasons and equipment, and so on. In 1998, the Jengi Project was launched by the Government in collaboration with international NGOs with the aim of establishing new protected areas and fixing sustainable forest management processes in their periphery. Small-holder farming, livestock keeping and anti-poaching measures were strengthened. Despite claiming participatory forest management, the projects remained fundamentally top-down in process, and were based on land segregation designing that discouraged forest dwellers from entering the forest, thus obliterating the adhesion of local communities to the proposed forest management plans. In 2003, the Government eventually adopted a drastic logging plan to mitigate timber exports. In 2005, the Boumba-Bek and Nki National Parks were created, southwest of Gribe.

The daily life of the Baka of Gribe was severely impaired by these external drivers of change. Activities to protect the primary forest were put in place whilst logging continued, which ended with severe restrictions of access to the forest for all local communities. Establishment of protected areas and anti-poaching measures reduced their average home range by approximately 80 percent. Exclusive concessions delivered to sport-hunting enterprises also contributed to lessen people's access to their forest. Despite laudable efforts of organizations to try and conciliate the diverging interests, conflicts are inclined to expand. Many challenges remain to achieve compatibility between conservation goals and the livelihoods of local peoples who are being caught between forest-intensified and non-sustainable exploitation, and more acute conservationist sanctions.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

A summarized assessment of 13 indicators of resilience is presented below.

1. Exposed to disturbance: The major disturbances affecting the Baka consist of climatic shocks such as heavy rain, strong winds and prolongation of the major dry season. Other sources of disturbances are wild animals that cause damage to their crops, along with some insect pests and weeds. These shocks are relatively rare.

2. Globally autonomous and locally interdependent: Despite higher interference of the market economy, the Baka still stay autonomous as they source most food from the local food system, and the Baka and Bantu are strongly interdependent through frequent exchange of products and labour. Even with the exchange not always being profitable for the Baka, the Bantu are seen to play an important role in buffering the Baka against the negative impacts of the market economy, as their collaboration has increased. However, augmented monetization has also created more confrontation with the Bantu.

3. Appropriately connected: Gribe has about 10 local stores but they are of only minor importance to the Baka for food procurement. The road to Gribe is poorly constructed, impeding merchants from visiting, as well as increasing the prices of goods from those who do travel to the village. However, for the Bantu, the connectedness to markets and access to commercialized foods has increased largely since the 1990s. Further, the arrival of mobile phones in 2018 greatly enhanced their ability to gather timely information on NTFPs and demand in urban areas, enabling more efficient profit maximation. However, the Baka have not benefited from this information network as much as the Bantu. The village has seen technical agricultural guidance from NGOs, yet it has never continued long term.

4. Socially self-organized: The social frame is organised through a shared set of norms based on respect of every individual's autonomy and extensive sharing of goods and services. The ad-hoc groups organised to perform ritual ceremonies and for labour purposes are intended to share entertainment and mitigate drudgery, thereby strengthening social ties. The Baka are reluctant to participate in systematic initiatives by external organizations, as they are greatly excluded from decision-making processes in the wider community and landscape. In light of recent economic commercialisation, the Baka still value the well-being of the entire group with close kinship more than pursuing personal property.

5. Reflective and shared learning: The Baka maintain flexibility in their resource management, and base it on changes in forest resource availability, the conditions of their crops and opportunity for exchanging with the Bantu. This contributes to strengthening and stabilizing their food system and risk management and reflects a process of learning and adaptation over time. They emphasize that all community members are free and encouraged to enhance collective happiness and food security through sharing and thereby acquiring knowledge for livelihood maintenance. Their relationships with the Bantu and other communities contribute greatly to introduction of new knowledge.

6. Honours legacy: The Baka greatly value and maintain their ancestral practices based on traditional knowledge, beliefs and interactions with the environment. The growing market for NTFPs and bushmeat is seen by community members as a way to strengthen the relationship between Baka and the forest, and to contribute to the reproduction and further development of their knowledge. Yet, written documentation of their traditional knowledge does not exist. The recent increase in contact with the Bantu and merchants through exchange and trade has made the Baka realize to a greater extent that they are exposed to marginalization, such as the inability to join information networks, unfair exchange rates, and lack of participation in decision-making.

This has led the Baka to further strengthen their common identity. This phenomenon is pointed out in revisionism, arguing that hunter-gatherer societies are formed as a result of marginalization within the power structure of the macro system.

7. Builds human capital: The Baka build and strengthen human capital by transmission and uptake of knowledge through observation of and participation in their livelihood activities. Knowledge is transferred horizontally as well as from older generations to youth by observation, active participation and word of mouth. Yet, lack of infrastructure, health and education institutions pose challenges for community members.

8. Coupled with local natural capital: The Baka have livelihoods that demand almost no external inputs, other than fuel for transportation of NTFPs and cacao beans. Their major energy sources for the food system, human labour and firewood are locally sourced and sufficiently supplied. Water is abundantly available. Soil quality is generally adequate due to a long fallow system, although some Baka recognized the quality to be inadequate for plantains. The major waste products are biodegradable from crop and forest products. The major changes seen since the 1990s are a result of their increased use of processed foods and, subsequently, non-biodegradable wastes.

9. Ecologically self-regulated: The Baka's activities for forest management allow for spontaneous growth and ecological self-regulation, with little or no degradation of the environment. Some of their activities, relating to gathering honey and wild plants, ensure dispersal of useful fruit trees. Their philosophy behind resource management is not connected to the notion of sustainability, but rather "how to successfully collect food resources and promote health". Despite the sustainability of the Baka's practices, recent increases in bushmeat trade, commercial logging and conservation policies have not only caused a large disturbance to the ecological processes in the community but have also somewhat segregated the Baka's livelihoods from the forest.

10. Functional diversity: The Baka source foods from 12 food groups (seven from their fields, eight from the forest), providing substantial diversity in their diets. Further, their forest resources can also be used for other purposes, such as building materials, furniture, cooking utensils, igniters, carriers, ropes, lighting, cosmetics and medicines. Agricultural and forest resource diversity has not changed in a major way over time. In the 1990s, some species were given cash value by the external economy and the profits from these contributes to the household economy considerably.

11. Optimally redundant: Because of the crop and species diversity, the food system has redundancy for some food groups. Having more varieties with different characteristics is perceived as a source of joy. Several food groups are also available through exchange with the Bantu and purchase in local stores, further increasing the diversity of available foods. The redundancy of forest resources has remained high over time; however, it has decreased with external interventions such as commercial logging. One exception is the increase of plants demanding substantial amounts of sunlight.

12. Spatial and temporal heterogeneity: The forest used by the Baka has areas with different types of vegetation, swampy areas and natural clearings. In the agroforest zone, a mosaic distribution of vegetation in different stages has been generated through the fallow system. Tree diversity in the agroforest zone is significantly higher than that of the logging zone.

13. Reasonably profitable. The Baka earn an income from which they can live on through NTFP sales, wage labour with the Bantu, and small-scale cacao cultivation in a few households. The cash income amount is still small, yet since they are nearly self-sufficient in food provision, only minimal supplies are necessary. The Baka are not driven to put significant effort into increasing their revenues. Their interest in cash use is oriented toward continuously fulfilling their daily needs, as well as satisfying instant personal or collective interests.

SECTION 3
CONCLUSIONS AND FUTURE PROJECTIONS

1. FOREST-BASED FOOD SYSTEM

Outputs and inputs

Over time, the Baka had managed to maintain a resilient and self-sufficient livelihood based on forest resources, including wild edible plants, animals, NTFPs, fish and swiddens. The outputs of forest sourcing, namely hunting, gathering, fishing and agriculture, rely on approximately 60 animal species, more than 83 wild edible species, at least 6 common species of fish and freshwater animals, and 32 crop species that compose 12 categories of food items (Tables 1.1, 1.2, 1.3). Moreover, forests provide various plant and animal resources for material and spiritual purposes, including building materials, cooking utensils, tools for hunting and gathering, firewood, medicines, ornaments and cosmetics. Sunlight, rain, stream water and firewood are plentifully available sources of energy and material and are obtained by a labour force that is generally mobilized collectively. For transportation, no fuel is used. Material inputs including tools, seeds and clones for farming, and instruments for foraging activities, are almost exclusively procured locally. Pesticides are rarely used. Intellectual inputs are sustained by an achieved traditional ecological knowledge and know-how.

Food sharing is a fundamental part of Baka's culture. A portion of the food they produce or collect from the wild is used to barter with the Bantu, in exchange for food, daily commodities and cash. The Baka regularly work for their neighbours, mainly in farming activities. They occasionally sell NTFPs and cacao beans to merchants for which they are paid cash or with manufactured goods and processed foods. Wastes are generated from every process. Whereas wastes from forest sourcing circulate within the system, non-biodegradable wastes via exchanges and trade tend to accumulate.

Highlights of sustainability assessment

The Baka consume a diversity of foods with different nutritional properties, including starches, meat, fish, dark green leafy vegetables, other vegetables, fruits, nuts, wild eggs, insects, pulses and honey. Most Baka experience food shortages over short time spans, lasting one to two days, in any season and resign themselves to go to sleep without eating. When facing food shortages during their stay in the forest, they prefer to spare their energy and to give up searching for food, summarizing their philosophy by the expression "In days when food is lacking, persisting searching is a waste of time." The seasonal mobility of the Baka also supports their food security. Through alternating stays in the forest and in the village, they enhance the follow-up of resource availability in both sites, as well as opportunities for working with the Bantu and trading with merchants. Food sharing functions as a mechanism to socially mitigate food shortages. Agriculture and exchanges with the Bantu have become increasingly important for food procurement. In the 1990s, the Baka practised long-term expeditions during the major dry season to collect wild yams. In today's context of reduced access to the forest, this practice has been replaced by labour exchanges, as well as short-term stays in the near forest for fishing and NTFP gathering.

Major cash income sources are NTFP selling and wage labour for the Bantu and, more occasionally, temporary jobs in sport hunting and logging companies. The Baka have poor negotiation skills and their consensual feeling is that they do not obtain fair payments for their products and workforce. Although they obtain low incomes, it is liveable since they are nearly self-sufficient in food provision and only minimal supplies are necessary to procure. Yet, incomes are insufficient to cover schooling and medical care when needed. Besides not having enough income, saving money is not in their habits.

The onset of full-scaled agriculture in the 1990s has been a major cause of increase in human energy inputs into the food system, along with intensified harvesting of NTFPs to satisfy a market demand that has become higher after the opening up of the district. According to the Baka, though, wage labour remains the most profitable means for cash income. Wire cables for trapping that arose in the 1970s at first notably reduced labour and time spent hunting. However, animal populations and related hunting efficiency dropped as a consequence of an exploding number of non-Baka hunters and firearms, in response to bushmeat demand from cities.

The Baka cultivate a reasonable diversity of cultigens and cultivars, particularly for plantain (28 varieties) and cassava (18 varieties). The younger Baka farmers like to test new varieties without renouncing those that were transmitted by their parents, and this diversity circulates through sharing within the community. The diversity of foods produced in their swiddens includes many spontaneous and ruderal edible plants, which contribute to diversifying the diet. Respecting the sequence of short-term mixed cropping followed by long-term forest fallowing allows the maintenance of the farming system's overall fertility and contributes to the assemblage of a mosaic ecosystem that is home to a rich faunal and floral biodiversity.

Although not conservationists in the Western sense, the Baka way of living entails modalities for successfully and sustainably collecting food resources from the wild. Customary rules of distinctive access to forest areas by different residential groups, and respect for food prohibitions are salient expressions of their traditional ways to regulate resource extraction. Unfortunately, increasing market demands for NTFPs and bushmeat undermine the efficiency of these cultural regulations, although many Baka inhabitants of Gribe estimate that local biodiversity is not critically depleted, and that fauna still has the capacity to recover from excessive hunting.

Whereas a broad area of forest is required for ensuring an extensive food sourcing that respects the spatial and temporal distribution of resources, access to the forest by the inhabitants of Gribe is increasingly confined. The "permanent forest", property of the State, which now allocates forest usufruct and management tasks to private-owned companies, is no longer freely accessible by the Baka. Conflicts are now chronic amongst the different stakeholders and participation of the Baka in tentative negotiations is weak. Identifying ways to enable Baka to participate in the decision-making process is of utmost concern.

2. FUTURE PERSPECTIVES

Reflecting on the trends in their food system over time, the Baka participants in the study were encouraged to formulate tentative predictions for the next 20 years. According to them, they do not expect their livelihoods to drastically deviate from ongoing changes. They envision their swiddens to become bigger and their dietary regime to depend less on the forest as they more massively rely on food crops. They do not expect yields to become higher as they notice a constant decrease in the mature post-agricultural regenerated forest, a sign that fallowing periods are shortened. Women anticipate that their children will no longer forage in the forest as their parents did in the past. Knowledge related to hunting and gathering will no longer be transmitted, and women fear that the loss of knowledge regarding using forest plants as medicines will undermine the health of the community.

When questioned about their likes and aspirations for the future, the children provide an intermediate answer that reflects their entanglement with a changing environment. They still praise forest-sourced foods and cite bushmeat, wild fruits, wild yams and fish amongst their favourites. But foods obtained from farming have become standard components of their diets so they enjoy eating cassava flour, plantain, banana and peanut sauce; they also enjoy eating rice and tuna in cans bought in the market and they crave snacks sold by itinerant merchants. A majority of young children accompany their parents for gathering wild edible plants (yams, fruits, *Gnetum* leaves) and working in the fields. Only half of them attend hunting and fishing expeditions. They additionally procure water and wood, and help process food (cassava cutting and pounding, *Gnetum* leaves slicing). Beyond similarly assisting their parents, older children carry out gathering, fishing, trapping and ***gbasà*** (small-scaled hunting) without their parents. They share obtained food with members of their residential group and occasionally sell NTFPs to the Bantu. They also learn how to prepare bushmeat and to gather stingless bee honey. All the children expressed a desire to stay and raise a family in the locality and perform well in their livelihoods, to be split between the forest and the village. But whilst some aspire to be hunters and make their own fields for cacao, others dream of becoming a motorbike taxi man, teacher or salaried worker in the logging company.

Over the past three decades, the environment surrounding the Baka has changed tremendously. Nevertheless, the Baka of Gribe have maintained a predominantly forest-based lifestyle, attempting through various ingenuities to adapt to the changes; these included greater investment in shifting cultivation, greater contribution to the market economy through NTFPs and reinforced wage labour for their neighbours, and more frequent back and forth movements between the forest and the village.

These adjustments were made possible through three internal processes:

First, social processes: Values, knowledge, labour and food are shared amongst the Baka, shaping and reshaping their social relationships and implicit norms. Adopting agriculture that requires more advanced planning of activities and sustained work effort is a tremendous challenge compared to the more elusive and opportunistic ways of conducting foraging activities. Farming labour can also trigger a stronger sense of ownership over crops. Nevertheless, the shared tolerance over picking crops from the swidden of another Baka farmer is a social mechanism that moderates excessive individual ownership and renders swiddening more compatible with egalitarian values that conditioned Baka's past life as pure hunter-gatherers.

Second, knowledge processes involve the acquisition of knowledge, understanding and know-how for adaptation through experience and observation, as well as reaffirmation of their basic values. As crops that are cultivated with minimal investment, are stored alive in the field, and are progressively harvested according to needs, plantains and cassava are a good illustration of the value of knowledge processes, gained by direct practice, of the Baka farming practices. These crops are also the most adequate in terms of the Baka's foraging way of life. Other annual crops cultivated by the Baka and the few cacao plantations they hold generally result in poor yields, when they are even harvested.

Third, biocultural processes are interactions between the forest and the Baka that mutually influence each other and create a continuum between foraging and farming activities. Swiddens do not only provide crops but also ensure the production of spontaneous plants that are encouraged to grow in association with crops. In the forest, presumably wild resources are in fact para-domesticated by the Baka. They do not grow randomly in the forest but are purposely encouraged to cultivate in precise patches in the forest. Spiritual relationships with wildlife and supra-natural forces are the keepers of forest resources, as well as all kinds of social adjustments regulating access to resources, which result in a more sustainable use of the forest.

These processes are fully consistent with the egalitarian principle and the pillars of a hunter-gatherer lifestyle, which value high mobility, low labour and solid interethnic relationships with the farming neighbours. These "manners of relationship with the forest and their neighbours" provide good resilience to the Baka's food system and great latitude to adjust to the environmental changes affecting their daily livelihood.

However, adaptive attempts by the Baka to the changing environment do not comprehensively solve all the problems. Logging, intensified bushmeat trade, sport hunting, protected areas and governmental zoning policy are cumulative drivers of change that constantly challenge the resilience of the Baka's food system. Long-term expeditions during the major dry season have greatly declined. Exchange with the Bantu is influenced by the diktat of a broader market economy, which imposes a more acute dependency on cash income. As primary producers and poor negotiators, the Baka lament about a widened economic disparity between them and the Bantu, who have imposed themselves as middlemen in transactions, and whose voice predominates in negotiations with outsiders. Lack of commitment in supposedly participatory approaches of forest governance is a source of growing frustration and a serious risk to convert the connivance between the Baka and the forest into a poverty trap. There is a need to revert the tendency. How these forest dwellers have recognized, used and maintained forests should incidentally benefit the rest of the world, as far as it is first and foremost a means for these peoples to avoid poverty whilst preserving their cultural integrity.

CHAPTER 2

Voices from Arctic nomads: an ancestral system facing global warming

Reindeer herding food system of the Inari Sámi people in Nellim, Finland

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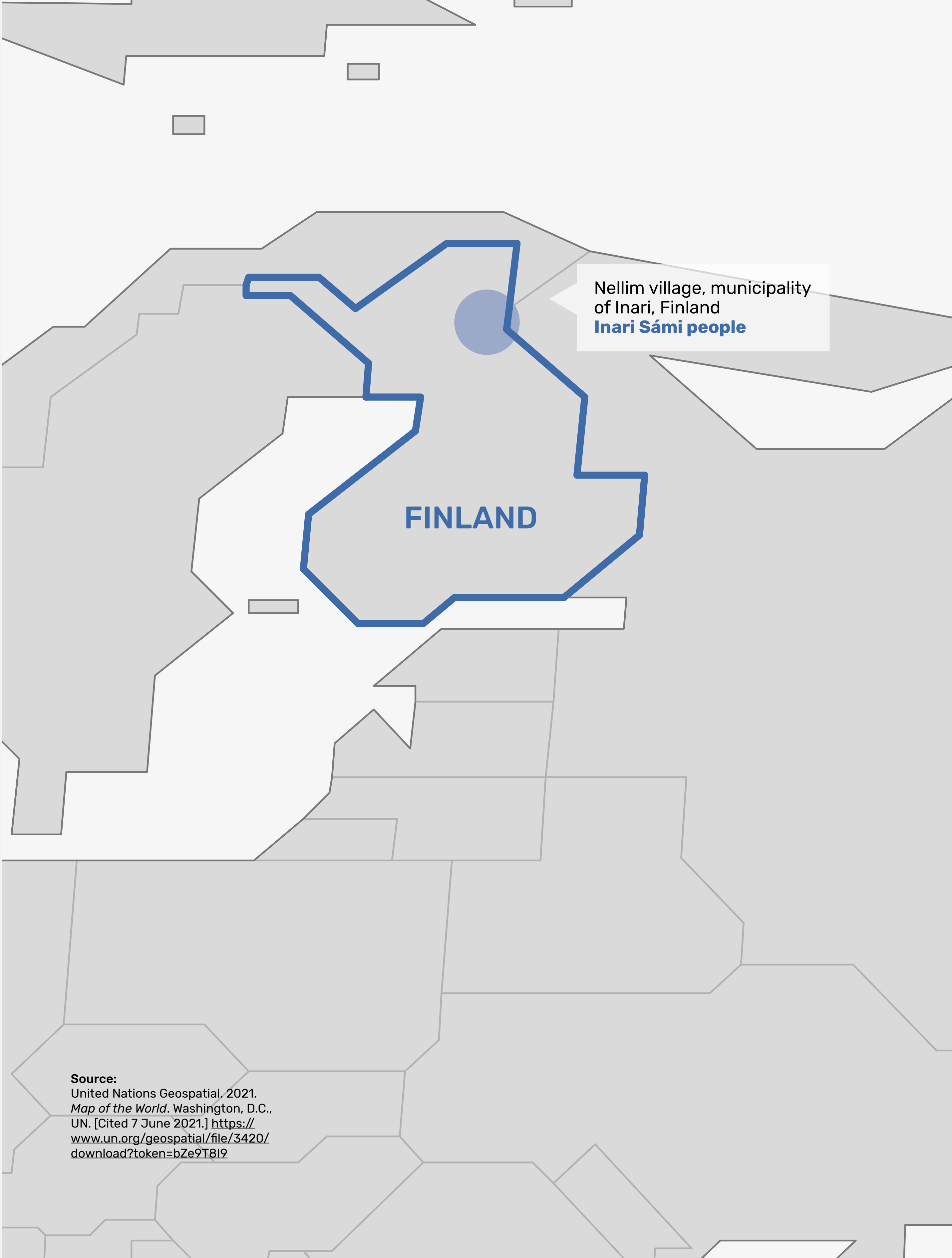
Traditional fishing in Nellim village.



Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

"When we speak about fish, we speak about whitefish, unless otherwise specified."

Elder from Nellim community.

AT A GLANCE

This study profiles the Indigenous People's food system of the Inari Sámi community called Nellim, located in Finland, in the municipality of Inari. Results of the research demonstrate that the Inari Sámi traditional food system has survived, largely as a result of continuation of traditional livelihoods such as reindeer herding, fishing, hunting and gathering. Traditional Inari Sámi foods include reindeer meat, fish, wild berries and game meat. In general, reindeer meat was shown to be the most important source of protein, albeit fish is also highly consumed. Wild berries, such as lingonberries and cloudberries, are still consumed as an important source of vitamins and minerals. Food purchasing from grocery stores, however, has become a normal way of obtaining food along with traditional livelihoods. Traditional dishes and cooking methods have not changed significantly in the past 50 to 100 years. However, various factors, principally environmental changes caused by competitive land usage and climate change, are decreasing the key food resources as practicing and maintaining traditional livelihoods and knowledge become more challenging. Deforestation is seen as the main influential factor, thus protecting the land environments that produce the Inari Sámi traditional food system is crucial.

Note from the editors: Inari Sámi terms are mentioned using the official alphabet for Inari Sámi officially adopted in 1996.

SECTION 1
COMMUNITY AND FOOD SYSTEM PROFILE

1. GEOGRAPHIC CONTEXT

The Nellim community inhabits an area located 260 kilometres beyond the Arctic Circle in the eastern part of Lake Inari, the largest lake in northern Finland, 42 km from the town of Ivalo and around 10 km west from the Russian border in the region of Lapland. More than 3 300 islands are located close to the shoreline. For the Sámi, the area is known as ***Sápmi***, or Sámiland.

Nellim is situated on the border of the subarctic and temperate climatic zones and belongs to the sub-boreal vegetation zone. The nature around Nellim includes vast areas of wild forest and some fells and wetlands. The water quality of the lake is still, in a near-natural state, meaning that there is low impact from human activities. Overall, the water quality is good enough for the community members to drink it. The lake is influenced by hydro dam stations, causing large variations in water levels, erosion events and other alterations, such as variations of ice levels. The water from the lake is discharged into the Barents Sea through the Paatsjoki River.

Lake Inari is located far from large settlements; hence, its environment has elements that are undisturbed and intact. The lake is crucial for the Inari Sámi community, and carries cultural, social and economic value. The Inari Sámi language, endemic lifeways and traditional economies evolved around the lake, thus the lake has been a central component of this socio-ecological system. Many of the place names on the eastern and south-eastern side of Lake Inari are a mix between Inari and Skolt Sámi toponyms, thus it can be derived from this that the region has been a border area between the two Sámi nations in early historical times.

The main tree species in the forests around Nellim is Scots pine (*Pinus sylvestris* L., Pinaceae). Birch (*Betula pendula* Roth, Betulaceae) occurs as an admixture amongst the pine and in some parts spruce (*Picea abies* (L.) H. Karst. subsp. *abies*, Pinaceae) can be found.

2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

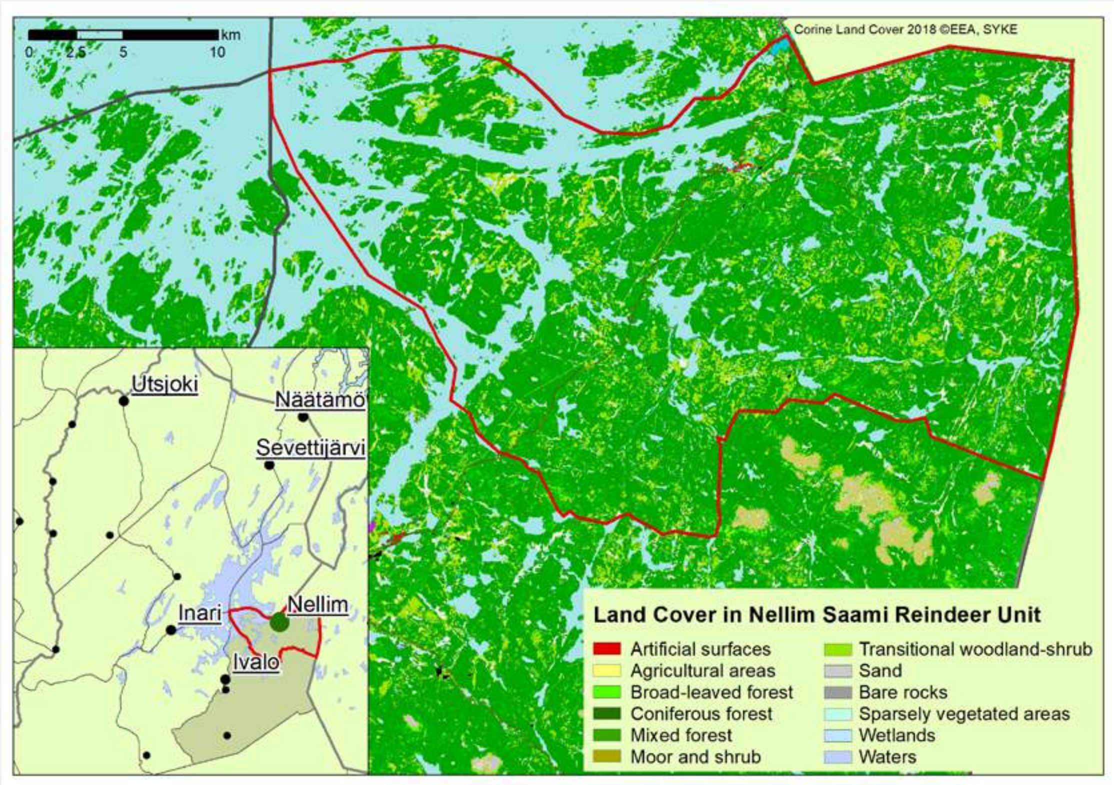
The Sámi are the Indigenous People in Finland, and there are 10 000 Sámi in the country. The status of the Sámi was written into the Constitution of Finland in 1995 and the Sámi have constitutional self-government in the Sámi Homeland in the spheres of language and culture since 1996. This self-government is managed by the Sámi Parliament, an indigenous parliament established by a law. Sámi livelihoods are reindeer herding, fishing, handicrafts, hunting and gathering. The three Sámi language groups present in Finland are North Sámi, Inari Sámi and Skolt Sámi.

The traditional reindeer herding community in Nellim village is called "Nellim ***siida***" or "Nellim unit". Most of the community members participating in this research are members of the Nellim ***siida***, which is part of the Ivalo reindeer herding cooperative, even though some of them belong to another reindeer herding cooperative called Paatsjoki. Community members who were interviewed for this report are mainly Inari Sámi as the study focuses on this Sámi group.

The different ethnic groups in Nellim are Inari Sámi, Skolt Sámi and the Finnish population. The languages spoken are Inari Sámi, Skolt Sámi and Finnish. Nellim has around 150 people, and the population of the Nellim ***siida*** is around seven families. Most of the inhabitants are elderly. The village consists of wooden houses that are fairly close to one another.

The households are mainly structured by nuclear families and extended families, although there

FIGURE 2.1. Overview of land cover in the Nellim region and reindeer herding area



Source: European Environmental Agency 2018, edited by Johanna Roto, Snowchange cooperative, 2010.

are some unmarried men who live by themselves. People marry around 25-35 years of age. Reindeer herders herd the reindeer together as ***siida***. Reindeer herding in Finland is regulated by the State and the reindeer herding area is divided into cooperatives. The area of Nellim is divided into two different cooperatives, the cooperative of Ivalo (2 889 km², 98 reindeer owners) and Paatsjoki (1 053 km², 8 reindeer owners). Most of the Inari Sámi reindeer herders of Nellim belong to the Ivalo reindeer herding cooperative and herd their reindeer in a traditional ***siida*** way. Herders spend a lot of time together because of their various tasks of herding, such as gathering reindeer in the forests, marking them and holding reindeer roundups. Families and relatives eat together, in addition to eating with neighbours and friends.

Nellim village belongs to the municipality of Inari, thus public administration includes local self-government of the municipality. Villages are represented in Finland through village associations of the third sector and have no specific legal status. Nellim ***siida*** reindeer herder leaders are normally both an elder and a younger reindeer herder.

Ancient Sámi religion was based on animism and shamanism. The Sámi believed that all significant natural objects possess a soul. Sámi religion had a multitude of spirits and gods. Over the course of time, the Sámi have converted to Christianity. The spiritual and cultural traditions of the Sámi society were greatly affected by residential schools during the assimilation process, carried out by the Finnish State, as they were often run by missionary services and churches. This led to the disappearance of many older cultural elements and spiritual leadership. Today, most Sámi practise the dominant Lutheran religion of the Nordic countries in which they live. However, their current belief system is based on a synchronistic mix of older thoughts regarding nature and imported religious spiritual practices. In Nellim, Inari Sámi are evangelic Lutheran. Further, the Skolt Sámi population brought Orthodox religion to the area, thus an orthodox church was built in the village in 1987. The traditional belief system is rarely discussed in public even though it is a target of a large-scale public and touristic interest.

3. LOCAL FOOD PRODUCTION

The community's main food-providing activities are reindeer herding, fishing, hunting and wild berry picking. Traditional Inari Sámi livelihoods are practised in a sustainable way. They let the nature restore itself; reindeer migrate between different grazing lands, fish populations are not traditionally overfished, and game populations are maintained in a carrying capacity to ensure food for the coming years.

Reindeer herding

Reindeer herding is one of the most evident parts of the Sámi culture. Albeit every Sámi do not practise reindeer herding, its social, cultural and economic importance is immense. It is the only traditional Sámi industry that is seen as being the most profitable without subsidies.

Traditional Sámi reindeer herding is based on the annual migration of the reindeer. For the Nellim area, the seasonal cycle follows the demarcation of the cooperative territory, in addition to the Nellim unit winter and summer pastures. Fences separate their usage areas from other cooperatives, but all the modern-day herding areas are in the north boreal. The grazing system is based on reindeer biology as an Arctic ruminant. Reindeer stomach rumination is adapted to the different seasonal foods. The reindeer graze in different summer and winter areas. In summer, the areas provide multiple food sources available in nature including mushrooms. In winter, the pastured areas provide traditionally lichen and tree-hanging lichen as the primary food, although they also offer a place for animal feeding. The boundaries of the grazing areas are not static and they may change according to the grazing conditions within the herding cooperative territory. Herding constitutes a socio-ecological system where the indigenous knowledge and culture of the herders also influence where the animals will feed. Good grazing conditions are formed when the snow is dry in early winter, the ground is properly frozen, and the snow cover has not frozen the vegetation. These kinds of conditions keep the vegetation edible and available for reindeer, so that they can dig and smell the food. The impact of climate change has already started to change these conditions and affect the food security and animal well-being.

Reindeer stocks in Nellim are of the boreal type of forest deer (*Rangifer tarandus* L., Cervidae) that was domesticated for herding purposes. Currently, the Ivalo cooperative is assigned 6 000 reindeer, including those of the Nellim Inari Sámi. As a distinct herding practice, the Nellim unit maintains a Sámi-style herding that is built on free grazing of stocks between winter and summer pastures. Herders are joined by other community members when marking the calves in June, and doing reindeer roundups during autumn and winter. The herding is therefore a "pulsating" tradition with a core of herders and reindeer owners involved in the daily work, but with a social impact that cuts across the whole village. More men than women are involved with herding activities.

In the winter, the reindeer eat lichen as their primary food. Lichen grows in woodlands, boreal pine forests, wetlands, fells and tundra. Reindeer can smell lichen even through thick snow, and they dig it out from the snow. However, given the land use changes and impacts of climate change, all reindeer are now also fed with supplements. Meat and other food products are processed and packaged in the village. During the herding roundups, the animals meant for

Inari Sámi herders gathering reindeer during the roundup.

the markets are chosen and then transported for slaughter. Reindeer meat is used for both private consumption and sales. The meat can be sold together by the cooperative to a preselected buyer, or each owner can process the meat and sell it privately. The cooperatives also collaborate during the roundup process and herd reindeer to the roundup places by motorcycles, quads, snowmobiles and even helicopters. All members of the cooperative are allowed to take part in the gathering.

Reindeer are marked with earmarks, indicating the ownership of the reindeer and family system. Each family has its own mark line. Whilst new technology, such as snowmobiles and the Global Positioning System (GPS), are now being used in reindeer herding, the traditional indigenous knowledge on reindeer, nature and climate still plays a very important part.

Fishing

Fishing is another central Sámi practice. In the past, before the development of reindeer herding, fishing was most likely the key livelihood for the Inari Sámi. Each Sámi fisherfolk and family has traditional fishing places in lakes or rivers. In Nellim, fishing is practised in almost every household. Both men and women, elders and youth are involved in the cultural subsistence fishery. Traditionally, especially unmarried women would take part in such activities.

Inari Sámi language and fish are cultural indicators of the environmental knowledge. For instance, whitefish (*Coregonus lavaretus*), with its range of subspecies in the Lake Inari catchment, is an iconic species for the Inari Sámi. This is evident due to their archaeological catch sites, some dating thousands of years back, as well as the endemic linguistic concepts of whitefish as expressed in their language.

TABLE 2.1. Inari Sámi words related to whitefish

Inari Sámi name	Meaning
šapšâ	Overall concept for whitefish
kyeli	Whitefish in colloquial conversation
rijgá	Old and thin whitefish
sáávjáš	A small whitefish
riäská	A dwarf whitefish endemic to the lake Inarijärvi
reevâs	Another dwarfed stocks of whitefish endemic to the lake Inarijärvi

These linguistic features can be seen as cultural indicators, and a socio-ecological matrix of how the Inari Sámi and their waters are interconnected. Even subtle changes to the keystone species cascade have both ecological and social impacts. The importance of fishing methods are also reflected in the local language.

TABLE 2.2. Inari Sámi words related to fishing methods

Inari Sámi name	Meaning
viermi	Gill net fishery
uágguđ	Ice rod fishery
nyetti	Seining
stuorrâlääni	Fyke, a fish trap
sapšâpeesi	Fish trap specializing in the whitefish

Fishing has always been conducted using multiple gear depending on the seasons and species. One of the most important fishing methods for the Inari Sámi has been seine fishing, and they have practised it for hundreds of years. Seining is a method of actively pulling nets that circle the fish. Seining requires very precise knowledge of the lake bottom, the water column, seasonal conditions, winds and the behaviour of the fish itself. Usually it is used to catch schooling fish such as whitefish and perch.

Another method, gillnets, is used for fishing all year round. During winter, the net is spread under the ice between two holes. The summer gillnet season opens in May as the ice breaks up and targets first traditionally northern pike, grayling and perch. In the autumn, spawning species such as whitefish constitute the majority of the catch. Trolling, spin fishing and ice fishing are also practised. Fish is caught for one's own consumption or to sell within the community as a whole or fillet. Fish dishes are prepared by boiling and baking fish on an open fire, in a pan and or in an oven. The most common species for fishing and consumption are whitefish, northern pike (*Esox lucius*), grayling (*Thymallus thymallus*), yellow perch (*Perca fluviatis*), lake trout (*Salmo trutta*), Arctic char (*Salvelinus alpinus*) and burbot (*Lota lota*).

Fishing is a key practice to maintain food security in the community. However, there are currently no professional fisherfolk left in the community, who traditionally would provide additional income to the community by selling their fish to restaurants and grocery stores.

Hunting and trapping

Hunting and trapping have always been part of Sámi livelihoods. The Sámi use different kinds of traps to catch animals and birds. Nowadays hunting alone is not a profitable financial

TABLE 2.3. List of wildlife used as food: fish

Group	Scientific name	English name
Fish	*Coregonus albula* L., Salmonidae	Vendace
	Coregonus lavaretus L., Salmonidae	Whitefish
	Esox lucius L., Esocidae	Northern pike
	Lota lota L., Lotidae	Burbot
	Perca fluviatilis L. Percidae	Yellow perch
	Salmo trutta L., Salmonidae	Lake trout
	Salvelinus alpinus L., Salmonidae	Arctic char
	Thymallus thymallus L., Salmonidae	Grayling

livelihood, however, approximately 20 people are still involved in hunting activities in Nellim.

Community members hunt during the hunting and trapping seasons. The main game species are the capercaillie (*Tetrao urogallus*), willow grouse (*Lagopus lagopus*), mountain hare (*Lepus timidus*) and moose (*Alces alces*); and amongst waterfowl, the mallard (*Anas platyrhynchos*) and taiga bean goose (*Anser fabalis*). Big game, such as bear, requires a special hunting license. Hunting is practised close to the village, and mostly men take part in this activity, although women can also participate. The traditional methods of hunting are stalking, tracking and hunting with dogs, but today guns are mostly used.

TABLE 2.4. List of wildlife used as food: game species

Group	Scientific name	English name
Birds and poultry	*Anas platyrhynchos* L., Anatidae	Mallard
	Anser fabalis Latham, Anatidae	Taiga bean goose
	Lagopus lagopus L., Phasianidae	Willow grouse
	Tetrao urogallus L., Phasianidae	Capercaillie
Mammals	*Alces alces* L., Cervidae	Moose
	Lepus timidus L., Leporidae	Mountain hare
	Ursidae sp.	Bear

In the community, some hunting products are sold for income. There used to be an auction for the moose meat during the special feast for moose during the fall. However, hunting is practised mostly for own consumption. Animals such as capercaillie and willow grouse are cooked in the oven, roasted or boiled. Moose meat is used for stew, minced or roasted.

Wild edibles

Gathering and wild berry picking continue to be important parts of the Sámi food culture. As with fishing, the Inari Sámi have their own traditional picking areas, one for each family. Families respect others' territories, and the whole family is involved in berry picking. The most common varieties of gathered berries are lingonberry (*Vaccinium vitis-idaea*), blueberry (*Cyanococcus* sp.) and Arctic cloudberry (*Rubus chamaemorus*). The village also uses the berries for sale to supermarkets nationwide, thereby receiving a supplementary income. The Arctic cloudberry is particularly attractive across the country. From the forest, the community also collects other wild plants and mushrooms such as boletes, brittlegills, milkcaps and false morels. Wild berries are eaten fresh, frozen, stored or used for baking. The community also uses them for juices, jams and marmalades. The Inari Sámi did not begin to eat mushrooms until the 1990s, as mushrooms were previously used primarily for reindeer food. Today, community members fry, stew, marinate and use mushrooms in soups. Mushrooms can also be preserved by drying, salting or freezing them.

TABLE 2.5. List of wild edibles

Group	Scientific name	English name
Fruits and juices	*Cyanococcus* sp.	Blueberry
	Rubus chamaemorus L., Rosaceae	Arctic cloudberry
	Vaccinium vitis-idaea L., Ericaceae	Lingonberry
Mushrooms	*Boletus edulis* Bull., Boletaceae	Bolete
	Lactarius deliciosus (L.) Gray, Russulaceae	Milk-cap
	Russula sanguinaria (Schumach.) Rauschert, Russulaceae	Brittlegill
	Various	False morel

Some plants and animals collected in the community are used for handicraft materials or in medicines. Chaga mushroom (*Inonotus obliquus* (Fr.) Pilát, Hymenochaetaceae) is an example of a species used for medicine.

Agriculture became part of the Sámi culture in the 18th century, especially in the Utsjoki and Inari areas. However, agricultural activity is limited due to the harsh Arctic climate and short summer periods. The species that can be cultivated in this area are potatoes, carrots and turnips. Cultivation areas are in close proximity to the households. There are in total approximately 20 to 30 hectares of agricultural area in Nellim.

4. LOCAL CALENDAR

Due to the close tie between Sámi culture and reindeer herding, many of the Sámi calendars are based on the life cycles of the reindeer, in addition to seasonal changes of climatic conditions. Nellim is located in an area with a subarctic climate characterized by mild summers and cold, snowy winters during which 70 cm to 80 cm of snowfall is recorded on average. During the coldest period, from December to February, the average temperature is about – 15 °C, with occasional lows of about – 30 °C or colder. The duration of the snow period is from October to May. In the summertime, temperatures usually oscillate between 10 °C and 15 °C or warmer and rainfall is moderate, between 400 mm and 550 mm. However, climate change has started to alter the established cycles. Long droughts and periods with temperatures over 30 °C have been recorded, with record temperatures in the summer of 2018.

The Inari Sámi traditional calendar used to reflect the specialized seasonal land use called ***varriistâllâm***. The land use is particular for its internal governance and use of natural resources, such as small-scale herding and fishing. In older times, the traditional cycle used to be over 13 months. The names of the months still reflect the seasonal conditions.[6]

Reindeer herders follow the yearly cycle of reindeer. The yearly migration cycle is determined by reindeer's natural movement from the forests in winter to the treeless areas in the summer, for instance to the coast or up to the

[6] Inari Sámi meaning added, all materials are summarized from the oral history archives.

Wild berry picking.

fells for the calving period. The roundup period is the most important, as the reindeer that are going to be kept alive are separated from those that are to be slaughtered for processing and selling.

The herding cycle has been impacted in recent years by climate change. These include the following examples:

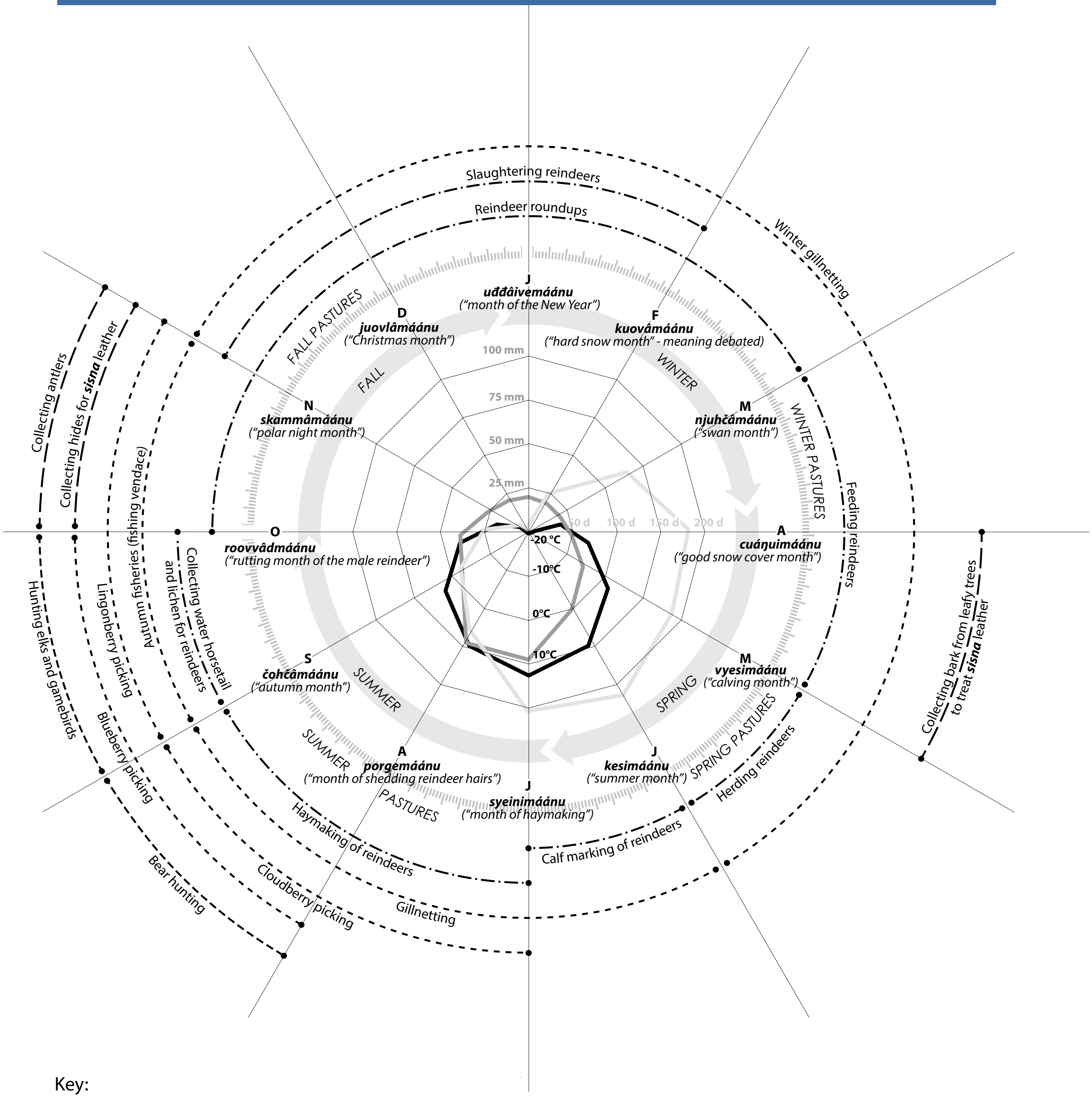
- the ground freezes up as an ice layer: in the autumn, the bottom layer of soil gets soaked in rain and then quickly freezes. This makes the pastures of lichen unavailable for reindeer, as they cannot access their primary natural winter food through the ice.

- rain-on-snow (ROS) events: the snow freezes, following the warm winter rains.

- decreased travel safety: the ice takes shape later than usual, and forms in unpredictable ways, in addition to earlier melting. The transport associated with herding is therefore more dangerous and new travel conditions are appearing that have not been experienced before.

- droughts and summer events: extremely warm summers are causing localised drought events that affect the quantity and quality of the reindeers' drinking water. The heat also propagates in waterways, which negatively affects the salmon and other cold-water-dependent fish species.

FIGURE 2.2. Average annual rainfall (mm), temperature (°C) and monthly cumulated daylight hours (d) in Nellim, and seasonal activities by the Inari Sámi of the Nellim ***siida*** (elaborated by Yanto Wahyantono, IRD, 2020)



Key:

Activities related to livestock

Activities related to wild food (gathering, fishing, hunting)

Other activities related to livelihood

5. MARKET SOURCING AND TRADE

Food purchasing from grocery stores has become a normal way of obtaining food, in addition to traditional livelihoods. Approximately 70 percent[7] of households still eat traditional food and complement their diets with purchased groceries. The community buys the following basic groceries from the supermarket: dairy, grain products, vegetables, macaroni, a range of meats and fruits. Potato is grown and cultivated as a summer crop and consumed over the winter months, thus community members do not have to buy potatoes. Previously, bread and sweet bakery products, such as pies, cakes and so on, were homemade, yet now they are mostly bought from grocery stores. The proportion of local diets that come from the market varies according to the seasons, however, approximately 75 percent of the meat and fish that community members consume come from the community.

Three grocery stores are found in Ivalo, 42 kilometres from Nellim. Supermarkets are typical chain supermarkets found in Finland, but they also sell some local products, including seasonally available products such as fish. Inari Sámi communities used to exchange products between the inland and coastal fishing peoples. The community does not exchange food with other communities anymore. Due to the advent of a cash economy, people who do not herd reindeer usually buy meat from the locals. However, some of the community members buy reindeer meat from the grocery stores, as they think it is easier.

6. COMMUNITY HISTORY AND FOOD SYSTEM TRANSITIONS

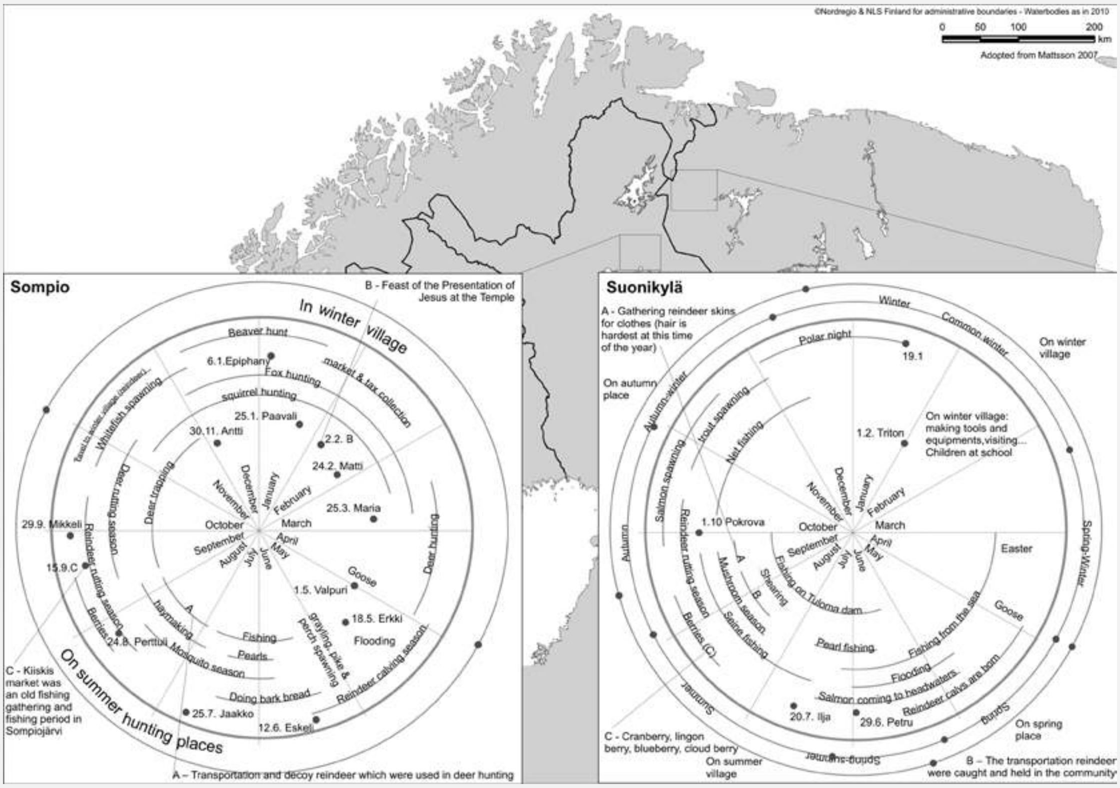
The first historical reference to Inari or Aanaar was made in 1517. In those times, the region would be influenced by six ethnic societies: the North Sámi, Skolt Sámi to the east, Russians, Norwegians, Finns, and the "local" Sámi, the Inari Sámi people. The Inari Sámi language and culture are specific and their own in the family of surviving Sámi languages and areas. Traditionally, Sámi people were organised in a ***siida*** system, which describes the organization of Sámi society before assimilating to Finnish culture and before the State started to control Sámi land and reindeer herding. Some studies reveal that the ***siida*** system was potentially developed as early as in the Stone Age. ***Siidas*** were large and were formed by several nuclear families. The ***siida*** owned and administered the land and families used it. At least 11 ***siidas*** existed around the Aanaar-Inari lake system in early historical times.

Before the introduction of reindeer herding in the 1600s, the life of a ***siida*** was based on fishing and hunting. Instead of following the reindeer yearly migrations, families in a ***siida*** migrated by the seasonal cycle of fishing and hunting. It is unclear exactly when reindeer herding began in Nellim. Initially, reindeer herds were small, as the main livelihood was fishing, and meat consumption was based on deer and other wildlife. The switch from a hunting economy to herding was caused by the Finns and Swedes settlements in the Sámi area. It increased the hunting pressure, and the ecological carrying capacity of the northern ecosystems could not support the growing needs of the local population. This gave rise to the herding. In the eastern Sámi areas, including the Inari Sámi homeland, the herds remained small and fishing constituted the second major activity until the 1960s.

When the ***siida*** eventually became based on reindeer herding, the ***siida*** was more loosely organised, and individual families started to have more power to make decisions. This system is known as nomadic reindeer herding and is the centre of traditional north Sámi reindeer herding. Introduction of a herding economy changed the social structure in the community and allowed for specialization to advance in the society. In contrast to several Sámi communities in Norway with larger herds, the Inari Sámi have practised a smaller-scale herding system based on ***varriistâllâm*** (annual migration), as their

[7] These percentage analytics have been calculated from the community participants and their answers, either through an oral interview or a survey collected for this study. Original data available from the authors.

FIGURE 2.3. Analysis of a seasonal resource in two of the neighbouring communities of Nellim – Sompio and Suonikylä, in late 1800s to early 1900s. Source: Mustonen and Mustonen, 2013 (used with permission)



fishing economy is central in the community. Concerning the species, there is a complex history over centuries of Sámi breeding and genetic choices. Often reindeer were exchanged between villages to renew bloodlines and quality of stocks.

Nellim is one of the oldest inhabited Inari Sámi communities. However, life in Nellim has changed considerably over the past 100 years. Originally Nellim was the name of a household in the area of the present village. However, the Nellim area began to develop in the 1920s as a result of road construction from Ivalo to Nellim, and logging. Trees were transported to storage sites on the shores of Lake Inari in the winter, from where they were transported by boats, often either to local sawmills or down the Paatsjoki River to the Barents Sea coast in Norway. Later, some of the wood was cut in the village with a large sawmill.

During the Winter War, between the Soviet Union and Finland in 1939, the Inari Sámi from Nellim were evacuated to more southern parts of Finland. After the end of the Second World War, Finland had to hand over the Petsamo area, which corresponds to the northeastern corner of the country and the homeland of the Skolt Sámi, to the Soviet Union. The Skolt Sámi could not return to their traditional lands; thus, they were relocated to the Inari area, including to Nellim. Other major events include the establishment of the Virtaniemi border check-point between

Russia and Finland, which provided local employment and trade flows in the community. Further, in 1960 a power line was established in Nellim. Yet, the most important factor affecting the community is seemingly the assimilation policy practised by the State. The policy included the imposition of State-led religious activity, schooling, reorganization of the reindeer herding, new road and transport construction, and, most importantly, the use of Inari Sámi land for the development of hydropower and forestry, largely affecting the Inari Sámi community.

The Sámi have historically suffered through various types of discrimination and repression. Since the nation-states of Norway, Sweden and Finland first began settling ***Sápmi***, the Sámi have been removed from their land, stripped of their culture and made to believe that they were inferior. In order to eliminate Sámi culture, the church and the governments established boarding schools whose purpose was to assimilate Sámi children into the majority culture. Sámi children were denied the right to use their native language or to engage in their cultural practices. Since their beginnings in the 19th century, boarding schools were a major part of Sámi life until the 1960s, when a Sámi movement began demanding reforms to the educational systems. In Nellim, the boarding school system was active until the 1960s. Assimilation of Sámi people to the Finnish society was particularly rough, and as a consequence the Inari Sámi language is almost extinct. The Inari Sámi language is no longer the main language used with reindeer herding. However, it is used in a hybrid way, being central to the concepts and tasks of herding. Traditional reindeer herding maintains and renews the survival of the Inari Sámi culture, particularly in Nellim.

Major changes in the community's livelihoods have included the structural changes in reindeer herding, in addition to the aging of the population. Today the population size of Nellim is constantly decreasing and the largest group in the community is elderly people. This is a threat to reindeer herding, as not enough young people are willing to take on the responsibility. The same applies to fishing. Further challenges connected to reindeer herding concern competition for land use and changes in regulations and legislation. The State highlights the production aspect of reindeer herding for the markets, whilst the Sámi population stresses the importance of maintaining a socio-ecological system, with the financial component being only one of many. Reindeer herding also provides cultural and linguistic services to the community. The landscape around the village has also changed, due to the intensive logging, tourist industry and a new road from Ivalo to Nellim.

Today it is a village of three different cultural communities, since the Finns settled in Nellim in the twentieth century and the Skolt Sámi were relocated to Nellim after the Second World War. Most of the Inari Sámi families currently live in modern houses, as Inari Sámi reindeer herders now also settle down far away from their traditional lands. This change was induced by new legislation, providing cheap loans and patches of land and forest to those who wanted to build a homestead and establish modern reindeer herding communities, as part of the State's attempt to modernize traditional herding communities.

SECTION 2
SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM

1. PROVISION OF LIVELIHOODS, EQUITY AND SOCIAL WELL-BEING

Adequacy of income opportunities

The professions of the people in the community are reindeer herders, fishers and civil servants. The elderly are retired, but this concept should be understood in the cultural sense – many people are still engaged in traditional activities despite their formal retirement status. Community members generate income from the selling of meat, fish, berries and mushrooms, particularly false morel.

The reindeer meat is sold to a supplier of reindeer meat or to private buyers. It is brought to grocery stores from slaughterhouses and suppliers that meet the standards of European Union's directives. Meat can also be bought straight from reindeer herders from the roundup corrals (structures and events where the reindeer are separated based on ownership, age and slaughter) or houses. Community members get a fair price for their products. If products would cost more, the market would decrease. The price of reindeer meat increases slightly each year, slightly compensating the accumulating and increasing costs of fuel and equipment. To community members in Nellim, herders would prefer to sell their meat at a lower price, yet the costs of herding forces them to maintain a certain price.

The following points summarize some aspects of the meat prices for a comparative value:

- Overall, the price of reindeer meat was 10-13 EUR[8]/kg in November 2019. It will vary according to the parts of the animal sold and cutting methods and processing level used.

- Direct sales price of meat, without bones, straight to the customer from the herder can be 15-16 EUR[9]/kg.

In Nellim, the reindeer herders earn a livable wage from reindeer herding, but challenges continue to increase. Today, herders rely on subsidies, for instance European Union subsidies for farming and the compensation fees from the State regarding the impact of predation on reindeer. Reindeer herding is less lucrative nowadays since the costs of practicing it has increased with the continued increases in fuel prices, taxation and equipment. Further, wolverine, bears, wolves, lynxes and eagles prey on reindeer, and although the State provides compensation, the damages are still remarkable. In 2017 and 2018, compensations for the Finnish reindeer herding sector were around 7 to 8 million euros each year from national and European sources. Depending on the reindeer, the amount varies between EUR 1 300 and EUR 2 200.[10]

New activities in the area concerning natural resources, such as development of forestry, negatively affect sales of reindeer meat. The opening of roundups for tourists is another concern of the herders in the community. During roundups, reindeer are caught by their antlers and sometimes some accidents can happen, for instance a reindeer can break a leg. The habits and incidents can seem cruel and like

[8] Equivalent to USD 11.1–14.4. Applying the UN Operational Rate of Exchange of 1 November 2019 (1 USD = 0.9 EUR). This rate will apply throughout the entire chapter.

[9] Equivalent to USD 16.6–17.7.

[10] Equivalent to between USD 1 444 and USD 2 444.

brutal treatment to tourists who have no basic information on the traditions. Pictures and films of roundups are shared on social media, quickly reinforcing a negative picture of herding. This can have a negative impact on the whole tradition of herding and even lead to boycotts of Sámi reindeer meat in supermarkets. The phenomenon is regrettable since the Sámi, as Indigenous People in general, have high respect for nature and animals.

A reindeer herder spends approximately 20 percent of his or her income on food and drinks, whereas non-reindeer herders spend approximately 35 percent. Food in the market is affordable for everyone. Healthier food is more expensive, especially fresh food, but everyone can at this point afford to buy the food they wish.

Adequacy of diets

The traditional Inari Sámi food system of the community has the capacity to provide enough to eat, but it is still complemented with groceries purchased from stores. The traditional food system is diverse and adequate throughout the year. Community members have not experienced conditions of food insecurity since nature and its products have been diverse and abundant at all times of the year. However, the worsening impacts of climate change may alter this situation. Berries and mushrooms are examples of food strongly dependent on a stable climate. If there is a good early summer, there will be a good year for berries, but recent climate events might indicate that the coming years will be bad for collecting berries. Public access rights, or so-called "everyman's rights", refer to the right of everyone in Finland to enjoy outdoor pursuits regardless of who owns or occupies an area. There is no need to obtain the landowner's permission, and there is no charge to pick wild berries, mushrooms and flowers, or to fish with a rod and line, or through a hole in the ice in wintertime. Other types of fishing always require a fishing license.[11]

Reindeer meat is a staple food in the community, in addition to fish, game meat, fruits and vegetables. The most common dishes prepared from reindeer meat are reindeer meat soup, dried reindeer meat soup and reindeer stew. Meat is dried and can also be smoked. The bone marrow is also eaten, as well as tongue, heart and liver. Reindeer blood is used for blood pancakes and sausages. Meat can also be minced, smoked or cooked as steaks. The diets of the community are heavier during the winter months and become lighter toward spring. Traditional wind drying of reindeer meat and fish is practised in the spring, and in addition to freezing of foods, this ensures a stable food supply year-round. There is a perception that the food consumed in the community provides sufficient nutritional value for community members, particularly as reindeer meat is especially lean and has high nutritional value, being rich in protein, vitamins, minerals and trace elements (Hassan, Sandanger and Brustad, 2012). The community members also have the freedom to choose which food they want to eat. However, some of the non-herders would like to purchase and eat more reindeer meat, but they find it expensive. The community in general still has a preference for traditional food. Children in particular favour reindeer stew and fish.

Although the traditional foods consumed are nutritious, the Soviet-era atomic bomb tests and the fallout from the Chernobyl nuclear accident in 1986 affected the region. Cesium and other radioactive elements were stored in lichen, eaten by reindeer and thereafter by humans. A State-led monitoring programme has sampled the community members since the 1960s to monitor these effects. With regards to the quality of the food products in the supermarkets, it is generally good and healthy, yet food that has higher quality or is organic costs more. In the past decades, with the proliferation of pizza, hamburgers and other fast foods, the amount of fat and other harmful substances in people's diets has increased, as a shift in food culture has taken place. This is compensated locally in Nellim with the large amount of nature-based healthy foods, especially berries. According to the community, a person with good nutrition is healthy and eats the right proportion of meat, starches and vegetables. The local way of classifying food is traditional food or local food and food produced elsewhere.

[11] For further information, see https://www.ymparisto.fi/en-us/nature/everymans_rights.

Reindeer meat stored in freezer.

Changes in the provision of livelihoods and social well-being over time

The income level for the community members has changed over time. Reindeer meat is more expensive, thus herders earn more, albeit costs related to the practice have also increased. If we look at the general picture, salaries have generally increased. Trade relations have also changed over time. Previously, there was an active exchange of goods between the community and Norway. This changed when the first grocery store opened in Nellim.

Despite transitions in the community's food system, traditional food still plays a large role in the lives of the community members. The main change potentially concerns the amount of the animal being used, and the preservation methods. In previous times, the reindeer was completely utilized. Today some community members eat more processed meat, such as pork, and less reindeer meat. This is a result of modernization processes, as well as increased prices on reindeer meat, which in turn has reduced the consumption of meat for the community members who do not herd reindeer. Concerning vegetable consumption, nowadays some mushroom species seem to spread from southern Finland to the north, such as matsutake, a mushroom that was not found before in the Nellim area. This might be caused by climate change, thereby introducing new foods into the Nellim food system. With regards to wild edibles, it is currently more normal to consume oranges and red-fleshed fruits than wild berries. The consciousness of healthy eating has increased throughout Finnish society, leading the community to integrate more types of fruits and vegetables in their diets. In general, the community has not had a problem with obesity, yet similar to other indigenous communities, members of the Inari Sámi community have experienced alcohol problems, also leading to obesity for some. Alcohol is mainly available at the State monopoly store "Alko" in Ivalo.

One of the main challenges facing the Nellim community is the migration of young people. Both reindeer herding and the fishing tradition are threatened by this trend. When a Sámi moves outside the Sámi homeland area, their legal right to use nature in certain areas is lost, thus young people lose their connection to their traditional fishing areas. As a result, the traditional knowledge embedded in fishing disappears. Traditional traps are also being replaced with new technology.

2. RESOURCE USE EFFICIENCY

Labour and fuel energy

The main power source to the village of Nellim is provided by a recently renewed 20 kV power line from Ivalo. In addition to the electric power from the grid, burning of firewood is an important component of heating the local houses. The cabins further out of the community used for herding and fishing are heated using firewood. A small amount of solar panels are used in the region. Modern heating methods, and the use of modern gadgets and communication services, are totally dependent on electricity. The snowmobiles and quad bikes used for herding are also dependent on the fuel, supplied from the town of Ivalo.

New technology is used in reindeer herding and fishing activities. For instance, fish finders can be used to find fish underwater. Previously, electricity was generated via a portable generator in the roundup corrals. Nowadays, power lines that have been built near the corral site are used. Still, these practices rely mostly on human labour and household firewood collection. Snowmobiles alleviate some of the previous efforts connected to transportation across distances, but there is still a need for manual labour, especially in the roundup corrals. The rotational system of reindeer herding demands that there are shifts in the feeding patterns of the animals. People take turns delivering hay and pellets to the animals at the time of supplementary feeding. This decentralizes some of the energy needs, but the supplementary feeding itself is costly and affects the profitability of the reindeer herding practice.

Water

Every household has their own water supply and a localised wastewater system. The water is clean and drinkable. Seasonal cryosphere changes, in other words the freezing and melting of the lake and river ice, determine the availability of and access to open water. The communal water supply relies on a water cooperative, operated by the municipality of Inari. In total, the length of the water pipeline is 7 km and 50 households use it. The water supply comes from a point in Lake Inari that is approximately 700 metres east of the village. The community has no municipal sewer or wastewater services. Reindeer can find water in nature. In the wintertime, they get their drinking water from snow.

Waste

The main waste products in the community come from grocery packaging and other goods from supermarkets and construction. Nowadays, as a result of recycling, there is no non-biodegradable waste accumulating in the landscape. The recycling is divided into mixed waste, organic waste, newspapers and magazines, glass, plastic and bottles, and some hazardous waste, like batteries. Bottle recycling is popular in Finland, as consumers can return bottles to bottle banks and collect money for each returned bottle and can. The community members aim to recycle everything, especially composting food waste for local gardens. Hazardous waste is transported to Ivalo. Some community members see Ivalo as too far away to recycle everything efficiently, as the nearest collecting points for many goods are in Ivalo. Nellim used to have a waste dump, but now the bigger waste must be taken to Ivalo.

Changes in resource use efficiency over time

The tools, technologies and energy sources used by the community have changed over time. Most changes have happened over the past 100 years. The modernization of reindeer herding started back in the 1960s with the so-called "snowmobile revolution". The introduction of snowmobiles reflects the State's attempt to modernize herding practices to boost commercial meat production. The arrival of snowmobiles proliferated possibilities for the use of territories, yet created new dependencies on the cash economy, including fuel, technical parts and reparation. Lately, gas prices have increased, making reindeer herding a costly activity. Frequently, the costs of herding are higher than the income, forcing Inari Sámi families to find additional occupations on the side.

The community has gone through a transition from a self-governing ***siida***, with traditional land use and human-driven labour connected to reindeer herding, hunting and fisheries, to a modernized hybrid economy. With the advent of the State's presence, and their new governance over the natural resources, the characteristics of the ecosystems have shifted. Namely, the biggest ecological changes concern the hydroelectric regulation of Lake Inarijärvi and the large-scale clear-cut forestry that has altered the landscape. The alteration has changed the landscape from a natural north boreal taiga forest to a managed economic forest plantation zone used for pulp and paper industries.

An assessment of the resource use efficiency cannot be directly extrapolated by comparing traditional systems with modern natural resource management. Their scales and alterations of ecological systems operate in different contexts. One can look at the speed, scope and extent of the forestry operations as efficient. However, this activity has rather large negative implications for ecology, traditional occupancies and biodiversity. Traditional systems are "ineffective" as seen from a modernist view but contain a low ecological footprint and a capacity to deliver ecosystem services and goods for hundreds of years.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

The traditional indigenous culture of the Inari Sámi people is based on the free use of land, water and natural resources. Their way of life and identity are based on traditional livelihoods and have always depended on the communal and family use of land and water areas. The regeneration of ecosystems is a slow process in the traditional homeland of the Inari Sámi, thus they have become accustomed to practicing their livelihoods and culture over large areas, thereby protecting the sustainability and reproductive capacity of the environment.

Crop and livestock biodiversity

Since the primary traditional economy of the community depends on the wild uses of resources, there is very little in terms of crop or livestock alterations. In the 1960s, the community kept other livestock for dairy production, yet after such products became available in grocery stores, the demand for local production disappeared. Concerning reindeer herding, in the traditional system the Sámi have managed and developed genetic variations of the reindeer through exchanges and even selective breeding of certain types. Reindeer are domesticated, as wild deer no longer live within the Sámi area in Finland. The reindeer owned by the Inari Sámi in Nellim are considered northern forest reindeer.

Wild harvested plants and animals

Since the 1920s, the Metsähallitus, the Finnish State agency, imposed a more modern governance system for natural resources on the community. This entailed quotas for fishing, wild birds and other hunted animals. Since tourists have also started hunting in the Inari Sámi area, they have created tension with the local community because their numbers are included in the local quotas. There is also tension connected to the hunting of large animals such as wolverine and wolf. These are predators to the reindeers of the Inari Sámi, but are often considered important for biodiversity by mainstream society.

Ecosystem conservation and protection

The terrestrial ecosystems around Nellim are northern coniferous boreal forests with Scots pine dominating the landscape. Lake Inari has kept its high water quality in the main parts of the lake, but it is negatively affected by human land use in the catchment area, and also in the flow stream from the Paatsjoki River. These human activities include:

- ditching and subsequent loading of mercury, organic matter from industrial logging, and aggravated erosion in the catchment area;

- gold mining in the Lemmenjoki sub-catchment area and national park;

- road and infrastructure development around the lake;

- increased tourism and associated construction of hotels, in addition to the nutrient flows from the tourism activity to the lake;

- leaking events from past industrial sites such as the Peuravuono sawmill;

- large-scale hydroelectric regulation of the Paatsjoki River and the hydropower at Kirakka;

- airborne and climate-driven changes, such as nutrients, algal blooms and warm spells.

Terrestrial changes in the community include:

- large-scale industrial logging that alters the forest stands and structures and converts natural forests into monoculture plantations;

- large-scale forestry road construction that has altered and demarcated the former wilderness areas into smaller remaining stands;

- road and infrastructure development on land, especially power lines and the new road to Nellim going across reindeer areas;

- arrival of other species from southern areas as a result of climate change;

- degradation of reindeer pastures as a result of cumulative impacts of forestry and climate change.

The central traditional economy for the community, reindeer herding, suffers from the impacts of both human industrial land use and climate change. Lichen, reindeers' primary food in winter, can only be found in middle- to old-growth natural forests. Because these forests have been severely impacted, the need to feed the animals additional food in the winter has increased, adding to the costs of herding.

Through traditional governance of the pasture areas, herders can use their knowledge to determine the snow cover, forest structure, winds, predator situation and alternative pastures so that some areas could be left to grow back as land use rotates and shifts. However, these days, industrial forestry cuts the trees in several areas, changing the biodiversity, in particular affecting the species dependent on natural forests such as hanging lichen, birds and mammals. As some species die due to the lack of habitat, other populations seem to be increasing. This is the case for small predators, as there has become a lack of larger predators. Some of the wild species hunted, for instance taiga bean goose, have seen a drastic decline in population size since the 1980s. In addition, populations of mountain hare (*Lepus timidus* L., Leporidae) and willow grouse have collapsed. The reason for this is considered to be the shrinking of their natural habitat, caused by more intensive land use – forestry in particular.

Additionally, forestry uses techniques like tilling and churning of the soils to dry up what the industry considers as too wet conditions for tree growth. All these actions alter the soils and cause a range of impacts from erosion to release of mercury and organic loading downstream. Regeneration of grazing lands is a long-term process. A lichen stand usually takes over 20 years to grow back in a natural forest. Rewilding and restoration might be options, but they would have to follow decreased impacts from the industrial use of the land.

Changes in the conservation and protection of resources over time

From the time of settlement in what today is known as Lapland, and for centuries, bands of hunters and fisherfolk would occupy the lands surrounding Lake Inari and the Nellim area according to their seasonal cycles. This was before the community organised itself into ***siidas***. It is important to note that these ***siidas*** were autonomous, indigenous-controlled reindeer herding and hunting societies that have existed for a long period of time. The original ***siida*** system was destroyed through the colonial acts of the Swedish, Russian and Finnish nation-States. The semi-nomadic ***siidas*** of the Inari Sámi were forced into partial settlement around Aanaar-Inari as early as 1666. However, the semi-nomadic cycles of seasonal life continued through this period well into the twentieth century.

There are several important sources of data concerning the history of the use and settlement of the indigenous land. The Inari Sámi place names are one of them. Further, one can clearly see how the landscape is shaped by the community's wide variety of activities, including hunting and fishing areas that are adapted to the different species, seasonal cycles of land use and sacred places. The links every family has to their land use and pattern of occupancy constitute an important baseline for further studies of land use in the region.

The major change in natural resource management for the community happened in 1917 with the Finnish independence. What was previously Inari Sámi land became Metsähallitus or State lands. The lands were considered natural resources alongside the fish, animals, birds and other elements of the ecosystem. The forests around Nellim were not formally protected until the 1980s.

In the 1980s, the area was renowned for having the last old-growth forests in the region, thus a series of land use conflicts arose. Between 1985 and 1991, the proposed logging of the Kessi area and associated road construction triggered national resistance, which led to the establishment of ***erämaa*** or "wilderness" areas, which were weak conservation or traditional use areas. As previously mentioned, a second wave of land use conflicts also emerged from the late 1990s to 2009, when Metsähallitus intensified road construction, as well as logging operations around Nellim. Creating a conservation area did not solve this dispute. Rather, a social agreement between the herders and the Metsähallitus for 20 years demarcated parts of the pasture lands outside economic forestry actions. This was supported by the adoption of a view by the United Nations (UN) Human Rights Committee on the dispute that led to a moratorium on the logging activities in 2005.

Fishing activities have also changed throughout the years. The Inari Sámi used to have a seasonal indigenous governance system for their home area, through the ***varriistâllâm***, a small-scale nomadic society around Lake Inari. Integrated in the governance system was the preservation of fish stocks, which was carried out by leaving certain lakes and spawning areas to self-replenish over time – usually five years – and diversifying the catch sites across many lakes and in Lake Inari itself. Lake Inari is still regulated by Russia with a hydroelectric power plant, constructed in the Paatsjoki River in the Soviet Union, which started operating in the 1930s. The regulation impacted local species of fish, and some of the populations have decreased since the 1930s. In the 1990s, the community experimented with freshwater trawling, but it did not last long. The main catch from the trawling fleet was the human-introduced vendace (*Coregonus albula*). At first, the catches were major but soon both the ecological impacts of trawling and the boom-and-bust style of trawling closed the activity. Some fisherfolk still sell fish outside the village. The catches are mostly from standing winter and summer gillnets.

Increasing tourism has had a significant impact on the practice of the traditional livelihoods, particularly in reindeer herding and fishing. Examples of services provided to tourists in the area are snowmobiling and dog sled safaris. This activity forces reindeer to move away from their traditional grazing lands. Community members also consider tourist activities responsible for contaminating the water around Nellim, which is no longer drinkable. Fishing is also impacted by eutrophication of lakes. This can be noticed when fishing nets are pulled out of the lake, as they carry a bad smell that they did not have before.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of natural resources

Nellim is in the Inari Sámi homeland area, and the Sámi people have self-governance rights guaranteed to them as an Indigenous People by Finland's Constitution. Nellim belongs to the municipality of Inari, thus public administration includes local self-government from the municipality. However, villages have no legal status in Finland and are represented through associations. Nellim ***siida*** leaders are one elder and one younger reindeer herder. Sámi traditional livelihoods rely on the communities being de facto owners of their land areas and natural resources. The practicing of traditional Sámi livelihoods requires access to extensive areas of land and depends on the Sámi livelihoods being defined as the primary form of land use in these areas. However, the government still owns the land.

The Sámi are granted several rights through the nation's Constitution. Under section 17(3) of the Finnish Constitution (731/1999), the Sámi, as an Indigenous People, have the right to maintain and develop their own language and culture. Under section 121(4) of the same, in their native region, the Sámi have linguistic and cultural self-governance, as provided by an Act. However, despite the traditional livelihoods of the Sámi being considered an essential part of Sámi culture, there is no legislative provision enshrining the rights of the Sámi to land, water and natural resources. Instead, the Sámi are considered to have the same rights to land, water and natural resources as any other residents of the Sámi homeland.

In Finland, the State manages 90 percent of the land in the Sámi homeland. The State regulates the land use through legislation, the Act on Metsähallitus in particular. The Act establishes municipal advisory boards in the Sámi homeland region that are responsible for making proposals and statements on the use of land to the Metsähallitus. The prohibition to undermine Sámi culture is laid down in three different Acts: the Mining Act (2011), the Water Act (2011) and the Environmental Protection Act (2014). Furthermore, paragraph 9 of the Act on the Sámi Parliament, which refers to the "obligation to negotiate", requires State authorities to negotiate with the Sámi Parliament in all far-reaching and important measures that may directly, and in a specific way, affect the status of the Sámi as an Indigenous People. The obligations also count for measures that concern matters in the Sámi homeland such as the management, use, leasing and assignment of State lands, conservation areas and wilderness areas. This "obligation to negotiate" has been implemented in the case of the forest management department Metsähallitus and Inari Sámi reindeer herders. However, the negotiations have been challenging. The parties have implemented the Akwé Kon guidelines for good negotiations on questions of land disputes, mainly associated with logging and reindeer herding. However, no major breakthroughs have taken place due to diverging positions of the parties. Indeed, in 2002, the Nellim unit entered a legal and land-use conflict with the State forestry enterprise "Metsähallitus". Their logging activity complicated the herding, as it split the winter grazing lands and thereby aggravated reindeer nutrition. In 2005, three Inari Sámi herders from the Nellim unit filed a lawsuit against Metsähallitus for harming their livelihood. The conflict spiraled quickly into a battle between the Inari Sámi and the State, also with international engagement. The UN Human Rights Committee issued a first-ever moratorium on logging on specific parts of the Nellim area until the parties could reach an agreement. This Nellim case is of national significance, because it represents the only occasion in modern history when the United Nations has been able to secure land rights of the Sámi in Finland by overriding the State's decision. To this day, the moratorium is the only decision that has explicitly recognized modern Sámi rights and land use in Finland. In 2009, the two parties reached an agreement where the important lands for the Inari Sámi herders would be conserved for the next 20 years, as long as reindeer herding continues in Nellim. This was a significant victory, not only for Inari Sámi reindeer herding but also for the Sámi as Indigenous People.

Today reindeer herding is highly organised and regulated by State laws and European Union regulations. The reindeer husbandry area covers 36 percent of the entire surface of Finland, on almost the entire area of Lapland and part of the province of Oulu. The land is divided into 54 cooperatives. These cooperatives can vary from a few herders to hundreds. Competitive land use such as mining, and mainly forestry practised by the State of Finland, limits reindeer herding and hunting. Reindeer and small game animals do not like to stay in the logged areas and therefore move to other areas. Therefore, it is challenging to find food and lichen.

The cooperatives have strictly defined boundaries and the Reindeer Husbandry Act from 1990 regulates their operations, such as their function, fees, marking, slaughtering and roundups. The members of the cooperatives are the reindeer herders. Each cooperative has a chief of district, a vice-chief of district, a council and a treasurer. The chief of district is the manager and an official representative of the cooperative. The council manages the activities and must ensure that the reindeer herding law is obeyed. The cooperatives are controlled by the Reindeer Herders' Association, which operates under the supervision of the Ministry of Agriculture and Forestry. The Ministry determines the maximum number of reindeer, a number that is decided for a 10-year period. The current number is 203 700 reindeer, out of which 6 000 are for the Ivalo cooperative.

The cooperatives' responsibility is to obey the Ministry's regulations, thus regulate the number of reindeer. This is done through a yearly slaughtering plan, where the cooperative decides the number of reindeer to be slaughtered. Each year around 100 000 reindeer are slaughtered, whereas 120 000 to 130 000 calves are born.[12] Over the years, the Nellim Inari Sámi have established a dialogue to obtain the right to create their own herding and animal production goals. This has not yet been accomplished.

Changes in governance of natural resources over time

Starting from the 1600s, the traditional Sámi natural resource governance system was actively eroded and colonized by the Swedish and later by the Russian and Finnish States. By adapting and diversifying their options, the community was able to negotiate many of the pre-modern governance impositions until the 1920s. Then the large-scale timber and sawmill activities expanded in the region and in Nellim. The community became a gateway to northern Norway for timber floating and trade. Since Finnish independence in 1917, the region where Nellim is located was seen as a major area for timber industry and post-1944 for pulp and paper. This proliferated the use of clear cuts, land tilling and churning for the forest stands and eradicated the Sámi indigenous governance as a viable alternative. This process also removed all their rights to lands and waters from the community. However, in the 1980s, the Sámi communities responded to the large-scale logging activities with a campaign containing many demands concerning environmental and Sámi rights. As discussed, similar events occurred in the 1990s, 2000s and a settlement in 2009. These events can be considered modern-era attempts to reinstall Sámi governance systems on land use. The moratorium on logging issued in 2005 by the UN Human Rights Committee also falls under such a description as warned by the Finish government to stop the tree felling.

[12] For further information, see https://paliskunnat.fi/reindeer-herders-association/.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

A summarized assessment of 13 indicators of resilience is presented below.

1. Exposed to disturbance: The community has experienced some climate shocks that have had serious consequences to reindeer herding for some of the herders, including deaths of calves and lack of available food. According to the Intergovernmental Panel on Climate Change (IPCC, 2018), the average Arctic temperature has so far been rising at least twice as fast as the global temperature, as the ice and snow are melting, inducing the landscape to absorb instead of reflect the sun. Reindeer herding is highly dependent on climatic conditions, and as reindeer find less food, they produce less calves. This food insufficiency requires supplementary feeding, inducing large costs on the community.

2. Globally autonomous and locally interdependent: The community has high self-sufficiency for food such as reindeer and game meat, fish, wild edibles and vegetables. Community members do not exchange food with other communities anymore. Nellim sells fish, wild berries and mushrooms to restaurants in Ivalo. Most families in the community consume local products for the majority of their diet.

3. Appropriately connected: The local grocery store in the village was closed down, making it more difficult to access market food as one must have a car. However, there is a collaborative spirit amongst the community members, so they help each other out. Access to the grocery store is good year-round, given the newly constructed road. Reindeer herders have access to domestic markets to sell meat. The community has access to different buyers for their food produce.

4. Socially self-organised: A handful of Inari Sámi families organise reindeer herding activities amongst themselves. Nellim ***siida*** belongs to a larger Ivalo cooperative, thus it is under the cooperative's regulations. Concerning natural resource management, the State is responsible for governance, and, according to the Act on Metsähallitus, the management shall be adjusted to ensure the possibility of the Sámi people to practise their culture. The management shall also fulfill the obligations laid down in the Reindeer Husbandry Act. There are several challenges connected to the implementation of these acts, with regards to interpretation of definitions from the two parties.

5. Reflective and shared learning: The community has recovered well from past disturbances. The traditional knowledge of the community is considered one of their most important assets to maintain well-being. In the case of the forestry conflict in the 2000s, the Inari Sámi herders stuck together, trusting that their knowledge and viewpoint were valid. This paid off in terms of the moratorium issued by the UN Human Rights Committee, and the subsequent agreement in 2009. However, the Inari Sámi are ridiculed for taking stands that diverge from mainstream discourses and face large challenges in having their voices heard.

6. Honours legacy: Traditional practices are still maintained, yet today they are being mixed with contemporary technologies. However, the language has suffered significantly due to the assimilation processes. Recent efforts such as Sámi media and workshops have attempted to restore the language, but they have proved to be challenging. The elders still hold a significant role in the Nellim community, and their experiences and stories are well respected and listened to. Nellim community traditions are best integrated and preserved in the Inari Sámi-style reindeer herding, the seasonal fisheries of the families, and some aspects of the gathering economies. To help the traditional practices thrive as in previous times, the main pressures from the industries should decrease or be removed.

7. Builds human capital: Traditional knowledge is maintained and transmitted through traditional livelihoods. These transmissions go from the elderly to youth, who are still interested in traditional practices and knowledge. Traditional knowledge is also taught in the Sámi Education Institute, promoting Sámi culture and languages throughout the Sámi area. Institutions to support human health and social services for the community members are provided by the municipality, and everyone is entitled to adequate social and health services. However, social and health services should be more widely available in Sámi languages.

8. Coupled with local natural capital: The food system is well coupled with the natural capital, given the low external input from outside the system for nutrients and energy. There are few signs of degradation of natural resources and little waste accumulation in the landscape. However, reindeer herding is affected by a decrease of lichen caused by soil degradation in areas of intensive logging. The bottom of Lake Inari has also seen some degradation.

9. Ecologically self-regulated: Ecosystems can regenerate naturally as the community lives and harvests according to the seasonal cycles. The community does not over-harvest nor exploit the natural resources as their livelihoods and culture depend on them. Further, community members protect ecosystems and wildlife by fighting against the intensive logging in the community areas. Securing land and water rights would support the Inari Sámi food system's ability to reach an optimal efficiency and even more enhanced self-regulation capacity.

10. Functional diversity: The Inari Sámi community manages to respond to the natural environment in several ways, for example in cases where reindeer struggle to feed due to excessive snow amounts or ice cover. Their redundancy of food groups also ensures their capability of sustaining themselves throughout the year.

11. Optimally redundant: The community enjoys a diversity of foods from farms, reindeer herding, the lake and the surrounding environment, as well as the market. With regards to climate change, wild berries, mushrooms and farmed vegetables are particularly vulnerable to climate hazards. To overcome periods of food insecurity, if one food group is unavailable or the amount is reduced, the community can consume more of other food groups. Several of the community's food groups are based on several species, increasing the resilience of the food system. However, with regards to hunting, there are few species, making this traditional practice more vulnerable.

12. Spatial and temporal heterogeneity: The spatial and temporal distributions of the Indigenous People's food system reflect the seasons and events in nature. The specific small-scale nomadism of ***varriistâllâm***, as co-developed with Lake Inari, is an example of adaptation to northern nature and the seasonal cycles over long periods of time.

13. Reasonably profitable: The food system provides diverse opportunities of income generation through the selling of meat, fish, berries and mushrooms on different markets. Overall, the price that the community members get for their products is fair, although production costs rise yearly. However, even though reindeer herding might be the only traditional Sámi livelihood that is profitable by itself, herders still rely on subsidies from the European Union and, when the herds are impacted by predators, from the State.

SECTION 3
CONCLUSIONS AND FUTURE PROJECTIONS

1. FOOD SYSTEM SUMMARY

Outputs and inputs

The community's main food sources come from reindeer herding, fishing, hunting and wild berry picking. Along with the traditional livelihoods, purchasing food from grocery stores has also become normal. Of the community's total food consumption, today approximately 30 percent comes from the market, including dairy, grain products, vegetables and fruits. Potato is grown and cultivated in the community as a summer crop and consumed over the winter months. Grocery stores are found in Ivalo, a larger town 42 kilometres from Nellim. People who do not herd reindeer usually buy meat from the locals.

The Nellim food system is a hybrid system, utilizing certain modern tools and elements, such as the water cooperative, electricity, freezers, and more effective gillnets, and the community mixes them with their unique cultural practices and knowledge, such as the Inari Sámi style of reindeer herding, cultural fisheries and gathering activities.

2. HIGHLIGHTS OF SUSTAINABILITY ASSESSMENT

The indigenous culture of the Sámi people is based on the free use of land, water and natural resources. The ecosystem regeneration is slow in the traditional homeland of the Inari Sámi, thus they have become accustomed to practicing their livelihoods and culture over wide areas, allowing for sustainable use of resources. The Sámi people have a self-government guaranteed to the Sámi as an Indigenous People by Finland's Constitution. However, the State manages the land use in the Nellim area.

Several challenges threaten the sustainability of the Inari Sámi community. Increasing tourism activities have significant impacts on their practice of traditional reindeer herding and fishing. Further, industrial logging occupies reindeer herding areas.

The food production capacity of the traditional Inari Sámi food system is sufficient, yet complemented with groceries purchased from grocery stores. In general, the community members do not experience conditions of food insecurity, as nature and its products are diverse and abundant. The food consumed by the community is also adequate for nutritional needs.

Currently, the largest threat to the community's food security comes from hazards induced by climate change. Wild edibles like berries and mushrooms are vulnerable to climatic changes. Further, it can negatively impact reindeer herding, hunting and fishing. Some changes are already visible, but the community members are not always sure whether climate change is the cause. There is less lichen, and it is more unavailable to reindeer due to harder layers of ice. The summer temperatures have also risen above normal during the past few years, and in general the seasonal calendar is changing. In addition to climatic events, the exploitative land use activities in the area have degrading effects on the community's sustainability, such as industrial logging, gold mining and road construction. The activities cause loss of grazing lands, loading of organic matter in the lake, decreased soil quality and degradation of the lake bottom ecosystem. In addition, the logging industries have induced a decline of wildlife habitat, subsequently leading to smaller game populations.

The transmission of traditional knowledge is key for the community's sustainability. Elders have a significant role in advising and leading the community based on their experiences. The traditional knowledge is maintained and transmitted through traditional livelihoods based on nature, as well as the Inari Sámi people's relationship with nature.

3. FUTURE PERSPECTIVES

The community identifies their well-being as based on several elements. First, well-functioning social structures and services in the community must be in place, using the Inari Sámi language. Second, community members must have wide respect and tolerance of the three cultures within the community, and there must be joint and democratic decision-making processes. Third, women, youth, elders and other marginalized groups are entitled to secure and thriving environments for schooling, working and maintaining the Inari Sámi way of life.

The major concern of the community is that forestry activities will further increase and consequently lead to a decrease of reindeer herding. They further foresee that tourism activities will continue to increase. Some community members are also concerned about what the renewed road will bring to the community. Normally road construction in the Finnish peripheries has led to intensifying natural resources extraction such as mining and forestry. An improved road system is also seen as a gateway that will increase social issues, such as narcotics and alcohol in the community, as well as the major tourism operations. A future potential development plan also includes the Arctic Railway. Initially scheduled for 2018-2019, the plan is currently in hiatus.

Traditional life and livelihoods will inevitably change along with changes in the landscape, production and diets. Factors such as changing soil quality, eutrophication of lakes, decrease of and eventual loss of game species and some fish population, and a drastic decrease of reindeer herding areas will cause large changes in the traditional food system in the future. Reindeer herding is particularly vulnerable, as there is a lack of younger people willing to continue the practice.

Members of the community are confident that nature will still provide berries and mushrooms. However, industrial forestry negatively impacts the growth of berries and mushrooms, in addition to the water quality downstream. Fishing will continue to be one of the community's main practices, yet the population of some traditional fishing species, such as trout, has drastically decreased whilst other species, such as northern pike, has increased. Hunting will continue to be practised, but it is difficult to see whether there will be sufficient game animals to hunt, as some of the small game populations have drastically decreased in the past years.

The main challenge for the maintenance of the community is potentially the migration of youth. Nellim does not have many children and young people living in the village anymore. Life in the community is challenging and the uncertain future of reindeer herding has caused many young people to abandon traditional livelihoods and move away from the village. However, the younger generations still living in the village would like to continue traditional livelihoods and food systems. There is a general sense amongst the community members living in the village that they would like to maintain their traditions related to their local food system, foster the natural habitat, and keep it healthy and intact.

4. CONCLUSIONS

The research conducted demonstrates that the Inari Sámi traditional food system has survived largely as a result of the continuation of traditional livelihoods, such as reindeer herding, fishing, hunting and gathering. Traditional Inari Sámi foods include reindeer meat, fish, wild berries and game meat. Traditional dishes and cooking methods have not changed

Ice fishing on Lake Inari

significantly in the past 100 years. In general, reindeer meat is shown to be the most important source of protein, even though many community members also consume fish. Wild berries, such as lingonberries and cloudberries, constitute important sources of vitamins and minerals. In addition to traditional food sources, community members supplement their diets with food from grocery stores.

Indigenous traditional knowledge is key for the maintenance of traditional land uses. Inari Sámi culture is also integrated in what is left of the Inari Sámi language, for instance the ways they have named different fish and reindeer – whitefish especially being a significant species in the community over hundreds of years. The Nellim Sámi have managed to maintain their traditional land use practices over a long period of time. Whilst the starting point may have been a total of 15 indigenous Inari Sámi ***siidas*** around Lake Inari in prehistoric times, we know that the contemporary population was able to maintain their ***varriistâllâm*** specific seasonal land uses well into the 1900s. This can be considered an endemic indigenous governance of lands and waters. A century of modernization and exploitation of natural resources, also disturbing the reindeer herding, has not destroyed the traditional herding in the community. It co-evolved and survived, and is now enmeshed into the State's natural resource management.

Nevertheless, the general lack of recognition of the traditional Inari Sámi reindeer husbandry and the competing use of land threaten the Inari Sámi culture. A settlement concerning the question of land and water rights, integrating the recognition of the traditional Sámi reindeer herding husbandry, would require new national legislation that considers all cumulative impacts on Sámi livelihoods. In times of increasing climatic hazards and increased resource extraction, it is pressing to put in place such legislation to ensure the sustainability and survival of the traditional Inari Sámi livelihoods.

CHAPTER 3

Treasures from shifting cultivation in the Himalayan's evergreen forest

Jhum, fishing and gathering food system of the Khasi people in Meghalaya, India

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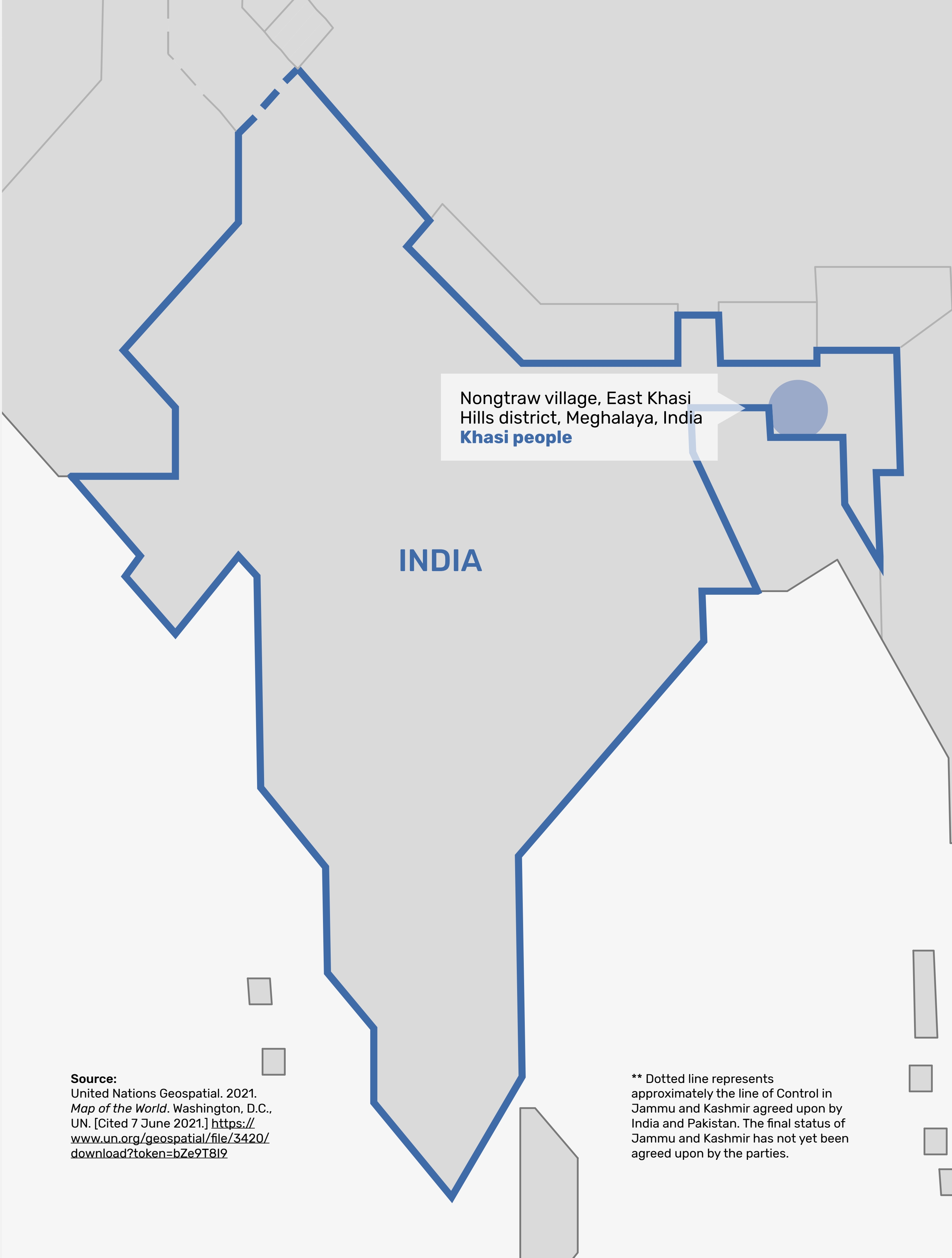
Khasi women from Nongtraw descending stairs with handmade baskets.



Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

** Dotted line represents approximately the line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

“Burom ia ka mei ramew bad ka hi kan sa theh ia ki jingkyrkhu ha ngi.”

“Respect Mother Earth and she will shower her blessings on us.”

Richard Ranee, custodian farmer and artisan in Nongtraw.

AT A GLANCE

This study characterized the food system of Nongtraw Village in Meghalaya, India that is inhabited by people of the Khasi ethnic group, which is one of the dominant groups of the northeast region of the Indian subcontinent that follows a matrilineal system based on matriarchal values. The community sources food from ***jhum*** (shifting cultivation), ***kper*** (home gardens), wild sourcing and the market. The ***jhum*** lands and the forests are communally managed. A high diversity of crops is produced (more than 60 were named), including a rich heritage of indigenous and traditional varieties. Access to local resources is vital for local food security and diet quality, since the landscape provides 50 to 60 percent of local diets and approximately 60 percent of income derives from crops and livestock.

Local markets are important destinations for sale of food and non-food products from the community, contributing to household income. Access to land has so far not been a major issue, but since 2016, the Government has started to restrict local people of the practice of shifting cultivation, which could have an adverse affect on local food production in the future. Decline in soil fertility and scarcity of land are other challenges faced by the community. People are of the opinion that local diets are adequate for fulfilling their nutritional needs but they are not completely immune to food insecurity, which has been experienced as a result of extreme weather conditions in recent years. Markets are reasonably accessible and stocked with a diversity of locally produced nutrient-dense foods, but prices can be a barrier. Local systems of governance, which have persisted from pre-colonial times, that are inclusive and led by respected elders are a strength in the community that support land access, sustainable use of natural resources and development in alignment with local values.

SECTION 1 COMMUNITY AND FOOD SYSTEM PROFILE

1. GEOGRAPHIC CONTEXT

Nongtraw is a village located in the Khatarshnong-Laitkroh Community Development Block of East Khasi Hills District, Meghalaya, India. The village is situated in the Cherrapunjee region, a highly dissected plateau along the southern margins of the Meghalaya Plateau in the northeast part of the country. Nongtraw lies along the mid-slope of a deep gorge. There is no road access to the village, so the only way to reach or leave the village is to climb 3 000 steps. Several streams are near the village, with the most important being Wahsohra, situated in the valley below.

This region receives one of the highest rainfalls in the world, with average annual rainfall of more than 1 000 cm (Prokop and Walaus, 2003; Soja and Starkel, 2007). The region experiences a cold temperate climate with foggy winter months. January is the coldest month with average temperatures just above 10 °C and June is the hottest month with maximum temperature approaching 25 °C (Quadir *et al.*, 2004). The main vegetation in the study area is a subtropical evergreen forest. The upper canopy is occupied predominantly by *Castanopsis* spp., *Magnolia insignis* Wall., Magnoliaceae, *Lithocarpus elegans* (Blume) Hatus. ex Soepadmo, Fagaceae, and *Vitex* spp., Lamiaceae, and the lower layer is composed of *Haldina cordifolia* (Roxb.) Ridsdale, Rubiaceae, *Daphne involucrata* Wall., Thymelaeaceae, and *Millettia glaucescens* Kurz, Fabaceae (Prokop, 2004). Large bamboo species like *Dendrocalamus hamiltonii*, *Dendrocalamus giganteus* Wall. ex Munro, Poaceae, and *Bambusa bambos* (L.) Voss, Poaceae are also common (Prokop, 2004). The upper slopes are dominated by *Pinus kesiya* Royle ex Gordon, Pinaceae with some broad leaf species like *Acacia dealbata* Link, Fabaceae, *Quercus griffithii* Hook. f. & Thomson ex Miq., Fagaceae, and *Schima* sp., Theaceae (Prokop, 2004).

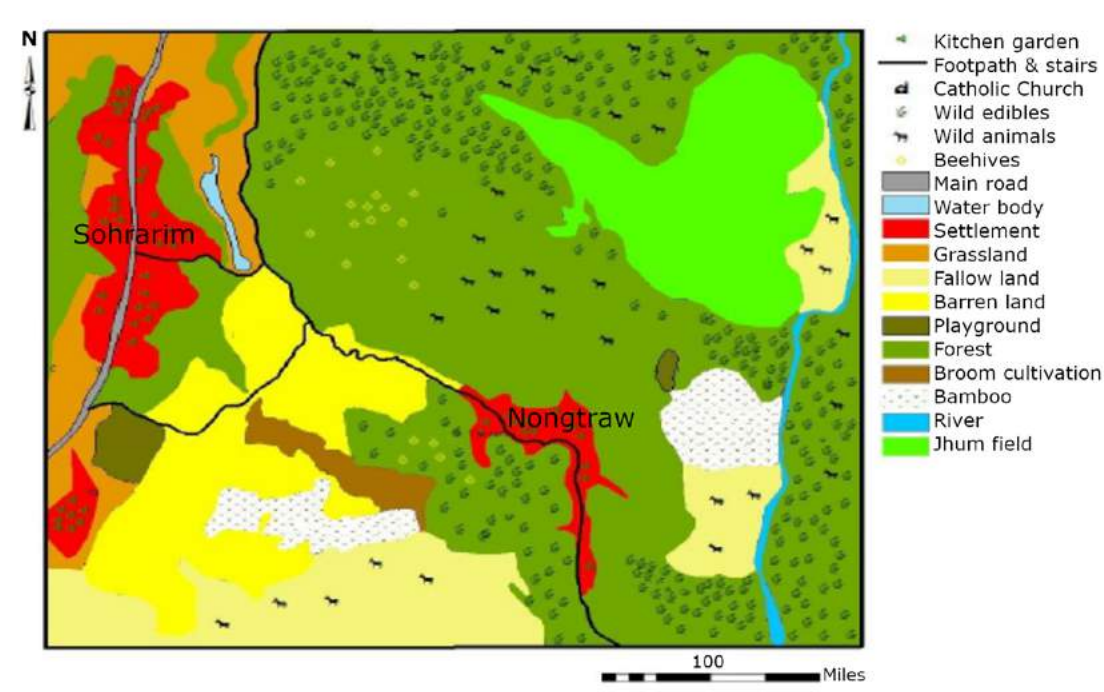
2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

Nongtraw has a population of 250 persons residing in 40 households, according to the latest records by the Accredited Social Health Activist (ASHA) of Nongtraw. Current residents stay in five localities: Khliehshnong, Pdengshnong, Mawsohlah, Wahshatroh and Diengmuiñ.

The Khasi make up almost 100 percent of the population in the Khatarshnong-Laitkroh Community Development Block except for a small number of Bengali, Assamese, Punjabi and Bihari in the Cherrapunjee/Sohra town (Office of the Registrar General and Census Commissioner of India, 2011). Nongtraw, however, is an exclusively Khasi village. The Khasi are an Austro-Asiatic community composed of seven ethnic groups: Khynriam, Jaintia, Maram, Bhoi, Lyngngam, War and Diko (Gurdon, 1914; Nongkynrih, 2007). In this village, only the first three groups are found, with the Khynriam being the main ethnic group. The groups themselves are made up of different clans. Nongtraw has 25 clans: Rani (Mynrieng), Khonglam, Diengdoh, Khongsit, Riahtam, Dohling, Kharshiing, Khongngain, Nongrum, Rapsang, Wahlang, Pyrtuh, Lyngdoh Nongum, Mawpat, Kurbah, Shabong, Khongrymmai, Nongkynrih, Mylliem umlong, Sawian, Thongni, Sohkhlet, Maslai, Lyngdoh Nonglait and Shanpru.

Different Khasi communities have their own dialects. Presently, in Nongtraw, the older generations are the only ones who speak the local dialect. Nongtraw dialect can be used to communicate with nearby villages, but during interaction with upland communities, they use the Sohra dialect. This latter dialect is widely

FIGURE 3.1. Landscape of Nongtraw



Source: Google map, 2018, edited by the authors with the support from community participants, 2018.

used as the lingua franca within the Khasi-Jaintia areas of the State and is taught as part of the school curriculum, along with English (Marak and Mawroh, 2020). The predominance of this dialect arose because Sohra was the first base for the English in Khasi-Jaintia Hills and it was the dialect used for the first Khasi translation of the Bible. Because of marriage, schooling and involvement in daily wage labour outside the community, new words have gradually entered the local dialect from English, Sohra, Hindi, Maram (dialect from West Khasi Hills), and Khatarshnong (dialect of neighbouring communities from the opposite watershed), and it gradually transformed. The dilution of the original dialect has become particularly intense since 2000. Other than four or five people in the community who still hold onto the traditional faith, all have adopted Christianity. They belong to the Catholic denomination.

The Khasi are a matrilineal society, in which land is owned and inherited by women and clan lineage is traced through the mother's side (Gurdon, 1914). The youngest daughter plays an important role. She stays back with her parents and gets custodianship of the ancestral property (Mukhim, 2008). People in the community live in both joint as well as nuclear families. In the latter, the father and the mother live with their youngest daughter, who, when married, brings her husband to stay with the family. The other siblings eventually move out of their parent's house and build a new house for themselves. Within households, there is a demarcation between men and women's roles. The man is the rice giver and money earner, performing the heavier tasks. Women perform household chores like cooking, feeding, cleaning and washing. They are the ones who handle the household's marketing concerns, buying or selling. They

Jhum fields in Nongtraw village.

are also responsible for the cleanliness of the community and its surroundings. The youth and children in the community are involved in many activities, including going to school, helping parents at home or in the field, helping elders with any function in the community, and collecting firewood from the fields and the forest.

Traditionally, Khasi Hills has been divided into administrative units known as the ***Syiemships***, which can be equated to the historic princely states of the Khasi Hills (Rao, 1984; Lyngdoh, 2016). Nongtraw is part of the ***"Sohra Syiemship"***. The ***Rangbah Shnong*** is the leader of the community who is elected by a voice vote in the ***Durbar*** (General Council of the community). The Executive Committee is the main body that executes the decisions of the General Council (i.e. village ***Durbar***). In addition to the Executive Committee, many other committees are set up to assist in implementing the various schemes and programmes introduced by the Government and other non-governmental organizations (NGOs). After the ***Rangbah Shnong***, Members of State Legislative Assembly (MLA) and Members of Autonomous District Councils (MDC) are other important actors for bringing development to the community.

3. LOCAL FOOD PRODUCTION

The food-producing activities in Nongtraw are agriculture, livestock rearing, some amount of fishing, and collection of wild edibles from the forest. In the local perception, food is divided on the basis of where it is sourced, which means ***jingbam na lyngkha*** (from the ***jhum*** field), ***jingbam na kper*** (homestead garden), ***jingbam na khlaw*** (forest) or ***jingbam na wah*** (rivers).

Crops

All the households in Nongtraw are engaged in agriculture. The most important form of agriculture that people follow is ***jhum*** wherein a new plot of land is cleared every year for farming. The old plots are allowed to remain fallow for a period of 7 to 10 years, after which they are again put under cultivation. Crops grown in the ***jhum*** field include tubers like yam (*Colocasia esculenta*), potato (*Solanum tuberosum*), sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), other tubers like ***phan sawhoin, phan jata*** and ***phan shriew*** (*Solanum* sp.), and ***sohlah***; vegetables such as: ***jaïing, jarain*** (*Fagopyrum acutatum*, buckwheat), ***jali*** (*Gynura nepalensis*), ***sla phan karo*** (*Ipomoea* sp.), ***jyllang*** (*Allium tuberosum*, garlic chives), mustard leaves (*Brassica juncea*), cucumber (*Cucumis sativus*), etc. Fruit trees are also found in the ***jhum*** fields with the important fruits being ***sohbrap*** (passion fruits, *Passiflora edulis*), ***soh pdok*** (*Solanum myriacanthum*), papaya (*Carica papaya*), ***sohtrun*** (*Ananas comosus*, pineapple), etc. The other important crops cultivated in the ***jhum*** fields are maize (*Zea mays*), millets (*Eleusine coracana*), Job's tears (*Coix lacryma-jobi*), a small amount of sugar cane (*Saccharum officinarum*) and ***kait khar*** (*Musa* sp., banana variety), amongst others.

Jingbam na kper or crops grown in kitchen gardens is another important category of crops identified by the community during the thematic discussions. Here, crops are mostly fruits like banana, ***sohiong*** (*Prunus nepaulensis*, Khasi cherry), ***sohshang*** (*Elaeagnus latifolia*, silverberry), ***sohpyriam*** (*Psidium guajava*, guava), ***sohlyngdkhur*** (*Morus australis*, mulberry), ***sohphie*** (*Myrica* sp., box myrtle), passion fruit and ***sophan*** (*Artocarpus heterophyllus*, jack fruit). Other important crops grown in the kitchen garden are, for instance, sugar cane, bay leaf (*Laurus nobilis*) and mustard leaves.

TABLE 3.1 . List of cultivated foods: crops, planted trees and other cultivated foods

Group	Khasi name	Scientific name	English name
Condiments, seasonings, snacks, and sweeteners	***shynrai***	*Curcuma longa* L., Zingiberaceae	Turmeric
	sla tyrpad	*Laurus nobilis* L., Lauraceae	Laurel
	pudina	*Mentha* sp., Lamiaceae	Mint
	sohmluh	*Rhus chinensis* Mill., Anacardiaceae	Chinese sumac
	sohpai; pai	*Saccharum officinarum* L., Poaceae	Sugarcane
	sying	*Zingiber officinale* Roscoe, Zingiberaceae	Ginger
	sying makhir	*Zingiber rubens* Roxb., Zingiberaceae	Variety of ginger
Fruits and juices	***sohtrun***	*Ananas comosus* (L.) Merr., Bromeliaceae	Pineapple
	sophan	*Artocarpus heterophyllus* Lam., Moraceae	Jackfruit
	sohkymphor	*Carica papaya* L., Caricaceae	Papaya
	sohjew	*Citrus × aurantium* L., Rutaceae	Lime
	lemon	*Citrus limon* (L.) Osbeck, Rutaceae	Lemon
	sohmongor	*Citrus maxima* (Burm.) Merr., Rutaceae	Pomelo
	sohmad	*Citrus medica* L., Rutaceae	Citron
	sohniamtra	*Citrus reticulata* Blanco, Rutaceae	Mandarin orange
	orange	*Citrus sinensis* (L.) Osbeck, Rutaceae	Orange
	sohbaingon dieng	*Cyphomandra betacea* (Cav.) Sendtn., Solanaceae	Tree tomato
	sohshang	*Elaeagnus latifolia* L., Elaeagnaceae	Silverberry
	sohlyngdkhur	*Morus australis* Poir., Moraceae	Mulberry
	kait mon	*Musa acuminata* Colla, Musaceae	Banana
	kait	*Musa* sp., Musaceae	Banana
	sohphie	*Myrica esculenta* Buch.-Ham. ex D. Don, Myricaceae	Box myrtle
	sohbrap	*Passiflora edulis* Sims, Passifloraceae	Passion fruit
	sohplom	*Prunus domestica* L., Rosaceae	Plum

TABLE 3.1. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Khasi name	Scientific name	English name
Fruits and juices	***sohiong***	*Prunus nepaulensis* (Ser.) Steud, Rosaceae	Khasi cherry
	sohphareng	*Prunus persica* (L.) Batsch, Rosaceae	Peach
	sohpyriam	*Psidium guajava* L., Myrtaceae	Guava
	sohphoh	*Pyrus communis* L., Rosaceae	Pear
	sohngang	*Solanum americanum* Mill., Solanaceae	Night shade blackberry
	sohbuitrieh	Unknown	Unknown
	sohkpu	Unknown	Unknown
	sohkyrwiat	Unknown	Unknown
	sohmyndong	Unknown	Unknown
Nuts and seeds	***neilieh***	*Perilla frutescens* (L.) Britton, Lamiaceae	Perilla seeds
Pulses	***prisbin***	*Phaseolus vulgaris* L., Fabaceae	French bean
	ri	*Phaseolus vulgaris* L., Fabaceae	Common bean
	motor	*Pisum sativum* L., Fabaceae	Peas
	rymbai ja	*Vigna umbellata* (Thunb.) Ohwi & H. Ohashi, Fabaceae	Rice bean
Starches	***sohriew***	*Coix lacryma-jobi* L., Poaceae	Job's tears
	shriew; riew (various varieties)	*Colocasia esculenta* (L.) Schott, Araceae	Cocoyam
	krai	*Eleusine coracana* (L.) Gaertn., Poaceae	Finger millet
	phan (various varieties)	*Ipomoea batatas* (L.) Lam., Convolvulaceae	Sweet potato
	phan dieng	*Manihot esculenta* Crantz, Euphorbiaceae	Cassava
	alarut	*Maranta arundinacea* L., Marantaceae	Arrow root
	phan tlang	*Solanum* sp., Solanaceae	Winter potato
	phan (various varieties)	*Solanum tuberosum* L., Solanaceae	Potato
	sohlal	Unknown	Wild potato
	riewhadem	*Zea mays* L., Poaceae	Maize
Vegetables	***piat***	*Allium cepa* L., Amaryllidaceae	Onion
	lasun	*Allium sativum* L., Amaryllidaceae	Garlic
	tyrso	*Brassica juncea* (L.) Czern., Brassicaceae	Mustard leaves
	kubi; phulkubi	*Brassica oleracea* L., Brassicaceae	Cabbage; cauliflower
	coriander	*Coriandrum sativum* L., Apiaceae	Coriander
	sohkhia	*Cucumis sativus* L., Cucurbitaceae	Cucumber
	pathaw	*Cucurbita moschata* Duchesne, Cucurbitaceae	Pumpkin
	biskot	*Cucurbita* sp., Cucurbitaceae	Pumpkin
	salad	*Lactuca sativa* L., Asteraceae	Lettuce
	sohla	*Lagenaria siceraria* (Molina) Standl., Cucurbitaceae	Calabash
	shiahkrot	*Smilax perfoliata* Lour., Smilacaceae	
	sohsaw	*Solanum lycopersicum* L., Solanaceae	Tomato
	sohbaingon dieng	*Solanum melongena* L., Solanaceae	Brinjal

Livestock

Food production from ***jhum*** and homestead gardens is supplemented by livestock rearing. All the households rear chickens (*Gallus gallus* L., Phasianidae). These chickens roam around the premises of the house during the daytime and sleep in the tree at night. Some of the eggs are consumed at home and the rest are sold at the market. The chickens are given cooked as well as uncooked rice, maize and millet. They are fed in the morning and then set free to roam and eat the waste food from their neighbouring houses and any insects they find. In addition to chickens, 15 households practise piggery, which is an important income source. The paddocks for keeping the pigs (*Sus scrofa* Erxleben, Suidae) are built on the premise of the household. They are fed cassava, potato, rice and wild banana mixed in ***um sait khaw*** (leftover water after washing of rice) with ***skop sniang*** (husk). Wild edibles like buckwheat, wild banana, ***jali*** (*Gynura nepalensis*), ***jatwat, jakhi*** and ***jasim*** are also fed to the pigs twice a day, morning and evening.

Beekeeping is another important activity for some households. Big logs are used for keeping the beehives. Another method known as ***sympa*** allows the bees to make their hive on a standing tree in the forest. After the hive is completed, the beekeeper takes the beehive home for upkeep and harvesting. Beekeeping households can harvest around 40 litres of honey from two beehives during spring and autumn.

Wild edibles

Connected with the ***jhum*** are the forests from where there is ***jingbam na khlaw*** (foods from the forests). Wild fruits like ***sohlymwai***, ***sohum*** (*Syzygium cumini*, Java plum), ***soh thylliang, sohliang, sohkhlot, soh khyrwiah, soh jrumshiah, soh-pong, sohshiah*** (*Rubus ellipticus*, Himalayan raspberry), ***sohmad*** (*Citrus medica*, citron), ***sohkhawiong*** (*Rubus niveus*, snowpeak raspberry), ***soh khaw-iong*** (*Amomum aromaticum*), ***sohpen*** (*Eriosema himalaicum*, Chinese bush carrot) and wild edibles like buckwheat, ***jali, jakhria, ka nub, pashor kait, tyrkhang iong*** (edible fern), ***jaïing*** and so on are important food items that people collect from the forest. These are found in greater numbers in summer as compared in winter. Honey is also collected from beehives from the forest. Wild edibles like ***jaïing*** and garlic chives are important products sold to the market by the community.

TABLE 3.2. List of wild plants used as food

Group	Khasi name	Scientific name	English name
Fruits and juices	***soh khaw-iong***	*Amomum aromaticum* Roxb., Zingiberaceae*	
	sohthri	*Calamus erectus* Roxb., Arecaceae	
	sohot	*Castanopsis indica* (J. Roxb. ex Lindl.) A. DC., Fagaceae	Chestnut
	sohmad khlaw	*Citrus medica* L., Rutaceae	Citron
	sohshan	*Duchesnea indica* (Andrews) Teschem., Rosaceae	Indian strawberry
	sohpen	*Eriosema himalaicum* H.Ohashi, Fabaceae	Chinese bush carrot
	soh liia	*Myrica nagi* Thunb., Myricaceae	Bay berry
	sohshiah	*Rubus ellipticus* Sm., Rosaceae	Golden/yellow Himalayan raspberry
	sohkhawiong	*Rubus niveus* Thunb., Rosaceae	Snow peak raspberry
	sohpdok	*Solanum myriacanthum* Dunal, Solanaceae	
	sohum	*Syzygium cumini* (L.) Skeels, Myrtaceae	Java plum
	sohlarpung	*Tetrastigma obovatum* (M.A. Lawson) Gagnep., Vitaceae	Grape variety
	sohjriamshia	Unknown	

TABLE 3.2. List of wild plants used as food

Group	Khasi name	Scientific name	English name
Fruits and juices	***sohkhlot***	Unknown	
	sohkhyrwiah	Unknown	
	sohkyrsiew	Unknown	
	sohkyrwoh	Unknown	
	sohliangkiang	Unknown	
	sohlymwai	Unknown	
	sohlyngksang	Unknown	
	sohnub	Unknown	
	sohpong	Unknown	
	sohsameh	Unknown	
	sohthylliang	Unknown	
Insects and insect products	***niangphlang***	*Lepidoptera* sp.	
	niang kait	Unknown	
	niangkynthah	Unknown	
	dkhew	Unknown	
	kber	Unknown	
	kir	Unknown	
	lwai	Unknown	
	niang krai	Unknown	
	niang sbai	Unknown	
	niang sohriew	Unknown	
	nianglyngkta	Unknown	
	nianglhur	Unknown	
	niangktang	Unknown	
	shalyngur	Unknown	
	sohlah	Unknown	
	jaïing	Unknown	
	tangduma	Unknown	smoking pipe plant
	khritwait	Unknown	
	jatwat	Unknown	
	jakhi	Unknown	
	jasim	Unknown	
	trykhang	Unknown	
	pashor kait	Unknown	wild banana
	ka nub	Unknown	
	jalyngiar	Unknown	
	latyrkaiñ	Unknown	
Mushrooms	***tit lung***	*Lactifluus volemus* (Fr.) Kuntze, Russulaceae*	Mushroom
	tit thlong	*Turbinellus floccosus* (Schwein.) Earle ex Giachini & Castellano, Gomphaceae	Mushroom
Vegetables	***jaut***	*Allium hookeri* Thwaites, Amaryllidaceae	Hooker chives
	jyllang	*Allium tuberosum* Rottler ex Spreng., Amaryllidaceae	Garlic chives
	sla jajew	*Begonia roxburghii* A. DC., Begoniaceae	East Himalayan begonia

TABLE 3.2. List of wild plants used as food

Group	Khasi name	Scientific name	English name
Vegetables	***batpyllon***	*Cyclea bicristata* Diels, Menispermaceae	
	lungsiej	*Dendrocalamus hamiltonii* Nees & Arn. ex Munro, Poaceae	Hamilton's bamboo
	jarain	*Fagopyrum acutatum* (Lehm.) Mansf. ex K. Hammer, Polygonaceae	Buckwheat
	jali	*Gynura nepalensis* DC., Asteraceae	
	jamyrdoh	*Houttuynia cordata* Thunb., Saururaceae	Fish mint
	sla tyrkhang	*Nephrolepis cordifolia* (L.) C. Presl, Nephrolepidaceae	Sword fern
	jatira	*Oenanthe javanica* DC., Apiaceae	Water celery
	jakriah	*Rhynchotechum ellipticum* (Wall. ex D. Dietr.) A. DC., Gesneriaceae	
	sla sohshiah	*Rubus ellipticus* Sm., Rosaceae	Golden/yellow Himalayan raspberry
	jaïing	Unknown	
	jakhi	Unknown	
	jalyngiar	Unknown	
	jasim	Unknown	
	jatwat	Unknown	
	ka nub	Unknown	
	khritwait	Unknown	
	latyrkaiñ	Unknown	
	pashor kait	Unknown	Wild banana
	sohlah	Unknown	
	tyrkhang	Unknown	

*Identification is unsure

In addition to wild edibles, people collect many medicinal plants from the landscape. The important ones are ***bat tyrphin*** (*Eucalyptus tereticornis* Sm., Myrtaceae) – for curing toothache, food poisoning or stomach-ache; ***khnaing; bat rben*** (*Bryophyllum pinnatum* (Lam.) Oken) – used for curing wounds, fever, cold, burns and for making chutney; ***lapata*** (*Vitex negundo* L., Lamiaceae) – used for curing sprain, ***pangat*** for strain in the veins; ***mebteng*** – used for curing cuts; and ***bat baidoh*** (*Sida rhombifolia* L., Malvaceae) – for curing boils by crushing the leaves and placing them on the boil, which helps pull out the pus. Other common medicinal plants used by the people are ***sla pata***, ***soh jalu*** and ***sla rynsi***.

Hunting and trapping

Meat from the wild is also included under ***jingbam na khlaw*** and has always been an important source of food for the community. Presently, the community occasionally gets meat from the wild. People trap animals for eating like ***phyllad*** (*Mustela* sp., weasel), ***dkhan*** (*Heterocephalus* sp., mole rat), ***khnai lum*** (*Sundamys infraluteus*, Mountain giant sunda rat), ***khnai lieng*** (*Sundamys* sp., rat), ***risang*** (*Dremomys lokriah*, orange-bellied Himalayan squirrel), ***syllih*** (*Petaurista philippensis*, Indian giant flying squirrel), ***ksar*** (*Prionailurus bengalensis*, leopard cat), ***syiar khlaw*** (*Gallus gallus*, red wild fowl), ***bsad*** (*Viverra zibetha*, large Indian civet) and ***lymbit*** (Chiroptera sp., bats). Men and especially children go to the forest to hunt and trap mole rats in the winter.

Fishing

Some of the people from the community catch fish from nearby streams for household consumption.

TABLE 3.3. List of wildlife used as food: birds and mammals

Group	Khasi name	Scientific name	English name
Birds and poultry	***syiar khlaw***	*Gallus gallus* L., Phasianidae	Red wild fowl
Mammals	***doh skei***	*Axis porcinus* Zimmermann, Cervidae	Indian hog deer
	lymbit	Chiroptera sp.	Bat
	risang	*Dremomys lokriah* Hodgson, Sciuridae	Orange-bellied himalayan squirrel
	dkhan	*Heterocephalus* sp. Rüppell, Phanodermatidae	Mole rat
	phyllad	*Mustela* sp. L., Mustelidae	Weasel
	syllih	*Petaurista philippensis* Elliot, Sciuridae	Indian giant flying squirrel
	ksar	*Prionailurus bengalensis* Kerr, Felidae	Leopard cat
	khnai lum	*Sundamys infraluteus* Thomas, Muridae	Mountain giant sunda rat
	khnai lieng	*Sundamys* sp. Musser & Newcomb, Muridae	Rat
	khiat	Unknown	Bigger deer
	dngiem	Unknown	Bear
	doh sim	Unknown	
	bsad	*Viverra zibetha* L., Viverridae	Large Indian civet

A few people will sell some of their catch to other members of the community or to people outside the community. The fish species caught from the nearby stream are ***dohsher*** (*Garra lissorhynchus*, Khasi garra), ***dohsher iong, sher syngkai, dohthli*** (*Channa orientalis*, Ceylon snakehead) and ***khasaw*** (*Neolissochilus hexagonolepis*). The latter come up in the river during the summer season from the plains of Bangladesh and return during winter, only to return the following summer. ***Dohpieh, dohjiar*** (Anura sp., species of frogs, the latter being of greenish brown colour), ***ka lun*** (Anura sp., tadpole), ***dohkad*** (Anura sp.), ***dohlun*** (Anura sp.) and ***tham*** (*Uca* sp., crab) are some of the other animals caught from the streams and brought home. Fishing is mostly done during the summer season as the fishes hide themselves in crevices during winter and are difficult to catch.

TABLE 3.4. List of wildlife used as food: amphibians, fish and crustaceans

Group	Khasi name	Scientific name	English name
Amphibians	***dohjiar***	Anura sp.	Small frog
	dohkad	Anura sp.	Small red frog
	dohlun	Anura sp.	Tadpole
	japieh	Anura sp.	Green-brown frog
	dohpieh	Anura sp.	Frog
Fish	***dohthli***	*Channa orientalis* Bloch & Schneider, Channidae	Ceylon snakehead
	dohsher	*Garra lissorhynchus* McClelland, Cyprinidae	Khasi garra
	khasaw	*Neolissochilus hexagonolepis* McClelland, Cyprinidae	Katli
	sher syngkai	Unknown	Unknown
	dohsher iong	Unknown	Unknown
Crustaceans	***tham***	*Uca* sp. Leach, Ocypodidae	Crab

Kong Bisikrin Marwein showcases varieties of potato.

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4. OTHER LAND-BASED PRODUCTIVE ACTIVITIES

In addition to food production, several important non-food plants are cultivated in the community as well. ***Synsar*** (*Thysanolaena latifolia*, (Roxb. ex Hornem.) Honda, Poaceae, broom grass) is the only pure-cash crop grown in the ***jhum*** fields. It is a main cash income for many households. ***Shken*** (*Bambusa pallida* Munro, Poaceae, a variety of bamboo) is an important crop that people use for constructing houses, weaving baskets, making pigsties and fencing their kitchen garden. Other important non-food plants are ***phlang tylli, phlang riat, phlang saw, phlang sharait*** (all types of grass), ***prut*** and ***sla kait*** (*Musa* sp., banana leaves). ***Phlang tylli*** is used as roof material or to cover the sides of the house; ***phlang riat*** is kept in the livestock shed; ***phlang sharait*** is kept in the basket where chickens laid their eggs so that they do not break, and ***sla kait*** is used to wrap potato seeds. ***Tangduma*** (*Nicotiana tabacum* L., Solanaceae, tobacco) is both cultivated and gathered from the wild by the community for their own consumption.

Apart from farming, almost all the households in the community are engaged in ***thainkriah*** (basketry), which is the activity of making baskets out of bamboo. Various types and sizes of baskets are produced, including ***kriah phan, kriahsohsaw, kriahpiat, kriahdkhar, khohtyntong*** and ***kriahprah***. This ancient skill from their ancestors is currently a major source of income for the community. The work is carried out throughout the season because it is in great demand. Mostly men make baskets, as few women have acquired such knowledge. ***Shken*** is the raw material for baskets and it grows around the houses of the people. However, increasing demand cannot be met from local bamboo production. As a result, artisans from the community buy bamboo from other areas to make their baskets.

5. LOCAL CALENDAR

The traditional calendar of Nongtraw has 12 months. It is a lunar calendar, where the beginning and end of the month correspond with the phases of the moon. The people count the month after every four weeks because that is when the moon appears again. According to the community, on the first day of its appearance, the moon cannot be seen because it comes out along with the sun. The people continue to use the traditional calendar for guiding their farming decisions. They increasingly use the Gregorian calendar for other everyday decisions.

The community recognizes four seasons in the year: winter, spring, summer and autumn. Winter includes the months of ***naiwieng*** (November), ***nohprah*** (December) and ***kyllalyngkot*** (January). This season is the coldest of the year. Blowing of cold winds signals its onset. Spring starts from ***rymphang*** (February) and continues through ***lber*** (March) until ***iaïong*** (April). According to the community, spring is the season of new beginnings and rebirth of the plants. Trees and bushes that had lost their leaves during winter begin to grow new leaves and most flowering plants bloom during this season. Animals and insects emerge out of their holes or dens to meet and enjoy each other's company. The blooming of ***tiew maitong*** flowers heralds the beginning of April. Meanwhile, birds like ***sim puhnei*** fly in flocks. Spring is also the season of thunderstorms, especially in April. Spring is followed by summer, beginning from ***jymmang*** (May) and continuing to ***jylliew*** (June) and ***naitung*** (July). This is the season of landslides caused by heavy rainfall. When the blue worms start climbing up from the river in April and May, people know that summer is approaching. The ***tiew jymmang*** flowers bloom at the beginning of May. The season is known as the youngest daughter, who is very important in Khasi culture. June is the month considered to receive the highest rainfall. July is called ***naintung*** because of the smell, which comes from the decomposition of weeds or agricultural wastes in the hot and humid climate. The last season, autumn, includes ***nailur*** (August), ***nailar*** (September) and ***risaw*** (October). According to the community, this is the season when trees shed their leaves, grass changes colour, and the rivers start running dry. Insects like ***niang kongwieng, shalymmen, niang krai, niang sbai, niang sohriew, niang kseng*** and ***niang ktang*** all come out within a week of each other in August. Leaves start falling and the surroundings become beautiful in September. The wind that blows during this season is cool and it is nice to spend leisure time in the hills and rivers. When lightning strikes during this season, it is a sign for animals like snakes, worms and other insects to go back to their holes. When the blue worms descend again in September and October, they twist themselves into a ball and their downward movement is a sign that winter is coming. Bamboos begin to crack and break in October. The end of autumn and beginning of winter is accompanied by increasing dryness of the soil and people's skin, and headaches amongst the people.

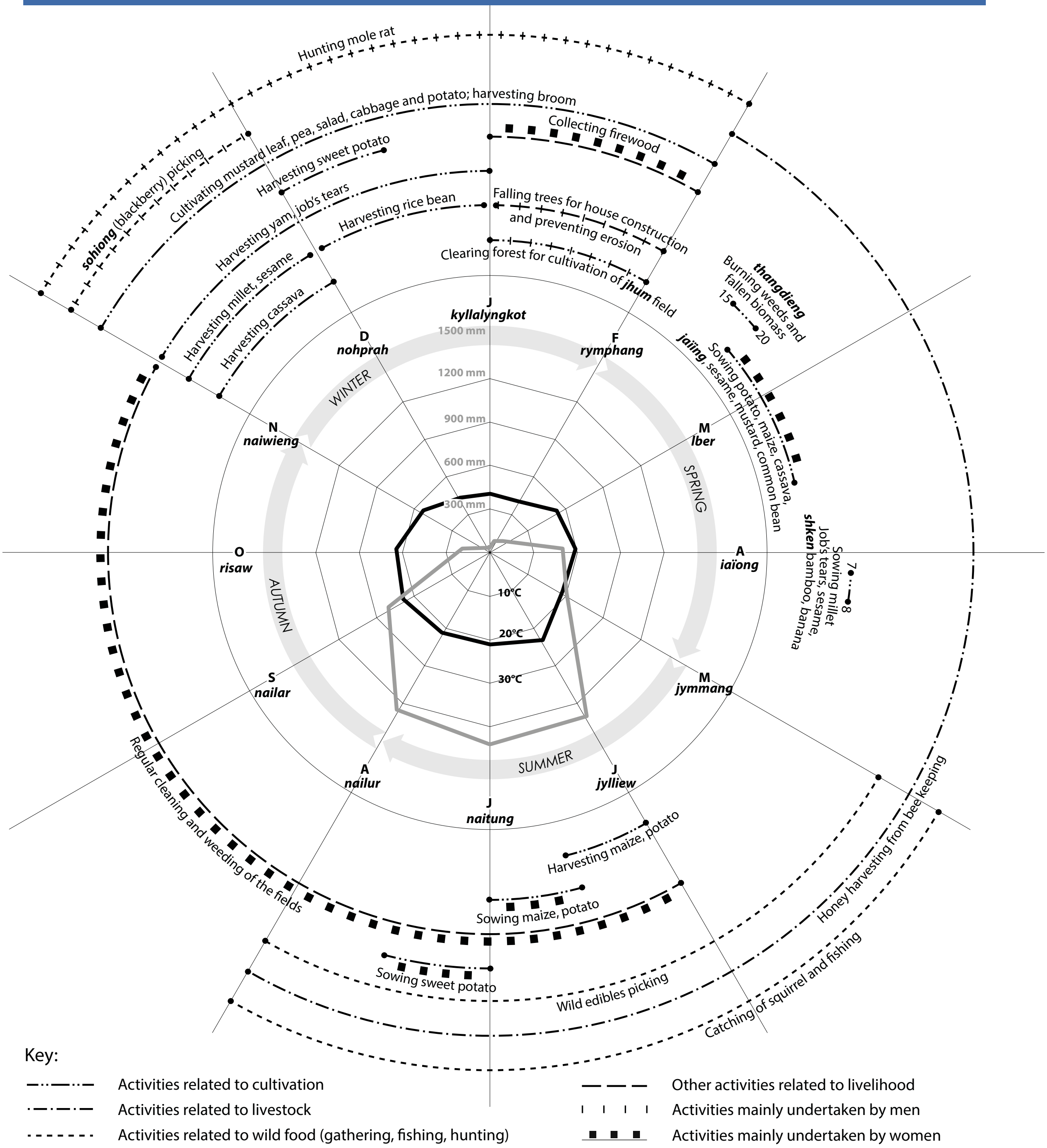
January corresponds to ***kallyalyngkot*** in the local calendar, which is named so because ***kylla*** means "to turn", alluding to the fact that in this month people turn the logs in the fire to keep themselves warm. In January, men clear the forest for ***jhum*** cultivation and fell trees for ***dienging*** (house construction). Logs are collected and kept laterally along the borders of the fields to prevent ***kynring dieng*** (soil erosion). Women are also engaged in these activities and they spend time collecting firewood. To get the land ready for sowing, the fallen biomass is burned with the weeds so that the ash can fertilize the soil. This process, called ***thangdieng***, takes place between the 15th and 20th of February and all households from the village take part. The weeds must be burned before the arrival of the rains. Once the ash has settled down, planting can begin. Women are the main actors for sowing seeds. Some of the households start sowing potato and maize and by March the whole village has started planting cassava, ***jaïing*** (a domesticated wild edible), sesame, mustard and ***ri*** (*Phaseolus vulgaris*, beans). The month of April is associated with the black colour and is considered inauspicious, so people do not build their houses or get married during this month. In the first week of April, until the 7th and 8th, people start sowing millet, Job's tears and sesame. ***Shken*** (a variety of bamboo) and banana are also planted. In June, people start sowing cucumber in their fields. The first batch of potato crop is harvested and another batch of potato and maize is planted. In July, they sow sweet potato, which is the last crop. Summer is the main planting season for the community, which continues until August. Cleaning and weeding of the field is also done in this season, which women perform at least thrice in the year between June and November. Wild edibles are especially plentiful during the summer. Both men and women pluck them on their way home from the fields. In October, millet blooms, whilst crops like Job's tears, sesame and rice bean (*Vigna umbellata*) reach full maturity. November is the month when people start harvesting. The important crops in this season are yam, millet, Job's tears and sesame. Men help in harvesting blackberry from the trees around the village for sale in the market. In December, the harvest continues with yam, Job's tears, rice bean, sweet potato and cassava. Crops like mustard leaf, ***motor*** (*Pisum sativum*, peas), ***phan tlang*** (winter potato), ***kubi*** (*Brassica oleracea*, cabbage) and ***salad*** (*Lactuca sativa*, lettuce) are grown during the winter for self-consumption. Men and women also harvest broom grass in this season. Men and children go to the forest to hunt and trap animals for food, especially mole rats. The community is busy with celebrations.

6. MARKET SOURCING AND TRADE

The market has become an important source of the community's dietary needs, currently providing approximately 40 to 50 percent of foods consumed. Items like ***dal*** (*Lens culinaris*, lentil), egg, rice and potato are bought throughout the year from the market. Other food items bought regularly include beef, pork, radish (*Raphanus raphanistrum*), turnip (*Brassica rapa*), carrot (*Daucus carota*), beetroot (*Beta vulgaris*), grams, sugar, salt, mango (*Mangifera indica*), apple (*Malus* sp.), ***sohlang*** (*Viburnum foetidum*), gooseberry (*Ribes uva-crispa*) and grapes (*Vitis vinifera*).

Nongtraw has a few shops open every day where people can buy household items to fulfil their daily needs. However, many products have to be bought at other markets that are further away in Sohrarim, Laitryngew, Sohra and Shillong. Sohrarim is an hour's climb from the village and has a few shops where people can buy items such as tea and snacks. The shops are open throughout the week except on Sundays when people go to church. Laitryngew is a weekly market located 4 km from Sohrarim.

FIGURE 3.2. Average annual rainfall (mm) and temperature (°C) in East Khasi Hills, Meghalaya, and seasonal activities by the Khasi of Nongtraw village (elaborated by Yanto Wahyantono, IRD, 2020)



(These annual rainfall and temperature data are averages. It may not reflect the important interannual variability of rainfall in Nongtraw, where 3 000 mm of rain can fall in a month.)

Khasi women fishing in summer.

Farmers go to this market to sell some of their produce and to buy household necessities, especially meat. Around 20 percent of the goods from the village find their way to this market. Sohra, located a bit further away (13 km) from Sohrarim, is the most important market where people go to sell their produce on a weekly basis. Apart from being the main destination of their agricultural products (70 percent are sold here), Sohra is also the market from where they buy most of their essential items. Sohra's importance is due to the fact that it is an old market that has been in existence since the pre-colonial period. Amongst the bigger markets of the region, it is the most accessible. It has the best diversity and quality of products available in terms of both food and non-food items. Shillong (41 km from Sohrarim) is the biggest market in the region. It is a daily market where people from all over the Khasi-Jaintia region come to sell and buy goods. An estimated 10 percent of the products made by the community reach this market, including baskets and some silverberry and blackberry. Occasionally village members will visit Shillong to deliver baskets and buy essential items.

TABLE 3.5. List of edibles sourced from the market

Group	Local name	Scientific name	English name
Fruits and juices	***apple***	*Malus* sp., Rosaceae	Apple
	mango	*Mangifera indica* L., Anacardiaceae	Mango
	gooseberry	*Ribes uva-crispa* L., Grossulariaceae	Gooseberry
	sohlang	*Viburnum foetidum* Wall., Viburnaceae	Himalayan viburnum
	grapes	*Vitis vinifera* L., Vitaceae	Grapes
Pulses	***dal***	*Lens culinaris* Medik., Fabaceae	Lentil
Starches	***wheat***	*Triticum* sp., Poaceae	Wheat
Vegetables	***beetroot***	*Beta vulgaris* L., Amaranthaceae	Beetroot
	turnip	*Brassica rapa* L., Brassicaceae	Turnip
	carrot	*Daucus carota* L., Apiaceae	Carrot
	muli	*Raphanus raphanistrum* L., Brassicaceae	Radish

7. COMMUNITY HISTORY AND FOOD SYSTEM TRANSITIONS

Before the 1960s, there was no settlement at Nongtraw. The area was covered with forests in which the people from the surrounding area practised ***jhum*** cultivation. Two brothers from the Nongtraw clan came and settled in the area for farming. After marriage, the two brothers left the area for their wives' villages, following the matrilocal custom of the Khasi. In 1958, four families belonging to four clans came to the area in search of cultivable land and they established the village, naming it Nongtraw after the two brothers who were the first to settle in the area.

These four clans came from different villages. Dohling came from Rikyrshang, Rani and Khongsit came from Wahsohra, and Khonglam came from Shnongphong.

The second major event for the people was the establishment of the village school in 1964. After the families had settled down for a few years, they decided to open a school. The community applied to establish a school to the parish of Sohra (Cherrapunjee), which was under the priesthood of Father Carmelo. He accepted their request and within a week a school was established. In the beginning, the school had no building and operated out of Khno Diengdoh's house until a building was allotted

Young Khasi girl in her house.

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for that purpose. Initially, the school had only 15 students and one teacher. The establishment of the school attracted people from different villages to Nongtraw, contributing to an increase in population. In fact, the 1960s were characterised by the arrival of new households to the village. The families that arrived had different reasons. An outbreak of malaria in Wahsohra forced families to migrate to Nongtraw. Catholic families from surrounding villages were attracted to the village. Even those who were not Catholic when they first arrived later become converts. The establishment of the school was also a big attraction for families. Finally, compared to other villages, governance in Nongtraw was considered efficient and this attracted those who wished to live under a more receptive institution.

The Bangladesh Liberation War in 1971 was a period of great turmoil. This led to the foundation of the nation of Bangladesh, located just 60 km south of Nongtraw. The war affected Nongtraw especially in terms of food security, as the village experienced food shortages during this time. After Meghalaya attained statehood in 1972, an upturn in the area's fortune occurred when the Government improved its service delivery and the market became stronger. People's lives changed tremendously in subsequent decades, beginning in the 1980s and intensifying in the 1990s. The Public Distribution System (PDS) was introduced in the 1980s, providing subsidized rice and sugar products. Electricity came to the village in 1992. The Public Health Engineering Department (PHE) initiated the community's public water supply in 1998. Since 2000, roads have improved and vehicles have started ferrying people from one place to another.

The farming system in Nongtraw has remained the same since the village was established. People still practise ***jhum*** cultivation. However, the foods produced, consumed and traded by the community have changed considerably over time. Until the mid-1990s, people in Nongtraw consumed primarily local grains, vegetables and tuber crops that were grown in the local landscape. Sweet potato, millet and cocoyams were the staple diet of the people in the area. Plants and animals from the forest supplemented their diet. With the introduction of the PDS in the 1980s, along with increasing incomes and market access, rice has become ubiquitous in the diet and is the most important food of the community. It has taken the place of millet and other grain crops like Job's tears. In general, the amount of food sourced from the wild has decreased over time. In the past, when harvests were not ready, people would go to the forest and collect wild vegetables and fruits.

From 1960 to 1970, the people of Nongtraw exchanged goods like Job's tears, cassava, maize, cucumber, ***syiar*** (chicken), rice bean, sesame, sweet potato, banana, potato, millet, yam, etc., with the surrounding communities of Wahsohra, Diengsong, Dewlieh and Tyniar. These exchanges typically happened twice a year during the planting season between the months of February and July. Now, however, the barter system is no longer practised, with people exchanging goods for money rather than in kind.

SECTION 2 SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM

1. PROVISION OF LIVELIHOODS, EQUITY AND SOCIAL WELL-BEING

Adequacy of income opportunities

People in the community have a diversity of livelihood opportunities. The most important is agriculture. Daily wage labour (farm labour) and artisanal activities (from local agrobiodiversity products like bamboo) are some of the other important livelihood activities. According to the community, all households are engaged in agriculture and daily wage, 95 percent are artisans, 50 percent rear livestock, 10 percent are employed in the public sector (government servant), and 5 percent have small businesses (selling fish and agricultural products). Except for daily wage work, in which members of the community may have to go to different areas for work, the remaining activities are very much linked to the local landscape.

Selling crop products contributes an estimated 40 percent of household income. Crops like cassava, sweet potato and its variety ***sla phan karo***, yam, ***phan myngor*** (variety of potato), cucumber, maize, soy, sesame, Job's tear, millet, banana, blackberry, tree brinjal, brinjal, pumpkin (*Cucurbita* sp.), silverberry, box myrtle, blackberry nightshade (*Solanum americanum*), passion fruit, bird's eye chillies (*Capsicum frutescens*), ginger (*Zingiber officinale*), mustard leaves, rice bean, ***nei*** (*Perilla frutescens*, sesame), bay leaf, pineapple, guava, and wild edibles like ***jaïing***, garlic chives and so on, are sold in local markets.

At present, the community does not process many of the items for sale. They just take the raw or washed foods, pack them, and sell them according to weight. Sweet potato and cassava are sometimes sold cooked, prepared the night before. Likewise, wild edibles like ***jaïing*** and cassava are cleaned and packed in banana leaves tied with threads made out of bamboo skin. An exceptional situation exists for millet. A group of 16 youths from the community have formed a cooperative society for marketing millet. They sell both raw (grains removed from stem) and processed form (ground into a powder) millet, the latter of which is packed nicely for sale at the market. The moment community members arrive at the market, the first task they do is search for a spot to sell the produce. Sometimes, shopkeepers offer to buy their entire produce at a wholesale price, which they sell again in their own shops. To avoid being oppressed by low prices, farmers try to sell the produce on their own. The community is known for bringing organic products for the market and therefore, in some cases, obtaining better prices than other villages.

Broom grass is a cash crop that has an entirely different value chain. Unlike other crop products sold by the community, broom grass is not sold directly to consumers. Intermediaries (Marwari in this case, a trading community originally from the Marwar region of Rajasthan) come to Sohrarim and buy the entire stock from the villagers. These traders then take the product to Shillong, where it is sent to other parts of India. In some cases, the broom grass is exported to Bangladesh.

Income from livestock contributes an estimated 20 percent of household income. Chickens primarily are sold within the community to friends and other members, whilst their eggs are sold outside the village. Pigs are sold directly to consumers both within and outside the

Khasi woman selling products at the market.

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community. Within the village, the pig seller organises a gambling session. Those who take part in this game win a certain amount of meat as well as money. Some households sell honey to middlemen.

Amongst non-farm activities, basket making brings a substantial amount of income to the community. Their prices are quite lucrative, and demand is high thanks to the influence of middlemen who help market them in more distant markets. Shillong is the most important market for such baskets. ***Mahajans*** (business people) buy the baskets from the artisans and sell them to different business establishments in Shillong, which then sell them to consumers. A variety of daily labour activities and services are carried out in the community, including ***kit nong*** (carrying loads up and down the 3 000 stairs that connect Nongtraw to the main road), carpentry, ***shoh maw*** (breaking rocks into smaller pieces), infrastructure development under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), domestic work in Sohra or Shillong, ***thangrnga*** (charcoal production), driving, teaching, and working in NGOs.

Although they participate in several value chains, the community faces many challenges in accessing the market to sell their products. Because there is no motorable road to their village, they have to carry their products from the village up 3 000 steps to Sohrarim to reach the road. When they reach the top, they have to hire and pay people to carry their goods to Sohra or Shillong markets. Oftentimes, they have to wait for long hours to catch a vehicle to the markets and they may not make it there on time. If they reach the market late, they may have trouble obtaining a good price for their goods. There is no fixed price for selling the produce, as it depends on demand and quality. The ***mahajan*** to whom they sell the produce will offer them low prices because most buyers have gone back home. Those who sell on their own also tend to lower their prices because they have no place to store their produce for the next day. Demand for honey has increased since 2000, with the price going up to INR 550[13] per kg, but the middlemen take all the profit. The beekeepers themselves have limited capital and recurring investments like construction and maintenance of beehives is very high.

Income is spent on many things, including different kinds of food and drinks, dresses, toys for the children, and other household materials like utensils. Money is also spent on rice and in tea shops during the journey to the market and on the way home as well. Other activities that require cash include transportation fares, education for children (school fees, books, uniforms, etc.), donations to the church, medicines and treatments, building houses, electricity bills, disc TVs, and recharging mobile phones. Expenses for agricultural needs include renting the land for cultivation and purchasing seeds. Potato is an important crop for the community and its seeds have to be purchased every year by the farmers. People also buy piglets from outside the village. Artisans have to buy bamboos from other areas to make their baskets since local production cannot meet demand. In addition to this regular spending, some money is spent on special occasions such as weddings, birthdays, Easter, Christmas and New Year's celebrations. Moments of grief like funerals also incur a lot of expense in the form of contributions to the bereaved family. During such times, money is required for serving tea and food to those who have come to the funeral service. Money is also spent playing ***teer***, a local gambling sport.

The community benefits from various government subsidies and welfare schemes. India is a welfare state and it has many programmes for rural development, upliftment and poverty eradication. The community receives support from different schemes, including the PDS, pension scheme, Integrated Child Development Schemes (ICDS), Widow Scheme for Housing, scheme for child delivery, PHE for water supply, ASHA, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), and Meghalaya Health Insurance Scheme (MHIS). All these subsidies are helping the community by reducing their financial burden and enabling access to services, such as vaccinations for which the cost may otherwise be prohibitive. According to men, people can survive without subsidies, but it will entail great difficulties. Women, on the other hand, agree that subsidies have helped a great deal in earning a liveable wage but also insist that they can sustain themselves in its absence as well. They would have to work harder, but they would be able to manage. Thus, supported by the Government's welfare schemes, the local food system is able to provide income opportunities for the community.

Adequacy of diets

The community consumes a large variety of foods. Starches (cereals and tubers) are the most common food group (consumed by 100 percent of participants in the thematic discussions in the past 24 hours), followed by dark green leafy vegetables (> 50 percent consumed in the past 24 hours). Eggs are eaten three to four times a week and meat and flesh foods are consumed weekly. Other foods (e.g. fruits, pulses, nuts and seeds, milk) are consumed more sparsely. People consume rice daily at lunch, dinner and other occasions. Currently, it is the most important staple food of the community. In addition, at least half of the respondents had consumed a variety of tuber in the last 24 hours. Dark green leafy vegetables consumed by the community are mostly wild edibles collected from the surrounding landscape, such as garlic chives, ***jaïing, jatira*** (*Oenanthe javanica*, water celery), ***jali, jaut*** (*Allium hookeri* Thwaites, Amaryllidaceae, hooker chives), and buckwheat. Chicken and pork are the most important meat products. Pork is consumed at least once a week. Chicken, on the other hand, is consumed only occasionally, mostly during the winter season. Many festivals and celebrations take place during this season and people cook chicken dishes for these occasions. Everyone consumed chicken recently during the lunch break of the thematic discussions. Oil is used regularly to cook the various dishes.

Local diets change during the year as the food available from the local landscape experiences

[13] Equivalent to USD 7.8. Applying the UN Operational Rate of Exchange of 1 September 2018 (1 USD = 70.74 INR). This rate will apply throughout the entire chapter.

drastic seasonality changes. People like to eat fruits and nuts, but they are available only seasonally. The case is similar with pulses as ***dal*** and beans from the local landscape are very important. In the summer, wild edibles like buckwheat, ***jali, jakhria, jamyrdoh*** (*Houttuynia cordata*, fish mint), ***sla tyrkhang*** (*Nephrolepis cordifolia*, sword fern), Himalayan raspberry, ***latyrkaiñ, sla jajew*** (*Begonia roxburghii*, East Himalayan begonia) and ***pashor kait*** start becoming available in the landscape. People also begin harvesting some of the food crops from their agricultural fields in the summer and some people catch Khasi garra from nearby streams. By autumn, people consume many of the foods that they harvest from their fields. During the winter season, far fewer wild edibles are available and people buy more foods from the market. In the spring, dependence on the market is high because this is the sowing season and most of the crops are not ready for harvest. Only a few wild edibles like buckwheat and ***tit tung*** (*Lactifluus volemus*) are harvested from the wild during this season.

People use a variety of techniques to ensure that certain foods are available for longer periods. They store millet in sacks that they keep in a warm and dry place, which allows the grain to be stored for two to five years. Maize is hung near the fireplace to get rid of insects. People normally keep maize for the next season's sowing, but it is possible to store it for 5 to 10 years. Similarly, potato and its varieties are normally kept for sowing in the following season (from November to February), but if kept in a dry place they can be stored for one year. Sesame wrapped in a ***jaiñ sala*** (white cloth) and kept in a warm place can last for one year. Generally, sesame is stored from November (harvesting) to April (sowing). Storing of rice bean follows the same procedure as sesame. Job's tears are stored in sacks only until the next planting season but if their seeds, like sesame and rice bean, are wrapped in ***jaiñ sala*** and kept free of moisture, they can last for four to five years. Ginger, citron and ***shynrai*** (*Curcuma longa*, turmeric) are stored in the soil itself. Cocoyams are stored in sacks and can remain so for at least six months. Fruits like box myrtle, silverberry and chillies, and vegetables like brinjal and radish can be kept for longer durations by pickling them. The longer they are preserved, the tastier they get. Meats are dried by a fireplace so they can be stored for a long time before consumption. Meat of ***dohpieh*** can be kept for up to a year if properly dried. Thus, people in the community can prolong the lifespan of crops and meat, allowing them to consume such food during times of scarcity.

People in the community do not often consume five food groups a day. Nevertheless, the community is of the opinion that their local diets are adequate to fulfil their nutritional needs. By and large, they have enough cash income to buy food from the market when they need it. Nevertheless, they are not completely immune to food insecurity. In 2017, the community suffered huge losses in agriculture because of heavy rainfall. The people could not start their farming on time and the broom grass plants (the main cash income for many) were damaged. As a result of these losses, people had to reduce consumption and were only able to eat a few kinds of food items. This situation was not unique to a few households but was faced by everyone in the community.

Jingbam na iew (foods from the market) have become important in the recent past. Around 40-50 percent of the food now comes from the market. A diversity of nutritious foods is available in the market, including fruits, vegetables, pulses and meats, amongst other foods. People consider carrot, lettuce, grapes and apples to be amongst the healthiest foods, which can be easily bought from Sohra. The food available in the markets is generally considered to be of good quality. However, women noted that they do not know whether the fruits or vegetables in the market are fresh and it is difficult to find out if the food items purchased have been grown using pesticides. They have more faith in their local production in terms of quality and health effects. Food sold in the Nongtraw market is from the local landscape and people know that the food has been produced in a safe manner and will not have any side effects. Nevertheless, the diversity of foods available in the local Nongtraw market is low.

Whilst the availability of foods in the market is good, people's access to it depends on

Typical meal in Nongratw village.

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availability of cash. Many in the community have adequate income to buy good food from the market, but for some it can be an issue. Currently, people spend about half of their income on purchasing food, with a single household spending around INR 2 000[14] per week. Smaller households with less income spend around INR 1 500[15] per week. People would like to have more of certain food items. In particular, meat and fish are highly sought, but they are expensive and out of reach for many households. The case is similar with processed food, oils, and orange- and red-fleshed fruits and vegetables.

The local landscape is well endowed in terms of food items from various food groups. Access to these local resources remains vital for local food security and diet quality, since the landscape provides 50-60 percent of the food in local diets. The community maintains a rich traditional knowledge of nutrition and feeding practices. People are aware of the nutritional value of crops like yam, which they know helps strengthen bones and teeth, rice bean helps with growth, and millet helps improve haemoglobin. The community is informed about the value of consuming nutritious foods in their diets, such as grams, milk and flour. Active and regular counselling is provided for children up to 6 years of age, as well as the elderly, pregnant women and adolescents. Local production is supported by the active involvement of ASHA workers, Auxiliary Nurse Midwife (ANMs) and Anganwadi workers, who follow up on the health status of people in different age groups. Availability of healthy local produce and support provided by health workers has ensured that the local diets provide the necessary nutrition to the community.

Those who enjoy good nutrition have certain characteristics, which are noticed by everyone in the community. Such persons are believed to have good height and are fat, fit and strong. They have a good-looking face and are always smiling. They are believed to be less susceptible to diseases, they are smart, wise and free from depression, and they drink less alcohol. Such people go to bed early to rise early in the morning. Generally, people in the village consider rice, meat and vegetables to be an ideal meal. Although they would like to have good diets, there are some practical difficulties. For example, sometimes both parents have to leave early in the morning to work in the fields and they do not have time to cook vegetables. Meat is only available two to three days a week because of its cost and perishability. People typically consume meat on the days after going to the market.

Changes in the provision of livelihoods and social well-being over time

Prior to the 1970s, food insecurity was a big issue in Nongtraw. Not having enough food to eat was a constant preoccupation. There was no breakfast, food at home was much less than today, and whatever was available was seasonal in nature. At times people were forced to skip meals and eat less than what they thought was needed. Sometimes, food would run out and people had to stay hungry for the night. This might happen when relatives would come unannounced. To deal with food insecurity in the family, parents would reduce the quantity of food. For example, instead of cooking three pieces of yam they would cook only two. Another strategy was to replace the staple food with another item. If there was not enough rice for everyone, the parents would ask the children to eat cassava instead. People had much less cash income and they were often unable to buy rice from the market. Sometimes when food items were less, people would mix rice and vegetables instead of cooking them separately. At the community level, collective sharing was an important strategy during periods of food insecurity. Such strategies were common 20 years ago.

Now things have improved. After Meghalaya attained statehood in 1972, the area's fortune experienced an upturn, with the Government improving its service delivery, the transportation network getting better, and the market becoming

[14] Equivalent to USD 28.

[15] Equivalent to USD 21.

more prevalent. Livelihood opportunities also increased, with more options for daily wage labour and sales of agri-food products. In this context, the introduction of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) was a positive step for the people that improved their financial status. Working as miners in the nearby coalfields of Laitryngew, Sohra and distant locations like Jowai was an important source of income for many people from the community for a while. However, since the 2014 ban on coal extraction from the National Green Tribunal (NGT), people are not engaged in that work anymore. Basketry is an ancient practice for the community, but it has risen as an income-generation activity since 2000 as the price became more lucrative once several middlemen began marketing them in more distant markets. This has encouraged many people to learn the skill and has brought additional income to the community. In the past, most of the products from the community reached only Sohra and Laitryngew, with few reaching distant markets like Shillong. Now bamboo baskets from the community reach markets like Mawngap (on the way to Mawphlang Sacred Forest). Broom grass, traditionally present in the ***jhum*** fields, was introduced as an important cash crop, which started to be commercialized in the 1990s. After the market for crops, especially broom grass, started becoming more lucrative, families in the area began replacing thatch roofs with tin as a symbol of increasing prosperity. Better governance, availability of money, and a stronger market from which they could buy a diversity of food throughout the year were factors that led to an increase in income and the amount of food consumed in the community. Notably, the introduction of the PDS in the 1980s led to a big rise in the consumption of rice, which was only rarely consumed in the past. According to the women, however, the village's food supply sufficiency has dropped since 2005. Declining soil fertility is one reason for this trend.

It can be said that the adequacy of income earned in the community has improved over time. However, whilst household income has been rising since the 1990s, at the same time, so have the various demands for the lifestyle people choose to adopt. New needs have emerged whilst old ones have transformed. For example, rather than using locally available traditional medicines, people now use modern medicines and have more associated medical expenses; instead of constructing houses with local materials, they are building concrete houses; they now purchase trendy clothing rather than using their traditional cloth; and they must pay bills for phone, electricity, etc. Expenses for agriculture have also increased in terms of renting land and purchasing seed and piglets. As expenses have risen, MGNREGS along with other schemes like ICDS, Person with Disability, Widow Pension Scheme, and the MHIS have helped the community increase their earnings to meet the demands. Adequacy of income therefore is not static but keeps on changing as income also changes.

Despite improvements in incomes and food security, according to the community, nutrition and health have seen a decline in recent years. People are less healthy, some illnesses have become more frequent, and new ailments have started to appear. The body mass of the present generation has declined, with strength also dropping drastically. People no longer can carry heavy objects like they once did, and they tire more easily. Gastric issues and diarrhea are more frequent amongst community members and their memory is not as sharp as it used to be. Alcoholism has increased in the community, with many young people mired in its grips. Previously, only people above 30 would consume alcohol, but now 18-year-olds are buying alcohol from the market with their own money.

Both men and women tend to agree that the changes in food consumption have had a negative impact in terms of health and nutrition. With the increasing availability of cash income, people's desire to consume different varieties of food not found in their area also increased. In the past, people would eat sweet potato for breakfast. A typical meal would consist of millet, yam, and either rodent meat, ***dohpieh*** (frog meat), or Khasi garra. ***Jadoh*** (rice mixed with meat) and ***tungrymbai*** (fermented rice bean) was another important dish. Limb of a cow was also consumed, called ***doh lyngkhot*** (rationed meat), which was cheap and mostly eaten by poor families. Traditional beverages included drinks made out of fruits like blackberry, box myrtle, roots of plant like ***shiahkrot*** (*Smilax perfoliata*), and alcoholic drinks ***kyiad krai*** (millet beer) and ***kyaid jyndem*** (rice beer). Millet was a staple diet in the past but rice has taken its place. This has not only happened to millet but other grain crops like Job's tears as well. Wild meat was a big part of the diet in the past, with people going to the forest to catch these animals regularly. People would hunt ***doh khnai*** (*Sundamys* sp., rat), mole rat, ***doh bsad*** (large Indian civet) and ***doh sim*** (birds), squirrel meat, ***doh skei*** (*Axis porcinus*, Indian hog deer), bat meat, ***doh dngiem*** (bear meat), ***doh dkhait, doh shrieh*** (monkey's meat) and red wild fowl. However, presently, many of the larger animals like deer, ***khiat*** (a bigger deer) and ***kyrbei*** (Chinese pangolins) have disappeared from the local landscape. People now trap only smaller animals to eat. That practice is dying out, though, and in its place, people are depending more on meat from the market. People now consume meat less frequently but in larger quantity. Fishing in the Wahsohra stream also used to be much more common. The people never consumed dairy products in the past because they did not rear cattle and milk was considered taboo. Now they consume it occasionally with tea. Consumption of fruits, vegetables and pulses is more frequent throughout the year nowadays because previously these foods were only seasonally available. Non-traditional food items that have gained importance in the local diet are ***sohsaw*** (*Solanum lycopersicum*, tomato), ***prisbin*** (*Phaseolus vulgaris*, French bean), mustard leaves, radish, ***phulkubi*** (*Brassica oleracea*, cauliflower), cabbage, ***piat*** (*Allium cepa*, onion), ***shini*** (sugar), ***slasha*** (tea), oil, wheat (*Triticum* sp.), beet, ***lasun*** (*Allium sativum*, garlic), lentil, and others. Meanwhile, the consumption of certain traditional wild vegetables like ***jaïing, lung siej*** (*Dendrocalamus hamiltonii*, bamboo), ***trykhang*** and ***jalyngiar*** has declined during the past 15 years, with many people preferring vegetables from the market. Consumption of fruits has also seen changes, with wild fruits like ***soh liia*** (*Myrica nagi*, bay berry), ***soh thylliang*** and ***soh lymwai*** declining, whilst those purchased from the market have become a more important feature in local diets. However, many items purchased from the market have been produced through the application of chemicals, which makes them harmful to health and nutrition.

2. RESOURCE USE EFFICIENCY

Land and soil

The availability of good soil has made cultivation of the various crops and life in Nongtraw possible. The community has learned to read certain signs to determine the quality of the soil. Soil mixed with ***dew saw*** (red soil), ***dew iong*** (black soil) and particles of rocks is fertile and good for cultivation. Soils with an abundance of earthworms are deeper and have more moisture, an indication of good health. The presence of trees (especially fruit trees) is also good for the soil because it helps prevent erosion and increase water absorption. In contrast, according to the community, soil that does not mix with other types of soil, like sandy soil, is not good for cultivation because it does not contain enough fertility. Sandy soil needs to be combined with other soils to be suitable for cultivation. The return of weeds and trees to the previous jhum site is an indication that the soil is ready for cultivation.

Soil and land quality for cultivation is not uniform throughout the landscape. As such, the community adjusts by growing specific crops in certain locations. These decisions are not just based on soil quality but also orientation of the land and its exposure to sunlight. If the plot is in the ***rngi*** (south-facing slopes), people grow all types of crops but if the fields are in ***dymmiew*** (north-facing slopes), cassava and sweet potato cannot be grown.

The community has local practice and rules for maintaining soil fertility. In ***Jhum*** cultivation, the land is left fallow for 7 to 15 years to allow it to recuperate its fertility through natural formation of humus. ***Thang bun***, the burning of biomass, is practised so that it can be used as manure. Sometimes people bring ash of wood from their home to add to the soil in the fields to improve its fertility. The people in the community practise mixed cropping to maintain soil fertility and to produce as much food with the available land. In the ***jhum*** field, potato is grown alongside ***jaïing***, sesame, millet, mustard, beans, sweet potato, maize, cucumber, cocoyams and Job's tears. These crops grow in the same plot but are harvested at different seasons. In the kitchen garden, compost made from kitchen scraps and pig manure is also used to enhance soil fertility.

A major problem in hilly areas such as Nongtraw is soil erosion. The community is well aware of this and takes certain steps to guard against it. Terraces are built in ***jhum*** fields to slow down the flow of water and stabilize the soil. Logs are kept laterally at the edges of the plots to prevent soil being washed away. People also grow ***shken*** (variety of bamboo) and ***synsar*** (broom grass) along field margins during the main rainy season to prevent soil erosion. These plants have deep roots and hold the soil in place during heavy rainfall events.

Labour and fuel energy

The most important sources of energy used in the food system are human energy, firewood, electricity, charcoal and solar energy. Human energy is the major source in the community for carrying out agricultural work, wild sourcing, selling and procuring products from the market, preparing food, and other activities related to the local food system. The community does not use much inanimate energy, instead depending on human energy to undertake most of their livelihood activities. With the topography being incredibly steep, people do not use any draft animals and rely on only a few power tools to support their work.

Firewood is the major energy source for cooking and heating water. It is known as ***kynrad*** (something that provides good care and makes people feel alive because of its presence). The people light firewood as soon as they wake up in the morning and it is lit until they go to sleep at night. Without it, there is a feeling of emptiness in the house. People cook with the traditional constructed hearth. Three stones known as ***maw byrsiew*** provide support for the pots, and above that is the ***ryngien***, a hanging platform for drying meat and storing firewood. In some cases, the ***shawla*** (stove) is also used to cook food. Firewood is entirely sourced from the local landscape. Charcoal, produced from burning wood, is less commonly used for cooking but is preferred for warming the house during winter by burning it in the ***shawla*** (stove). Some charcoal is produced within the village from fuelwood in ***jhum*** fields, but most of it is purchased from the market.

Electricity is an increasingly important source of energy in the community. The Meghalaya Electricity Corporation Limited (MeECL) provides electricity to the community. Every house has a connection, but supply is not regular and is often interrupted. Electricity has a critical role in providing a lighting source for men to produce baskets at night, which is important for cash generation. For food processing and preparation, a few people have electric rice cookers and kettles, and the community's grinding machine for millet uses electrical energy. People use electricity to charge their phones, watch television and play music. Electricity furthermore provides light for children to study and power for microphones and speakers during church and community events. Much of the electricity in Meghalaya comes from hydroelectric power generation in the State but a large amount of energy is also imported from other regions. Renewable power constituted just 33.6 percent of total capacity in India in October 2018, whereas the major source for electricity is burning charcoal (Central Electricity Authority of India). Electricity plays only a minor role in food system activities but its role in connecting the community via telephone and internet and in providing light for children's education and community gatherings has an indirect influence on the food system. The streetlights in Nongtraw are powered by solar panels. People also use battery-powered torches for light at night.

Production and preparation of food in Nongtraw is primarily dependent on locally sourced renewable energy, especially human energy and firewood. Enough skilled people are available from the village for farm work and other jobs.

Even if some labour is brought in from outside the community, it has more to do with a feeling of kinship and friendship rather than inadequacy of labour. The supply of firewood and charcoal is also considered sufficient for the needs of the community. The people mainly collect firewood from their own land/forest and if not, they rent or buy it from others. Local charcoal production cannot keep up with demand, but it is readily available in the market at Sohrarim at the price of about INR 30[16] per kilogram. By contrast, the supply of electricity is highly insufficient. When it goes off, it becomes a great hindrance. This usually happens during the rainy season and it affects the work people do, especially basket making. Kerosene lamps and candles are used as backup energy sources for lighting but they are not sufficient. The energy sources used for producing and transporting the products purchased in the market requires further analysis. These foods would likely have a larger dependence on fossil fuels for transportation and may be produced using more non-renewable energy sources than foods produced within the community.

Community members use several tools to reduce the amount of time and drudgery to cultivate and wild source foods. The ***wait pam*** and ***wait lyngngun*** (types of machete) are used to cut down trees and clear shrubs and weeds to prepare the land for cultivation. They are also used to cut down dry trees from the forest for firewood and to harvest wild plants and mushrooms. The ***kurat*** (saw) is also used to cut down trees and saw logs. Unlike the ***waits***, this tool requires two people to handle it but it gets the task done faster. Many people now use ***sdie*** (axes) as well. The ***mohkhiew*** (spade) is used to dig up the soil for cultivation. The ***tari*** (knife) is used to cut harvesting crops during the harvesting season, including both cultivated crops and wild plants and mushrooms. The ***khoh*** (basket) is used to collect and carry the crops after harvesting them from the field. The ***star*** is the harness that goes around the forehead of the person carrying the ***khoh*** from the field to home. Wild edibles are carried in ***ruhthepjhur*** (baskets for keeping vegetables).

[16] Equivalent to USD 0.42.

Working together is important to reduce the amount of time and drudgery involved in food system activities. ***Jhum*** cultivation begins with clearing the land of wood materials and undergrowth. If a single person is involved, it takes 30 days, which is reduced in half if two persons are hired. People mostly hire someone from the village itself. The wage paid for a day's work is about INR 300.[17] For ***kynring dieng*** (collecting logs along the borders of the fields), a similar number of people is required, and a similar wage rate is paid. ***Thangdieng*** (burning the fallen biomass) requires a member of each household from the village to take part. In total, 40 people are involved in this activity. Sometimes children are also involved. The landowners provide lunch and alcohol to the participants. Dividing tasks by gender helps to optimize labour. After the field is burned, women are engaged in sowing seeds because men continue to be busy with ***kynring dieng***. Women can be hired to help with sowing for a period of 30 days at the wage rate of about INR 150.[18]

Water

Meghalaya receives one of the highest rainfalls in the world, with average annual rainfall of more than 1 000 cm. Water in Nongtraw is plentiful and available throughout the year. Water taps are available near most of the houses within the community. The taps bring water via metal pipes from the source at Kremlynbuit, which is a cave with a spring. Some storage tanks are located in the village as part of this water system. In addition, the community has several water tanks they use for rainwater harvesting and to store water for use in times of water scarcity. These water tanks are village property, which means that although individual households can use them, they have to leave the tanks behind if they chose to migrate. Nearby to Kremlynbuit is a ***jingdih um*** (spring), where people can collect drinking water. As of now, there is limited reliance on water from outside the local landscape. The sources of water are within the community's boundary and they provide water

[17] Equivalent to USD 4.2.

[18] Equivalent to USD 2.1.

for household consumption and livestock needs, as well as crops in the garden during winter.

Of all the needs in the community, the highest demand for water is for domestic washing and cleaning. Drinking and cooking are other important uses of water. Amongst the livestock, pigs require a lot of water. Some households that rear pigs clean the shed once a week and others clean it every day. Bathing the pig also requires one to two buckets. ***Jhum*** cultivation is rain-fed but water is needed for the kitchen gardens. For a small garden, around 20 litres of water is required every day during the dry months, November to March. A handful of houses grow flowers and they can use around 50 liters of water per day during the winter season. These are generally the most water-demanding activities in the community.

The people follow certain rules to ensure water availability both in terms of quantity and quality. It is strictly prohibited to dirty the source and the catchment around it is protected from any kind of deforestation. Water from the source is tested regularly to assess its suitability for human consumption. The community also has a filter, which cleans the water from the main source. Cleaning the village water tank occurs once a year. A general announcement is made so that the community can gather and clean the tank. At the household level, ***umsohkhawja*** (water that has been used to wash hands after eating food) and ***umkhawja*** (water that has been used to wash the rice before cooking) is given to pigs. Some crops are vulnerable to water scarcity, such as beans, mint, French bean, ***sohthliem***, lettuce and mustard leaves. The community cultivates other crops that are tolerant to climatic stress, including maize, turmeric, cassava, sweet potato, ***phan jata*** and ***sohphan*** (varieties of potato), guava, banana, pineapple, blackberry, orange, ***sohjem*** (*Citrus* × *aurantium*, lime), citron, ginger and ***jaïing***.

Waste

Households in the community generate biodegradable wastes like vegetable skins, spoiled food and ***sohkhawja*** (cooked rice that falls on the ground whilst eating). They also generate non-biodegradable wastes like torn clothes, used cups, plates, buckets, pots, umbrellas, ***mura*** (local stool), chairs, broken spoons, etc. At the community level, plastic bags, bottles, damaged disposable cups and other kinds of wastes are often left behind when programmes are held in the community. When people visit the community, they bring plastic water bottles, which are often thrown away without any thought. People have different ways of disposing waste depending on its nature.

Some people collect kitchen scraps and feed them to the pigs. Fruit and vegetable scraps are also thrown into the compost pit in the kitchen garden, a practice that was promoted by the Soil Department a couple of years ago. Traditionally, biomass, crop residues and ashes from shifting cultivation were collected in one place and left for mulching. Some households use these wastes as manure by keeping them near the roots of vegetables in their ***kper*** (kitchen garden). The same is done in the ***jhum*** plots as well, where the wastes are used as manure for the crops. Use of crop residues as manure for crops in ***jhum*** fields is a practice that people have been doing for a long time. Some of the seeds from the crops consumed in the house are kept in the kitchen near the fireplace to control weevils' infestation so that they can be planted next season. People collect chicken droppings and sell them to farmers outside the village who use that as manure to grow crops like potato. The community prefers not to use the chicken manure because it is highly acidic and has to be mixed with soil. Pig droppings, on the other hand, are used more commonly as manure for the crops and some sell them outside the community. For dirty water, some households have soak pits. However, most of these pits are already full and people allow the water to flow into their kitchen garden.

Dustbins are kept around the village to stop waste from being strewn all over the area. Metals are sold to dealers from Mylliem, who buy them according to weight for recycling. Other non-biodegradable wastes like clothes, cups, plates, buckets, pots, umbrella, chair, stool and spoons have until recently been thrown in a pit dug for the purpose located near the school garden. People would then light fire to the wastes. In

Kong Healthynoris Kshiar weeding in jhum fields.

© Lyngdoh NESFAS/ Alethea Kordor.

2018, the PHE came to the community and taught them how to segregate wastes and stop burning plastic. Instead, they were asked to collect waste in plastic bags and inform PHE when they are full. Officials then come and collect the waste. This initiative from the Public Health Engineering Department is recent and people do not yet know how it will turn out.

Changes in resource use efficiency over time

People still follow traditional practices in ***jhum*** cultivation to help them maintain and protect soil quality. At the same time, they admit that soil quality was much better in the past. This is because the fallow period was longer (around 15 years), which allowed the soil to regain its fertility. Now, that period has become shorter (7-10 years). With an increase in population, there is now more demand on the land. The forest area is declining and the fallen leaves from trees are essential for maintaining fertility of the soil. With fewer trees available from the landscape, the community has seen a decrease in the number of logs available to keep at the edges of the plots as well as landscape terracing. According to the community, these changes have resulted in a decrease in the yield of crops like sweet potato. Now more ash is brought from home to maintain the fertility of the soil.

Demand for non-renewable fuel and electricity has increased in the community over time. Since the installation of the electrical supply in 1992, the demand for electricity has progressively increased to provide light sources and charge electronic devices, amongst other uses. Previously, people used torches made out of local materials, such as ***prew*** (waste from bamboo) for lighting. Kerosene lamps were also a primary lighting source but are now used only as a backup when the electricity fails. The community's increasing link with the market is associated with an increased dependence on fossil fuels. These are used to transport food and goods from elsewhere for local consumption and to bring community goods to buyers in Shillong and other parts of India. The production practices for foods sourced from the market may also be more dependent on non-renewable energy compared to locally produced foods.

Local food production, wild sourcing and processing remains, however, based in locally sourced renewable energy sources, especially firewood and human energy. Firewood is currently sufficient but sourcing it has become more difficult. Less wood is available from nearby areas and more travel is required. Some people have either started buying firewood from outside the community or they pay people to collect firewood for them from the surrounding landscape. In the past, children used to collect firewood from the forest but now they are sent to schools to learn rather than work in the fields. Children collect firewood only during holidays.

Human energy is critical in the local food system and demand for human labour is increasing in the system since people are becoming engaged in many activities other than farming, such as daily wage labour and basket making. Nonetheless, compared to the past, there is less time to work in the fields. The shortage of human labour can cause problems at times, such as during blackberry harvesting, which is time sensitive and delays can lead to a loss of harvest. The increasing role of daily wage labour is also associated with an increase in drudgery. The scope of relaxation was greater when people worked in their own fields. When they are doing daily wage labour in other fields, those who own the fields dictate their time. The case is similar for people who work in MGNREGA, where they have to follow rules and regulations for breaks, lunchtime, and when they start and end their workday.

Work in the fields is still very much exclusively manual and people continue to use traditional tools, such as machetes, iron cups and spades for cultivation, hunting and wild sourcing. These tools are mainly made from iron and wood. Iron smelting is a traditional practice known by the Khasi (Prokop and Suliga, 2013). A few innovations in production practices have occurred. For example, the use of the ***wait*** (machete) has decreased compared to the past as people now prefer ***kurat*** instead, which is faster for cutting down trees and sawing logs. Many people also now use ***sdie*** (axes), which have become more available at the market. Perhaps the greatest innovation and change regarding human drudgery has occurred in food processing. People in the community used to grind ***riewhadem*** (maize), ***krai*** (millet) and ***sohriew*** (Job's tears) with the help of grinding stones. Now the community has an electric-powered grinding machine, which has lessened the burden for people. The change of diet has also contributed to less drudgery in food processing. The community is eating more rice, which means that they are spending less time processing millet, maize and Job's tears.

Although water has always been plentiful in the village, people had to travel much further to collect water. During the 1980s, people collected water from two sources: ***Wahlyhuh Wahrit*** and ***Wah Mahep***. The first was near the garden of Kong Gills, whilst the other was in the forest. It took around 20 minutes for a round trip to ***Wah Mahep*** and half an hour to collect water from ***Wahlyhuh Wahrit***. They collected water in ***khiew khyndew*** (pots made with soil), ***khiew saraw, ktang*** and ***tangmoh***, which were covered with leaves to ensure that water would not spill when it was carried in ***khoh***. In 1984, the Government installed plastic pipes to transfer water directly to the village, thus saving travel time to the water's source. Metal pipes replaced the plastic pipes in 1988, when the community received materials from the PHE to construct storage tanks and pipes to supply water within the village. Now water collection takes around 10-15 minutes.

In addition to the installation of water storage tanks, the community has also received water tanks from Khadar Shnong Organization (KSO) and Meghalaya Rural Development Society (MRDS). The people were taught about rainwater harvesting and how to store water in times of water scarcity. This intervention has improved the level of water capture and efficiency of water use in the community. The rise of pig farming as a livelihood activity has increased water demand in the community, although some recycling of water in the household is practised: ***umsohkhawja*** (water that has been used to wash hands after eating food) and ***umkhaja*** (water that has been used to wash the rice before cooking) is given to the pigs. In general, water limitation is not an issue in Nongtraw.

The protection of waterways and water quality has improved through better management of human waste. In the past, open defecation was the norm. People would go to the forest to relieve themselves. Now, that is prohibited and even when there are large church service gatherings, people are not allowed to defecate anywhere. Awareness programmes conducted by various government departments and NGOs were behind that change, as they educated people on the negative impact of improper waste management on the environment. Since 2012, every house has its own toilet.

Whilst management of biodegradable waste has improved over time, the management of non-biodegradable wastes has become a challenge. In the past, bamboo was a resourceful product from which many traditional implements were made, like baskets (small and big), ***ruh doi, tyndong mluh, maloi tongum*** (bamboo mug), ***tang moh*** (salt container) and ***rusiangja-jyntah*** (container for keeping spoons). But now plastic and aluminium have replaced bamboo as the materials from which household items are made.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

Crop and livestock biodiversity

A high diversity of crops is cultivated in Nongtraw. More than 60 species were named by the participants in the thematic discussions that are cultivated in the ***jhum*** field or in the kitchen garden. These include cereals (3) and other starches (6), pulses (3), vegetables (17), fruits (22), nuts and seeds (1), and other edible species (8). Many of the crops grown by the community have multiple varieties, for a total of 34 recorded. In particular, potato has 13 varieties, cocoyam has 7 varieties and sweet potato has 7 varieties (Table 3.6). The other crops have fewer varieties.

TABLE 3.6. Variety diversity in Nongtraw

Scientific name	English name	Varieties
Brassica oleracea L., Brassicaceae	Cabbage; cauliflower	1) ***kubi***; 2) ***phulkubi***
Capsicum frutescens L., Solanaceae	Chili	1) ***sohmynken pylon***; 2) ***sohmynken war***; 3) ***sohmynken khnai*** (birds eye chili); 4) ***sohmynken***
Colocasia esculenta (L.) Schott, Araceae	Cocoyam, shriew	1) ***wang***; 2) ***riew siahiong***; 3) ***shriew lieh***; 4) ***riew lyngkait***; 5) ***riew khnap***; 6) ***riew lar***; 7) ***riew plang***
Eleusine coracana (L.) Gaertn., Poaceae	Finger millet	1) ***krai lon***; 2) ***krai jasheh***
Ipomoea batatas (L.) Lam., Convolvulaceae	Sweet potato, phan karo	1) ***phan hehsla***; 2) ***phan sawlia***; 3) ***lynniong***; 4) ***massar***; 5) ***phan lyniong***; 6) ***phan masal***; 7) ***sla phan karo***
Manihot esculenta Crantz, Euphorbiaceae	Cassava	1) ***phan dienglieh***; 2) ***phan dieng saw***
Musa sp., Musaceae	Banana	1) ***kait mon***; 2) ***kait jrong***; 3) ***kaitkhar***
Solanum tuberosum L., Solanaceae	Potato, phan	1) ***phan sawhoin***; 2) ***phan lieh***; 3) ***phan jata***; 4) ***phan lynseng***; 5) ***phan jyoti***; 6) ***phan imslem***; 7) ***phan tira***; 8) ***phan pyllonsla***; 9) ***phan prak***; 10) ***phan meikha***; 11) ***phan tlang***; 12) ***phan myngor***; 13) ***sohphan***
Zea mays L., Poaceae	Maize	1) ***riewhadem heh***; 2) ***riewhadem rit***
Zingiber rubens Roxb., Zingiberaceae	Ginger	1) ***sying makhir***; 2) ***sying bah***

Some of the crops and varieties are indigenous, whilst others have been introduced into the community. Indigenous crops from the region include Job's tears, cocoyam, banana, ***sohniamtra*** (*Citrus reticulata*, mandarin orange), blackberry and ***neilieh*** (sesame). Nongtraw is situated within an important centre of crop origin and diversity and the process of domestication of local plants is ongoing. For example, ***jaïing*** is a domesticated wild edible that is planted in the ***jhum*** field. Wild fruits of yesterday are in fact the domesticated fruits of today. The community tells the story of a woman who had gone to the forest and tasted a very sweet small fruit. She brought the seeds to the village and sowed in her garden. With time, its cultivation spread all over the Khasi Hills and this particular fruit eventually became the world-famous Mandarin orange. Some crops grown in the community were introduced centuries ago and are considered traditional because of their long history in the region. These crops include millet, rice bean, maize, cassava, sweet potato and potato, amongst others. Some crops have been introduced more recently. These newer crops include lettuce, carrot, tomato, orange, guava, mustard leaves, pumpkin, radish, French bean, peas, lemon, beet, turnip, mango, papaya, pineapple, mint and cabbage. Quite a few of them were introduced by the Agriculture and Soil Department on a trial basis.

Nowadays, traditional crops are not being produced in large quantities. Cocoyam, millet, Job's tears and cassava are grown only in small quantities. These crops are only used as snacks rather than as staples, which was previously the case. The most common varieties of potato are ***phan jyoti*** and ***phan myngor***, from the Horticultural Department of Meghalaya. Other important potato varieties cultivated in the community are ***phan imslem*** and ***phan jyoti***, both of which are introduced varieties from the Agriculture and Soil Department and are grown by many households in large areas. These are meant for household consumption and sale in the market. Two varieties of cassava are cultivated in local fields. ***Phan dieng saw*** is of the local variety and has been grown for a long time, whilst ***phan deing lieh*** was introduced by the Block office in 1964. The latter is bigger in size and is produced in larger quantity.

In contrast to the high diversity of cultivated plants, the community only maintains two species of livestock: chickens and pigs. Both species were indigenous to the region, whilst now, only chicken is. The community strictly forbids the introduction of non-local chicken breeds into the village. This is done to prevent the local breed from falling sick from illness brought from outside the community. By contrast, for pigs, ***sniang khasi*** (the local breed) has been replaced by ***snieng shitent*** and ***snieng pawa*** (introduced breeds) brought from Majrong, Mawngap and Sohra. These latter ones can attain a weight of 50-70 kg within a year and have a better market price compared to around 25-30 kg for the local breed.

Wild harvested plants and animals

In addition to cultivating and raising a large diversity of animals, people in Nongtraw collect a large diversity of wild edibles (such as plants, honey and mushrooms). Men and women pluck wild edibles on their way home from the fields and they collect them in the forest. Honey is quite sought after and people go to the forest to collect it. When they reach a beehive, they introduce themselves to the bee, informing the bees that they will only take what is required. Then they create smoke by burning jute so that the bees do not sting the person collecting the honey. Before the honey is collected, the queen bee is removed and kept inside the ***ruh ngap*** (basket) so that the others can follow her. There are no specific rules and regulations for harvesting wild edibles from the forest. Everyone is free to do so in any way in their own plots and in the forest. However, if they want to access private lands, permission from the landowner must be sought. Sometimes people from surrounding communities like Sohrarim collect wild edibles from the community's lands, as there are plenty in the area.

In addition to gathering wild edibles, people from the community hunt and fish in nearby forests and streams. Men and especially children go to the forest to hunt and trap animals for food. At other times, they kill animals to prevent them from destroying their agricultural plots. People use guns or ***ryntih*** (bow) and ***nampliang*** (arrow) for killing animals from a distance. People also use ***jri siat sim*** (catapult) for hunting wild fowl. Apart from stalking and bringing down the prey, people also use ***pap*** (a trap that looks like a pincer) to capture animals. ***Wait*** (machete) and ***tari*** (knife) are other tools used during the hunt. Animals are hunted during specific periods of the year. Animals like ***dkhan*** (mole rat) are greatly sought after and are trapped during the winter. In the summer, they usually burrow deep into the soil and are difficult to find. Squirrels, on the other hand, are caught in the summer, with traps, because they come to the fields to eat the maize crops.

Only a few people from the community fish in the rivers of Wahsohra village. Fishing occurs primarily by a few people who operate a small business and sell the fish in the village. They mostly fish during the summer season as the fishes hide in crevices during winter and are difficult to catch. Furthermore, the ***khasaw*** fishes only come up the river during the summer season from the plains of Bangladesh and they return there during winter. Women occasionally make the trip to the streams during the winter season to bathe and wash clothes so they can spend some leisure time, and they often fish as well. The techniques used for fishing are ***riyngwiang*** (fishing pole) attached with hooks, ***khwai sai um*** (fishing line), ***tong bniej*** (a kind of net), ***tong jar*** (fishing net), ***tutia*** (sodium carbonate), and poison. Insects are important as bait. Some people use ***musari*** (mosquito net) as fishing nets to catch fish. They throw it to the water and bring it out with fishes and other aquatic creatures trapped in it. When women go fishing, they put on the ***jain tapmoh*** (headscarf) and ***jain kyrshah*** (traditional shawl). When the fish are caught, they are kept inside ***khohsiah*** or ***ruh*** (small baskets made for keeping fishes).

Ecosystem conservation and protection

The community is aware that the health of the wild edibles and wild animals depends very much on the state of the surrounding forest. A few areas in the landscape are under formal protection and are actively being restored. These areas are the Village Development Committee (VDC) lands, ***Wah Shah Roh***, and the area under the water source. Farming is not allowed on VDC lands without the permission of the ***Durbar Shnong*** (village council). Strict regulations exist regarding harvesting of bamboo varieties like ***ktang*** (bamboo bigger in size) and ***rynai*** (bamboo with medium size) from VDC lands. Hunting, cutting and harvesting of other wild products is also strictly managed. Furthermore, planting of trees occurs in this area to improve the vegetation cover. In ***Wah Shah Roh***, the ***Durbar Shnong*** has banned agriculture. This is because the area is highly susceptible to landslides and the community is apprehensive that the disruption of the soil could eventually lead to damage to their houses and water storage tanks. Cutting trees up to 10 metres from the water source is strictly prohibited, as are digging of soil and open defecation. This is done to protect the catchment. Furthermore, permission has to be sought to cut trees from ***law adong*** (restricted forest). According to the rules, people are allowed to cut trees only for purposes like house construction, construction of livestock sheds, etc. Collection of timber for firewood is only allowed from one's own field. These rules are important to prevent soil erosion, which would negatively affect farming. Wild plants collection would also decrease if the forests are removed from the area, thus depriving people of the food and medicinal benefits that they currently receive.

Changes in the conservation and protection of resources over time

The community maintains many of their traditional and indigenous crops (e.g. cocoyam, millet, Job's tears and cassava) in the ***jhum*** field but the area has decreased over time. The community informed that they have lost many traditional varieties in favour of introduced ones. Varieties of potato like ***phan syntiew, phan tira, phan thiahdieng, sla phan karo, phan pyllon sla, phan prak*** and ***phan sawlia*** have disappeared in the last few decades. In their place, new ones have been introduced like ***phan jyoti, phan meikha*** and ***phan saw***. The same is the case for sweet potato with the varieties ***sawlia, heh sla, phansawlia, phanlynger*** and ***phanprak*** disappearing from the community landscape, but new ones such as ***lyniong*** and ***massar*** have been introduced. These varieties were lost after 2000. Generally, the new varieties offer better yield than the traditional ones. Several varieties of cocoyam have also been lost such as ***riew snem, riew kal, riew saw, riew siahiong, riew dahri*** and ***riew wai***. The last two varieties were particularly vulnerable to pests and diseases and have been extinct for 50 years. In the case of millet, farmers are still growing ***rai long*** and ***rai jasheh*** but in lesser quantities, whilst ***rai soh*** and ***rai thohriaw*** have entirely disappeared in the last 30 years. Previously, people only reared the local pig breed but since the 1980s, they started breeding ***sniang shi pawa*** and ***sniang shiteng*** pigs, which were introduced from Mawngap. Other new crops introduced are lettuce, carrot, tomato, orange, guava, mustard leaves, pumpkin, radish, French bean, peas, lemon, beet, turnip, mango, papaya, pineapple, mint, cabbage, and new varieties of brinjal, chillies and banana. Quite a few were introduced by the Agriculture and Soil Department on a trial basis.

Many of the larger animals the community used to hunt, like deer and Chinese pangolin, have disappeared from the landscape because of the loss of dense forests. The process of the disappearance of wild game started in the 1980s and intensified in the 1990s. The community has reduced their level of hunting and gathering as a response and consequence of this change. According to the women, an awareness programme offered by different NGOs and institutions like KSO, Bosco Reach Out, North East Network (NEN) and North East Slow Food and Agrobiodiversity Society (NESFAS) encouraged people to reduce their hunting, so the change is not only due to a decline in the game. These species are still available in the surrounding region. The most important reason for reducing hunting activities is that people have become increasingly busy with other livelihood activities. In the past, no rules or prohibitions existed for regulating hunting in the village. In 2012, rules were established that one cannot dig for rodents in someone else's field but can do it in his/her own field.

People have long been aware of the importance of maintaining natural and protected areas in the landscape. They have long had a community forest where there are strict regulations to control harvest. At present, awareness has only increased and, as such, with increasing pressure on resources, people have come up with various rules and regulations to make sure that the local landscape is in a healthy state. In the past, no rules existed for cutting trees down in the forest. As years passed and the forest became thinner, people began to realise the importance of a healthy forest. In addition to wild animals, fruit trees are also disappearing such as ***soh thylliang, soh lymwai, sohkyrwiat, sohlum*** and ***sohliang***. Some are still available, but they are far from the settlement and few in number and are continuously declining. In 2007 and 2008, the Forest Department and Social Service Center conducted awareness programmes on environmental protection. Since then, the village has established rules for cutting trees down in the forest. Similarly, in the past, no restrictions existed on fishing, but since 2012, the village committee along with the Soil Department developed regulations regarding what tools could be used for fishing. To prevent the extinction of the local fish species, only fishing rods and small nets are allowed. Many obey these rules out of fear of punishment. People are not allowed to poison or throw dynamite in the river to kill the fishes. However, some people still use those practices and cover an area of around 5 metres that they want to poison with a net of ***jaiñ kyrshah***, although they have to pay a fine of about INR 300 to INR 400.[19] They use poison extracted from the ***snep dieng*** (bark) and ***thied dieng*** (roots) of plants like ***khariew, sohliya, phyllud, shiwi, sohrumtheiñ*** and ***sohliang***.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of natural resources

The most important institution in the community governing the use of natural resources is the ***Durbar Shnong*** (village council) (Lyngdoh, 2016).

[19] Equivalent to USD 4.2-5.7.

The ***Durbar Shnong*** is part of the traditional administrative structure, which begins from the ***Hima Sohra*** (erstwhile tribal principality), under whom is the ***Raid Diengsaw*** (a collection of villages, viz. Mawlyngngat, War War, Phong, Kshaid, Mawthawtieng, Mawtuli, Nohshuit, Wah Sohra, Nongtraw, Tynniar, Dewlieh, and Diengsong) and finally the ***Shnong*** (village). The ***Rangbah Shnong*** is the head of ***Durbar*** and is assisted by office bearers like the secretary and treasurer, along with the executive members. The villagers make up the general body of the ***Durbar***. The ***Durbar*** has many functions in the village including: (1) Maintaining law and order within the area of jurisdiction; (2) Looking after the welfare of the community, including the poor and underprivileged; (3) Law making and implementing activities provided by the Government through various schemes and programmes; (4) Settling disputes to maintain peace and harmony within the village; and (5) Making rules and regulations to protect and preserve the forest and other natural areas within the local landscape. People who have registered themselves in the village ***Durbar*** have the traditional right of cultivating, renting and buying land in the village. They also have the right to practise shifting cultivation.

The community sources its food from both private land holdings and community lands. Both community land and private land holdings are governed by the rules framed by the village durbar. In addition to the ***Durbar Shnong***, the VDC plays an important role in managing natural resources. The VDC has a chairperson, secretary, treasurer and ordinary residents of the village as the general members. Its most important function is to obtain land for cultivation. The VDC also makes rules and regulations for harvesting of natural products from the community land. Their activities are done with the intention that in the future, people will not face land shortages to grow food and the landscape can continue to provide the natural resources needed to secure their livelihoods.

At present there are three community lands: (1) near the water source of the community; (2) along ***mawshongthait ba nyngkong*** (the site of the first resting stone); and (3) near the neighbouring Dewlieh village. The latter is the land where the current ***jhum*** occurs. It was purchased by the VDC from Bah Tariang (a resident of Sohrarim) and was distributed to all the community members through a lucky draw. Families can practise shifting cultivation upon payment of a fee of INR 200-INR 1 000[20] for four years, based on the size of the plot. Members of the community are allowed to use this land only for farming and house construction. The VDC has restricted cutting of trees within the VDC land without obtaining permission. Strict regulations exist regarding harvesting of bamboo varieties like ***ktang*** (bamboo bigger in size) and ***rynai*** (bamboo with medium size). This was done to provide protection to the land against soil erosion and landslides, which represent a loss of highly precious fertile soil. In addition to these lands, the community has a restricted forest area. Cutting of trees from this community forest is only allowed to build houses for orphans and single mothers. People can freely collect and cultivate vegetables and fruits in forests that are not owned by anyone.

Private landowners are not bound by these rules. Harvesting or usage of private land lies within their prerogative. Private land holdings can be owned individually by up to 40 people from the community. The VDC established in 2001 also owned some lands available for rent in areas close to Riatlwar, Wahsohrot and Syngiar. Those who do not have their own land for farming can rent land from these private landowners. This process is known as ***wai lumrep*** (renting hill for cultivation). The price of the land varies according to size. People take on a plot of land to rent for four years and can grow whatever they want.

Ancestral lands are handed down through the family, usually given to the youngest daughter along with the ancestral house (Mukhim, 2008). The woman is custodian of the land and is responsible for taking care of it and maintaining it, but she cannot sell it without the permission of her maternal uncle. If she so desires, she can share the land with her siblings. If there are

[20] Equivalent to USD 2.8-14.1.

no female children, the ancestral house goes to the youngest son, but the land is divided amongst the other siblings. In the case of ***bri*** (self-acquired property), the owner can choose to transfer it to anyone (such as his wife, son, daughter or someone else) based on personal choice. On some occasions, the same formula used for ancestral land is used (i.e. priority is given to the youngest daughter or son, in cases of only male children). In the case of only male siblings, sometimes the parents offer the land for rent and divide the money amongst their children. However, if there is a lack of understanding amongst the siblings, the parents will sell the land and give them the money instead. It is strictly prohibited to sell village land to outsiders. Although privatisation occurs, the community has continued to maintain control by following this rule. Community members are allowed to rent land to anybody of their choice. Farmers from the neighbouring villages of Deingsong, Wahsohra, Nongtyngiar or Sohrarim have been farming in Nongtraw by renting land. Clan land is absent in Nongtraw but is available in neighbouring Dewlieh, where land belongs to the Langstieh clan.

Land holdings are generally respected and there are no disputes in the community. According to the community, land availability and access to it is "medium" because it is available to rent. Access is considered equitable because, apart from land that is rented, community land is available to all members of the community. Socio-ecological mobility is medium because people are able to move between different locations depending on rent.

Aside from the Durbar Shnong and the VDC, many other institutions have come up in the village to manage and guide the sustainable use of natural resources. The Biodiversity Management Committee (BMC) has a main responsibility of maintaining the People's Biodiversity Register. The Village Disaster Management Committee (VDMC), headed by the ***Rangbah Shnong***, maintains a report of natural calamities like landslides and reports them to the Block Office. Barefoot Environment Educators (BEES) is an initiative of the Soil Department of the Government of Meghalaya, whose main activities are planting trees, digging compost pits for biodegradable and non-biodegradable waste segregation in all households, and constructing retaining walls. Four self-help groups (SHGs) have been trained in food processing (juice, pickles, jam and honey) and encouraged to buy land for cultivation and planting of trees and herbs for traditional medicines. The Nongtraw Multipurpose Cooperative Society Ltd. works to process millet and package it for sale in the market. Finally, a Participatory Guarantee System (PGS) exists in the community to motivate farmers to increase production and encourage them to adopt organic processes.

The work of the village institutions, like the ***Durbar Shnong***, is transparent and proposals made for community development are meant to look at the welfare of all the residents (children, women and general masses). It might happen that someone who is an MLA or MDC could become the ***Rangah Shnong*** and vice versa but typically these roles are kept separate, which means that one cannot assume a dual role in the community. Whilst only a man can become head of the village and take higher positions like Chairman and Secretary within the community, women are included in the ***Durbar*** and can hold positions on the Executive Committee. They are thus able to contribute to decisions regarding natural resource management. In fact, Nongtraw is the only village in the ***Hima Sohra*** that allows that. Women are also members of SHGs, women's groups, social welfare associations (ASHA, Anganwadi), MGNREGA committee, VDC, Village Water Sanitation Committee (VWSC), Village Employment Committee (VEC), Village Health Nutrition and Sanitation Committee (VHNSC), Power Committee, BEES, Church, Vigilance Committee, etc. As such, there is an adequate multi-stakeholder platform/ institution to effectively plan and manage natural resources in the landscape. However, connection, coordination and cooperation between communities for managing natural resources is low because only ***Wah Sohra*** has a good understanding with Nongtraw in this regard.

Changes in governance of natural resources over time

Changes in the governance of natural resources have occurred over time. In the past, only the ***Durbar Shnong***, which was formed in the 1950s when the village was founded, existed. Support from the Government for development activities was uncertain. Things have improved now. Apart from the Executive Committee, many other committees assist with implementing the various schemes and programmes introduced by the Government and other NGOs, including the MLA and MDC. Many new institutions have been developed recently in the village to deal with the use of natural resources and its governance, including the VDC (2004), SHGs (2007), VDMC (2009), BEES (2012), PGS (2016), BMC (2017) and Nongtraw Multipurpose Cooperative Society Ltd. (2017). These institutions formed with the support and encouragement of both government institutions and NGOs, including Bosco Reach Out (VDC), Khatarshnong Socio Organization (VDC/SHGs), MRDS, Block Office (VDMC), the Soil Department of the Government of Meghalaya (BEES), NESFAS (PGS/NMCS Ltd.), and The State Biodiversity Board of Meghalaya (BMC).

Many rules have been developed fairly recently to manage natural resources, including those regarding: areas where people can dig for rodents (2012), tools and methods acceptable for fishing (2012), and cutting trees (since 2008). Thus, in the recent past, community-based landscape governance has increased. The inclusiveness of governance is also increasing. In the past, only men who were 30 years old or older were allowed to take part in the proceedings of the ***Durbar***. Women were not allowed because it was believed that they might disturb the decision-making process because they were supposedly more talkative. In 2004, when the VDC was formed, it intervened and advocated for women to take part in the ***Durbar***, which began occurring in 2008.

Whilst in some ways governance of natural resources has become stronger, at the same time, since 2016, the Government has been intervening in the functioning of the community. The Government has implemented some new rules, notably one that deprives the local people from the practice of shifting cultivation. The Forest Department suggested that people plant more trees in areas where trees have been cut down. Additionally, from now on, a written document will be required from the Government for those who bought lands from others. According to the people, the Government does not fully recognize the rights of land use by the community. This is because it does not understand the community's procedures and laws. As such, the community's right over land, water and other natural resources is decreasing. There is thus a keen tussle between community members who are trying to strengthen the use and governance of natural resources and the Government, which is trying to increase its influence on the same.

The land on which the community now resides initially belonged to the Tariang clan. Because of a rise in population, the community bought some parcels of land from the owners. This land was again distributed to the members who had contributed to the fund for purchasing the land. These lands became private holdings. In 2004, more land was bought from the clan. But this time, the land was for community use and was not distributed as private plots.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

A summarized assessment of 13 indicators of resilience is presented below. The food system of Nongtraw shows many indications that it is resilient and endowed with the capacity for adaptation and transformation.

1. Exposed to disturbance: Over the years, the community has experienced many environmental shocks including storms, landslides and unpredictability in rainfall, as well as pest outbreaks. Although disruptive when they occur, the community has recovered well after these events and they have not had an adverse impact in the long run.

2. Globally autonomous and locally interdependent: The community has a high self-sufficiency in food production (50-60 percent) by farming, raising livestock and wild sourcing. These activities also provide an important contribution to incomes (approximately 60 percent from crops and livestock). Local markets are supplying many foods that are produced within the region and, in this sense, a high level of regional autonomy in food provision is observed.

3. Appropriately connected: A few shops operate in the village but they offer a limited range of products. Accessing the weekly markets in Sohra and Laitryngew is challenging because of the required 3 000 steps, demanding effort and time. It can then delay community members' arrival to the market and contribute to lower prices.

4. Socially self-organised: The community has several institutions that support and strengthen the food system with high participation from local people. The activities of these groups are working to strengthen capacities in local food production, market local foods, and protect natural resources, amongst other themes relevant to the food system.

5. Reflective and shared learning: The community is always learning, adjusting and improving its practices. They have introduced new rules for protecting forest areas and controlling hunting and fishing in reaction to observed changes in soil quality, forest cover and wildlife populations. Over the past few decades, the community has made many adjustments to its livelihood strategy to increase their incomes and meet emerging challenges and opportunities.

6. Honours legacy: Elders are respected in the community and the community maintains many traditional practices, crops and livestock. The community wants to maintain their traditions related to their local food system for the future and new ways are being used to document and transmit traditional knowledge.

7. Builds human capital: The school garden gives children an opportunity to learn about local crops but the responsibility of maintaining tradition rests mainly on individual households rather than on the community. Older students must travel outside the village to go to school and accessing medicine and medical attention can also require travelling outside the village.

8. Coupled with local natural capital: The community's food system is very much linked with the natural resources found in the local landscape. Whilst depending strongly on locally available resources, the food system is able to provide a high number of products to support the livelihoods of the community, whilst not experiencing grave issues with water scarcity or shortage of fuelwood or labour.

9. Ecologically self-regulated: The community recognizes that if the forest is healthy, the soil is also in good condition and they have accordingly taken action to protect the forest areas to improve their yields in the ***jhum*** fields. Positive interactions between crops and animals and between different crops are recognized and leveraged in their farming practices.

10. Functional diversity: The community produces foods with a diversity of nutritional values, including starches, legumes, meat and flesh foods, eggs, nuts and seeds, dark green leafy vegetables, orange- and red-fleshed fruit and vegetables, other vegetables, and other fruits. In addition to providing a wide diversity of nutritional values, the local landscape also provides a number of other useful products and functions such as livestock feed, medicines, structural materials, and wood for heating and cooking. Several stress-tolerant varieties and breeds are maintained that provide harvest security during periods of climate stress.

11. Optimally redundant: Multiple species and varieties are maintained in the farming system for different food groups, which provide a safety net for crop failure. Wild areas and the market provide an important supplement for local production.

12. Spatial and temporal heterogeneity: The community enjoys a diversity of ecosystems and land usages in the local landscape where they source both food and non-food items. Land rotation, mixed cropping and some amount of agroforestry in the form of coffee plantations are a handful of the practices the community follows to increase heterogeneity in the system. A few weaker points in resilience were highlighted in the assessment.

13. Reasonably profitable: Agriculture, including farming crops and raising livestock, is estimated to provide 60 percent of income. Secondary employment has an important role and the community depends on various subsidies and welfare schemes of the government. According to men, without subsidies people can survive but it will entail great difficulties. Women, on the other hand, agree that subsidies have helped a great deal in earning a liveable wage but also insist that they can sustain themselves in its absence as well. They would have to work harder but they would be able to manage the situation.

Kong Pliemon Barim harvesting tapioca.

© Lyngdoh NESFAS/ Riteilang Khongrangjem.

SECTION 3 CONCLUSIONS AND FUTURE PROJECTIONS

1. FOOD SYSTEM SUMMARY

The food-producing activities in Nongtraw are agriculture, livestock rearing, and some amount of fishing and collection from the forest. The most important form of agriculture that people follow is ***jhum***, wherein a new plot of land is cleared every year for farming. The old plots are allowed to remain fallow for a period of 7-15 years, after which they are again put under cultivation. The ***jingbam na kper*** (kitchen garden) is another important production space. Around half the food consumed by the community is estimated to come from local production. Collecting wild edibles is an important supplement for the diet, especially in the summer months when they are highly available. Along with occasional fish and small animals, wild sourcing provides an estimated 10 percent of local diets. The remaining 40-50 percent of the diet is sourced from the market and PDS. In addition to its important subsistence role, agriculture also provides an important contribution to the income of the community (around 60 percent). Various products are sold in local markets directly to consumers or to shopkeepers for local consumption. Broom grass is a cash crop sold to more distant parts of India. Basketry and daily wage labor are other critical income sources. The major markets visited by the community are located 4-13 km from Sohrarim, which is an hour's climb from the village.

2. HIGHLIGHTS OF SUSTAINABILITY ASSESSMENT

The agricultural system in Nongtraw involves very low input. ***Jhum*** cultivation is rain-fed and fertilized by ash from burning the felled biomass. Abundant water from the nearby water source is used to water the garden crops in the winter and to bathe and clean after the pigs. Food production and processing are based primarily on locally sourced renewable energy, particularly human labour and fuelwood. Biodegradable wastes are well managed as kitchen scraps are fed to the pigs and to produce compost, which then fertilizes the crops along with pig manure. Recent improvements have been made in managing human waste and non-biodegradable wastes. Protection of forests and wildlife has also been strengthened recently with new rules formed by the community for regulating hunting, fishing and cutting trees. The governance of natural resources is led by the traditional village council with a growing body of community-based organizations supported and encouraged by several NGOs and government institutes.

The community produces a high diversity of crops. More than 60 species were named by the participants along with a high number of varieties, particularly for potato and cocoyam. The local agrobiodiversity includes a rich heritage of indigenous and traditional crops, varieties and breeds such as 8 varieties of cocoyam, 13 varieties of potato, and 2 varieties of finger millet. The diversity in local production contributes to diet diversity in the community. Starches such as rice and tubers are eaten daily. Dark green leafy vegetables, eggs and meat are also eaten regularly. People are of the opinion that local diets are adequate for fulfilling their nutritional needs but they are not completely immune to food insecurity. Heavy rains in 2017 meant the community could not plant on time and damaged the broom crop, which is a main income source for many. Therefore, the community had to reduce food consumption and eat a more limited number of foods. Markets are reasonably accessible and stocked with a diversity of locally produced nutrient-dense foods but prices can be an issue for some people to buy food. Whilst the adequacy of income earned in the community has improved over time, at the same time so have the various demands for the lifestyle people choose to adopt. The amount of chemicals used in production of foods from the market is also a concern for the health and well-being of the community.

The community sources its food from both private land holdings and community lands, the latter of which are controlled by the VDC. So far, access to enough land is not an issue. However, since 2016, the Government has started to deprive local people of the practice of shifting cultivation. According to the people, the Government does not fully recognize the rights of land use by the community. Private land available for cultivation is also decreasing day by day because of an increase in population. Yields are also decreasing. These factors could have an adverse impact on local food production in the future.

Highlights of the 13 indicators of resilience as per Cabell and Oelofse (2012) are several and we summarise some of them. First, the community has recovered well after climatic shocks including storms, landslides and unpredictability in rainfall, as well as pest outbreaks. The community has further demonstrated a high self-sufficiency in food production (50-60 percent) via farming, raising livestock and wild sourcing as well as local markets that provide for high regional autonomy. Thanks to several institutions that are well organised to produce and market local foods, as well as to protect natural resources, the community has demonstrated that they are socially self-organised. Moreover, there are clear indicators for reflective and shared learning as the community is continuously adjusting its practices, for instance by devising new rules for protecting forest areas and controlling hunting and fishing. Respect for elders is another highlight of resilience that has led to a continuous transmission of traditional ecological knowledge and sustainable, ancient old practices to the younger generation.

Thanks to an abundancy of natural resources available in the local landscape, there are no grave issues with water scarcity or shortage of fuelwood or labour. Positive interactions between crops and animals and between different crops are recognised and leveraged in their farming practices. The community is also ecologically self-regulated. Recognising the interlinkage between forest and soil health, particular attention is given to adequate fallow periods and rotation in the ***jhum*** fields.

Resilience is also demonstrated in the diverse range of foods that provide for both a complete nutrition in people's diets as well as multiple functions including livestock feed, medicine and housing material, for instance. Crop varietal diversity also confers greater harvest security in times of climate stress. Diverse land use including land rotation, mixed cropping and some amount of agroforestry in the form of coffee plantations are a few of the practices the community follows to increase heterogeneity in the system.

3. CONCLUSIONS

According to community members, one of the greatest strengths of their community is good and clean governance. The functioning of the ***Durbar Shnong***, a premier traditional institution, is transparent and it works according to the interest of the people, making decisions for the common good. The ***Rangbah Shnong*** and the executive committee perform their duties with full participation of the community. Nongtraw is the first village under the ***Hima Sohra*** that has allowed women to sit in the ***Durbar Shnong***, which is seen as a positive change as they can now have greater input on social issues in the community. They are members of the executive committee as well. If men do not attend the ***Durbar***, they have to pay a fine but if women are unable to attend, they are exempted because they have multiple duties to perform. As a result, everyone's voice is heard and there is welfare without any discrimination. The future of the local food system depends greatly on the quality of governance.

Within the community there is strong unity, with everyone actively participating in making decisions for the betterment of the community. A close bond exists between the members of the community, which helps create understanding and cooperation amongst themselves. Participation in community activities is in fact quite strong compared to neighbouring communities. For example, when someone passes away in the community, everyone comes out to help the deceased family. In the same way, the community also has strong relationships with outside agencies like the Government, NGOs and other institutions that support and offer guidance in agriculture, marketing and other socio-economic initiatives. The interaction with groups from outside the village has broadened the thinking of the people.

The community also believes that being able to maintain and sustain their traditional farming practices by avoiding fertilizers and pesticides is one of their greatest strengths. Agriculture offers a way for community members to interact and connect with one another, allowing them to help each other in times of food insecurity and sharing/exchanging of seeds and food within the village. The traditional knowledge regarding the food system is still being passed on to new generations.

At the same time, certain weaknesses exist that the community wishes to remove. One of the most important weaknesses is having office members of the ***Durbar Shnong*** who are not educated. The education infrastructure has remained the same since the establishment of the school in 1964, but the community would like to upgrade it and have a secondary school as well. Health infrastructure is also quite weak, with only one traditional healer and the ICDS centre functioning more as a storeroom.

CHAPTER 4

From the ocean to the mountains: storytelling in the Pacific Islands

Fishing and agroforestry food system of the Melanesians[SI] people in Solomon Islands

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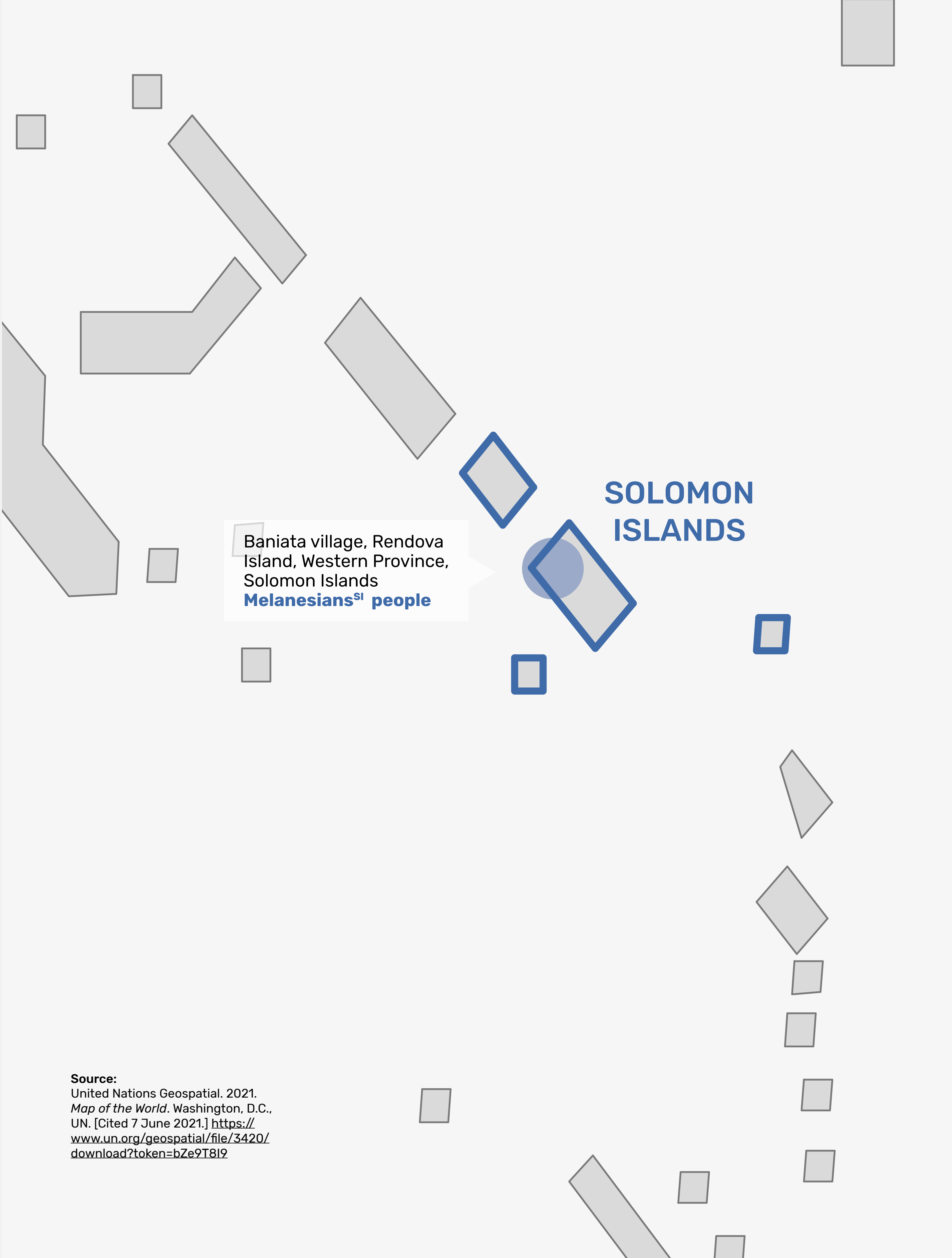
Indigenous People's food system profiling in Baniata community, Solomon Islands.



Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

“We are a welcoming community that works together, and we are proud of our baked **ngali** nuts.”

Woman from the community in Baniata.

AT A GLANCE

This study characterised the food system of the village of Baniata, on Rendova Island in the Western Province of Solomon Islands. The original land-owning tribe of Baniata was Irurego, but currently eight different tribes live amongst one another. The community is self-sufficient, with the majority of food production, 70 percent, by agroforestry farming, fishing, hunting and wild sourcing; however, an increasing percentage (30 percent) of their food is sourced from imported or processed foods from the market. Home foods are produced without agrochemical inputs, as villagers have expressed interest in maintaining organic production practices. All villagers rely on agri-food sale as their primary source of income including garden produce, copra (dried coconuts) and ***ngali*** nuts. Traditional foods are eaten daily in Baniata, often mixed with imported and highly processed foods. Food insecurity is perceived as a result of seasonal availability of home garden foods, impacts of pests and diseases on crops, changes in weather patterns and impacts on seas, high costs of food items such as meat and milk, and shifting taste preference from traditional crops to processed foods. Whilst the diversity of crops is declining, the local traditional varieties offer resilience against climate and pest disturbances, helping promote nutritious diets and access to diversified foods.

SECTION 1 COMMUNITY AND FOOD SYSTEM PROFILE

1. GEOGRAPHIC CONTEXT

Solomon Islands is a Melanesian archipelago of more than 600 000 people and more than 900 islands. Approximately 65 000 live in the capital Honiara on the island of Guadalcanal. The remaining Solomon Islanders reside in villages of varying size, spread across the other islands.

This research was conducted in the village of Baniata, in the Western Province on Rendova Island. Baniata, with a population of around 900, is a 90-minute petrol-powered boat ride from the nearest city and airport – Munda. Two smaller villages are within walking distance of Baniata: Havila, with a population of approximately 250, and Retavo, with a population of approximately 250. The three villages sit between steep mountain faces and the Solomon Sea. The climate of Solomon Islands is equatorial, characterised by heat and humidity, with distinctive wet and dry seasons. The temperature is consistently around 29 °C, with mild seasonal fluctuations, and rainfall varies amongst the islands, with the Western Province receiving the highest levels of approximately 3 000 mm per annum. Villages are surrounded by dense biodiverse bush, home to numerous native and endemic species.

2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

Villages typically contain one dominant tribe. The original land-owning tribe of Baniata was Irurego. However, with migration related to marriage, headhunting and religious practices, eight different tribes – constituting approximately 900 villagers – live amongst one another. Baniata consists primarily of Melanesians, however, a few Polynesians have married into the village.

Households usually consist of multigenerational families, who typically eat and spend leisure time together. Youths outnumber adults, and national data predicts a doubling of Solomon Islands' population over the next few decades.

The Solomon Islands archipelago is home to over 75 distinct languages. The official language is English, the common language across all the islands is Pidgin, and the local language in Baniata is Touo. Most villagers are able to speak multiple local languages, including those spoken on Rendova Island or across the Western Province. Despite English being the official language, it is only spoken by about 2 percent of the population. Children are not required by law to attend school. Most children in Baniata previously attended schools, as their parents raised enough money through selling agri-food products to pay fees.

Religion is a significant part of daily life in Baniata. Two primary religions are practised in Baniata: Christian Fellowship Church (CFC) and Seventh-day Adventist Church (SDA). The two religious communities live next to each other in Baniata; however, there is a physical boundary, a planted hedge, that separates the two sides. The Christian Fellowship Church makes up the largest proportion of village residents (approximately 70 percent). Seventh-day Adventist Church followers are prohibited from consuming crustaceans, pork, possums, crocodiles, molluscs and turtles. They are also prohibited from drinking alcohol, tea, coffee, smoking tobacco, or consuming betel nut (*Areca catechu* L., Areaceae) – a commonly chewed sedative drug in Solomon Islands. The age of marriage varies, but typically occurs when the men and women are around 25-30 years old. In order for men to prove they are ready to marry, they must be capable of building a house and lighting a fire using a stick. For women to prove they are ready for marriage, they must cook using a ***motu*** (earth oven) and weave a basket.

Baniata has a diverse mosaic landscape made up of seven primary methods of land use. These include village settlements; mountain ranges; the sea, rivers and streams; food gardens; agroforestry (***ngali*** nut trees, (*Canarium indicum* L.)); and coconut plantations.

3. LOCAL FOOD PRODUCTION

Baniata has over 127 food-providing species available for production, raising, collection from the wild, and ultimately consumption. Production systems include coconut plantations, food gardens, agroforestry systems, small amounts of domesticated livestock that are free-roaming chickens, hunting, fishing, and wild food harvesting. Homegrown foods are produced without agrochemical inputs, as villagers have expressed interest in maintaining organic production practices. However, pests and diseases are increasing in impact and severity. Food waste and animal manure are not typically recycled back into food production systems. Local production coupled with wild food collection has been the primary source of dietary energy for centuries.

Crops

Home gardens produce roots, tubers, bananas, vegetables and fruits. Crop rotations and intercropping techniques are often practised. ***Ngali*** nut trees (*Canarium indicum*) are reported to be a significant source of both nutrition and income. Since domestication, they are planted with companion crops such as ***karuvera*** (*Xanthosoma sagittifolium*, Chinese taro), yams, bean and shade-tolerant cassava. In total, 19 different crops are intercropped with ***ngali*** nut agroforestry. The nuts are also a primary source of food for ***ghausu*** (doves), which are raised as a food source for the villagers. Coconut is planted along the shoreline of the village and used for agri-food sales, as well as consumption in forms of coconut milk and water.

FIGURE 4.1. Landscape of Baniata and surrounding villages of Havila and Retavo

Source: Google Earth, 2018, modified by Chris Vogliano from Baniata community mapping exercises, 2021.

TABLE 4.1. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Local name	Scientific name	English name
Condiments, seasonings, snacks and sweeteners	***tuva migori***	*Zingiber officinale* Roscoe, Zingiberaceae	Ginger
	aro migori	*Zingiber officinale* var. *rubrum* Theilade, Zingiberaceae	Ginger
Fruits and juices	***pineapple***	*Ananas comosus* (L.) Merr., Bromeliaceae	Pineapple
	soursop or omo	*Annona muricata* L., Annonaceae	Soursop
	me'u*	*Artocarpus altilis* (Parkinson) Fosberg, Moraceae	Breadfruit
	starfruit	*Averrhoa carambola* L., Oxalidaceae	Carambola
	fetu	*Bruguiera gymnorhiza* (L.) Savigny, Rhizophoraceae	Mangrove fruit
	pawpaw	*Carica papaya* L., Caricaceae	Pawpaw or papaya
	melon	*Citrullus lanatus* (Thunb.) Matsum. & Nakai, Cucurbitaceae	Watermelon
	half orange	*Citrus x aurantium* L., Rutaceae	Sour orange
	pomolo	*Citrus grandis* (L.) Osbeck, Rutaceae	Pomelo
	madarin	*Citrus reticulata* Blanco, Rutaceae	Mandarin
	sweet orange	*Citrus sinensis* (L.) Osbeck, Rutaceae	Orange
	mango	*Mangifera indica* L., Anacardiaceae	Mango
	multiple cultivars*	*Musa* sp., Musaceae	Banana (cooking)
	several cultivars	*Musa* sp., Musaceae	Banana (desert)
	rambutan	*Nephelium lappaceum* L., Sapindaceae	Rambutan
	avocado	*Persea americana* Mill., Lauraceae	Avocado
	gema fruit	*Pometia pinnata* J.R.Forst. & G.Forst., Sapindaceae	Pacific lychee
	guava	*Psidium guajava* L., Myrtaceae	Guava
	encori or ***opiti***	*Spondias dulcis* Soland. Ex Frost. fil., Anacardiaceae	Golden apple
	kapicala	*Syzygium aqueum* (Burm.f.) Alston, Myrtaceae	Watery rose apple
	kapicala	*Syzygium malaccense* (L.) Merr. & L.M.Perry, Myrtaceae	Malay apple
Nuts and seeds	***voze voze****	*Barringtonia edulis* Seem., Lecythidaceae	Cut nut
	anire tinge*; cut nut* (several varieties)	*Barringtonia novae-hibernae* Lauterb., Lecythidaceae	Cut nut
	tinge*	*Barringtonia procera* (Miers) R. Knuth, Lecythidaceae	Cut nut
	reef nut	*Canarium harveyi* Seem, Burseraceae	Canarium nut
	gasio (black nut)	*Canarium indicum* L., Burseraceae	Canarium nut
	ngali nut*	*Canarium indicum* L., Burseraceae	Java or canarium nut
	ngali nut*	*Canarium solomonense* B.L.Burtt, Burseraceae	Canarium nut
	coconut*	*Cocos nucifera* L., Arecaceae	Coconut
Pulses	***peanut***	*Arachis hypogaea* L., Fabaceae	Peanut
	waku bean	*Benincasa hispida* (Thunb.) Cogn., Cucurbitaceae	Wax gourd
	butterfly bean	*Psophocarpus tetragonolobus* (L.) DC., Fabaceae	Wing bean
	snakebean* (cocoa)	*Trichosanthes cucumerina* L., Cucurbitaceae	Snake gourd
	snakebean*	*Trichosanthes cucumerina* subsp. *anguina* (L.) Haines, Cucurbitaceae	Snake gourd

TABLE 4.1. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Local name	Scientific name	English name
Pulses	***cowpea bean***	*Vigna unguiculata* (L.) Walp. var. *unguiculata*, Fabaceae	Cowpea or dwarf bean
	bean (several varieties)	*Vigna unguiculata* subsp. *sesquipedalis* (L.) Verdc, Fabaceae	Yardlong bean
Starches (roots and tubers)	***ozo****	*Alocasia macrorrhizos* (L.) G.Don, Araceae	Giant taro
	fivo or buini; mahio; ruta; sisiri; sofu (various varieties)	*Colocasia esculenta* (L.) Schott, Araceae	Taro
	kakake	*Cyrtosperma merkusii* (Hassk.) Schott., Araceae	Swamp taro
	yam*	*Dioscorea alata* L., Dioscoreaceae *Dioscorea* sp. L., Dioscoreaceae	Greater yam
	vanuatu*	*Dioscorea cayenensis* subsp. *rotundata* (Poir.) J.Miège, Dioscoreaceae	Greater yam
	pana	*Dioscorea esculenta* (Lour.) Burkill, Dioscoreaceae	Pana or lesser yam
	bou*	*Dioscorea* sp. L., Dioscoreaceae	Pana or lesser yam
	kumara*	*Ipomoea batatas* (L.) Lam., Convolvulaceae	Sweet potato
	various varieties	*Manihot esculenta* Crantz, Euphorbiaceae	Cassava
	karuvera	*Xanthosoma sagittifolium* (L.) Schott, Araceae	Chinese taro
Vegetables	***slippery cabbage****	*Abelmoschus manihot* (L.) Medik., Malvaceae	Slippery cabbage
	shallot	*Allium cepa* var. *aggregatum* G.Don., Amaryllidaceae	Spring onion or bunching onion
	saladia	*Brassica campestris* L., Brassicaceae	Saladeer
	paksoi; choy sum	*Brassica rapa* subsp. *oleifera* (DC.) Metzg., Brassicaceae	Chinese cabbage
	cucumber	*Cucumis sativus* L., Cucurbitaceae	Cucumber
	pumpkin leaves	*Cucurbita maxima* Duchesne, Cucurbitaceae	Pumpkin leaves
	kankung	*Ipomoea aquatica* Forssk., Convolvulaceae	Kang kong
	watercress	*Nasturtium officinale* W.T. Aiton, Brassicaceae	Watercress
	bonio	*Sauropus androgynus* (L.) Merr, Phyllanthaceae	Sweet leaf
	eggplant	*Solanum melongena* L., Solanaceae	Eggplant
	karuvera* leaves	*Xanthosoma sagittifolium* (L.) Schott, Araceae	Chinese taro leaves
	corn	*Zea mays* L., Poaceae	Maize

*Species present in the ***ngali*** nut agroforestry system

Solomon Islands family standing near their home and personal garden in Baniata Village.

© Massey University/ Chris Vogliano.

Livestock

Livestock in Baniata was previously more productive, with chickens and pigs raised in fenced areas, but now primarily consists of free-roaming chickens and a few domesticated pigs. The featherless neck chicken breed, which has an increased tolerance to heat, was introduced in 2016. It is not uncommon that men catch young wild pigs and raise them until they have grown large enough for slaughter. During 1975–1980, cattle grazed in the community. This is no longer practised due to cattle spoiling gardens, as well as a lack of expertise required to raise the animals. Chickens are raised both for their eggs and meat. Non-seafood-animal-sourced foods are consumed once a month or less, and reserved for special occasions such as birthdays, marriages, Christmas and New Year's. All animals are processed and consumed within the community. No meat conservation techniques were reported. Main forage and feed for livestock include coconut leaves and waste, and food scraps. Less frequently, ***hote*** (white ants) collected from the bush are given to chickens, as well as cassava leaves from the home gardens.

TABLE 4.2. List of livestock

Group	Local name	Scientific name	English name
Birds and poultry	***chicken*** (whiteman)	*Gallus gallus domesticus* L., Phasianidae	Chicken
	naked neck chicken (featherless neck)	*Gallus gallus domesticus* L., Phasianidae	Chicken
Mammals	***pig*** (crossbreed)	*Sus scrofa domesticus* Erxleben, Suidae	Pig

Fishing

Fishing is primarily the role of men, however, women are able to fish if desired. Open seas are a source of tuna and reefs are the source of numerous varieties of coastal fish. To catch fish, a rope is crafted from the inner bark of a ***pusi*** tree. The bark of this tree is flexible and can be easily tied to a bamboo pole with a traditional hook known as a ***zuahango***. Occasionally villagers will use a poisonous plant, ***buna*** or ***deris***, as bait to kill fish. The community has motorboats to go further out to sea, and members use nets and modern fishing lines with hooks. Traditional knowledge guides fishing: full moon is the best time for catching ***ghohi*** (*Sphyraena barracuda*, barracuda) and ***mara*** (*Caranx* spp., trevally); new moon, especially from the first to the fourth day, and on the seventh day, is best for fishing generally; and June and July are the best months to catch Kingfish.

The primary seafood caught is ***bonito*** (*Katsuwonus pelamis*, skipjack tuna), turtles, sharks and eels; however, over 51 different aquatic species were fished locally. Villagers are able to keep any size of fish caught. Fish is consumed fresh, with only a few villagers smoking fish for preservation. Fish and eels are declining due to increased populations of villages, higher pressure on the resources, and increased flooding, which washes eels out to sea. Fishing is restricted for multiple days directly following the death of a villager.

TABLE 4.3. List of wildlife used as food: fish, molluscs and crustaceans

Group	Local name	Scientific name	English name
Fish	***asirae***	*Acanthurus gahhm* Forsskål, Acanthuridae	Brown tang (surgeon fish)
	bireke	*Acanthurus lineatus* L., Acanthuridae	Lined surgeon fish
	evaeva	*Acanthurus nigricauda* Duncker & Mohr, Acanthuridae	Epaulette surgeonfish
	tavazi	*Acanthurus xanthopterus* Valenciennes, Acanthuridae	Yellow fin surgeon fish
	eelfish	*Anguilla marmorata* Quoy & Gaimard, Anguillidae	Giant mottled eel
	fubua	Balistidae sp.	Triggerfish
	makoto	*Balistoides viridescens* Block & Schneider, Balistidae	Titan triggerfish
	topa	*Bolbometopon muricatum* Valenciennes, Scaridae	Humphead parrot fish
	mamula	*Caranx* spp. Lacépède, Carangidae	Trevally
	rainbow or babalu	*Elagatis bipinnulata* Quoy & Gaimard, Carangidae	Rainbow runner
	eoea	*Encrasicholina punctifer* Fowler, Engraulidae	Buccaneer anchovy
	orufu	*Epinephelus hexagonatus* Forster, Serranidae	Starspotted grouper
	zoata	*Epinephelus lanceolatus* Bloch, Serranidae	Giant grouper
	bukulu	*Epinephelus* spp. Bloch, Serranidae	Round head grouper
	noto	*Etelis* spp. Cuvier, Lutjanidae	Deep water snapper
	sogari	*Gazza achlamys* Jordan & Starks, Leiognathidae	Smalltoothed ponyfish
	zaoto	*Halichoeres argus* Bloch & Schneider, Labridae	Angus wrasse
	viviru	Istiophoridae sp.	Marlin
	bonito	*Katsuwonus pelamis* L., Scombridae	Skipjack tuna

TABLE 4.3. List of wildlife used as food: fish, molluscs and crustaceans

Group	Local name	Scientific name	English name
Fish	***hegosune***	*Kuhlia marginata* Cuvier, Kuhliidae	Dark-margined flagtail (river fish)
	mihu	*Lethrinus miniatus* Forster, Lethrinidae	Sweetlip emperor
	fufu	*Myripristis* spp., Holocentridae	Soldier fish
	fagu	*Naso brevirostris* Cuvier, Acanthuridae	Canvass or unicorn fish
	begozo	*Philypnodon grandiceps* Krefft, Eleotridae	Olive flat head gudgeon
	fehu	*Plectorhinchus lineatus* L., Haemulidae	Yellowbanded sweetlips
	embo	*Pseudomyxus capensis* Valenciennes, Mugilidae	Freshwater mullet
	katukatu	*Sardinella* spp. Valenciennes, Clupeidae	Sardine
	heta	*Sargocentron tiereoides* Bleeker, Holocentridae	Pink squirrel fish
	sioura	*Scarus* spp. Forsskål, Scaridae	Parrot fish
	eusava, lasilasi	*Scomberoides lysan* Forsskål, Carangidae	Doublespotted queenfish
	kingfish	*Scomberomorus cavalla* Cuvier, Scombridae	Spanish mackerel
	shark	Selachimorpha spp.	Shark
	gore	*Siganus corallinus* Valenciennes, Siganidae	Blue-spotted spinefoot (yellow reef fish)
	sirusiru	*Siganus lineatus* Valenciennes, Siganidae	Golden-lined spinefoot
	gohi	*Sphyraena barracuda* Edwards, Sphyraenidae	Pinkhandle or obtuse barracuda
	tatalingi	*Thunnus albacares* Bonnaterre, Scombridae	Yellowfin tuna
	vavanaka	*Toxotes jaculatrix* Pallas, Toxotidae	Archer fish
	dalo	*Trachinotus baillonii* Lacepède, Carangidae	Small spotted dart
	somasoma	*Tylosurus crocodilus* Péron & Lesueur, Belonidae	Houndfish or needlefish
Molluscs and crustaceans	***deo***	*Anadara antiquata* L., Arcidae	Antique ark (bivalve)
	kenekene	*Atactodea striata* Gmelin, Mesodesmatidae	Striate beach clam
	coconut crab	*Birgus latro* L., Diogenidae	Coconut crab
	crayfish	*Cambarus* spp. Erichson, Cambaridae	Freshwater lobster
	ropi	*Cerithidea quadrata* G. B. Sowerby II Sowerby, Potamididae	Black chut-chut
	prawn	*Macrobrachium lar* J.C.Fabricius, Palaemonidae	Prawn
	octopus	*Octopus cyanea* Gray, Octopodidae	Octopus
	riki	*Pinctada margaritifera* L., Pteriidae	Oyster
	kapehe	*Scylla serrata* Forskål, Portunidae	Mud crab
	squid	*Sepioteuthis lessoniana* d'Orbigny, Loliginidae	Reef squid
Reptiles	***sea turtle***	*Chelonia mydas* L., Cheloniidae	Green sea turtle
	turtle	*Dermochelys coriacea* Vandelli, Dermochelyidae	Leatherback turtle

TABLE 4.4. List of wild eggs from marine animals used as food

Group	Local name	Scientific name
Eggs	***coconut crab***	*Birgus latro* L., Diogenidae
	turtle	*Chelonia mydas* L., Cheloniidae
	leathback turtle	*Dermochelys coriacea* Vandelli, Dermochelyidae
	crayfish	*Panulirus penicillatus* Olivier, Palinuridae
	fish	Unidentified

Hunting and trapping

Wild game is hunted in lowland forests and mountain ranges beyond the village. Spears, bows and arrows are used. Hunting is still common, although declining due to less interest from the youth. Primarily men and boys hunt, however, women will accompany them to help carry the food and spears, and bring the kill back to the village. Elders lead the youth on the hunting trail, which provides an opportunity to share traditional knowledge including uses of local plants, hunting and fishing techniques, and traditional songs.

Wild boars are hunted for celebrations and are sometimes sold at the market. They are targeted if they destroy gardens or eat ***ngali*** nuts from the forest floor. Wild boar hunting techniques include the use of spears, traps and domesticated dogs (up to five at once). Other wild species hunted in the bush include parrots, ***bias*** (red nose bird), flying foxes (bats) and possums. These are typically caught with slingshots or bows and arrows. Fresh water invertebrates are also collected for consumption.

TABLE 4.5. List of wildlife used as food: birds and mammals

Group	Local name	Scientific name	English name
Birds and poultry	***duck***	*Anas superciliosa* Gmelin, Anatidae	duck
	kurukuru	*Ducula rubricera* Bonaparte, Columbidae	red knobbed fruit pigeon
	hou	*Egretta sacra* Gmelin, Ardeidae	pacific reef heron
	belama	*Fregata minor* Gmelin, Fregatidae	great frigate bird
	helekai	*Larus* spp. L., Laridae	seagull
	red nose bird or ***bichere***	*Porphyrio porphyrio* L., Rallidae	purple swamphen
	parrot	Psittaciformes spp.	parrot
	hornbill	*Rhyticeros plicatus* J. R. Forster, Bucerotidae	hornbill
Mammals	***possum***	Phalangeriformes sp.	possum
	flying fox	*Pteropus vampyrus* L., Pteropodidae	flying fox
	pig (wild)	*Sus scrofa* L., Suidae	wild boar

TABLE 4.6. List of eggs from wildlife used as food

Group	Local name	Scientific name
Eggs	***duck***	*Anas superciliosa* Gmelin, Anatidae
	dove	*Ducula pistrinaria* Bonaparte, Columbidae
	dove	*Ducula rubricera* Bonaparte, Columbidae
	megapode	*Megapodius eremita* Hartlaub, Megapodiidae
	rednose bird	*Porphyrio porphyrio* L., Rallidae
	punder	Unidentified

Wild edibles

Wild harvesting of plants is a tradition in Baniata. Edible plants and fruit were previously a regular source of food, but the frequency and amount of wild foods harvested has declined over the previous three to four decades. However, wild foods are more heavily relied on when villagers are harvesting ***ngali*** nuts, camping away from the village, or during times of travel. Few wild foods are sold for income generation.

Starchy foods collected include wild yam, wild taro and wild breadfruit. Wild foods collected for consumption include green leafy vegetables such as ferns. Fruits harvested from the wild include ***voh***, ***gima***, ***sohvao*** and wild mangos. ***Voh*** is a sweet and juicy yellow flesh fruit, and is said to cause itchiness. Its season coincides with the ***ngali*** nut harvesting season, and it is often consumed during the collection of the nuts. Other wild foods include ***ivi*** (*Inocarpus fagifer*, Tahitian chestnut) and a ***gavu*** (*Gnetum gnemon*, tulip nut).

TABLE 4.7. List of wild edibles

Group	Local name	Scientific name	English name/ Variety
Fruits and juices	***me'u****	*Artocarpus altilis* (Parkinson) Fosberg, Moraceae	Breadfruit
	sohvao	*Burckella obovata* (G.Forst.) Pierre, Sapotaceae	Burckella
	gavu	*Gnetum gnemon* L., Gnetaceae	Tulip nut
	ivi*	*Inocarpus fagifer* (Parkinson) Fosberg, Fabaceae	Tahitian chestnut
	mango	*Mangifera indica* L., Anacardiaceae	Mango
	kapicala	*Syzygium malaccense* (L.) Merr. & L.M.Perry, Myrtaceae	Malay apple
	voh	Unidentified	Unidentified
	gima	Unidentified	Unidentifed
Seaweed	***seaweed***	*Caulerpa lentillifera* J. Ag., Caulerpaceae	Sea grapes
Vegetables (leaves)	***savita***	*Alsophila hornei* Baker, Cyatheaceae	Fern
	atiefao; faro; omu	*Colocasia esculenta* (L.) Schott, Araceae	Taro leaves
	puha	*Diplazium esculentum* (Retz.) Sw., Athyriaceae	Fern
	fengo; unofengo	*Diplazium* spp., Athyriaceae	Fern
	inomahi*	*Ficus copiosa* (Roxb.) Steud., Moraceae	Sandpaper cabbage or plentiful fig
	wagozo (several varies)	*Polyscias fruticosa* (L.) Harms, Araliaceae	Bebero or geke or tagala
	wagozo	*Polyscias verticillata* Stone, Araliaceae	Bebero or geke or tagala

TABLE 4.7. List of wild edibles

Group	Local name	Scientific name	English name/ Variety
Vegetables (leaves)	*rosi*	*Stenochlaena palustris* (Burm.f.) Bedd, Blechnaceae	Fern
	bie	Unidentified	Unidentified

*Species present in the ***ngali*** nut agroforestry system

4. OTHER LAND-BASED PRODUCTIVE ACTIVITIES

Many wild plants have non-food uses, including clothing, construction, bags, medicine, fuel and bedding. Wild timber is used for house and other structure construction. Firewood is typically harvested from wild ***vasa*** (*Vitex cofassus* Reinw. ex Blume, Lamiaceae, deuru) and ***gema*** (*Pometia pinnata*, Pacific lychee) trees. Chainsaws are now used, and have improved the efficiency of collecting wood. There has been no attempt to domesticate tree species for timber. Trees standing in or around taboo sites are restricted for use for any purpose. Raw materials sourced from the landscape are not directly sold to the market; however, crafted products such as baskets and bedding mats are made for home use, sale or trade.

Commonly used resources for clothing include pandanus, ***vusai*** and abalolo trees; construction materials come from sago palm, ***vasa, goliti, gema, vaho, loiacane*** and betel nut*[21] trunks; bags are made from coconut* fronds, ***gava***, pandanus and sugar trees; medicines include coconut, ***alite**** (*Terminalia catappa* L., Combretaceae), ***capica*** and ***ngali*** nuts; energy and fuel include any woods, ***vasa***, rai tree, coconut fronds, coconut husk and ***ngali*** nut shells; and beddings (mats) are made from pandanus and coconut fronds.

5. LOCAL CALENDAR

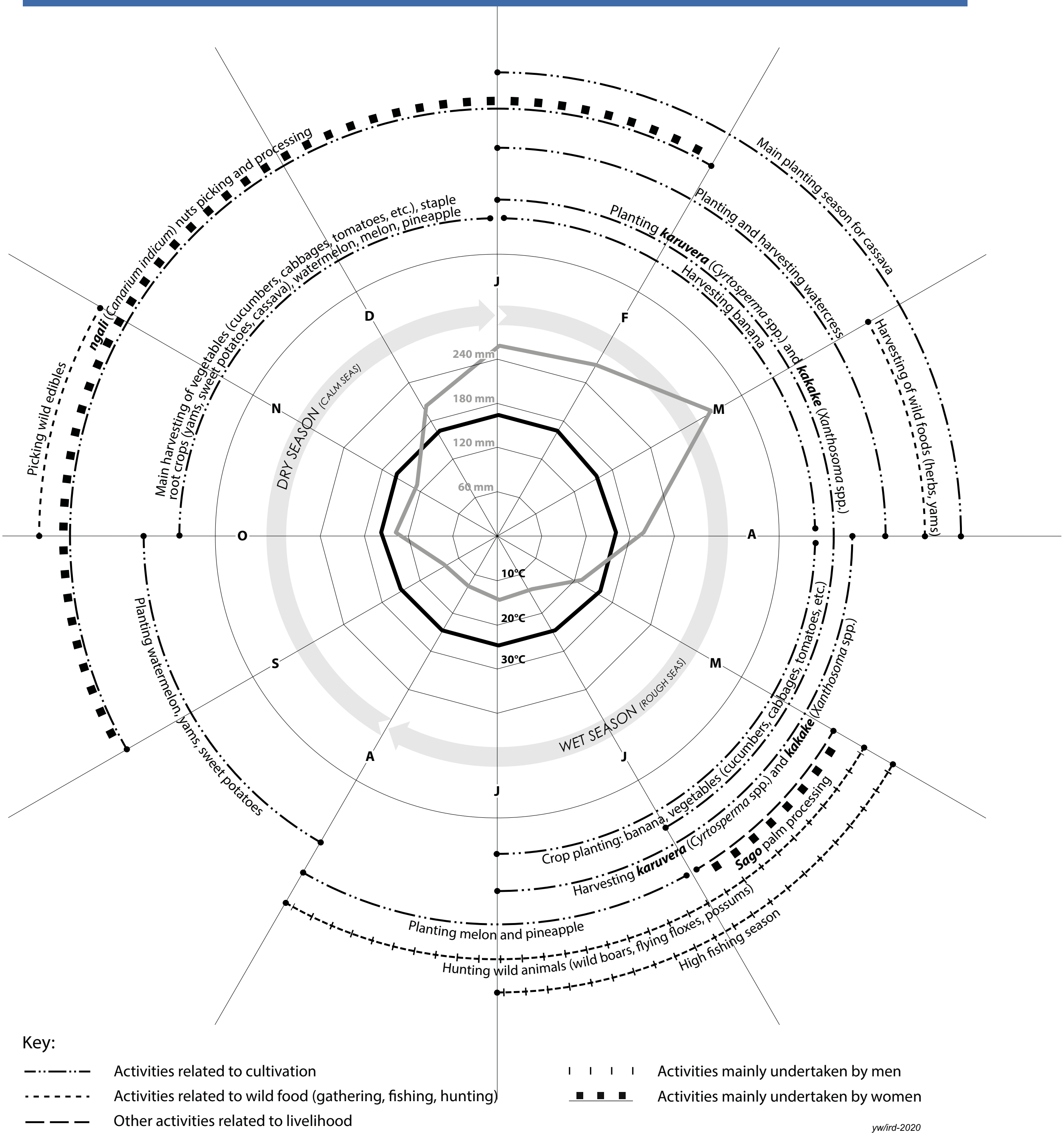
Villagers follow the 12-month Gregorian calendar and rely on nature's cycles to guide activities. For example, seven days after the new moon is best for fishing, as the fish – particularly reef snapper – are said to contain a higher content of oils. Certain crops are planted during either the full or new moon. Bananas planted during the season of high tides, caused by the gravitational pull of the moon, are believed to have the best harvests.

The temperature remains relatively stable throughout the year, and is 29 °C on average. However, there are variations in precipitation levels and slight variations in temperature. The two distinct seasons are dry and wet. The first seven months of the calendar year, from January to July, are the wet season, and the last five months, from August to December, are the dry season. Weather pattern changes bring varying intensities of storms and roughness of the seas. Rough seas can happen anytime of the year, but tend to concentrate between April and September. October through December have typically calmer seas, coinciding with lesser rainfall. Stronger winds and cyclones occur from January to March.

Crop plantings vary per season and rainfall. Cassava is preferably planted during the rainier weather from January to March, although it can be planted and harvested anytime throughout the year. During this time, watercress and bananas are harvested. In April, cucumbers, cabbage, bananas and taro are planted. Foods harvested and hunted during this season include ***sago*** palm, wild boars, flying foxes and possums. From August to October, watermelon, ***pana***, yams and ***kumara*** (sweet potatoes) are planted. At the beginning of this season, potatoes are typically harvested. Crops such as cabbages and cucumber are planted and harvested throughout the year but the main harvesting time for crops such as yam, pana and kumara is from October to December. It is also the season for ***ngali*** nut harvesting, however, the season has been more recently extended until February.

[21] *Species present in the ***ngali*** nut agroforestry system.

FIGURE 4.2. Average annual rainfall (mm) and temperature (°C) in Honiara, Solomon Islands, and seasonal activities by the Baniata villagers (elaborated by Yanto Wahyantono, IRD, 2020)



(These are available annual rainfall and temperature data in Honiara, the capital of Solomon Islands. Although following overall the same pattern, the rainfall profile may slightly differ from the one in Baniata village.)

Processing ***ngali*** nut.

Villagers can predict the onset of a cyclone by noting a ring of cloud around the moon at night, signaling that a cyclone or bad weather will hit in three to four days. Additionally, villagers take note of the quantity of ***ngali*** nuts that fall to the ground to determine the strength of winds. Typically, bad weather lasts either four or eight days. Rainbows are indicative of fine weather, as are particular birdsongs.

6. MARKET SOURCING AND TRADE

Munda is the primary town where villagers source foods from outside of the community. It is a 90-minute petrol-powered boat ride from Baniata, with a large wet market and multiple convenience shops. The Munda wet market provides a wide range of local food products including fish. Located near the Munda market are shops, which provide a range of processed foods, including sugar, oils and frozen desserts. These shops also sell household goods and supplies. Baniata has a small canteen that resells packaged foods sourced from Munda at a higher cost. Few items are sold here beyond canned tuna, sugar, rice, confectionaries, cigarettes and snacks. Foods purchased from markets and shops also include ferns, seaweed, shells especially mussels, reef fish, bananas, salt, noodles, flour, biscuits, bread, chocolate powder and butter. Non-food items include soap, kitchen utensils, clothes, knives, cups, plates, pots, carpet, diapers, garden hoe, kerosene, cutlery, cookware, rugs, nails, hammer, basket, axe, seeds, paddles, woven mats and local newspapers.

Traditionally, villagers would give foods to neighbours and friends. This now typically happens only for special occasions as a gift, such as for a birthday or wedding. Gifted foods include slippery cabbage, ***kumara*** (sweet potato), cassava, coconut or prepared dishes such as ***masi masi*** or local "puddings" made from starchy sago palm mixed with fresh ***ingi rusa*** (coconut).

Bartering and exchanges are commonplace. Bartering usually happens when villagers do not earn enough money or face financial challenges. These challenges occur more frequently during the lean season between April and July. Exchanges happen within Baniata, as well as with neighbouring villages. Common exchanges include sweet potatoes for fish; baked ***ngali*** nuts for kitchen utensils; sweet potatoes for mussels (two heaps for two heaps); ***ngali*** nuts for traditional weaved mats (5 kg of ***ngali*** nuts for three mats); ***sago*** palm starch for rice; ***ngali*** nuts for mattresses; and ***ngali*** nuts for plateware.

There are challenges to accessing and selling at the Munda market. The transport costs are high due to petrol prices, and foods often perish in transit and during sale at the market due to the lack of cold storage or refrigeration. Rough seas can limit villagers' ability to access the markets, adding another barrier to selling agri-food products. Certain women struggle to reach the market at all, as some husbands will not allow their wives to travel to Munda alone.

7. COMMUNITY HISTORY AND FOOD SYSTEM TRANSITIONS

Baniata was established as a village in the early 1800s, as a result of multiple numerous smaller villages of different tribes coming together. Up until a century ago, Baniata was almost completely self-sufficient, with community members relying mostly on homegrown and wild foods such as yams, bananas, taro, wild boars, possums and seafood. The arrival of the missionaries in 1915 led to the introduction of new foods including sweet potatoes and cassava, and the establishment of commercial coconut plantations. Seventh Day Adventist Church (SDA) arrived around 1920, influencing food production and consumption, including dietary exclusion of pigs, possums, eels and crustaceans.

The Second World War in 1941 catalysed further changes with the introduction of rice, canned meats, refined sugar and flour products, which were part of the American military rations. At the end of the war, these products were handed out to villagers, who developed a preference for these new foods that were high in salt, fat and sugar. Rice provided a quick and tasty alternative to traditional tubers that took significant time to process and prepare.

The destruction caused by cyclone Isa in 1950 was unprecedented, destroying coastal areas, including the coral reefs, which negatively impacted the availability of aquatic animals. The cyclone also led to the heavy flooding that destroyed many homes and gardens, ruining that season's harvest, and making the land difficult to cultivate thereafter due to the salinity of the flood water. This resulted in many households deciding to re-establish their home gardens far away from the coast, at the base or even up into the hills as a preventive measure. The migration of food gardens has been further influenced by the government subsidies in the 1970s encouraging coconut plantations, which were placed near Baniata's beach areas. As a result, the travel distance to tend to and collect food became a burden that fell on women and children. This practice continued until the 1980s, when additional expansion was no longer feasible due to lack of available suitable land.

Before the 1960s, Baniata was considerably smaller with fewer homes, and gardens close to each villager's home. Forests were also cleared to make room for expanding gardens, much further away from homes due to the increasing population of Baniata. In the 1990s, the logging destroyed much of the local forests within the greater mountain landscape. Since the early 2000s, Baniata has experienced an increase in population and a decrease in production yields, resulting in less local food for consumption and sale. Inexpensive and convenient imported food such as noodles and rice are replacing traditional foods such as root vegetables and bananas. An earthquake hit in 2007, causing a tsunami in Baniata, destroying home gardens, coastal houses and canoes that were needed to fish. This caused a period of food insecurity, during which villagers turned to externally produced and imported staple foods until the local production systems were able to recover.

SECTION 2
SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM

1. PROVISION OF LIVELIHOODS, EQUITY AND SOCIAL WELL-BEING

Adequacy of income opportunities

All villagers in Baniata rely on agri-food sale as their primary source of income. Outlets include local markets, as well as regional and national sales of specific agri-food products such as dried coconut and ***ngali*** nuts. Fortnightly incomes range from less than SBD 100 to over SBD 1 000[22] depending on the season, market prices for commodity crops, in particular copra, and agri-food sales at markets.

The Munda market provides 50 percent of market income, which includes homegrown produce and prepared foods. Occasionally villagers will sell at the Sombara market near Munda, or the Noro market more rarely. Roughly 30 percent of income is from regional sales, including the sale of copra; 20 percent from the sale of ***ngali*** nuts and betel nuts in Honiara; and 2 percent from international markets, mostly from selling ***ngali*** nuts to New Caledonia.

[22] Equivalent to USD 12.4–124. Applying the UN Operational Rate of Exchange of 1 July 2018 (1 USD = 8.045 SBD). This rate will apply throughout the entire chapter.

Copra is the primary source of income for most of the villagers, which they sell throughout the year. Coconuts are transformed into copra through the process of drying with a slow-burning fire in a grass hut near the collection sites. It is exported via boats to regional resellers in Munda and Noro, who then sell in international markets. When the buying price of copra is high, villagers can receive SBD 5 000[23] per 100 kg. When it is low, they only receive SBD 1 000[24] per 100 kg. National and international markets dictate the prices. ***Ngali*** nuts are becoming an important source of income, in local and international markets, in particular New Caledonia, although they are also consumed at the household level. ***Ngali*** nuts are shelled, baked and dried by women and sold at local markets for SBD 35[25]/kg. Community members also sell ***masi masi*** prepared from slippery cabbage and ***ngali*** nuts for SBD 10[26] per piece. ***Ngali*** nuts are ground in a bowl, spread between layers of the slippery cabbage, and then cooked in a stone oven. The community is working towards achieving organic certification for the ***ngali*** nut. A dedicated processing facility is currently being constructed in the village, which will ensure the product is Hazard Analysis and Critical Control Point (HACCP) certified for food safety. After the organic and HACCP certifications are complete, the community will likely be able to expand to other international markets and increase sales.

Marketing of farmed food and vegetables is the second most common source of income. On market days, villagers can receive anywhere from SBD 100 to SBD 1 000[27] per trip. The most commonly sold foods are eggplant, tomato, capsicum, ***fiji vahu*** (a variety of sweet banana), cooking banana, cassava, slippery cabbage, watercress, ***paksoi*** (Chinese cabbage), sweet potato, yam, ***pana*** and fish. Betel nut, whilst not a food, is also commonly traded at the markets.

[23] Equivalent to USD 622.
[24] Equivalent to USD 124.
[25] Equivalent to USD 4.4.
[26] Equivalent to USD 1.24.
[27] Equivalent to from USD 12.4 to USD 124.

Young Solomon Islands boy examining his father's daily fish catch.

© Massey University/ Chris Vogliano.

Availability is seasonal. Slippery cabbage and cassava, unlike many other foods, are available almost all year round. December has the most diversity and quantity of foods, whilst the first six months of the year, from January to June, have the least. One heap of sweet potatoes is SBD 10.[28] Chinese cabbage prices are consistent throughout the year. Some villagers state they are generally happy with the prices they receive for their products, whilst others state they are not satisfied with the prices and do not earn enough to meet their basic needs. Since the prices are fixed per heap of cabbage sold, there is no way to negotiate a better profit margin.

In addition to the Munda market, two outlets are located within the village of Baniata. On Fridays, villagers sell their products within the Baniata community. This market is important for garden produce, although it now features more baked and fried foods such as ring cakes.

Income earned from market sales is used to purchase food not available in Baniata, as well as non-food items from the Munda shops and markets. A rough estimate of money that an individual can spend in a single day in Munda after marketing is around SBD 300.[29] If families have money left over from their purchases, they give a small fee to help support the village. Villagers feel the prices for foods in Munda are reasonable and affordable – particularly at the stores. Certain foods such as taro, yam, ***pana***, fish and corned beef tend to be more expensive. Foods at the Munda markets are usually fresh, as produce is typically picked within the past day, and fish is sourced directly from the ocean. Noro market is the only exception, where the fish is stored in freezers, often for too long, and then sold to local Solomon Islanders.

Adequacy of diets

Local foods are sourced from home gardens, markets and wild collected foods. Villagers estimated that around 60 percent of foods come from food gardens and locally kept animals, 10-20 percent come from the wild, either hunted, fished or collected, and 20-30 percent come from the market and stores in Munda.

At some point throughout the year, many households in the community experience food insecurity. Issues include worrying they might not have enough to eat, not having access to healthy foods, eating only a few varieties of foods, and not having enough for the needs of the entire household. If they are completely out of foods, villagers may ask if they can harvest foods from a relative's garden. Rice is a commonly consumed food during times of low food access, as it is readily available and affordable.

According to the women in focus group discussions, household food insecurity is most experienced from April to July, the gap after the main harvest. Men state that between January and March it is difficult to provide enough food, mainly because sweet potato varieties that are planted in December and January do not provide the same yield as before. For example, the sweet potato plants may look healthy, but tend to have lower yield for the tubers. Men say this is most likely due to the increased duration of the rainy season. Additionally, the seas tend to be rougher during the rainy season, which reduces the catch, as the men venture to sea less frequently. What is caught, together with other agri-food products, is difficult to get to the market during this period, again because of the rough seas.

During the periods of food insecurity, villagers increase their consumption of cooking bananas and less-preferred varieties of roots and tubers such as wild yams and taros to supplement the low supply of sweet potatoes. The main taro species and varieties eaten at this time are ***voruku*** (*Alocasia macrorrhizos*, giant taro), ***ozo*** (*Alocasia macrorrhizos*, giant taro), ***kakake*** (*Cyrtosperma merkusii*, swamp taro) and ***karuvera*** (*Xanthosoma sagittifolium*, Chinese taro). Together with changing taste preferences, in the past taro was the staple food, which is slowly being replaced by sweet potatoes.

Traditional foods are eaten daily in Baniata, but are often mixed with imported and highly processed foods such as instant noodles, white

[28] Equivalent to USD 1.24.

[29] Equivalent to USD 37.3.

rice, biscuits, table sugar and vegetable oils. In addition, consumption of regionally caught canned tuna, called taiyo, from the nearby Noro tuna factory has increased.

In contrast with the common assessment that food diversity is high in the local food system and remains stable, diet quality is likely not sufficient. Community members all agree that rice dominates the plate and there is a heavy reliance on carbohydrate-based foods such as roots, tubers, rice, noodles and sugar-sweetened drinks. The major source of protein comes from canned tuna and other seafood. Protein intakes are low, as other high-quality sources such as meat, eggs, dairy and legumes are rarely consumed. Meat and dairy are rarely purchased from the market due to expense. They are commonly consumed once a month. Pulses are consumed twice a week between June and August when it is the season. Though prevalent throughout the village, seeds, orange fruits and red fruits are not consumed frequently. Coconut milk, oil or shaved coconut is incorporated into almost every meal, with processed commercialized vegetable oils starting to become more commonly used.

The perception of community consumption varies dramatically depending on the demographic. Older women estimate 75 percent of food is local, whilst only 25 percent is processed. Younger women think it is split evenly, and men think 25 percent of the food consumed is local whilst 75 percent is processed. However, villagers recognise that shifts away from traditional foods are resulting in unhealthy people and increased rates of non-communicable diseases. There is no clear local classification for foods or dietary guidelines in the village. Men classified local foods into four groups: meat, fruit, leaves and energy. Women classified local foods into three groups, which more closely aligns with the National Dietary Guidelines from Solomon Islands: energy foods, bodybuilding foods and protective foods. This comparison between men and women indicates that women are more knowledgeable of the national dietary guidelines than men.

TABLE 4.8. Men's and women's classifications of local foods

Men's classification of local foods				Women's classification of local foods[30]		
Meat	**Fruit**	**Leaves**	**Energy**	**Energy food**	**Bodybuilding food**	**Protective food**
fish pig opossum	pineapple ***pawpaw*** jackfruit	slippery cabbage fern pumpkin leaves shallot	potato breadfruit ***karuvera*** banana	taro potato yam banana ***pana*** cassava	fish crab	***pawpaw*** pumpkin cabbage coconut

Men perceived a healthy and well-nourished person as someone who is "a very happy person who likes to play all the time, always ready to work, does not get sick easily, not fat and well built. Some healthy people do have little bigger belly because they eat well." Women perceived a healthy person as someone who is "strong, fat, looks beautiful and handsome, clever and happy, looks very young and bright, willing to work and his/her body grows well."

There are numerous perceived and actual barriers to food security and diet quality. These include seasonal availability of home garden foods, local irregular production such as eggs, pests and diseases of crops, changes in weather patterns and impacts on seas, high costs of food, in particular meat and milk, growing interest in convenience foods, and shifting taste preference from traditional crops to processed foods. When asked, villagers wished they could purchase and consume certain foods more frequently – most of

[30] Energy food: carbohydrate-rich food; Bodybuilding: protein-rich food; Protective food: vitamin- and mineral-rich food.

which were processed foods, including cordial, mineral water, ice cream, butter, cola, onions, chicken wings, corned beef and bread. Villagers expressed interest in consuming more meat if it were more accessible.

Changes in the provision of livelihoods and social well-being over time

In the past, money was not required in Baniata. Villagers depended on their traditional crops for survival. There were no shops and villagers were satisfied with what they had. With globalization and the introduction of income, money is now required for foods, materials, transport, school fees, clinic fees, travel, and community contributions for special events or projects.

Prior to independence from British rule, Solomon Islanders made little money, but the British pound was worth enough to pay for an acceptable standard of living. After independence in 1978, Solomon Islands transitioned to the SBD, and everyday prices for all Solomon Islanders increased significantly. The majority of the people in the village now earn money from agri-food production activities, as traditional crops progressively became a source of income. With larger home gardens and the increasing ability to sell to markets, livable wages are now possible. Villagers now work harder than before independence, but recognise that income opportunities are rising as market sales and opportunities expand.

Incomes are rising due to overall increased sales of home garden products and handmade crafts and goods. Increased incomes are now altering relationships amongst villagers, as some villagers are hiding their fast-growing varieties of crops from their neighbours. Other villagers are even harvesting their neighbours' crops or "forgetting" to bring their neighbours' crops to the market for sale.

Meanwhile, villagers state that the quality of diets and food supply has changed dramatically over the past three to four decades. Since the 1990s, there has been an increase in imported and processed foods. If the market in Baniata was previously used to sell fresh produce, eggs and fresh fish, it now sells primarily nutrient-poor, highly processed baked goods such as ring cakes, donuts and sweet breads. Villagers are more often opting for this type of food over wild collected foods, as they are easier to find, cook and prepare. Traditional foods are also declining in consumption, as many are sold for cash to buy non-food products or to pay for children's school fees. In the past few years, crop yields have been decreasing, which reduces even further the amount of crops able to be sold at the market. Harvests have changed over time. The ***ngali*** nut harvesting was previously between September and February; now harvesting continues until June, which is assumed by community members to be caused by longer and more intense rainy seasons. Fish stocks and sizes are also declining, with negative impacts on dietary quality, especially protein intakes, and income generation. This, along with a tuna cannery opening in the nearby town of Noro in 1977, has shifted local diets away from fresh fish to canned tuna. The type of tuna consumed locally is "second grade tayio", made of the dark flesh that is less desirable and not suitable for export. In addition, new techniques of removing skins from traditional foods such as roots and tubers due to a preference in taste are making the food less healthy. This has resulted in poor health outcomes such as high blood pressure, diabetes, increasing rates of obesity and being overweight, to name a few.

2. RESOURCE USE EFFICIENCY

Land and soil

The landscape is characterised by sand along the shorelines followed by loamy soils inland. After this, the soil then becomes more stony/mixed gravel with clay, and towards the bottom of the hills and mountains it eventually becomes silt. Villagers prefer the soil that is less stony with more clay, a silty texture, and one that has been fallowed for a longer period. Soil quality is better immediately behind the shores or coconut plantations. These soils are deeper with less or no stones or gravels. This is unlike the soils closer to the foot of the mountain ranges, which are stony/gravelly due to the continuous accretion from the streams coming from the mountains.

Choices for crop cultivation are strongly connected to the landscape. Soft soils are usually planted with peanuts. Swampy areas along the riverside are used to cultivate crops such as ***kakake*** and ***ruta*** (*Colocasia esculenta*, taro). Home gardens are placed within close proximity to a river for easy water access. Sandy areas along the coasts are used for coconut plantations and dry loamy soils are used to produce crops like taro and sweet potatoes. Baniata's home gardens, ***ngali*** nut agroforestry systems, and coconut plantations are entirely organic, as villagers do not use synthetic pesticides, herbicides or fertilizers. Locals generally view their soil as very fertile compared to other islands in the Western Province. However, maintaining soil quality is a rising issue in Baniata.

Practices that aim to maintain and enhance soil fertility are often not adequate to cope with rising pressure on soil quality. Land fallowing and crop rotations are practised throughout the village, in the following sequences: sweet potato, cassava and ***karuvera***, followed by a three- to five-year fallow; potato, potato, potato and cassava, followed by a three- to five-year fallow; and watermelon, potato and cassava, followed by a three- to five-year fallow. Some villagers are beginning to integrate legumes such as bean or peanut in a crop rotation schedule to enhance nitrogen fixation. Most villagers do not improve soil fertility with compost or nitrogen fixation. Whilst some still use the old practice of stick for tilling and planting, most now use the hoe to cultivate.

Today, erosion is controlled by moving gardens to a different site and allowing the old gardens to fallow. Some growers use garden residues or rubbish such as rice sacks or containers as physical barriers to contain the soil and prevent erosion. Others dig small drains to divert water flow away from their food gardens. Villagers also avoid cultivating on slopes to minimise erosion.

Labour and fuel energy

Baniata is reliant on non-renewable and externally sourced energy for certain essential tasks. The primary use of petrol is to transport villagers and their goods to local markets in Munda or Noro, which are only accessibly by boat. The village owns a few petrol-powered generators; however, these are not commonplace and are being replaced with solar panels.

Most households have solar panels that were provided by a government grant. Kerosene lamps are still used, but not as frequently due to the increase in solar lighting and rechargeable torches. Candles made from ***ngali*** nut oil, coconut oil lamp and disposable operated torches are now rarely used. Firewood, collected from the surrounding landscape, is used for cooking and processing copra and ***ngali*** nuts. Women and children work together to collect firewood each week. Collecting firewood takes around one half day to complete. Wood is abundant and collected from old or fallen branches of ***ngali*** nut trees. Locally, demand for firewood and other fuels such as coconut shell and husk, as well as ***ngali*** nut shells, had increased due to increased processing of ***ngali*** nut and copra for export, combined with an increase in the village population.

In the village, men are responsible for clearing forests for new garden plots, gathering coconuts for copra, building new homes and teaching these skills to young boys. Besides their role in collecting firewood, women are also primarily responsible for agri-food activities including gardening, gathering wild foods such as ***ngali*** nuts, cooking, and selling goods at markets. Children help their parents with their gender-specific roles around the village. Boys typically help with planting cassava, hoeing mounds, planting sugar cane, clearing the gardens, and fishing. Girls assist with weeding, planting crops such as potato, corn, ***kumara***, etc., and collecting vines.

Human energy demands consist of gardening, collecting firewood that is primarily done by women, processing coconuts into copra, and processing ***ngali*** nuts. The food system is based on a subsistence farming system so labour requirements are high. The whole family is involved in food production and this is usually enough to meet the daily food needs, as well as yield surpluses that can be sold without needing extra labour.

Waste

The most common sources of waste include bio-organic waste from the kitchen, home gardens and crop processing (such as ***ngali*** nut skins and shells), plastic bags and wrappers, human sewage, medical waste from the health clinic, and leaves from trees in the village. The most concerning wastes are plastics and human sewage. Although people sometimes reuse plastics, they are usually burned or buried. However, a large percent of plastics end up in the sea, along the shores, or littered around the village. Medical wastes are typically buried in the ground.

Waste minimisation is not practised according to the community. However, some waste is reused. Kitchen scraps are recycled into animal feed or placed on banana trees for compost. Plastic instant noodle wrappers and rice bags are used as seedling starters, by placing soil and seeds into the plastic wrappers, and placing them in the sun. Plastic shopping bags are often reused for selling dried ***ngali*** nuts and for covering hanging fruits as a pest control method. Plastic bottles are reused for water collection. Other uses of plastics include weaving into door curtains, artificial flowers and purses.

Changes in resource use efficiency over time

Traditionally longer fallowing times or permanently moving to a new garden site was commonly practised. Increasing populations and decreased land availability has reduced the amount of time villagers have allowed land to fallow. Mixed cropping was previously practised in the distant past, usually consisting of small parallel plots with a different species or variety in each plot. This has been said to decrease the soil quality and therefore has reduced the efficiency of both land and soil use. In the past, fallowing and digging with stick minimised soil disturbances and helped control soil erosion. Pests and diseases are on the rise, including rat infestations, causing villagers to prioritize crops that rats consume less frequently.

Human labour demands have increased to account for a rise in agri-food sales and feeding a growing family size. The demand for cash through the sale of crops requires a larger plot of home gardens and this demands more labour. In the past, men would chop down forests by hand but now the slash and burn technique is the dominant method of clearing forests. Increased labour needs have women hiring others to help with the growing and cultivation of agri-food products. An example of this is ***ngali*** nut processing. A family would provide tea and sugar or cook rice, tuna and noodles to attract villagers to their nut-cracking sessions.

The community uses few modern or mechanized farming tools, except for diesel boat engines. In addition, the level of drudgery decreased after hoeing was introduced. Machetes, large knives and axes make it easy to clear the forest for cultivation compared to in the past, where they used stone axes that required a lot of human effort. The community decided to decrease external inputs in general, not just within agriculture, which was facilitated in 2011 when a local parliamentarian donated solar panels to reduce reliance on kerosene lamps and diesel generators for electricity and light.

In the past, women would walk for 10-15 minutes to collect water twice daily from the closest stream. In 1986, a pipe system from a nearby waterfall was established and taps were placed in various locations around the village. This greatly reduced the time required to fetch water, which now only takes around two to three minutes.

However, water quality varies, particularly during the rainy season when it is said to taste different and can become dirty. Some villagers blame this on leaking pipes that run to the village and the establishment of food gardens close to the water source. Because of this, sometimes women will walk to the water source to fetch fresh drinking

Coconut plantations lining the black sandy shores of Baniata Village.

© Massey University/ Chris Vogliano.

water. People now live alongside the river, which is creating new issues around water pollution and safety. The neighbouring village of Havila previously had water run through the village, but now they must walk to the river to fetch it due to the small streams drying up. Men state that recent landslides also changed the river patterns and slowed the flow of the water.

Waste management efficiency has decreased over time, as larger amounts of waste are now produced compared to the past. New ways of cooking are leading to increased kitchen waste, including peeling potatoes or taro skins, grating and scraping out the flesh of coconut before squeezing out the milk, or animal forage wastes. These wastes are disposed of by tossing them into the sea, or burning. Previously there was little external waste entering the food system. Now, due to imported and packaged goods, there is significantly more plastic waste. No apparent attempts have been made to address this issue, most likely due to lack of awareness about the dangers of plastics for marine animals, and the convenience associated with the use of plastic.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

Crop and livestock biodiversity

Baniata has over 53 crop species and 2 livestock species. The most prominent crops in Baniata are tubers and banana, which have numerous varieties: banana (19 cultivars), yam (17 varieties), cassava (8 varieties), taro (6 varieties) and sweet potato (11 varieties). Banana, yam and taro were traditionally the local staple crops, whilst cassava and sweet potato have been introduced more recently. Several varieties of banana and root crops are yellow or light orange fleshed.

Despite the diversity of crops maintained, villagers agree that agrobiodiversity is decreasing due to the increasing reliance on imported foods. Additionally, the opening of markets has led to impacts on the local environment through the introduction of a variety of crops and pests. This is particularly the case of the improved crossbreed of pig, nowadays raised by many households in large areas. Other introduced plant and animal species are still grown and raised by few households on small areas, such as wild pigs, featherless neck chicken, hybrid variety of guava, varieties of mangos, and hybrid variety ***pawpaw***. However, community members usually prefer the local varieties. Although not cultivated extensively, four varieties of gourd have been introduced in the food system.

Certain seeds are commonly traded within the community, particularly if they do not have high market value. Seed access remains a limitation for growing more vegetables in Baniata. Corn seeds are usually dried above the fireplace to preserve until next planting. Watermelon seeds are often shared with families free of charge and can be stored for up to two years without losing viability. Vegetable seeds can be accessed from the agricultural office in Munda, however, supply is irregular and seeds are not free. Crops with a higher market value are not shared because of increased competition in the marketplace. The local practices of ensuring household access to quality seed and an exchange of varieties are described below:

TABLE 4.9. Seed sharing and saving

Seeds shared in Baniata	Seeds shared with other communities	Seeds accessed from market, government, NGOs	Seeds saved from farm
watermelon, eggplant, maize, bean, cucumber, pumpkin, mandarin, pomelo, snake bean (gourd)	watermelon, eggplant, maize, bean, pumpkin, mandarin, pomelo, cucumber, local tomatoes	Chinese cabbage, saladeer, hybrid varieties of cucumber, tomatoes, capsicum	watermelon, maize, open pollinated bean, pumpkin, local tomatoes, cucumber

TABLE 4.10. Seed systems of traditional crops

Varieties shared within community	Varieties shared with other communities	Varieties of breed sources
bananas (fizi vahu, zario vahu, makira vahu) -sweet potatoes (tau mahu, vaero) -***ozo*** -taro	bananas (fizi vahu, zario vahu, makira vahu) -sweet potatoes (tau mahu, vaero) -***ozo*** -taro	-banana -sweet potatoes -taro -fruit trees -coconuts

Wild harvested plants and animals

There are minimal restrictions on harvesting wild plants or animals. Fishing is restricted after the death of a villager, and wild foods cannot be collected in sacred or taboo areas. At least 50 species are fished for food, including 37 fish species, 6 molluscs, 4 crustaceans and 2 turtle species. In addition, 3 mammal species and 8 bird species are hunted. The eggs from 5 bird species and 2 turtle species are gathered. In addition, leaves from 7 wild plants and 1 species of seaweed are harvested as vegetables, along with 6 wild fruit species. Wild foods collection is declining due to preference for imported foods and population increases.

Ecosystem conservation and protection

There are traditional areas where ecosystems are protected under informal schemes. These areas are known as taboo areas, where villagers cannot enter. It was believed that these areas were used by their ancestors and are now recognised as sacred areas. A Baniata village elder oversees certain protected areas, such as Lake Suri. The wild animals such as flying fox, fish, crocodile and lizards near this lake cannot be hunted. Men feel the landscape and seascape ecosystem protection is adequate and stable; women think protection is not adequate.

Similar to the past, the community relies mostly on natural pollination. Locally important pollinators include bees, butterflies, ***viku*** (yellow birds), flying foxes and ***ghausu*** (doves). Villagers do not actively engage in pollination due to limited knowledge. The community perceives current levels of pollination are sufficient, as indicated by yields of fruits and nuts around the village. However, many note that butterflies are no longer common, probably due to introduced plants that are considered toxic to the butterflies.

Changes in the conservation and protection of resources over time

The reliance on local, traditional animal breeds and plant species and varieties has decreased over time in Baniata. For instance, the Bougainville banana was introduced in 1992 and provided Baniata with a new and novel variety that was easy to grow. However, this was at the cost of the rich plantain and banana biodiversity that existed in the landscape, including the Vitamin-A-rich Fei banana, which used to be a staple that was roasted each morning over an open fire, providing a nutritious breakfast for the whole family.

Nowadays, traditional varieties are replaced by new varieties entering the marketplace. Less land space is expected to be available in the future, as these areas have reached the foot of the mountains. It is anticipated that sustainable intensification practices such as crop rotations and shifting between fallowed plots will need to be practised to ensure sufficient food is produced for the increasing population and, hence, demand.

Fish stocks are declining, as villagers state they must travel much further to catch fish. Villagers remember a time when rivers were full of fish and eels, but due to flooding and increased populations, river stocks are much lower. Timber trees, especially ***vasa*** and ***gema*** used as firewood, are also declining and becoming increasingly difficult to access due to overutilization and lack of domestication. Villagers are adapting by alternating species for timber to build their homes.

Men feel villagers are managing natural resources sustainably and that they are preserving the land for the future. For example, harvesting of fish in the sea and harvesting of animals in the bush is done in a sustainable manner, as they believe they hunt, catch or harvest only the quantity that is needed to feed their families. Home gardening plots can be moved when needed, which allows the opportunity for land to fallow and the soil to regenerate. On the other hand, women state that sustainability now is declining. In the past, small fish were returned to the sea, yet today fish of all sizes are kept for consumption, resulting in overharvesting. Women also noted that some villagers poison the river to catch fish, causing all fish in the river to die.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of natural resources

Village elders govern the use of natural resources. If someone wants to use natural resources, they must first consult the elders. Elders traditionally help resolve land disputes between families. Solomon Islands' government does not own land in Baniata. Everyone in the community has customary or formally recognised rights over land but the elders are the people who know most about land rights. The individual members of the community can farm and work on any unoccupied land, as long as they have consulted and received approval from the village elders. The Irugo elders have the majority when community decisions need to be made but will typically gather input from each household. As the elders age, they pass knowledge to their successors.

Fire roasted and beta-carotene rich Fe'i banana (*Musa x troglodytarum* L., Musaceae).

Baniata has a matrilineal system of land use rights and management. Women are the primary managers of the land. If a woman has a son, the son will inherit the land-use rights from his mother. However, both males and females have equal rights to use the land. Land has been handed down from elders to a tribe of family members, including their sons and daughters. Certain actors outside of the community can also use land with permission from the elders, including missionary groups, teachers, church leaders, nurses and pastors. Certain villagers hold land use rights in other communities too.

Changes in governance of natural resources over time

Community-based landscape planning is fluctuating and beginning to decline according to the villagers. In the past, natural resources were well cared for by the chiefs and leaders in the community. When the last chiefs died, no chiefs took their place and now elders have taken charge. However, elders are not governing the natural resources as effectively as chiefs once did. There are also no formal institutions to help govern the use of natural resources.

Baniata is home to one of the few nesting grounds of the massive yet endangered leatherback turtles. Previously, villagers would eat the turtle eggs as a source of nutrition, as each turtle lays anywhere from 300 to 700 golf-ball-sized eggs during her 10-day nesting period. However, now the Tetepare Descendants Association is helping to protect leatherback turtle populations by offering incentives to protect turtle egg nests from being harvested by villagers. However, many villagers – particularly youth – still collect these eggs at night and consume the eggs as food.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

A summarized assessment of 13 indicators of resilience is presented below.

1. Exposed to disturbance: Over the past few decades, villagers have experienced numerous disturbances. However, villagers cite more frequent natural disasters. Increasing intensity of weather patterns are inhibiting stability – from increased frequency of cyclones and flooding, to landslides drying up rivers. Tsunamis have also occurred after the earthquakes in 2007 and 2010. Further, pests are on the rise, jeopardizing the productivity of the local agri-food system.

2. Globally autonomous and locally interdependent: The community is self-sufficient, with 70 percent of the food production coming from farming, fishing and wild sourcing. However, an increasing percentage of their food is sourced from imported or processed foods (30 percent). Trade between villages is increasing with the improvement of market access via petrol-powered boats. Only a few programmes or local initiatives exist to promote agri-food products in the community, such as for ***ngali*** nuts.

3. Appropriately connected: The village is appropriately connected to two major markets – Munda and Noro. The barriers to reaching these markets include lack of access to boat use and ownership, rough seas, costs of petrol, and seasonality of produce.

4. Socially self-organised: In the community village elders make community decisions based on input from the villagers. Previously, Baniata had village chiefs, of higher status than village elders, and concerns have arisen with their recent passing. There is a strong notion of support within the community, as villagers regularly give a portion of their agri-food earnings to help support village expenses.

5. Reflective and shared learning: The village maintains traditional knowledge that has been passed down verbally for generations, such as songs written about local recipes (***masi masi***). New farming technologies have reduced the drudgery involved with agricultural production, and motorboats and improved fishing gear have extended the ability of villagers to catch more seafood. However, both men and women feel agricultural innovation is decreasing and that their methods need improvement.

6. Honours legacy: Elders are respected in the community as the primary decision makers. The community maintains many of its traditional ways of life, as the villagers have limited access to electricity or cellular phone service. Traditional knowledge and the local languages are not written or documented, and thus are slowly disappearing. There are some initiatives by the youth to reinvigorate pride and passion around the local food culture, which can be linked with the transfer of traditional knowledge from elders to the younger generations.

7. Builds human capital: Knowledge transmission mainly happens through storytelling, songs and teaching by watching and doing whilst carrying out daily agri-food activities. The teaching is often gender-specific per agri-food activity. The transferring of knowledge is seemingly decreasing due to the community's increased reliance on imported foods. Further, elders are concerned about a perceived lack of interest by the youth in learning traditional recipes and ways of life. However, when asked, the youth showed much interest in continuing agricultural and cultural traditions.

8. Coupled with local natural capital: The community's food system is intricately linked with the natural resources found in the local land- and seascape. Negligible external inputs are used for agri-food production, as Baniata's food system is 100 percent organic. Villagers hold high respect for the natural environment as it provides them with the majority of their food, shelter and fuel. Increased levels of waste seem to be a concern, due to increasing demographic pressure and reliance on packaged foods.

9. Ecologically self-regulated: The villagers have a strong connection with nature and view it as a necessary and positive relationship to ensure their own good health. Soil health, water quality and quantity, and energy sourcing are all viewed positively with minor areas of improvement required.

10. Functional diversity: Multiple food groups are represented in Baniata's agricultural production and land- and seascape, including starches, pulses, fruits, nuts and seeds, leafy vegetables, other vegetables, meat, poultry and fish, and eggs. However, diversity in crop production is decreasing due to the increasing reliance on imported foods.

11. Optimally redundant: All villagers rely on agri-food products as a primary source of income. Multiple varieties exist of many types of crops, including potatoes, bananas, ***pawpaws*** and green leafy vegetables. Of 53 crop species maintained, at least 25 have multiple varieties so that the food system generates 156 crop foods in total. Whilst the diversity of crops is declining, it is believed that in particular the local traditional varieties offer resilience against climate and pest disturbances and help promote nutrition adequacy.

12. Spatial and temporal heterogeneity: The landscape is located on a small, forest-filled peninsula surrounded by the open ocean. A large mountain limits the expansion of the village. The villagers use the available land to grow agri-food products through traditional farming methods, agroforestry and collection of wild foods.

13. Reasonably profitable: The villagers are generally satisfied with the income earned from selling agri-food products at the markets, such as home gardens' produce, copra and ***ngali*** nuts. The income is mostly used to pay for expenses such as school fees for children, houseware items and imported foods. Incomes earned by villagers are increasing due to the price villagers can get for their products at the market. However, the reliance on boats to reach the markets creates barriers for some community members in selling their produce, especially for women.

SECTION 3 **CONCLUSIONS AND FUTURE PROJECTIONS**

1. FOOD SYSTEM SUMMARY

The agri-food production system in Baniata is diverse and consists of small-scale agriculture, agroforestry, wild food collection of flora and fauna, and fishing. Food is mainly grown in home gardens and collected wild (70 percent), and increasingly by purchasing imported and processed foods (30 percent). The variety of crops grown in Baniata has shifted due to changing preferences of the villagers, reliance on imported foods and climate change. Regeneration of home gardens through fallowing was practised more in the past, but due to land constraints and a growing population, fallowing is decreasing. All villagers sell agri-food products such as copra, and prepared food items such as ***masi masi*** for income, and most of them rely on these sales as their primary means of income generation. Income is spent on foods from the market, household goods, and school fees for children. The primary market is Munda, which is a 90-minute petrol-powered boat ride away. There are only two main boats, which can hold around 8 to 12 people. These boats are the primary means to access markets to sell agri-food, so villagers rotate turns so that all households get a chance to earn an income. Additionally, a market within the village primarily sells baked goods. Overall, the food system is becoming less reliant on traditional foods, and increasingly reliant on imported and processed foods.

2. HIGHLIGHTS OF SUSTAINABILITY ASSESSMENT

Baniata and surrounding villages rely on the land for the majority of their sustenance. The village grows food organically and crops are primarily rain-fed. The agrobiodiversity of food production and availability is quite high, with over 127 food-providing species and their respective varieties and breeds for cultivation or collection from the wild. There is a wide diversity of root vegetables, bananas and leafy greens. Some varieties are local whilst others have been introduced to the community. Villagers use food scraps mostly to feed animals such as free-roaming chickens or pigs. The composting of food is not widely practised, and if foods were composted into a nutrient-rich soil amendment, this could enhance soil quality and fertility. Food is prepared and cooked using locally sourced firewood. Fishing was previously more sustainable, but now there are fewer restrictions on the size of catch – which is believed to reduce the amount of fish available for consumption.

Villagers feel the diversity of crops is decreasing due to reliance on imported and processed foods. Changes in market preferences, climate change and increasing pests are also dictating which crops are grown more frequently. Human waste management is not entirely sustainable, as villagers now use the beach as the primary waste area. This will likely be an increasing issue as the population continues to rise. Plastics litter the grounds and beaches due to mismanagement. Previously plastics were not widely used, but now since processed foods are increasing, plastic wrappers and waste are as well. Villagers feel the environmental conditions are decreasing because of plastic waste. Protection of land use remains stable, as land ownership on the individual level is not allowed. However, due to the increasing population, land for agri-food purposes is decreasing. Land is not able to fallow for long periods as it was in previous generations.

Overall, resilience has decreased over time, correlated with diminished reliance on homegrown and wild collected foods for the diet, and loss of knowledge of traditional recipes and ways of life in the Baniata community.

3. FUTURE PERSPECTIVES

Both men and women agree that they want to maintain traditional foods and recipes and pass them down to future generations. However, villagers are concerned that if no intervention is made, they will see a continued reliance on highly processed unhealthy foods, and a decreased reliance on their local food system. Villagers state that rice will likely continue to replace traditional staple crops in local diets. These changes are decreasing the food sovereignty and food security by means of reducing access, utilization and stability of the food supply, affecting their quality of life and contributing to the rise of non-communicable diseases such as heart disease and diabetes.

Decreasing land fallowing and climate change lead to decreasing yields of crops. To improve yields, it will be imperative to employ improved crop rotation and composting techniques to return nutrients to the soil. Additionally, food preservation is not widely practised, which can put the villagers at risk when natural disasters strike. In the future, villagers predict local agrobiodiversity will continue to decrease if no intervention is made. The school curriculum does not include education on local foods. Men are slightly more optimistic than women regarding the preservation of local varieties of foods. Meanwhile, there is a strong consensus that the transmission of traditional knowledge is declining, such as wild collected foods, hunting and fishing techniques, and utilization of local plant species and varieties. In addition, the majority of villagers also feel that the documentation of traditional knowledge is severely lacking

When speaking to the villagers about traditional foods, there was strong pride in traditional varieties of crops and recipes. Children are aware of local foods and 75 percent of the children enjoy them, whilst 25 percent prefer processed foods. Twelve of the 13 children who participated in the discussions stated they want to take over their family farm in the future, they want to grow their own food, make money from copra, and ensure that their own children will have enough food to eat. Interestingly, children who had these aspirations did not attend school. Those who expressed interest in leaving had aspirations to achieve higher education and eventually return to the village with their families. Children also shared interest in local foods, although the older adults assumed they are disinterested. Leveraging this passion could be key to keeping these foods and traditions alive and vibrant within indigenous Solomon Islands' communities.

4. CONCLUSIONS

Villagers are proud of their community and agri-food production. However their food system is rapidly changing due to internal and external pressures, resulting in rising levels of food insecurity and malnutrition. Baniata used to be fully self-sufficient, using the local sea- and landscape around the village. However, over the past 50 years, the community has become slowly integrated into wider markets, which is having positive and negative effects. Linking up with food systems beyond the immediate local food system of Baniata has increased access to new foods. Processed foods can be preserved and used during seasons of food insecurity. However, processed foods are also shifting diets toward lower quality, nutrient-poor foods, which leads to poorer health outcomes and decreases local agrobiodiversity.

Climate change is another big risk to their resilience and the community may not be prepared enough for it. Villagers need improved access to and sharing of climate-resilient seeds, planting materials and other adaptation strategies. Improved food preservation can also help prevent food insecurity during times of low food availability. Ensuring a sustainable food system for Baniata is essential for preventing the continued rise of malnutrition and local food system degradation.

CHAPTER 5

Surviving in the desert: the resilience of the nomadic herders

Pastoralist food system of the Kel Tamasheq people in Aratène, Mali

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Discussion group with community participants in Aratène.

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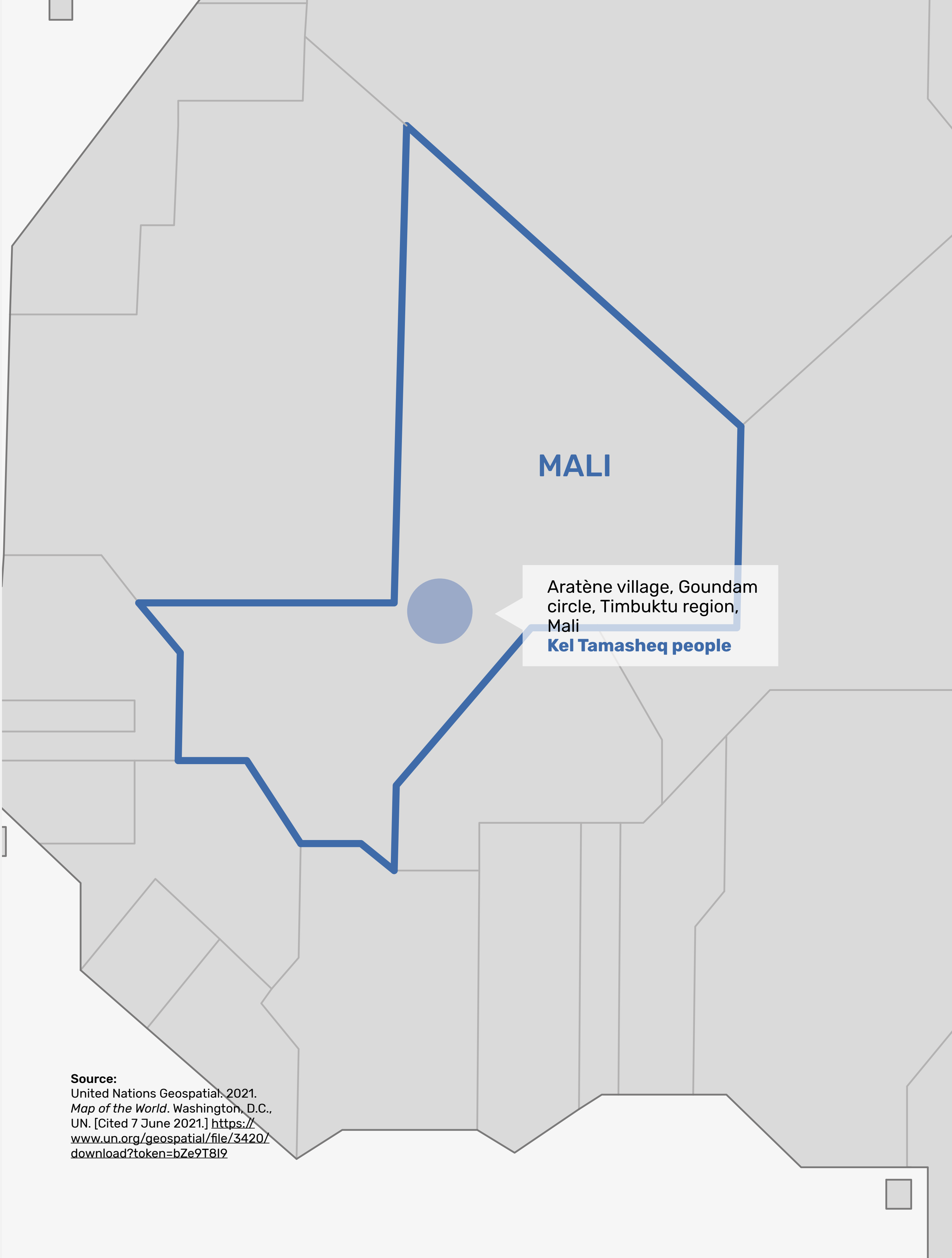


Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

“Animals are everything for a Kel Tamasheq. We drink their milk, we eat their meat, we use their skin, we exchange them. When the animals die, so do the Kel Tamasheq.”

Kel Tamasheq saying.

AT A GLANCE

This study profiles the food system of the pastoralist Kel Tamasheq herder community of the Aratène village in the region of Goundam Circle of the Republic of Mali. The Kel Tamasheq community’s food system is mainly based on livestock herding. Sheep, goats, milk, butter and cheese are amongst the main food products sold by the community. The community’s diet is based on milk, dairy products and meat, together with cereals, wild edibles, vegetables, fruit and nuts. Additionally, they complement their diet with purchases made at neighbouring markets and food exchanges with other communities. The study shows that 65 percent of the food comes from local production, whilst food purchased at markets constitutes around 35 percent of the community’s diet. During transhumance, herders drink milk and eat wild edibles and ground cereal that they store in goatskins. The community noted obstacles to food security as a result of drought, loss of livestock, social and land insecurity, diseases, and low incomes that limit their access to food produce. Nevertheless, at the same time, they show their resilience and adaptation to the harsh climate by maintaining and respecting traditions related to their local food system, whilst being open to innovations.

Note from the editors: Tamasheq terms are mentioned using the official alphabet for Tamasheq in Mali, which was adopted in 1967 and revised in 1982.

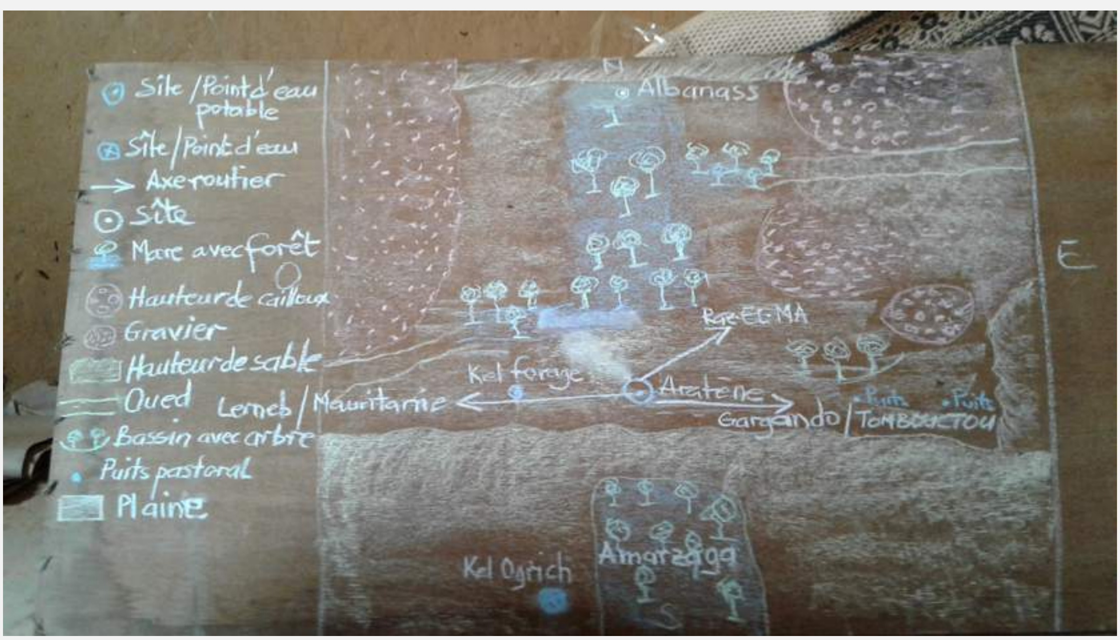
SECTION 1 COMMUNITY AND FOOD SYSTEM PROFILE

1. GEOGRAPHIC CONTEXT

The village of Aratène is located 55 km southwest of Gargando, the main town in the commune with an eponymous name. The commune of Gargando, in Goundam Circle in the Timbuktu region, is part of the lacustrine plain of the Lake Faguibine System. The Lake Faguibine System consists of five interlinked lakes filled by two channels effluent of the Niger River. Lake Télé is located a few kilometres north of the town of Goundam. In the past, it provided the town with the water it needed for its seasonal pastoralism and agricultural activities, but it has now become a vast expanse of land that is unworkable for agriculture. The community's boundaries have been fixed due to its borders to the north by the commune of Raz El Ma, to the south by the commune of Armarzaga, to the east by the commune of Gargando, and to the west by the commune of Tignère.

The area has a Sahel Saharan climate that is characterised by fluctuating temperatures that are as high as 45 °C in May-June and as low as 11 °C in January. The atmospheric circulation consists predominantly of the harmattan trade winds and the West African monsoon

FIGURE 5.1. Landscape of Aratène drawn by the participants



(Translation note: site/point d'eau potable: site/source of drinkable water; site/point d'eau: site/source of water; axe routier: road axis; site: site; mare avec forêt: pond with the forest; hauteur de cailloux: rocks elevation; gravier: gravel; hauteur de sable: dune; oued: oued; bassin avec arbres: basin with the trees; puits pastoral: pastoral well; plaine: plain).

Source: RPPS, 2018.

circulations. The average annual rainfall recorded in Aratène is the same as that in the Lake Faguibine System, ranging between the isohyets of 100 mm/year and 300 mm/year. Alternating years of good rainfall and years of drought have resulted in irregular years of rich yield and years of food uncertainty. The Sahel-type ecosystem is characterised by sparse and withered vegetation, made up of shrubs and thorn bushes, in particular, acacias (*Acacia* sp., Fabaceae), desert dates (*Balanites aegyptiaca*), jujubes (*Ziziphus* sp.), milkweeds (*Calotropis* sp., Apocynaceae) and spurges (*Euphorbia* sp., Euphorbiaeae), which dominate the most diverse grasses.

2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

The Kel Tamasheq people (also called Tuareg), who came from the east and from the Sahara, are considered to be the first ethnic settlement group to have visited the Gargando region. They are divided into three distinct socio-political entities or tribes, namely: (1) the Kel Antessar tribe, roaming in the north, in the area near the Lake Faguibine System; (2) the Tenguereguif tribe, roaming between Timbuktu and Goundam and in the river basin during the dry season; and (3) the Kel Hausa or Cheriffen, who are exclusively marabouts and whose families are related to the first two groups. According to sources, Aratène was established by a Kel Antessar fraction who lived there and who used it for their area of transhumance. Two Kel Tamasheq communities, both black and white, make up the village community: the white Kel Tamasheq and the black Kel Tamasheq.[31] In nomadic areas, any settlement exceeding 100 people can establish itself as a fraction. Like the village, the fraction is a base unit of the local authority. The current village population is estimated at 3 000 inhabitants, according to the General Population and Housing Census carried out by the National Statistics Institute of Mali (INSTAT) in 2009.

[31] Note from the editors: It is likely that the black Kel Tamasheq community mainly belongs to the Tengureguif tribe, while the white Kel Tamasheq community mainly belongs to the Kel Antessar tribe (Bernus, 1993).

Tamasheq is the local language; and it is also the only language used to communicate between the populations. Islam is the only local religion.

The community is organised in such a way that the family nucleus is extended to close relatives, who are uncles, nephews, cousins, aunts and grandparents. Women take care of household chores, process food to produce by-products, and often deal with picking and small-scale trade. Men practise transhumance and deal with transport, blacksmithing, and cultivating crops and vegetables. Other family members consult them on all family matters or projects. The village chief is the leader of the community and is assisted by other traditional leaders or notable persons and fraction leaders. Key decisions that affect the community's livelihood are made after consulting the village chief, along with notable persons and fraction leaders. The village chief's authority covers the entirety of the village, whereas the fraction leader's only concerns are his fraction.

3. LOCAL FOOD PRODUCTION

The Kel Tamasheq community's food system is mainly based on pastoralism: milk and meat production and their by-products such as curd, butter and cheese, as well as dry-cured spicy salted meat (smoked meat). These primary food groups, which constitute the Kel Tamasheq's core diet, are passed on through generations. The Kel Tamasheq community self-identifies through these food items and their unique local processing methods. Livestock herding is part of a pastoralist production system, characterised by mobility, namely transhumance and nomadism. The Kel Tamasheq food system includes other subsistence activities such as cereal and vegetable farming, as well as wild food gathering.

Livestock

In Aratène, pastoralist livestock herding remains the main activity and is also the main source of income of the community members. Their income is generated by selling animals, due to the absolute necessity, and also by selling derivatives such as milk, meat and their by-products. The species bred are sheep, goats, cattle, donkeys, camels and poultry (Table 5.1).

Donkeys are bred to transport people, building materials and firewood. The community does not use their meat or milk for consumption.

TABLE 5.1. List of livestock

Group	Tamasheq name	Scientific name	English name
Birds and poultry	***tekəšit***	Phasianidae sp.	Hen
Mammals	***ămajor***	*Bos taurus indicus* L., Bovidae	Zebu (Azawak breed)
	amnəs	*Camelus dromedarius* L., Camelidae	Camel
	tayat	*Capra hircus aegagrus* Erxleben, Bovidae	Goat
	ešəḍ	*Equus asinus* L., Equidae	Donkey
	tehăle	*Ovis aries* L., Bovidae	Sheep

Trees, grasses, livestock feed, bourgou (*Echinochloa stagnina* (Retz.) P. Beauv., Poaceae) fodder, rice, wheat, starches, salt and mineral lick stones are all used to feed the animals. This type of livestock herding is based on transhumance and nomadism, with these mechanisms complementing each other. Transhumance is based on the exploitation of the pastures and water sources available according to a specific itinerary and calendar pattern dictated by the alternating seasons. Nomadic/mobile pastoralism is characterised by constant movements that follow pastures and water availability without being tied to a fixed point. Transhumance and nomadism are regulated by seasonal short- and long-distance mobility. Beyond the fact that it is a production system essential for their subsistence because it enables a rational use of natural resources, mobility is an inherited ancestral cultural value based on a strong emotional relationship between the pastoralist and his animal, and which contributes to the social construction of pastoralist societies. The herd represents everything: strength, life, food, but also, and perhaps above all, prestige and peer admiration. Hence the propensity for numbers to grow. The average herd size varies depending on the species. It varies from (1) 20 heads for bovine, with a male/female ratio of 1:20; (2) 50 heads for ovine and caprine with a ratio of 4:50; or (3) 5 heads for camels with a ratio of 1:5. Animal owners keep their livestock numbers a secret. It is a taboo subject during livestock surveys in certain areas of Mali. Traditionally, one must not, under any circumstances, violate this secret for two reasons: (1) bank account concept: asking the herder how many animals are in his herd is like asking an employee, with fixed or variable income, how much money they have in their bank account; and (2) livestock tax: which has definitely made farmers more wary.

Milk is a product that has both economic and cultural significance for pastoralists. It is perceived as the most appreciated and vital food product for its numerous nutritive properties. On average, good milk producers provide up to 10 litres per day in two milking sessions. This drops to 6 litres in the dry season. Milk is stored in goatskins, both amongst families and during the transhumance period. Processing it enables community members to obtain by-products such as curd, butter from cow's milk, and cheese from goat and sheep's milk. Cheese making consists of mixing, in a wooden bowl, fresh milk and a piece of abomasum (last sac of a ruminant's stomach) from a young goat, which might have been slaughtered for the occasion. After the milk is fermented, the mixture is poured through a wooden press that is weaved locally by the women. The pressure separates the milk from the cheese curd. Meat is processed by drying it in the sun or in the shade with salt and spices. To make large quantities, a young bull might be slaughtered. The meat is placed on a wooden shed for sun drying, and when dry, the meat

Obtaining milk in Aratène.

is hung in the shade on cords weaved by local artisans. Dried meat can be ground and stored in gourds made by local artisans. To enable preservation up to one year, butter can be added to the dried meat, as well as honey optionally. Honey comes from the south of Mali and is therefore purchased from the market. The gourd is then air-tightly sealed to prevent air access. Curd, butter and cheese are the by-products sold at the market.

Transhumance can last six months. Family leaders decide when it starts based on information obtained beforehand from observers who have gone scouting to check water and pasture conditions. Men own their livestock and manage the herd, the arrival and departure of animals, milk deliveries, food and veterinary medication purchases, etc. In contrast, women own the milk and manage the income generated from its sale. Women are also responsible for processing milk and meat as well as gathered wild edibles. Depending on production levels, they decide how much is for family consumption, for processing, for selling, for stocking, and for donating to the poor or to parents in the larger towns. Women also look after small animals and poultry. Children play their role in the community by looking after young animals, such as calves, goat kids and lambs, and by going to school.

Crops

For the Aratène's pastoralist community, cultivating cereal crops is a random activity that exemplifies amateurism. Cultivation activities focus on three crops: pearl millet, broom corn and rice, all of which are rain-fed and do not require irrigation. The surface area of these rain-fed plots occupy between 1 and 1.5 ha of land. The community members carrying out these activities use the plots depending on their needs and their abilities, taking into account the interests of others and the shared ownership, as the land does not belong to anyone. Production methods are rudimentary. The women process millet into cream. The process consists of grinding the grains down to flour, which is then sprayed with a little water in a container to form a paste. This paste is then regularly turned with their fingers using regular coordinated movements to form fine dumplings, which are then steam-cooked. The flour can also be eaten without boiling it first. In both cases, the cream is eaten mixed with milk, in any form, and sugar. It is heavily demanded at the market.

Vegetable farming is a fairly recent seasonal activity introduced by non-governmental organizations (NGOs), cooperatives and technical services for the purpose of diversifying food production and promoting sources of livelihood, especially amongst the low and vulnerable classes, women and young people. It is performed during the dry cold seasons near a source of water due to necessity. These supplemental crops include tomatoes, lettuces, onions, carrots, eggplants, cucumbers, beetroots, cabbages, sweet potatoes, watermelons, peanuts, condiments (spices) and jujube.

Work tools for cultivation activities include pickaxes and hoes made locally, imported containers such as buckets and watering cans, and goatskins for transporting water. The seeds planted originate from markets outside of the local environment. In terms of storage, the practices and techniques used involve stocking the rice and millet in leather bags, which are suspended inside the home. Storage can last up to one year.

TABLE 5.2. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Tamasheq name	Scientific name	English name
Fruits and juices	***tăkănkanit***	*Citrullus lanatus* (Thunb.) Matsum. & Nakai, Cucurbitaceae	Watermelon
	ibăkatən	*Ziziphus* sp., Rhamnaceae	Jujube
Nuts and seeds	***matəji***	*Arachis hypogaea* L., Fabaceae	Peanut
Starches	***enəle***	*Cenchrus americanus* (L.) Morrone, Poaceae	Pearl millet
	məsəko	*Ipomoea batatas* (L.) Lam., Convolvulaceae	Sweet potato
	tafɣat	*Oryza glaberrima* Steud., Poaceae	African rice
	săba	*Sorghum bicolor* (L.) Moench, Poaceae	Broom corn
Vegetables	***hoy***	*Abelmoschus* sp., Malvaceae	Okra
	tamẓləlat	*Allium sativum* L., Amaryllidaceae	Onion
	bətərav*	*Beta vulgaris* L., Amaranthaceae	Beetroot
	afădaɣan	*Brassica oleracea* var. *capitata* L., Brassicaceae	Cabbage
	concumbər*	*Cucumis sativus* L., Cucurbitaceae	Cucumber
	tămadrasut	*Daucus carota* L., Apiaceae	Carrot
	sălad*	*Lactuca sativa* L., Asteraceae	Lettuce
	tămati*	*Solanum lycopersicum* L., Solanaceae	Tomato

*Initially French names that enter the Tamasheq vocabulary

Wild edibles

Gathering grass and other ad hoc wild foods takes place during and after the rainy season and is the sole responsibility of women and girls. The activity, free and unregulated, is intimately linked to animal production and its timeline. It is important in the landscape because of its nutritional and economic value. Participants in the thematic discussions estimated that gathering provides 5 percent of the dietary intake. Gathering is primarily centred on perennials, namely, wild grasses such as wild fonio and Indian sandbur. Wild jute is also collected for its leaves, as well as jujube, desert dates and wild rice. Indian sandbur is collected on the dunes using manual reaping, as is wild rice around ponds. Jujube and desert dates are hand-picked by shaking the trees or by using a wooden accessory, such as a stick, to make the fruit fall. Generally, jujube trees are near ponds. With regard to processing, Indian sandbur and wild fonio are ground prior to use. Community members prepare ***ăšăboraɣ***, juice out of dates. ***Ahufăr*** (jujube bread), chewed or sucked, helps prevent ripe seeds from going off should they be kept for a longer period. Soaked desert dates produce a juice used as a laxative. The produce obtained from gathering and their by-products are sold at the market.

TABLE 5.3. List of wild edibles

Group	Tamasheq name	Scientific name	English name
Fruits and juices	***iborayən***	*Balanites aegyptiaca* (L.) Delile, Zygophyllaceae	Desert date
	ibăkatən	*Ziziphus* sp., Rhamnaceae	Jujube
Starches	***tăkana***	*Cenchrus biflorus* Roxb., Poaceae	Indian sandbur
	tafɣat	*Oryza glaberrima* Steud, Poaceae	Wild rice
	asɣal	*Panicum laetum* Kunth, Poaceae	Wild fonio
Vegetables	***hoy***	*Abelmoschus* sp., Malvaceae	Wild okra
	făkohoy	*Corchorus tridens* L., Malvaceae	Wild jute

4. OTHER LAND-BASED PRODUCTIVE ACTIVITIES IN THE LANDSCAPE

In addition to production for consumption, the community does seasonal picking for the pharmacopeia (drugs sold at the market) and for fodder. The gum arabic tree (*Acacia nilotica* (L.) Willd. ex Delile, Leguminosae) is used by cobblers in tanneries and in traditional treatment against bad breath. The jujube and desert date trees are used for diabetes and hypertension. In addition, different parts of the desert date tree, when burned and ground down, are used to heal wounds and boils.

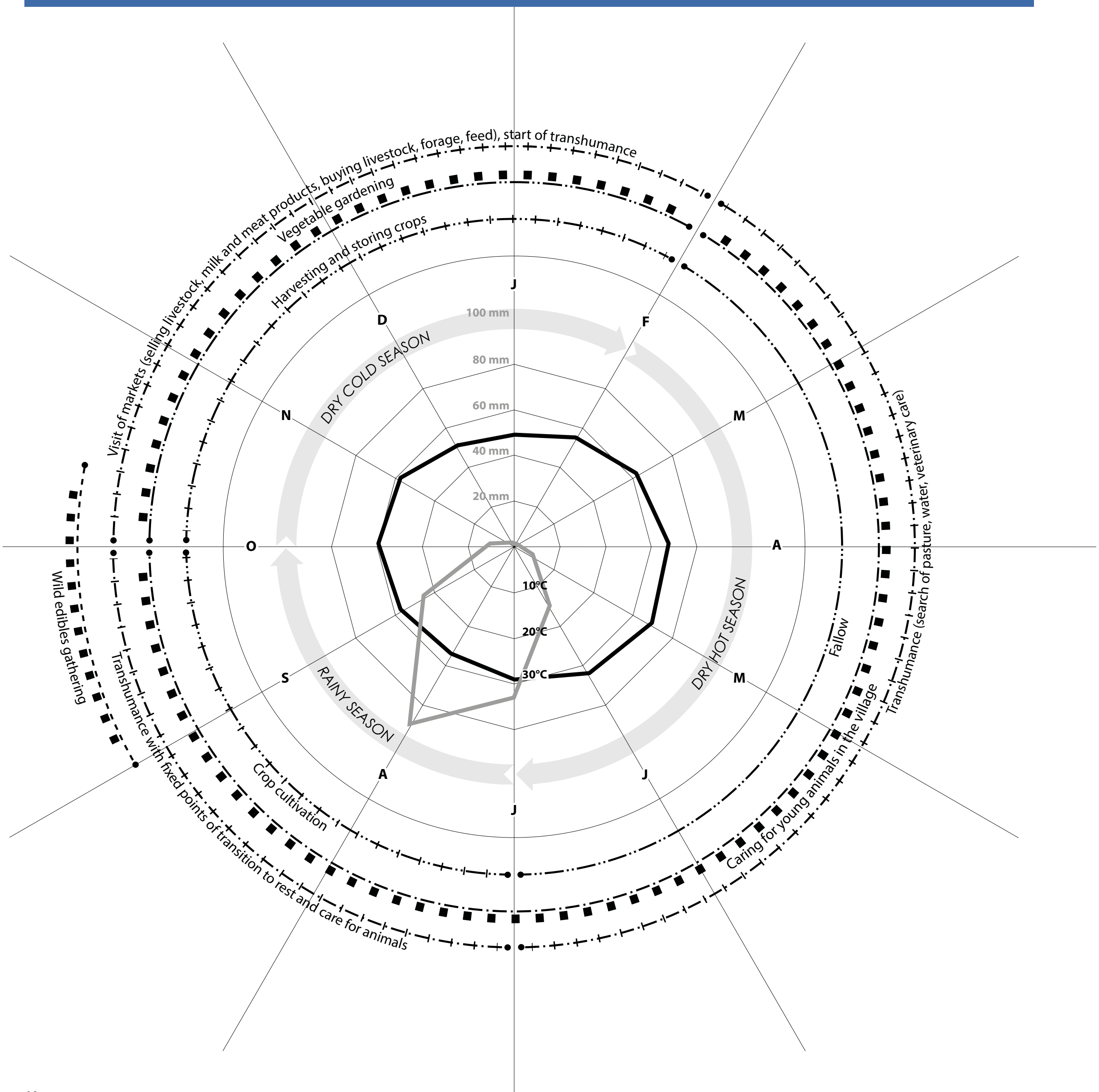
In the community, both men and women are local artisans, and the gender balance is especially apparent amongst blacksmiths, whose craftsmanship is passed down the generations and, as such, constitute their own social class. Products are made from raw materials like skin, leather, metals, wood and fabrics (dyes and sewing). These products are sold at the market and even exported to other regions in Mali. They also reach areas outside Mali thanks to art collectors.

5. LOCAL CALENDAR

The community follows both the Gregorian calendar and the lunar calendar depending on events, although no one loses sight of the date similarities between the two calendars. For instance, the Gregorian calendar is used for the school calendar, but the lunar calendar is used for the start and end dates of transhumance. The division of the year into three seasons is where both calendars coincide. The dry cold season runs from October to February. During this period, the average temperature is 11 °C. Between March and June is the dry hot season, when the temperature averages 45 °C. The rainy season, or wintering, runs from July to September during which the temperatures average 30 °C. The quantity of water collected varies between 100 mm and 300 mm depending on the year.

The community's activities are linked to each phase of the year, corresponding to the seasonal changes. The dry cold season marks the beginning of transhumance and corresponds to a period of reduced activity. Community members spend this period (1) promoting their animals and their products and by-products; (2)

FIGURE 5.2. Average annual rainfall (mm) and temperature (°C) in Timbuktu, and seasonal activities by the Kel Tamasheq of Aratène village (elaborated by Yanto Wahyantono, IRD, 2020)



Key:

Activities related to cultivation
Activities related to livestock
Activities related to wild food (gathering, fishing, hunting)
Activities mainly undertaken by men
Activities mainly undertaken by women

yw/ird-2020

(These annual rainfall and temperature data are averages recorded for Timbuktu. There may be a slight difference with the weather conditions in Aratène, although they remain close to each other.)

sourcing and stocking cereals for the year, which men harvest during this period; and (3) farming vegetables. Men go to the markets, where they sell or buy livestock, fodder and animal feed for the forthcoming months. Their motto is "it is when you feel happy that the worst is to come", meaning one should always anticipate. During the dry hot season, men take on mobility (nomadism, transhumance), which is dependent on pastures, livestock feed, water and veterinary care. The dry hot season is a period of recovery and corresponds to the summer fallow in cereal production. Women look after animals too young to go on transhumance during this period. During the rainy season (or wintering), if raining, the men on transhumance find fixed points of transition to rest and care for the animals and to stock up on food supplies. Cereal crops are cultivated during the rainy season. The collection of wild edibles starts at the end of the rainy season and lasts for as long as the quantities of seeds such as wild fonio, Indian sandbur, wild rice, and nuts such as desert dates and jujube, which are linked to the quality of wintering that allow for their growth.

6. MARKET SOURCING AND TRADE

In addition to the food produced and harvested in their food system, members of the community complement their diet with purchases made at neighbouring markets and food exchanges with other communities. Participants in the thematic discussions estimated that food purchased at markets constitutes around 35 percent of the community's diet. Members of the community have access to the following foods: roots such as yams, sweet potatoes and potatoes, peanuts, vegetable oil, sugar, tea, rice, salt, cereals and pulses such as local and imported rice, millet, beans, processed foods such as pasta and powdered milk, and fruit from the south of Mali such as mangoes, oranges, lemons, mandarins and watermelons.

Members of the community visit bazaars, which are periodic, and markets, which tend to be permanent.

Trading, exchanges and donations of products are done within the community and with other communities or groups of farmers. Reciprocal needs dictate the nature of the goods to exchange or trade, whilst the terms of exchange and trade depend on the value of the goods in question; for instance, a male sheep exchanged for another male or a female.

7. COMMUNITY HISTORY AND FOOD SYSTEM TRANSITIONS

The Kel Tamasheq roamed in Gargando during the dry season with their livestock well before the fifteenth century. According to sources, Aratène is one of the oldest nomadic settlements in the commune of Gargando, founded by a Kel Antessar fraction that lived there and used it for their area of transhumance. Aratène's hamlet was transformed into a settled village in 1980 as part of the decentralisation process, which enabled the creation of local authorities in Mali

TABLE 5.4. Markets visited by the community

Markets	Location	Frequency of visit and use by community members
Lerneb	45 km northwest	Visited once a week to (1) sell animals destined to be exported and (2) to buy food
Raz-El-Ma	35 km northeast	Visited once a week
Aratène	Village	Diverse commerce and daily market
Echell	80 km southeast	Visited once a week for main stock and other item replenishment
Goundam	120 km east	Visited once a week to buy food
Diré	150 km southeast	Visited once a week, especially to stock up on rice
Léré	80 km south	Visited once a week to (1) sell animals destined to be exported and (2) to buy food

Landscape of Aartène.
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such as the rural or urban community, the circle, the region and Bamako's district. To facilitate the settlement of the populations, the State carried out a pastoral borehole drilling. Settling was not imposed. Those who settled did so after losing their livelihood, particularly their livestock.

From the 1970s to today, the Faguibine System, in which Gargando is located, has become dependent on hydro-climatic variations. In 1973, the worst drought Sahel countries experienced occurred. Since then, Aratène's community has suffered from the 1982 and 1984 droughts at a national scale, followed by those in 2015 and 2017, which were relatively localised in the region. This recurrence, directly linked to climate change, resulted in the loss of livestock, and the movement of populations towards the centre of Mali or to countries like Libya, Saudi Arabia and Algeria. The departures affected up to 70 percent to 75 percent of the community residents. Livestock losses reached 85 percent on average. It is estimated that around three-quarters of arable land and pastoral resources were lost, with a significant decrease in pastures and wild edibles gathering. Prior to the drought periods that started in 1973, Lake Télé supplied the town with water for its pastoral and agricultural activities seasonally. Today, it is a vast stretch of unworkable land. This system currently tends to be characterised by increased dehydration, constantly facing problems of precariousness, vulnerability, resilience, poverty and food insecurity.

A rebellion broke out in 1990 and another episode reoccurred in 2012. The village of Aratène joined the movement to support the other communities involved in the rebellion. The main consequences were the involuntary departures of populations towards Mauritania, Algeria, Niger and Burkina Faso, destruction of the economic fabric, social insecurity, and theft of livestock.

A shelter and transit centre for refugees was opened and the administrative centre was temporarily delocalised from the main town, which facilitated the progressive return of administrative services and refugees from 1995 to 1996. As a supportive measure, in 1998, the National Hydraulic Office drilled a well, equipped with a solar generator, as part of the Village Hydraulics programme.

SECTION 2
SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM

1. PROVISION OF LIVELIHOODS, EQUITY AND SOCIAL WELL-BEING

Adequacy of income opportunities

The activities that generate the highest income in the community are first and foremost those related to livestock. Live animal sales constitute approximately 60 percent of their source of income. Sheep, goats, milk, butter and cheese are amongst the main agri-food products sold by the community. Each animal species is led by a herder. The herder is different from the animals' owner, who is the only one authorised to sell them. The owner covers the herder's food, accommodation, clothing and health needs. He is bound to the owner by an unwritten contract lasting between 6 and 12 months and at the end of which the herder is paid with live animals previously negotiated in the verbal contract. The second-best source of income is generated by other activities and occupations carried out by men, which include trading, craftsmanship, Quranic teaching, teaching, driver, blacksmith, labourer, first-aid responder, shopkeeper, transporter and woodcutter. Shopkeepers and transporters can have relatively high revenue levels. The sale of wild food resources is the third most important source of income in the community. Jujube, sometimes processed to make ***ahufãr*** (jujube bread), and desert dates are amongst the main agri-food products sold by the community. Other products sold include wild fonio and Indian sandbur.

Ninety percent of the income is used to meet the dietary needs of the family, followed by veterinary care and transport. Health care and schooling are covered by the State and NGOs. The community members believe that the food system does not offer sufficient and adequate income opportunities. The community's buying power is extremely weak. Marketing difficulties stem from the village's isolation during the rainy season and the insecurity in the region.

Adequacy of diets

The community's diet is based on milk, dairy products and meat, which constitute a typical meal or any traditional dish, together with cereals, vegetables, fruit and nuts. During transhumance, herders drink milk and eat collected wild edibles and ground cereal stored in goatskins. Their diet does not change following their departure from the village, but rather depending on the areas they pass through. The most important consideration for herders is to ensure they can preserve the food products they carry, as transhumance is a long-term challenge. The community's diet changes seasonally with changes in the food supply. Milk is plentiful during the rainy season thanks to lactating female animals benefiting from the season's goodness. During this period, milk, its by-products such as cheeses, and meat are the community's primary food sources, and their diet is rarely supplemented with cereals. Plants that grow thanks to the rain, such as wild jute and okra, are more commonly used as condiments. Cereals become more important in the diet after harvest in the dry cold season, when they become community members' main food along with meat, milk, cheeses and produce from the market. The dry hot season is the most difficult period of the year in terms of guaranteeing local produce.

Some of the herds' reproductive females always remain in the area during transhumance to supply milk. However, animals produce less milk during this period and wild plants are less abundant. Stocking up is important because no farmed products are available. Cereals become expensive and animals are devalued. The main food during the dry hot season are cereals, meat and market produce.

According to community members, local production supplies sufficient food for consumption during the rainy season and for stocking up for the dry season. One should note that for them, the concept of sufficiency is directly linked to the permanent availability of primary foods, those that constitute the traditional and secular core of their diet produced by the local environment, namely, milk, meat and their by-products, but also nuts such as desert dates and jujube, and wild seeds. Community members get their supplies from bazaars and markets when the environment does not produce sufficiently, especially during the dry hot season. According to community members, the quality of their diet based on local production seems insufficient in terms of meat and meat-reared animals, milk and dairy products, nuts and seeds, green leafy vegetables, and wild fruit (very few).

The community considers"a number of stressful situations, essentially of social nature" as obstacles for food security. These situations include drought, loss of livestock, social and land insecurity, diseases, and low funds that limit their access to food produce from the market in sufficient quantity and quality. Land insecurity is one of the factors that negatively influence the food system over time because it occurs to the detriment of livestock farming. The Lake Faguibine System area, in which the village of Aratène is situated, constantly suffers from land disputes, causing land insecurity. These issues especially concern animals being unable to access watering holes due to crop fields. Agricultural production remains insufficient to meet the needs of the community. Given the marginal nature of the activity, and what is most practised by livestock farmers, crop yield is insignificant, and harvest is insufficient in supporting the community's dietary needs. The ground quality, which is barely productive, will hardly meet a satisfactory level of production to meet the dietary needs of the community. Another factor is inefficient production equipment like carts, ploughs and other ploughing equipment, vaccination centres, and water sources, which stems from the lack of resources.

Changes in the provision of livelihoods and social well-being over time

Until 1973, Kel Tamasheq pastoralists produced for consumption. Today, they produce for the market and are discovering the law of supply and demand, which is subject to the seasonality of the food system. Over time, the Kel Tamasheq community has understood that income opportunities in the food system have increased to keep up with their increasing population and dietary needs. Prices have varied along the same lines.

New activities such as the sale of trade and craft production, transportation (of people, building materials, food products, firewood and coal), the creation of nearby bazaars, and agri-pastoralist activities reinforce the inclination towards production for markets. The community's trade relations with other communities are dynamic, which has resulted in an improved mutual exchange of information on the pricing of goods, stocks and farmed produce.

Since 1973, the community's self-sufficiency has decreased due to an array of different factors such as certain lakes drying up completely, recurrent droughts, lack of assistance, insufficient incomes and the livestock's poor productivity. Since the 1970s, the degradation of the local landscape has increased due to the different climate shocks and disruptions experienced. This resulted in the disappearance of certain plant species and wild animals, which used to be collected or hunted. Integrated crop production is a means to implement better practices. Vegetable farming and breeding hens are sideline activities that have diversified food products in the community's diet. The breeding of hens falls under the Kel Tamasheq women's responsibilities. This includes collecting eggs mainly for the consumption of their families, but also breeding hens that can be sold to increase income.

The Kel Tamasheq women harvest crops that are used for food preparation and consumed in a variety of recipes. In this community, regular consumption of cereals and other market products signifies helplessness in regard to their food system's production outputs. Community members declare that they "no longer have the choice" and the survival instinct determines behaviour.

2. RESOURCE USE EFFICIENCY

Water

The water need is hardly met. The community accesses water through traditional wells, the pastoral well and the only solar-powered borehole in the village, whose breakdowns are disabling for the community. These sources can barely meet their water needs.

The community's water sources, as identified on the participatory map, are the following man-made sources (boreholes, wells) and temporary surface waterholes (ponds, lakes):

- the pond with the forest to the north, in the northeast;
- a well in the basin with the trees, in the east;
- pastoral well at dune-level in the south; and
- a solar-powered borehole.

The choice of sites for traditional water sources is often a cause for land disputes, when the water source sites are in crop cultivation areas or near certain dried-out ponds that still fill slightly during the rainy season. The water source sites used to be determined by traditional indicators, which are the concentration of the vegetation and the direction in which it grew, and the concentration of livestock farmers and their animals, which is usually in line with the vegetation concentration.

The technique used to test for groundwater helps to confirm or deny the probability of the presence of water and to decide whether to drill or not. Drinking water for domestic use is the biggest reason for water demand in the Kel Tamasheq community. Households also consume water to process food and for hygiene as well as for vegetable farming irrigation. The water supply is deemed sufficient for the needs of households but not for all the community's needs when animals and vegetable farming are considered. Water shortages can occur when the solar generator breaks down. In addition, during the dry hot season, when temperatures can reach 45 °C in the shade, all the temporary waterholes disappear. Climate change potentiates these climatic extremes. Due to water shortages, the community restricts water usage by setting opening and closing times for the improved water sources, namely, the pastoral well and the solar-powered borehole. This also helps to reduce the human and animal pressure on these water sources.

Vegetable gardening in Aratène.

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Land and soil

The local ground is dry and arid and full of wadies, which means argyle valleys, rocky elevations, dunes, or sand elevations and ravines. The lack of rain, sometimes coupled with devastating and sudden floods, causes severe erosion whilst sandstorms and wind gusts at times carry everything in their paths, including humus, habitats, vegetation and household waste. These storms cause sand dune formations, which are problematic for human and animal mobility.

Certain soil defence and restoration activities centred on sustaining the ground's production capacity are carried out following traditional methods. Such methods include sand dredging, land clearing and spreading organic household waste from the food system and domestic animal waste on crop fields and vegetable farming fields. Working the land is a secondary activity in Aratène's pastoralist food system, compared with livestock farming, and the results from the survey have confirmed this gap. The ground quality, already barely fertile, can hardly reach a satisfactory level to meet the community's dietary needs.

Labour and fuel energy

The food system of the Kel Tamasheq is mainly based on renewable energies such as human labour, wood, coal and solar panels, and the use of non-renewable energies like fuel and oil. The system is based above all on manual labour, which guarantees food production, mobility (transhumance and nomadism), food processing, transport, and food preparation. The most laborious and time-consuming activity is looking after the livestock, which includes feeding, veterinary care, breed selection, selling and purchasing animals, and managing their numbers. Manual labour is sufficient for these labourious and time-consuming activities as it is always guaranteed.

Wood and coal are essential for the preparation and processing of food. Cattle and camel dung are often used as wood and coal substitutes when these resources become scarce. Some households have solar panels for lighting and powering televisions. Alternatively, the community uses different sizes of electric batteries or lamp oil for nocturnal lighting. Those who own 4x4-type vehicles use fuel to travel to bazaars and markets outside of the community. The means of transport highest in demand are cars and motorcycles. On the whole, fuel and oil supply meets their demand. Supplies come from Bamako, Timbuktu, Léré and Mauritania. Supplies are regular but they can be interrupted during the rainy season when the roads are cut off.

Waste

Aratène's food system produces very little waste thanks to a simple way of life in which the domestic equipment, both biodegradable and reusable, is made from local wood such as pestles, mortars, plates and spoons, as well as leather and skins such as bags and goatskins. The little bit of waste produced is made up of plastic and metal packaging, brought back from the markets and bazaars visited, and household cleaning waste. The waste is placed on the household's rubbish heap, outside and right next to their plot of land, but sometimes slightly further out if there is a larger multi-household rubbish heap.

Traditionally, waste that can be composted is moved towards crop fields when it encroaches on their land. It is carried on foot, using a camel or a donkey. The community's environment is usually clean, which is quite noticeable for any new visitor. This cleanliness is further accentuated by the sweeping gusts sandstorms create at the beginning of and during the rainy season.

Changes in resource use efficiency over time

The way water is collected has changed over time. Wells are preferred over ponds but since 1980 and 1998, boreholes are preferred over wells. In comparison with the past, this progression is a sign that water security, accessible via pumping and in quantity, is improving. Nevertheless, water needs are barely met, and breakdowns are problematic for the community. The water table reserve is decreasing due to the successive droughts caused by climate change. Wood is increasingly rare and substitutes must be found to ensure firewood for food preparation, for instance. This results in animal waste being used, when it should normally be used as organic manure, which causes a shortfall for the soil and plants.

Due to major soil degradation and dune formation, work activities are slowed down and vast expanses of land become unusable for livestock and vegetable farming as well as housing. Abandoning harsh landscapes with a marked profile and physical surface features is part of the adaptation strategies for the heterogeneity of the land. The use of energy sources has diversified to include non-renewable resources external to the local area, such as oil and fuel to power motorbikes and vehicles and oil for domestic lighting.

In summary, demand for oil has increased due to the market's dynamics but quantifying this increase is difficult due to the nature of this trade, which lacks accountability. Demand in electricity started with the tentative introduction of solar energy.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

Crop and livestock biodiversity

The cattle, ovine and caprine breeds farmed by the community are Sahel breeds. These breeds are kept in the food system despite their low production levels because of tradition, but also and mostly due to the tolerance they have acquired to the harsh local climate. The limited production levels of these Sahel breeds are related to the climatic conditions and the supply of pastoral resources in the environment. Livestock herders do not intend to introduce external breeds that are not hardened to the harsh climate, which the community tried to alleviate through pastoral mobility. This is also because of their limited resources.

Crops cultivated by the community, such as wild rice, Indian sandbur, broom corn, millet, jujube and okra, are also of sub-Saharan African origin and are well adapted to the Sahel region. Wild rice seeds are locally sourced or can be purchased at the market during seeding time when local quantities are insufficient. Millet, Indian sandbur and vegetables are purchased at the market. These are improved seed varieties and come from either the national research system or outside the country.

Wild harvested plants and animals

The community lost the right to hunt wild animals following the disappearance of wild game more than 20 years ago. Some wild plants are picked for food supplies, medicine, fodder and wood, and some are sold, depending on the season. That is the case for the gum arabic tree (*Acacia nilotica*), which the community does not allow to be felled. This is to safeguard the tree's survival and, consequently, to sustain its use. Tannin is used in shoemaking, and leaves and bark are used as a medicine against food allergies and bad breath. Cut trees are used as firewood, as fodder, on village building sites (homes and public buildings), and to build animal enclosures.

Ecosystem conservation and protection

The landscape of Aratène's community is heterogeneous and comprises diverse natural ecosystems: forests, ponds, gravel plains, lateritic plains, dune elevations and desert plains. The community's initiatives to preserve and protect the weak ecosystem need to be catalysed further by local authorities.

An example of a successful initiative from the local authorities is the measures put in place to stop bushfires. The prohibition to fell gum arabic trees is another substantial achievement. The pastoral use of the land is free for transhumance from one area to another, with

Livestock in transhumance.

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stopover dwellings. Transhumance itineraries are not formally mapped out. They are secular itineraries recognised by the entire community. There are also animal crossings, sometimes in areas of high human and agricultural density. In livestock herding, parturition is not organised, nor is mating. Addressing the decrease in animal numbers is also not on the agenda, despite the current physiognomy of the landscape and the perspective that improving it will take too long.

Changes in the conservation and protection of resources over time

Crop and livestock preservation remains traditional. The community knows that the varieties and species outside the system have the disadvantage of not being adapted to the local landscape due to their intolerance to the climate and the fact that the resources needed to maintain their production level are high compared to the community's revenues. These observations show that the use of local breeds and varieties tends to increase.

Practices, rules and current traditional customs that apply to wild plant picking and pastoralism are still the same as before. The degradation of the local landscape is very advanced due to the different climate shocks and disturbances experienced since the 1970s. Rainfall variability and the changing duration of the growing season, together with increasing temperatures, have resulted in an irreversible degradation of the vegetation. In addition, the inexorable advance of the desert also threatens the vegetation. A large part of the flora has disappeared, namely: mallow raisin (*Grewia villosa* Willd., Malvaceae); white cross-berry (*Grewia tenax* (Forssk.) Fiori, Malvaceae); false brandy bush (*Grewia damine* Gaertn., Malvaceae); cleome (*Gynandropsis gynandra* (L.) Briq., Cleomaceae); and wild watermelons (*Citrullus lanatus*). The activity of wild edible gathering is in constant decline due to the repetitive droughts and consequent degradation of pastoral resources. Nearly 20 years ago, the wildlife disappeared, including lions, giraffes, hyenas, ostriches, oryx, buffalos, zebras, gazelles, deer, guinea fowls, bustards, turtles, monkeys and warthogs. Today, hunting and trapping have receded naturally following the disappearance of the wildlife, decimated by armed groups proliferating in the local environment and who have no regard for the law.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of natural resources

Local institutions set up either by the community or the State govern the village's natural resources and native food system. As such, the Village Council, made up of the village chief, the notables and the religious authorities, is headed by the village chief, who is nominated for life by the administration, as proposed by the community. The Village Council, elected during a general assembly of the village, assists the chief. The Village Council is an advisory body to the communal authority and cannot make any decision regarding the commune's life without the council's agreement. The farmers' cooperative, set up by members of the community, is responsible for the promotion of livestock and regulates transhumance on aspects such as departures, organization and returns. Vegetable farmers form an economic group capable of internal organization. Vegetable farming is organised by women's associations, which set up a water management committee and decide how plots are allocated to the vegetable farming volunteers. The existence of these institutions that guide the community's life strengthens the food system and is a sign of good governance of the community's environment. At the end of the decentralisation period, the role of the communes was key in land management: transactions, land-use planning in accordance with the principle of subsidiarity, registration, and allocation. The community's citizens are aware of it and must speak to the communal authorities for all matters relating to land management where an official recognition of land titles is needed for third parties. The first land user possesses rights of use but not definite ownership. Access to pastures is free but is regulated by the following texts of law, which take into account the rights of third-party users:

- Law on Agricultural Orientation (Law n° 06-045 of 5 September 2006)
- Pastoral Charter (Law n° 01-004 of 27 February 2001)
- Enforcement Decree of the Pastoral Charter (Decree n° 06-439/P-RM of 18 October 2006)
- Decree on Transhumance in Mali (Decree n° 10-602/P-RM of 18 October 2010) setting out the terms of transhumance in the Republic of Mali.

There is freedom of movement and problems only exist around waterholes and pastures, which are rare and insufficient. As indicated previously, land insecurity is amongst the major obstacles to the evolution of food security and quality of food in Mali. This is especially accurate in Aratène, where herding expansion must co-exist with other land uses, such as vegetable farming. The way farmers interfere with animal crossings through crop fields is in contradiction with the legislation in force on pastoralism and transhumance. The Pastoral Charter guarantees access to pastoral resources such as salt lands, pastures, wells, waterholes and rights of use:

The present law defines the fundamental principles and general rules that govern pastoralist activity practices in the Republic of Mali. The present law recognises the essential rights of pastoralists, particularly with respect to animal mobility and access to pastoral resources. This law also defines the main obligations incumbent upon them in the practice of pastoralist activities, particularly with respect to the preservation of the environment and the respect of other people's property (Article 1 of the Pastoral Charter).

Land disputes are usually resolved amicably, which helps limit resorting to local authorities.

The participants recognise the fact that there is an"understanding between the communities" in terms of cooperation and coordination. This understanding manifests itself in the form of dialogues about the use of natural resources between the community's chief, the mayor, the notables and the religious authority and they recognise that, for all conflicts, solutions between the parties in dispute are always found eventually.

Changes in governance of natural resources over time

If the emergence of the cooperative movement goes hand in hand with Mali's independence since 1960, the way village chiefs and village councils are appointed is part of the accompanying measures of communalisation dating back to 1999. In Mali, the State has delegated land management to the communes, Gargando in this case, as part of decentralisation. The community members say that in colonial times, conventions existed that were repealed with the new laws on agrarian reform since the 1980s and also with the unequal administrative division of the region. A member of the community states that:

"In our environment, land is passed on by inheritance from generation to generation. It is neither sold nor rented or used by people external to our community because we only have right of use over the land, not ownership. The land was the community's well before colonisation and, until now, has been retained by resistance to all types of governance, but we do not own it. The community's rights are diminishing because of the agrarian reforms and because of corrupted practices that occur within the system (State, communal and judiciary administration), but also because of the droughts and poverty."

Prior to the Pastoral Charter adopted in 2001, no text existed to legislate transhumance through a definition of the fundamental principles and general rules that govern pastoralist activity in the Republic of Mali.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

A summarized assessment of 13 indicators of resilience is presented below.

1. Exposed to disturbance: The food system has faced repeated climatic shocks and disturbances since the 1970s, especially droughts, lack of rainfall and occurrences of storms. The region has also experienced locust invasions. For these reasons, it is considered to be more exposed to disturbances than in the past.

2. Globally autonomous and locally interdependent: Discussions held with the community indicate that 65 percent of the food for the family comes from the local environment, versus 35 percent purchased, donated or bartered. The food system is locally interdependent given the relations with other communities and via barter and local exchanges.

3. Appropriately connected: The food system's connection to surrounding markets, located within a maximum radius of 150 km, facilitates the community's access to market foods, which in turn has allowed for a diversification of income opportunities over time. This has been a logical consequence of the increase in food requirements related to demographic growth and the opening of increasingly dynamic and diversified markets. However, a substantial challenge is that the village is landlocked in winter during heavy rainfall, with all roads being cut off.

4. Socially self-organised: The native food system is self-organised. Also present are local institutions governing natural resources set up by the community and social support, which is particularly strong and represented by the Zakhat. Zakhat is a sort of charity where certain "wealthy" people within the food system, such as owners of cattle or land, donate to the poor in the community, often in the form of animals. The Zakhat is donated as follows: (1) yield: split 50-50 with those who provided manual labour, usually those in need; and (2) animals: each year, large owners count their animals and donate to the poor: one 2-year-old female camel out of a camel herd of 25 heads or more; one sheep out of a flock of sheep of up to 25 heads; one 4-year-old bull out of a cattle herd of 30 heads; one in-calf heifer out of a cattle herd of more than 40 heads; one 2-year-old sheep and one 2-year-old goat out of a flock of sheep/goat of 40/40 heads; or one 2-year-old sheep out of a flock of sheep/goat totalling up to 100 heads.

5. Reflective and shared learning: To tackle shocks and disturbances, the community implemented adaptation strategies such as relocating certain houses due to flooding, the abandonment of risk areas for animals such as ponds and shallow rocks, and the construction of mud houses, tents or other makeshift shelters in the forest to shelter from the cold. However, the community lacks resources to deal with pests. It is becoming increasingly evident that changes in food security adaptation strategies are moving towards the progressive acceptance of foods from the market.

6. Honours legacy: Community members have great respect for maintaining their traditions related to their local food system, whilst still being open to innovations. There are few indications of local practices being at risk of deteriorating. Local methods for livestock and vegetable farming ensure the community's preservation of breeds and local varieties, due to their acquired adaptation to the harsh climate.

7. Builds human capital: Traditional know-how on pastoralism, food processing and craftsmanship is passed on orally by elders and learned by heart by younger generations of the community. However, the lack of written documentation poses a threat to the survival of traditional knowledge. The State-built health centre covers health care provision for the community and the State school provides basic education for the children of the community. The education further provides children with the ability to document their traditional knowledge.

8. Coupled with local natural capital: The food system is strongly coupled with natural capital.

Agrochemicals are not used and soil is fertilized with kitchen scraps and animal dejections, allowing the recycling of nutrients such as carbon and nitrogen in crops and vegetable fields. The major problems of soil degradation relate to the formation of gravel and sand dunes, slowing down soil cultivation by taking over vast expanses of land, making them unusable for livestock and vegetable farming or housing. Further, local wood sources are in decline.

9. Ecologically self-regulated: Animal species and several varieties of plants have disappeared, and their habitat has deteriorated. However, community members have a high level of understanding the importance of ecological interactions between livestock and the environment, and of allowing the environment to regenerate. One of the reasons behind the decrease in animal species was over-hunting for food in previous decades. The main reason behind the decrease in plant species is the advancing desert and droughts, which have resulted in certain local lakes and ponds drying out completely. The community lives in an increasingly harsh environment in which it needs to adapt. Efforts and local initiatives, helped by significant resources, are still needed to guarantee ecological regulation of the food system.

10. Functional diversity: Livestock farming, crops, vegetable farming, and gathering of wild edibles supplies foods that fall into 11 food groups. The market also provides foods from several food groups, including pulses, which are otherwise not present in the local production system. The food system's diversity also builds on non-food local resources, such as firewood, plants for traditional medicine, and domestic equipment made from local wood such as mortars, pestles, spoons and plates.

11. Optimally redundant: Farming multiple livestock and crop species, as well as the supply of food from multiple systems, contribute to the redundancy of the system. The diversity of processed foods and the diversity of external markets and bazaars available are also optimally redundant.

12. Spatial and temporal heterogeneity: The local landscape of Aratène's community is heterogeneous and comprises diverse natural ecosystems such as forests, ponds, gravel plains, lateritic plains, dune elevations and desert plains. Their production and consumption are based on seasonality through their activities of the food system such as transhumance, nomadism, and the reproduction cycles of domesticated and wild plants.

13. Reasonably profitable: Income opportunities have increased over time, logically following the increasingly dynamic and diversified markets. Sales of animals constitute the main source of income. New activities such as trade and the sale of craft products, transport, the creation of the surrounding bazaars and agro-pastoralism reinforce the move towards markets. Currently, pastoralists produce for the market.

SECTION 3 CONCLUSIONS AND FUTURE PROJECTIONS

1. FOOD SYSTEM SUMMARY

The outputs and the inputs of the food system are presented below.

TABLE 5.5. Ouputs and inputs of the food system

Outputs	Inputs
• Meat and meat products from cows, sheep, goats, camels, poultry • Milk and dairy products from cows, sheep, goats and camels • Eggs from local hen rearing • Starches: cereals and root crops • Nuts, seeds, wild grasses • Local fruit such as jujube • Leafy vegetables: cabbage, lettuce, spinach, okra, chili pepper, cucumber, carrot, tomato from vegetable farming • Sweets • Oils • Tannin • Processed foods • Income • Waste	• Water from wells, boreholes, ponds (in wintering) • Land and soil, salt lands • Human energy used for manual labour, teaching, commerce, animal traction, water extraction (using donkey and camel), leading livestock, collecting dead wood, transportations • Animal traction for crops and transport • Fuel: lighting oil, wood, coal, dry dung from bovine and camel mostly, electric batteries, solar panels, butane gas • Local organic compost • Externally sourced seeds: tomato, eggplant, lettuce, cabbage, potato

2. HIGHLIGHTS OF SUSTAINABILITY ASSESSMENT

The sustainability of a food system implies the need for a system to continuously provide quality and diversified foods in sufficient quantity for everyone as main pillars of food security.

To be sustainable, the food system needs to: (1) maintain healthy rural ecosystems and fertile agricultural soils, and (2) limit its dependence on economic fluctuations and external politics. With respect to the protection of livelihoods, as far as Aratène's native food system is concerned, in comparison with the past, the diet shows little diversity and food security is seasonal. Livelihoods and incomes are inadequate. Only the sale of animals, out of necessity for that matter, provides relatively high revenues. These sales have limits that should not be exceeded to protect the herds' core reproductive members. One improvement that can be noticed in the pastoral environment is wintering that occurs between August and September when there is sufficient milk and meat, a sign of food sufficiency. All other livelihoods are adequately meeting the community's needs during this period. The farms, households with herds, can be qualified as self-sufficient during the period, since the other food types are not systematically sought.

The food system's main strength is the existence and preservation through the generations of one or more primary food groups, which constitutes the core diet. In addition to other criteria such as language, specific body markings, etc., communities identify themselves through these foods, such as milk, meat and tea in a Kel Tamasheq setting. This strength determines heritage. Other strengths include social self-organization, which is strong in this community thanks to the presence of local governing institutions for natural resources; and reflected and shared learning, an achievement conducive to the creation of the local food system's human capital.

3. FUTURE PERSPECTIVES

The community sees its future through the prism of the projections and future trends relating to: (1) the environment, where the settlement of populations and livestock farming will be favoured over long journeys, with the necessary accompanying measures in the form of development projects; (2) production, affected by the decline of wild edibles gathering, but mostly by the intensive use of the land and the soil for the cultivation of crops; (3) diets, which must remain dominated by local product consumption as much as possible whilst taking into account market produce – but changes in diets lead to other problems related to the costliness of "new foods" and the gradual abandonment of certain food traditions; and (4) the disappearance of their system and of traditional knowledge, a consequence of negative external influences, going by young people's current aspirations. The latter do not intend to stay in the village, but rather plan to leave to discover other worlds, to study, to take advantage of globalisation's new technologies, to become doctors, teachers, drivers, transporters or shopkeepers, or to enter military services. This list is not exhaustive. The same aspirations influence the diet, where variety is sought: hors d'œuvres, snacks, ice cream, fruit, vegetables and modern yoghurts. Adults continue to be demanding with regard to maintaining traditional practices in the future local food system, but they remain in tune with young people and children and are receptive to the positive changes from external influences such as, for example, the consumption of market foods not produced from the local landscape.

4. CONCLUSIONS

Aratène's native food system demonstrates strengths but also faces challenges for its sustainability. The big challenges for the food system's sustainability are: the risks caused by change and/or the abandonment of secular food traditions in support of "new foods", which will be accentuated by young people's aspirations to leave the community – who represent tomorrow's community members and its human capital; the condition of the local natural capital, damaged for the most part due to sand dunes and gravel crusts; and the food system's ecological self-regulation, which requires work and local initiatives to be functional because the scarcity, if not the disappearance, of certain forage crop varieties due to droughts and repeated animal grazing is a sign that the system has reached its self-regulation limits. This work and local initiatives must be backed by significant means provided by the State and development partners such as institutions and global political platforms to strengthen resilience and native food system protection in response to climate change. This will consist of prolonged rescue operations depending on the difficulties experienced at the time or on actions of a structural nature for rehabilitation/recovery. Development scenarios can be established, such as the settlement of population and livestock, for example, already envisaged by the community as a future trend.

The community's self-sustainability has decreased from 1973 to today due to certain lakes drying out permanently, recurring droughts, insufficient help, poverty, poor livestock productivity, and the disappearance of certain woody and herbaceous species used for food and medicines. It is the duty of the farmers' cooperative, in the absence of public or non-public consultancy support, to take the necessary steps depending on the urgency of the measures needed to strengthen the protection of the ecosystem. Education is needed in terms of training, raising awareness and capacity-building.

The preliminary solutions proposed by the community aimed at improving the diversity and quality of food include the flooding of dried-out lakes, helping farmers to make farms more profitable, simplifying subsistence agriculture, improving land access and learning other trades. Projects designed to help the community need to be implemented to achieve these solutions. This applies to the State in the first instance, with the solicitation of development partners. Participants in the thematic discussions noted that most of the indicators of resilience were weak and that, to improve them, they believe only projects designed to help the community in terms of livestock rearing, agriculture and learning new trades, as well as flooding dried-out lakes, should be introduced.

CHAPTER 6

Ancestral nomadism and farming in the mountains

Agro-pastoralism and gathering food system of the Bhotia and Anwal peoples in Uttarakhand, India

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Indigenous woman from Namik village carrying dry leaves from the forest for cowshed bedding and manuring.

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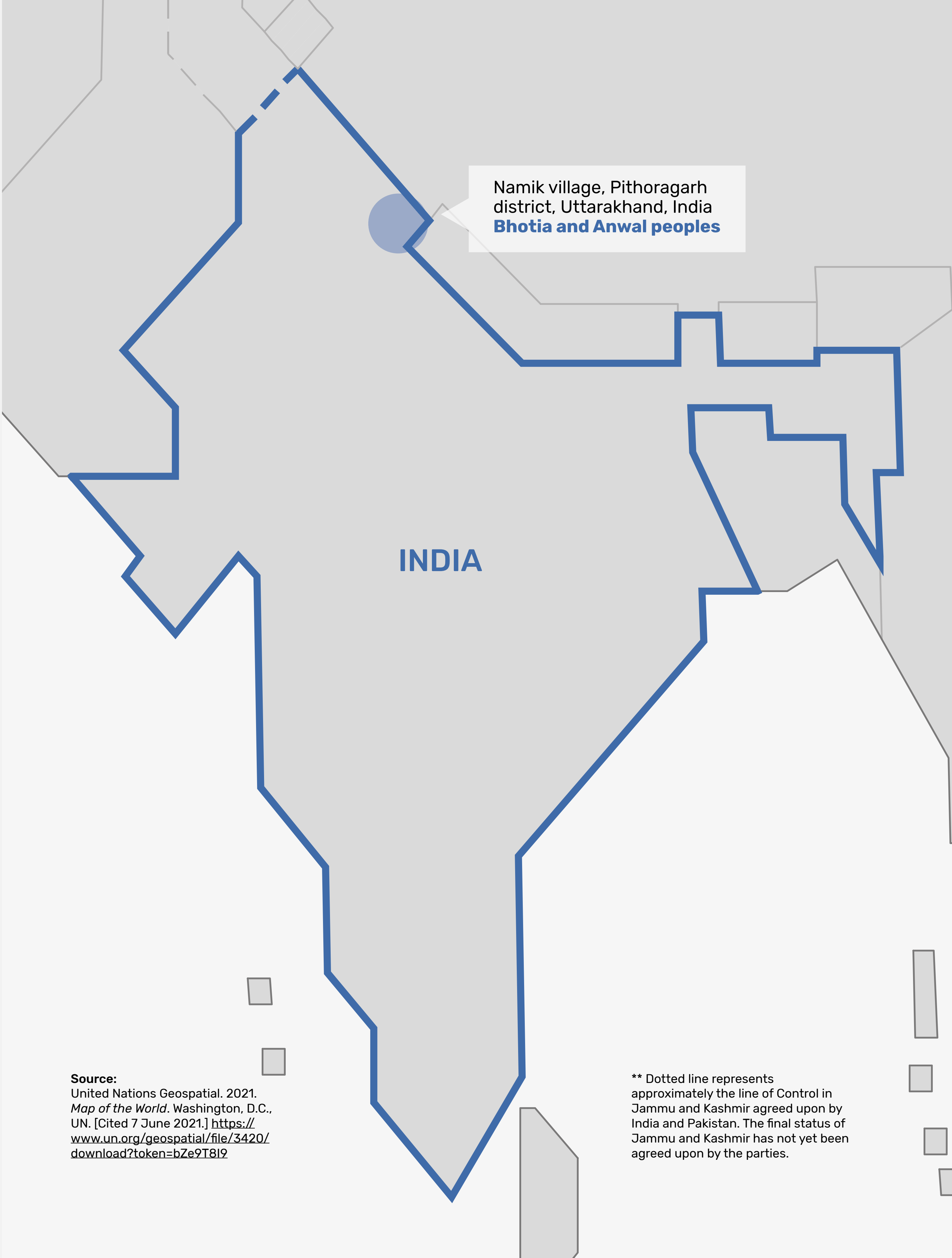


Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

** Dotted line represents approximately the line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

“Our traditional crops are not only part of our food but also an important part of our unique culture.”

Mr. Laxman Singh, community member of Namik village.

AT A GLANCE

This study characterised the food system of Namik, a mountain village situated in the Pithoragarh district of Uttarakhand in India. The village is inhabited by the Bhotia and Anwal. The food system in the village is agro-pastoral, and the majority of households are farming or rearing sheep. The schedule caste families practise blacksmith and traditional carpenter works. A minority is involved with trade and business. The community grows approximately 60 percent of the food within the village, whilst they obtain 30 percent from outside sources, 5 percent from the wild and 5 percent from barter. Approximately 95 percent of the cultivation and animal production comes from traditional varieties, with only 5 percent of the species introduced. The community practises organic farming techniques, such as adding sufficient manure, crop rotation and the cultivation of pulses. The villagers of Namik use most of the food produce for their own consumption. They sell only a small portion of their food to earn cash, as the majority of the extra produce is exchanged with adjoining villages or with traders who come to the village. They noted that the climatic conditions of the area and the limited access to land are the main barriers to food security and diet quality.

SECTION 1
COMMUNITY AND FOOD SYSTEM PROFILE

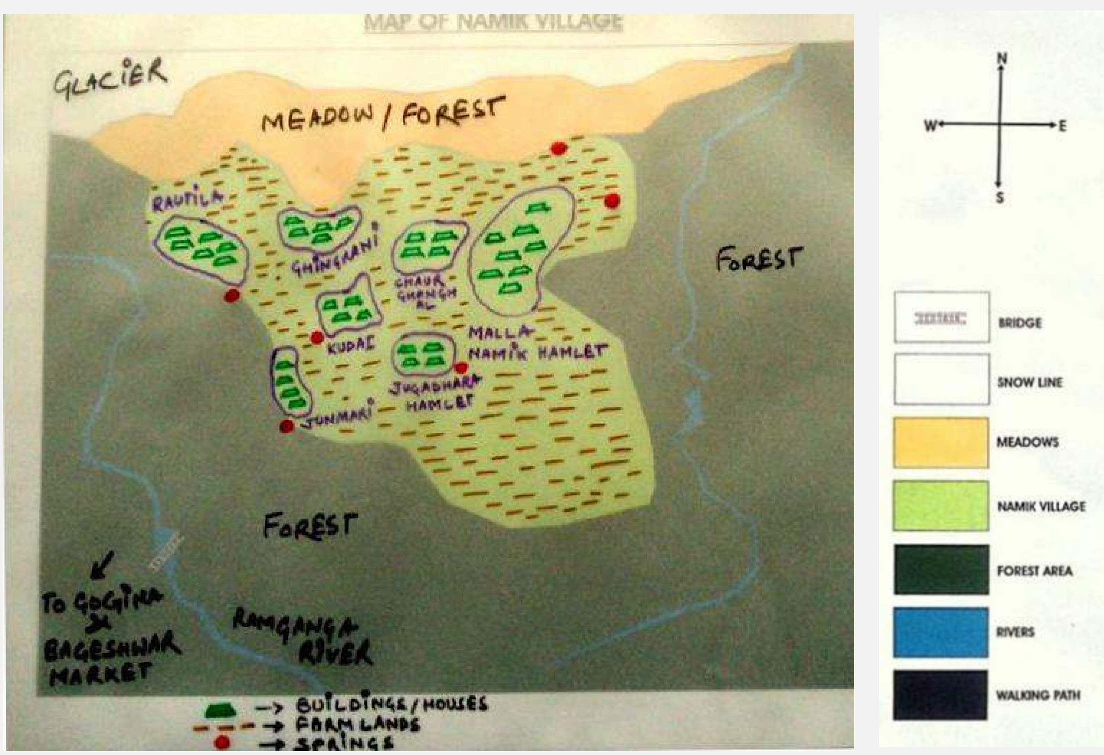
1. GEOGRAPHIC CONTEXT

Namik village is located in the Munsyari block of the Pithoragarh District in Uttarakhand, India. It is situated 60 km away from the sub-district headquarter Munsyari, 118 km away from the district headquarter Pithoragarh, and 80 km from the town of Bageshwar. Namik is the last village in the Namik valley. The total geographical area of the village is 486.38 hectares.

The village is located in a pristine location near the Heeramani glacier. It is divided into seven hamlets: Rautila, Ghungrani, Chaur Ghonghal, Kudai, Junmari, Jugadhara and Malla Namik. The map of the village drawn by the community clearly shows that the upper boundary of the village consists of high mountains surrounded by snow and glaciers. The part below the snow is a meadow and forest area, mainly used for grazing by sheep and goats.

Two types of forests surround the village. One is reserved forest and owned by the forest department. The community manages the other.

FIGURE 6.1. Landscape of Namik drawn by the participants



Source: community participants, with support of the authors, 2018.

The community also relies on pasturelands 4 kilometres away from the village, where livestock such as sheep and goats can freely graze. The forests are marked as dark green areas on the map. The light green area on the map is the village area with households and farms. Further, the Ramganga East River flows from the southeast of the village to the west. The village's five natural springs are their main sources of potable water.

2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

The two communities Bhotia and Anwal participated in the study. Three societal groups categorise these communities: general, schedule caste and schedule tribe. Both communities consist mainly of Hindus, although Buddhism also influences the beliefs of many Bhotia people. The Bhotia and Anwal peoples are closely related, as the Anwal community assisted the Bhotia community in their work with trade. The village community is mixed, consisting of various Bhotia groups, amongst them both general and schedule caste. The general caste speaks Kumauni and Hindi, whilst the schedule tribe group also speaks Bhotia language (Sino-Tibetan). With the exception of Hindi, there are no dialects of the other two languages.

According to data provided by the community, Namik village has 110 households. Forty-five households have one to two members working as migratory shepherds, an activity undertaken by the Anwal. Fifty households are of general castes, 41 households of schedule castes, and 19 households of the Bhotia tribe. The overall population of Namik village consists of around 600 individuals, out of which 70 individuals have migrated to cities and larger towns for work and education. Elderly people in the house are considered advisors, as they are highly respected. Nowadays young people spend the majority of their time on education, in contrast with the past, when they contributed to the family's daily activities. Many migrate to other towns.

With the exception of migrating youth, all family members usually live together. During meals, the elderly and the leader of the household are served first, thereafter the youth and children, and then the women.

Child marriages have traditionally been common in these communities, based on mutual understanding and family agreements. However, current Indian legislation views child marriages as a punishable offence. Women are required to be minimum 18 years old, and men 21 years old.

3. LOCAL FOOD PRODUCTION

The majority of the food in the community comes from their own farming and shepherding activities. They have two main crop cycles and grow vegetables continuously throughout the year. The Anwal community lives a nomadic/mobile shepherd lifestyle. Their households raise livestock for their daily consumption of milk and milk products.

Crops

The larger part of farm areas in Namik village are located around the cluster of houses. Each household has its own farmland, and households with home gardens grow vegetables. Community members cultivate mustard plants, spinach, fenugreek, potatoes, peas and green chillies in their home gardens. Villagers have also recently started to cultivate daikon radish, cabbage, tomato and garlic. Due to limited land holding, no fruit orchards exist in the village. With the exception of a few citrus, apple, plum and peach trees, as well as walnut trees, most of their fruit supply comes from local markets. With regards to crops, households cultivate a variety of species, such as maize, potato, taro, amaranth, finger millet, buckwheat, black soybean, black gram, pigeon pea, kidney beans and ***gurun*** (adzuki bean). Staking in climber beans occurs with the help of ***ringal*** bamboo collected from the forest, as well as from the community forest or their own farmlands.

TABLE 6.1. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Local name	Scientific name	English name
Fruits and juices		*Citrus limon* (L.) Osbeck, Rutaceae	Lemon
		Prunus domestica L., Rosaceae	Plum
		Prunus persica (L.) Batsch, Rosaceae	Peach
Pulses		*Cajanus cajan* (L.) Millsp., Fabaceae	Pigeon pea
	bhatt	*Glycine max* (L.) Merr., Fabaceae	Soybean
	gurun	*Vigna angularis* (Willd.) Ohwi & H. Ohashi, Fabaceae	Adzuki bean
	chana	*Vigna mungo* (L.) Hepper, Fabaceae	Black gram
Starches	***madua***	*Eleusine coracana* (L.) Gaertn, Poaceae	Finger millet
	ugal	*Fagopyrum acutatum* (Lehm.) Mansf. ex K. Hammer, Polygonaceae	Buckwheat
	aalu	*Solanum tuberosum* L., Solanaceae	Potato
	makki	*Zea mays* L., Poaceae	Maize
Vegetables	***lehsun***	*Allium sativum* L., Amaryllidaceae	Garlic
	chaulai	*Amaranthus* sp. L., Amaranthaceae	Amaranth
	tamatar	*Brassica oleracea* L., Brassicaceae	Cabbage
	mooli gobi	*Raphanus raphanistrum* L., Brassicaceae	Radish
		Solanum lycopersicum L., Solanaceae	Tomato

Livestock

The community rears a variety of livestock, such as ***badri*** cow (an indigenous cow breed of Uttarakhand), buffalos, mules, sheep and Changthangi goats (pashmina goats introduced from Tibet). They keep these herds either in the meadows or in the forest areas near the village. Two to three community members live with these herds to look after them, and particularly men from different families take turns looking after the herds. Cows and buffaloes provide milk and milk products such as cream, which is used to prepare butter, clarified butter called ***ghee***, buttermilk and yoghurt. The women are responsible for milking and the production of dairy products.

The community rears sheep and goats for meat and wool. The men shear the livestock and, thereafter, spin the animal hair to make thread. Women primarily weave and make jackets and carpets, whilst men knit sweaters. In contrast to cows and buffaloes, sheep and goats are taken to the meadows or the forest for free grazing. Regarding fodder, cows and buffaloes mainly feed on green leaves of oak species (*Quercus oblongata* D.Don, Fagaceae; *Quercus semecarpifolia* Sm., Fagaceae), ***ringal*** (*Drepanostachyum falcatum* (Nees) Keng f., Poaceae), and ***burash*** (*Rhododendron arboreum* Sm., Ericaceae), which are collected from the adjoining forests. *Celtis australis* L., Cannabaceae, ***phar patti*** (*Synotis rufinervis* (DC.) C. Jeffrey & Y. L. Chen, Asteraceae) and Horse chestnut (*Aesculus indica* (Wall. ex Cambess.) Hook., Sapindaceae) are also collected in lesser quantities. Some families have started growing napier grass around their farmland and home gardens. The community also uses ***chata*** (a mixture of flour, rice, salt and barn) as fodder to provide extra nutrients. Further, women collect dry leaves for cowshed bedding and manuring. Due to the remoteness of the village, some families keep mules to transport products and construction materials, in addition as occasional transportation for tourists.

Beekeeping is also part of the community's food system. Approximately 20 percent of the families have traditional log beehives made of oak or toon trees that are kept near a shade in the house. The nectar is mainly collected from wild and farm flora. Once the hive is mature and has

Indigenous woman from the community standing in front of bean plants.

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produced honey, families extract it manually and collect it in jars and plastic bottles. However, the extraction is somewhat harmful as the manual method kills larvae in the process. The honey serves mainly as medicine to treat sore throats, coughs and colds. During religious ceremonies, households also offer honey to local deities.

Wild edibles

The community has always lived in harmony with nature, even before they settled in the village. They have in-depth knowledge of wild edible plants. The women primarily collect these plants and use them as food sources as well as for medicinal purposes for their households. Wild edible and medicinal plants are collected from nearby forests and high-altitude meadows. They use ***jarak*** (*Phytolacca acinosa*, Indian pokeweed) for snacks and vegetables, and ***bhangeera*** (*Perilla* sp., Korean perilla) as a spice and dip to serve as chutney. ***Bhaang*** (*Cannabis sativa*, cannabis) is used for many purposes. The seeds are added to cuisine and chutney as a spice, whilst hemp is used to make ropes. The fluids extracted from the leaves are used to cure wounds. ***Sisun*** (*Urtica ardens*, nettle) can be consumed as a green vegetable, whilst the hemp is used to make ropes as well. ***Gethi*** (*Dioscorea bulbifera*, air yam) is eaten roasted or boiled and can relieve gastric pains. ***Kutki*** (*Picrorhiza kurroa*, picrorhiza) is a painkiller that can also be ingested to treat fevers. ***Chhipi*** (*Angelica glauca*, angelica) is consumed as an energy drink. ***Hisalu*** (*Rubus ellipticus*, golden Hymalayan raspberry) is eaten as fruit, as well as ***kilmora*** (*Berberis asiatica*, Asian barberry), which can also be used to treat asthma and coughs. ***Linguda*** (*Matteuccia struthiopteris*, fiddlehead ferns) is consumed as a green vegetable. After snowfall, the community harvests ***gucchi*** (*Morchella esculenta*, common morel), a rare mushroom in the area, for consumption. Certain orchids are used as plaster applied to bone injuries of cattle.

Traditional healers in the village have a deft understanding of the power of medicinal plants.

They collect the rare and recently discovered ***yarsagumba*** (*Ophiocordyceps sinensis*, a caterpillar infected by fungi) and the locals sell it at a high price due to its medicinal value. Trading the fungi is illegal, but it is smuggled into China through the Nepalese border. The fungi are high in protein. China uses the plant to produce various energy drinks, and due to this utility, purchasing the plant in China is quite expensive. Several people also believe that they can produce impotency medicine from this plant. Despite the plant's high demand, the only manufacturing done by the community is cleaning the mushroom before selling it to local traders. Because they receive such a low share of the income from their plants, the Government is in the process of legalizing its trade and developing a mechanism as part of Access and Benefit Sharing (ABS), so that the production can also benefit the communities.

TABLE 6.2. List of wild plants harvested (both for food and non-food uses)

Group	Local name	Scientific name	English name
Condiments, seasonings, snacks, and sweeteners	***bhaang***	*Cannabis sativa* L., Cannabaceae	Cannabis
	bhangeera	*Perilla* sp., Lamiaceae	Korean perilla
	jarak	*Phytolacca acinosa* Roxb., Phytolaccaceae	Indian pokeweed
Fruits and juices	***kilmora***	*Berberis asiatica* Roxb. ex DC., Berberidaceae	Berberis
	hisalu	*Rubus ellipticus* Sm., Rosaceae	Himalayan raspberry
Medicinal	***chhipi***	*Angelica glauca* Edgew., Apiaceae	Angelica
	kilmora	*Berberis asiatica* Roxb. ex DC., Berberidaceae	Berberis
	bhaang	*Cannabis sativa* L., Cannabaceae	Cannabis
	gethi	*Dioscorea bulbifera* L., Dioscoreaceae	Air yam
	yarsagumba	*Ophiocordyceps sinensis* (Berk.) G.H.Sung, J.M.Sung, Hywel-Jones & Spatafora, Ophiocordycipitaceae	Caterpillar mushroom
	kutki	*Picrorhiza kurroa* Royle ex Benth., Scrophulariaceae	Picrorhiza
Mushrooms	***gucchi***	*Morchella esculenta* (L.) Pers., Morchellaceae	Common morel
Vegetables	***linguda***	*Matteuccia struthiopteris* (L.) Tod., Onocleaceae	Fiddlehead ferns
	sisun	*Urtica ardens* Link, Urticaceae	Nettle

Aromatic plants such as ***koot*** (*Aconitum heterophyllum* Wall., Ranunculaceae), ***jatamasi*** (*Nardostachys jatamansi* DC., Caprifoliaceae) and ***guggul*** (*Commiphora wightii* (Arn.) Bhandari, Burseraceae) are collected from the forest by the community to prepare incense sticks and used at home or for religious purposes.

4. OTHER LAND-BASED PRODUCTIVE ACTIVITIES

Another principal land-based activity in the village is handicraft. The communities collect ***ringal*** (bamboo), which grows in the wild, to make mats, wicker and containers. Further, they use wood from the community forest for firewood, house construction and medicines. Women are responsible for these activities. House construction is dependent on the natural ecosystem. The communities gather stones, wood, soil and slates from the community forest. They make the internal plaster from red soil and cow dung, which acts as a repellent for insects. The walls of these houses are made from stones and are approximately 2 to 2.5 metres thick. The timber primarily comes from species like toon (*Toona ciliate* M.Roem., Meliaceae), ***thuner*** (*Taxus baccata* L., Taxaceae) and oak (*Quercus* sp.). The houses regulate temperature well as they remain cool during summer, because the heat during daytime is unable to penetrate the walls. They also keep the atmosphere warm during the winter, and the stone walls help insulate the heat from the firewood. Further, the community has constructed their houses to be earthquake resistant, as they build them with thick, interlocked walls with gaps in between.

5. LOCAL CALENDAR

During summers from May to June, the minimum temperature remains around 0.8 °C, reaching maximum 27 °C. During monsoon, from July to September, the temperature remains minimum 0.7 °C and maximum 17 °C. Finally, during winters from January to February, the temperature is minimum -3 °C and maximum 12 °C.

The community is engaged in many livelihood- and cultivation-related activities throughout the year. Anwal shepherds spend most of their year in the meadows with their herds of sheep. Summer and monsoon are the main seasons for farming and livestock migration. During this time, the community cultivates a variety of pulses, vegetables and other crops.

The availability of water remains sufficient throughout the year. In the summer, all streams and rivers overflow as the glaciers melt. The weather remains warm and clear during this time. For the Anwal people, monsoon season also carries beneficial conditions for an abundance of edible wild plants, and therefore livestock rearing. During these periods, they take their herds to higher meadows, following fresh grass availability. The green fodder contributes to the herds' healthy diets.

In contrast, early winters are cold and dry. During the day, the temperature is high, but the mornings and evenings are quite cold. During this period, the Anwal people migrate down to ***tarai***, the foothills of Himalaya, where temperatures are slightly warmer. During fall and early winter, the community collects dry grass, fodder and fuelwood, which they store for the upcoming winter season, when the area is covered with snow. This is the busiest time for the community, and they process many food products such as dried meats and cured vegetables.

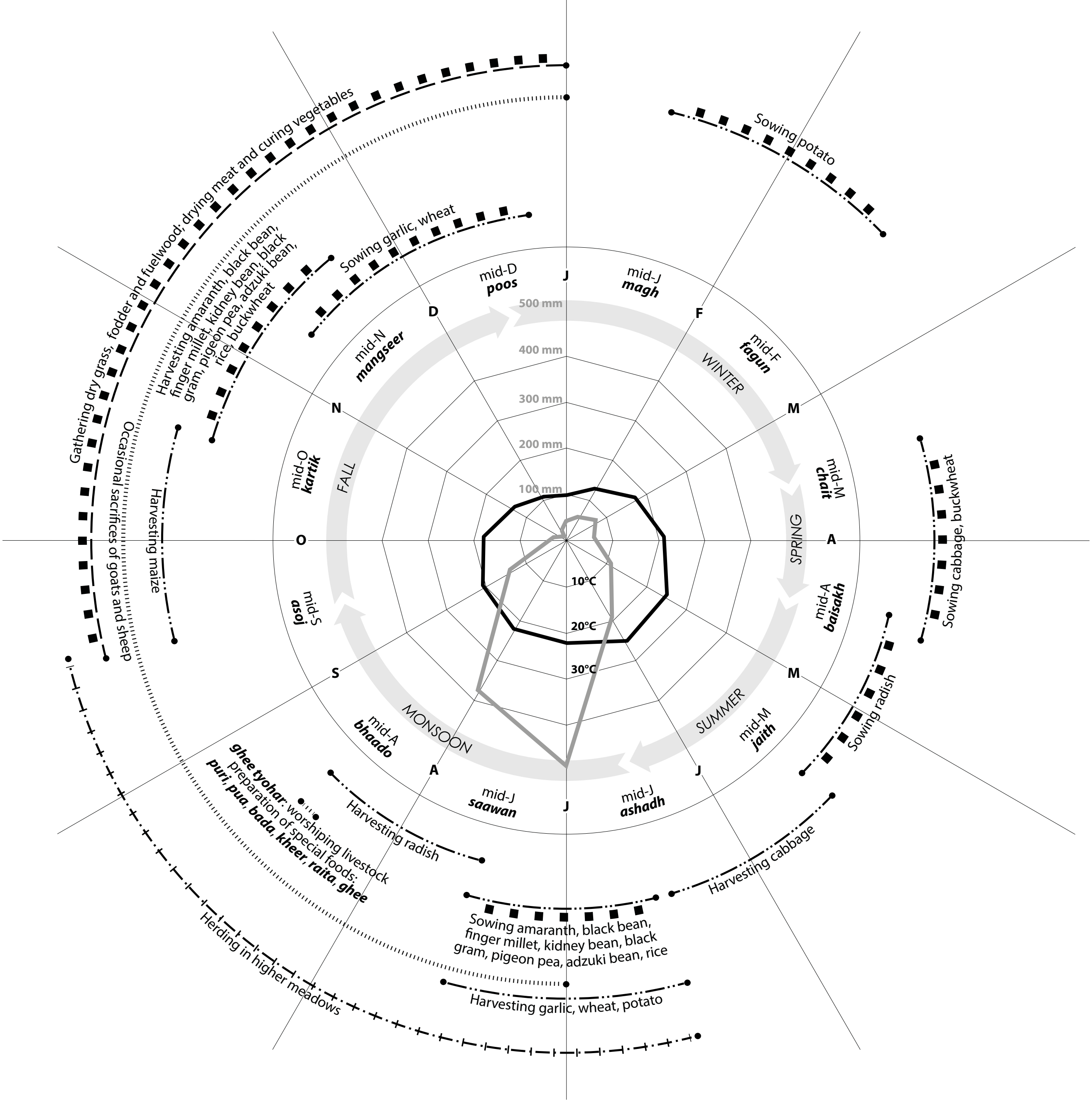
The Namik village hosts many celebrations throughout the year, the Hindu tradition involving a large number of festivals. ***Ghee Tyohar*** is an important celebration. It occurs on the first day of the month of ***bhaado***, in the middle of the monsoon, when the crops and meadow are lush green and the grains start to grow. Livestock is particularly worshiped during this time. Community members prepare clarified butter for food and they put it on their forehead. During festivals, they make special traditional foods in the houses, such as ***puri*** (deep-fried bread), ***halwa*** and ***pua*** (preparations from semolina flour and sugar either in mixture or fired), ***bada*** (fried ball of black gram and spices), ***kheer*** (rice pudding), and ***raita*** (mixture of cucumber and curd). The community gathers in the same place to worship gods and goddesses by performing various rituals and prayers. Thereafter, the whole community celebrates by eating together. Another important part of the celebrations is to send food items such as ***prashad*** (holy food) to relatives and friends in adjoining villages.

The community also worships local gods such as ***Balchhan bubu, Latu bubu*** and ***Raichan devta***, for which community members have built temples within the village. From time to time, they gather at these temples and worship in them. One of their religious practices includes ***bali*** (animal sacrifice) of goat or sheep to offer them to local gods. The meat of the animal they sacrifice is distributed to the whole community as holy food.

6. MARKET SOURCING AND TRADE

The nearest big market is Bageshwar, which is open six days a week and sells meat, diverse and nutritious foods, and other items. Community members usually frequent the market, which is far and contains expensive items, only for large quantities of purchases related to weddings and religious ceremonies, or for special imported food items. Local markets in Shama, Liti and Gogina are open throughout the week and sell basic food supplies, clothing, produce and medicines. The men are responsible for visiting the markets, which are far away from the village and for which

FIGURE 6.2. Average annual rainfall (mm) and temperature (°C) in Pithoragarh, Uttarakhand, and seasonal activities by the Bhotia and the Anwal of Namik village (elaborated by Yanto Wahyantono, IRD, 2020)



Key:

Activities related to cultivation
Activities related to livestock
Other activities related to livelihood
Celebrations
Activities mainly undertaken by men
Activities mainly undertaken by women

yw/ird-2020

there is road connectivity. A government store is located in the village that distributes food rations and kerosene at a quantity dependent on the economic classes above the poverty line (APL), below the poverty line (BPL) or Antodaya (extremely poor). The government store is opened daily and one of the village members manages it.

TABLE 6.3. List of edibles sourced from the market

Group	Food items
Starches	Rice, wheat flour
Pulses	Chickpea, pigeon pea, split pea and red lentils
Vegetables	Cabbage, onion
Orange/red-fleshed fruits	Mangoes, pomegranate
Other fruits	Banana, grapes, watermelons
Meat and animal products	Chicken, fish and eggs
Others food items	Salt, spices, sugar, cooking oil, jaggery rice, packed snacks, noodles, biscuits
Drinks	Soft drinks and alcohol

The barter system is still practised in the village. Community members exchange many items such as vegetables, meat, pulses, potatoes, kidney beans and milk products within the village, and also with neighbouring village communities. Earlier, communities used to exchange kidney beans with wheat from other villages. As farmers in Namik now grow less buckwheat and amaranth than in the past, the current demand for wheat flour has increased.

7. COMMUNITY HISTORY AND FOOD SYSTEM TRANSITIONS

The history of Namik village dates back 160 years, to when there were only a few small human settlements in the lower areas of Namik. These settlements belonged to general and scheduled castes. Most of these people were Anwal and were farmers. Anwal people used to migrate from the Corbett landscape and Tanakpur forest zone in the foothills of Himalaya to the meadows throughout the year. Namik was the place for their breaks during migration, and livestock exchanged hearty grasses for soil-enriching manure. Eventually, some of these shepherds built their temporary settlements in the Namik village. They found the soil quality, availability of water and weather conditions adequate for cultivation, particularly for potatoes and kidney beans that require cold temperatures and nutrient-rich soil. These adequate conditions for cultivation attracted more community members from the lower villages who moved and settled here. Staple foods such as potatoes, kidney beans, millets and maize thrived.

Later the Bhotia tribe, native from the Johar valley, on the eastern side of Namik village, settled in the village. This tribe was earlier involved in trans-boundary trade with Tibet, through an old trading system known as the Indo-Tibet trading system. The high passes of Himalaya were their traditional trading routes. The Bamba Dhura pass via Milam glacier was one of those routes, located in Johar valley. The Bhotia community used to live close to the Tibet border and they therefore learned to speak the Tibetan language. Thus, their language and culture are influenced by Tibetan culture. This skill gave them an advantage of keeping a stronghold in the Indo-Tibet trading system. Villagers of other castes such as the general and scheduled caste did not have this skill, thus they went on these trading routes as the Bhotia's helpers.

Their mode of trading was the barter system. People from Namik and other villages used to carry clothes, ***gud*** (jaggery), ***misri*** (Indian rock

View on Namik village.

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Ghanshyam Kalki.

sugar) and wheat to exchange for silk, salt and yak butter from Tibetan traders. As the trade halted due to various social and political reasons, they started farming and escalating their handicraft. Other products involved in the trade included salty tea from ***thuner*** (*Taxus baccata*) bark, clarified butter, ***chang*** (local beer made from barley) and local liquor. These practices continue in the Bhotia community today, and some have also been adopted by the Anwal community.

Since the community settled in the village, the production and consumption of food has changed. At the time, there was no access to the roads, nor any establishment of nearby markets. Indo-Tibet trade was the only source of supply for many goods, especially salt, which could be bartered with community members. The Namik village slowly learned to sustain their food system throughout the year. They introduced a variety of crops that could grow in their respective altitude and climatic conditions. The first major shock to their system happened when Indo Tibet trade routes were closed after the Indo-China war during 1962. After that event, the villagers' dependency on big markets like Bageshwar increased. When the Bageshwar-Shama road was built during 1970, it became easier to access the Bageshwar market. This had important implications for the community's food system. People started going to the Bageshwar market to shop, and they added new products such as biscuits, sweets, candies and noodles to their diets. Over time, the dependency on the markets for meat, eggs and other food items increased as a consequence of nature conservation legislation that prevented community members from sourcing food from the wild. As a result, a variety of traditional food disappeared from the community. Today, some natural edible plants are foraged just as a traditional practice.

The construction of a bridge over Ramganga River in 2000 increased the feasibility of trading. Before the construction, traders used to travel to Namik on their mules. Now, the farmers had a direct route to the market. Further, in 2011, the Liti-Gogina road was constructed, followed by the establishment of many small markets. Some villagers also opened shops in Namik village, making the products from the markets easily accessible. Alternatively, community members started to sell food products such as potatoes and kidney beans to local traders at the markets, and to barter those for rice.

Because of the increased connectivity with other towns, people started seeking work further away, and their purchasing capacity increased. This encouraged them to buy processed food from markets, rather than exert themselves through strenuous farming or gathering food from the forests. In addition, the Anwal's trading of sheep and goats was negatively affected by the youth's migration from the village in search of better jobs, as they were left with an insufficient workforce in the village. The lack of workers has curtailed many family-farming practices in the communities.

SECTION 2 SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM

1. PROVISION OF LIVELIHOODS, EQUITY AND SOCIAL WELL-BEING

Adequacy of income opportunities

The majority of households are farming or rearing sheep. The schedule caste families practise blacksmith and traditional carpentry. A minority are involved with trade and business, such as in the few shops located in the village. In the family, the most senior working male leads the household. He is responsible for generating income for the family, purchasing goods from the market, official work, and other income-generating activities in distant villages or towns. He is also responsible for cattle grazing and financial decisions.

The villagers of Namik use the major part of their food produce for their own consumption. Today, only 20 to 30 percent of their total income comes from activities related to the food system. Sheep rearing provides the majority of their main cash income. Sheep and goats are sold to nearby communities, and sheep herds in particular are sold in large scale to outside traders. Compared with agriculture, this constitutes a more profitable business, as the sales price of one sheep is approximately INR 3 000 to INR 20 000[32] depending on its size and age. Monetary income has increasingly become essential for the communities to afford children's education, clothing and other necessary items.

Certain crops like kidney beans, potatoes, garlic and maize as well as some milk products, such as clarified butter, are bartered or sold in the local markets and nearby villages to obtain some cash income. But the amount of these crops and other food products is very little, covering around 10 percent of a household's average cash income. Whilst the community first began selling only excess production of kidney beans and potatoes, they now grow these crops especially for the market, as well as to barter them for rice, which cannot grow at the altitude of the village. Preferably, community members save their high-quality products for the market and as seeds, whilst the rest is destined for self-consumption.

Villagers sell processed products like ***ghee***, honey, finger millet flour and ***chaang*** within the community as well as to nearby communities. ***Ghee*** is obtained from boiled cream and then packed in plastic or tin containers. Finger millets are dried, cleaned, and grinded in the traditional watermills and then sold. ***Chaang*** is a homemade beer made from rice and barley, usually prepared by Bhotia women with traditional inoculum. Finally, community members also sell woven jackets, carpets and sweaters in nearby villages or towns, as well as to tourists who visit the village.

However, one of the major problems in trading products is transportation. Community members use mules or sometimes carry their products on their own back. Prices for the products rapidly rise to compensate for the time it takes to transport them to markets that are far away, and they end up not being competitive compared to other important suppliers. By the time vegetables arrive at the market, they have started to become stale or less fresh, and community members cannot obtain an adequate price. Therefore, the community cultivates crops that could be stored

[32] Equivalent to USD 42.5 to USD 283. Applying the UN Operational Rate of Exchange of 1 September 2018 (1 USD = 70.74 INR). This rate will apply throughout the entire chapter.

and bartered at any time. The rentability of bamboo and woollen handicraft is low, although they have a high added value on the market. Community members do not benefit from proper market linkage to big markets, and retribution from local customers is not high enough; hence, few quantities are produced.

The cash income earned by the community is used for household needs like buying food products, such as sugar, tea-leaves, cooking oil, jaggery, salt, spices, fruits, chicken, eggs, rice, soap, detergent and vegetables, as well as medicines and medical treatment. They can also support their children's education and buy clothing and other necessary items. Additional expenses also now include mobile phones, mobile recharging costs and television recharging costs. However, income generation from the food system is not enough to meet the community's food demand. Community members are, therefore, dependent on government ration supplies to meet their needs.

Adequacy of diets

Namik villagers consider a healthy diet as one consisting of meat, eggs, green vegetables, kidney beans, ***ghee*** and milk. Rice is the main staple food in the community, consumed regularly for lunch. It was primarily received through the barter of kidney beans, but is now bought at the market or available in government ration shops. Together with wheat flour and pulses, these food items are eaten regularly throughout the year. Community members prefer to eat rice and pulses for lunch and reserve wheat bread or finger millets bread with curries and fresh vegetables for dinner. Kidney beans, potato and maize are the traditional crops of the Namik village. Milk and milk products are also regularly consumed, in contrast to meat, fruits and nuts. Costly and usually externally sourced, they are typically reserved for special occasions, such as during the festival season in late monsoon and fall. Monsoon is the period when diets are complemented with wild edibles such as fiddlehead and mushrooms. Further, the consumption of vegetables varies due to their seasonal availability. As such, the consumption of green vegetables is higher during fall and winter. Millets, corn flour and kidney beans are eaten in larger quantities during the winter, whilst cabbage and peas are consumed during summer. Buttermilk and ***ghee*** are common supplements to every meal. The main food of the Anwal during migration to meadows is ***sattu***, which is made from roasted barley, wheat and ***ragi*** (finger millets).

Adults in the community are not particularly interested in eating packaged and processed food, as these new items are costly and irregularly available in the markets. On the contrary, children find new processed food items such as chips, biscuits and noodles quite attractive. Community members process their own beverages such as salty tea, ***chhang*** and another local liquor.

The community never faced food insecurity, and community members rely on the market, barter exchange and monthly government-subsidized rations to complement any shortage of food that may occur during the year. Seventy to 80 percent of the wheat that community members consume is sourced from government ration shops or from markets. Each household buys from the market approximately 300 kg of wheat flour, 100 to 300 kg of rice, 30 to 70 kg of pulses, salt and spices, which can be stored for the winter months.

In addition, community members have developed a system to preserve food for several months. Corn is ground into flour and stored in ***bhakaar***, big containers made from local wood. Radish, taro roots, gourds and fenugreek leaves are dried under the sun. Similarly, the Bhotia dry and store around 5 to 20 kg of sheep and goat meat to meet their protein requirements during the winter months. Community members also clarify butter and women pickle garlic and chillies. Potatoes are kept in the ground and only picked when they are ready to be consumed. Honey or clarified butter is exchanged between families in case of food shortage.

However, community members face threats to food security and barriers for diet quality. Those are primarily limited to land holding, as well as harsh and changing climate. Only a few crops have adapted to these conditions. Limited income generation is an important barrier to food security. Big markets, such as the one in Bageshwar, are in general above their income capacity. Only 2 percent of households that have family members working in cities and towns succeed in obtaining an adequate income. Due to their low income, community members only buy food items for their basic needs, and at a cheap price, which prevents them from having an adequate intake of nutritious foods such as meat and fruits. Hence, community members can present signs of malnourishment, in particular the children and women.

Changes in the provision of livelihoods and social well-being over time

Income generation began due to the increased road connectivity to the village, allowing community members to reach markets to sell agriculture produce and handicrafts, and to migrate to nearby villages and towns for labour work in government and private sectors. Trekking companies developed and some community members became local guides or porters. The community is also accessing employment opportunities within the village, such as support for small businesses. In addition to running the shop with a licence to distribute government rations, one villager has purchased a vehicle and he now runs a taxi service.

Community members who obtain jobs in the cities or towns are now sending money back to their families, allowing them to purchase food from the market, buy better clothes, and afford to pay their children's school fees. Consequently, community members rely less on the barter system. The social bonds within the community have therefore changed, and community members now more frequently expect maximum returns from their production system, when families previously often offered each other gifts without an expectation of reciprocity.

Being dependent on the local ecosystem for their food, the community originally did not have income opportunities. Wild animals like Himalayan blue sheep (*Pseudois nayaur* Hodgson, Bovidae), Himalayan thar (*Hemitragus jemlahicus* C.H.Smith, Bovidae), Himalayan goral (*Naemorhedus goral* Hardwicke, Bovidae), wild boar (*Sus scrofa* L., Suidae), Himalayan monal (*Lophophorus impejanus* Latham, Phasianidae), satyr tragopan (*Tragopan satyra* L., Phasianidae), and kalij pheasant (*Lophura leucomelanos* Latham, Phasianidae) were hunted by the locals for their own consumption of meat. Big animals were caught with guns and spears, whilst nets or traps made from plastic and iron were used to trap pheasants. Community members used to stop hunting during monsoon, as they were aware that it is the time of reproduction. During monsoon, they therefore only hunted male animals. Villagers also used to migrate to hunt in different areas during different periods. This practice was sustainable as villagers caught only the necessary amount for their food supply, whilst still allowing enough time for the prey species to reproduce. The practice of hunting progressively phased out along with the implementation of conservation legislation, favouring the shift towards the domestication of animals in the food system. Similarly, community members used to gather wild plants for food and medicine. However, the increased availability of allopathic medicine and farm food has led to a significant decrease in this activity.

The level of consumption of various supplements, such as health tonics, has recently grown in the community, as a consequence of health campaigns led by the Government and private sector. Community members are becoming more aware of nutrition principles. For instance, campaigns and TV shows have educated the community about the importance of iodine. Most households now only use iodized salt in their diet, when they were previously consuming non-iodized salt.

Despite these new supplements and increased availability of products sourced from the market, community members state that loss of access to numerous wild plants and animals has had a significant impact on their health. These wild edibles had important nutritious and medical traits that community members cannot benefit from anymore, which they said has led to less strength and working capacity compared to past

Community member from Namik village making a mat from ***ringal*** (bamboo).

generations. Community members also state that the wild species that they do still cultivate are losing nutritional value due to changing climatic conditions, and diminishing seed and soil quality.

The forest and meadows of the upper area of the village are part of governmental property and declared as protected areas by the Government. Therefore, hunting and foraging is banned, and the overall socio-ecological mobility of the people in the village has decreased. With regards to the Bhotia, they used to travel to Tibet through silk routes for trade, their main livelihood. Now that Indo-Tibetan trade has stopped, they are confined to the village area and it is only the Anwal who migrate with their sheep and goats.

The land cleared by the community for farming is limited. Most families are joint families, but once they separate, the land is equally divided not only in measurement but also in terms of its use and quality, which means that both families will obtain an equal proportion of land that includes half rain-fed and half irrigated, if any. Similar distribution also occurs for livestock based on numbers, milking or non-milking. The land in Namik is not yet sold or rented to outsiders due to its remoteness. But due to its aesthetic value, tourism is on the rise, which may pique the interest of the tourism industry.

The community's agricultural production capacity has changed over time and with it their capacity to provide an adequate quantity and diversity of nutritious food. Due to their exploitation of forest resources, mainly for fodder and manure, the availability of green fodder for livestock has declined. This in turn affects the quantity and diversity of nutritious foods. The availability of wild grasses for livestock has also changed. Now people have to walk further distances to collect fodder for the livestock.

2. RESOURCE USE EFFICIENCY

Land and soil

Due to the village's remoteness, green revolution technologies never reached that far and, as a result, the community still practises organic farming techniques. Soil quality is evaluated by the colour of the soil. According to community members, the darker the colour, the more the nutrients. Fine-textured soil has been reported to be better in its capacity to hold water and nutrients. Community members favour the presence of earthworms in the soil. They state that stony soil hosts eggs and larvae of pests, which can be harmful for the soil. Soil in the village is dark brown, and it is covered with a layer of humus. Although soil erosion and landslides occur in some areas of the village, neither has impacted agricultural land so far.

Traditional practices, such as adding sufficient manure, crop rotation and the cultivation of pulses, which add nitrogen to the soil, are all contributing to the maintenance of good soil quality. Due to these beneficial practices, local farmers do not need to use inorganic fertilizers in their fields. Manure from animals' dung is the main soil additive used by the community. It is made by mixing livestock dung with dried leaves, grass and straw from cowsheds. Thereafter, they leave the manure in the form of a heap for one season. After decomposition, it can be used in the field at the time of ploughing, and later at the time of hoeing. These heaps are generally kept near the animal shed so that the women, who tend to it, do not have to walk long distances.

Potatoes are grown separately from fields dedicated to legumes cultivation like pulses, black soybeans and kidney beans. Community members keep the land fallow before starting a new cycle. Potatoes are harvested during the new moon. During the full moon, gravitational forces pull water out from the ground, and potatoes are more likely to rot afterwards.

The community prepares their own insecticides and pesticides. Ash from leaves is spread, and buttermilk and cow urine are sprayed on the crops. A common practice after harvesting is to burn the crop residue, hence destroying the pathogens of pests, whilst enriching the soil with phosphorous. Kitchen ash also contains phosphorous, from burning firewood for cooking. When mixed with the manure, it is commonly applied to vegetable crops, particularly potatoes.

To prevent soil erosion, farmers build a ***medh***, a wall of soil and stones around their fields. Over time, layers of grass and moss grow on the wall and solidify it. The wall stops soil erosion, and prevents soil nutrients from washing out during rains and strong winds. This practice further maintains the soil's fertility. From time to time, villagers use a spade to distort the soil, decompact it, and ensure nutrient circulation.

Labour and fuel energy

The major livelihood activities, such as cooking, depend on renewable energy, such as firewood and cow dung. Firewood is the main source of energy in the village. Community members collect wood from both the community and the reserved forests, and use it to cook and heat their houses during winters. Each family uses approximately 20 kg of wood per day for cooking. It reaches 30 kg during winters, counting additional consumption for heating. The building of two-story houses is a traditional practice shared throughout the entire Himalaya to minimise the use of energy in heating, and which can be found in Namik village. Livestock is kept in the lower story and the heat that it generates warms up the upper floor.

An additional source of renewable energy comes from a micro-hydel power plant established by the Uttarakhand Renewable Energy Development Agency (UREDA) in the village. It provides five to six hours of electricity supply to the village every day. The Village Urja Committee manages the micro-hydel, which is located on the strongest river in the village, called ***Roli gaad*** (gorge). The community uses this energy mainly to light the house, for electrical appliances like television, to iron clothes and to charge their mobile phones. The community shares the electricity with adjoining villages during the rainy season when there is an excess of production. However, the supply is not abundant enough to use heaters to warm the houses. Other sources of renewable energy include a watermill for grinding and solar lamps for lighting.

Only a small portion of the community's energy needs depends on kerosene, which is mainly used to light the fire. The government provides kerosene at subsidized rates, along with Liquefied Petroleum Gas (LPG). However, due to the poor transportation system and harsh weather conditions, the supply is frequently interrupted. Since most of the families cannot afford LPG, they rely on the forest to meet their fuel needs. The community uses diesel- and petrol-operated vehicles for transportation, which are available 6 kilometres away from the village.

Community members conduct all labour activities themselves. In fact, women undertake most of the activities related to the food system, spending 10 to 12 hours per day collecting firewood and fodder, caring after and milking livestock, and collecting water. Youth, particularly girls, also help women with these activities. In addition, they are responsible for the domestic labour. They are often the ones cooking, doing dishes and washing clothes, except during the fall, when they are busy with harvesting and collection activities. During this period, other members of the households take over the responsibility of the domestic work and the family members who have migrated come back to the village to assist.

Community members usually use traditional tools for ploughing, weeding, hoeing and harvesting. The tools are sourced from the landscape and built by blacksmiths. Community members buy these tools from them. Ploughs are made of wood, and men have the responsibility to use them in the field. Cattle pull the tools to reduce the amount of human energy expended. Families that do not have cattle rent them from other families in the village. Other activities under the responsibilities of women include sowing seeds, weeding, hoeing, and applying manure to the field. The women also manually harvest crops such as wheat, barley and finger millet. Both men and women undertake thrashing thanks to thrashers made of wood. The grinding of grains (mainly finger millets, maize, barley and wheat) occurs either in traditional watermills, where it is exchanged for flour with the owner, or manually with a ***musal***. A ***musal*** is a wooden pole with an iron ring fitted at its end, which crushes the grains placed in a stone pot. Community members relate that lack of technology is an issue given the level of drudgery associated with the activities required to sustain their food system.

Water

Five water springs exist in the village, which provide members with their main source of drinking water. These springs are 400 metres to 500 metres from the hamlets; however, pipelines channel the water, so that most village members have a water supply near their home. These natural springs recharge during monsoon and winter seasons, as well as during summer as glaciers start melting. The availability of water remains sufficient in these springs throughout the year. All families have access to these springs. The agriculture in the village is mostly rain-fed, but community members can also use irrigation in their home gardens. Crop varieties that are grown in the winter season require less water, whilst varieties that are grown in the rainy season are tolerant to heavy rain. Snowfall during the winter is important to maintain soil moisture, and for the sustainability of crops grown during spring and summer. After the snowfall, monsoon rains recharge the aquifers and the soil moisture. The community maintains the adjoining forest, which is dominated by oak and alder trees that store enough water in their roots and keep the soil moist. Amongst the livestock, buffaloes require the most water. The community mainly uses water for cooking food, processing food like washing of vegetables, rice, churning cream to prepare clarified butter, drinking water for households and livestock, washing dishes, washing clothing, and for bathroom uses.

Normally the villagers in Namik have enough water supplies throughout the year. With the various schemes introduced by the Government and private organizations, many households now also have constructed water storage tanks. These are useful as they contribute to the reduction of physical labour. The community has a practice to reuse water. Water outlets from kitchens lead to the nearest field to reuse the water and maintain soil moisture.

Waste

Most of the waste material generated in the village is biodegradable, such as vegetable peels, food leftovers, agricultural waste, waste from livestock like dung and urine, or leftover fodder.

Varieties of beans found in Namik village.

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The community recycles the waste by making manure, and livestock dung is used as fuel. At times, farmers get rid of waste by burning the residue.

Community members also generate non-biodegradable waste like plastic wrappers, polythene bags and medicines, normally originating from market products. Most of the time, families throw the waste outside of their houses, for lack of appropriate waste deposits. This practice is polluting the surrounding ecosystems. However, the community has certain practices to reverse this trend. They reuse plastic bags and large plastic sheets to cover the roofs of their houses and livestock sheds, during monsoon and snowfall periods. They also reuse plastic bottles to collect water, and to keep liquid items like oil, honey, milk and buttermilk.

Changes in resource use efficiency over time

The resource use has changed at the landscape level as community members would previously spend five months of the year, from April to August, for cultivation and raising livestock, and the other seven months, from September to March, for migration to the lower valleys. This practice halted 10 years ago, and most community members now spend the whole year in the village to conduct farm activities. A rotational system of crops has remained the same throughout time, although the recent introduction of new vegetable crops is creating change.

The demand for human and animal labour, and the use of tools for agricultural practices, remain the same. However, the migration of men out of the village to work has led to increased pressure on women regarding activities in the village. Despite the introduction of new sources of energies, firewood has remained primordial; the same goes for the micro-hydel, which remains as the primary source of electricity despite the introduction of solar lamps.

Over time, many governmental and private schemes have reached the villages, such as poly-house construction, water tank construction, walking path construction and road construction. The introduction of pipelines by the Government has saved significant time and reduced women's workload, as they used to fetch water directly from the springs. Previously, they would spend around one hour per day getting water. Now that supply is located approximately 50 metres from each household. This encouraged the use of irrigation for their home garden and helped maintain livestock, whose water demand began increasing once they started to permanently stay in the Namik area.

The introduction of plastic waste in the landscape is a matter of concern, as it will affect the community's water sources, agriculture and long-term health. Changes in their medicinal system are also a new driver of waste generation, as they now rely on allopathic medicine coming from nearby towns. Plastic containers are slowly replacing traditional containers. Community members are slowly becoming more informed through workshops, television and other informative programmes. Still, a disposal mechanism has yet to be developed.

Previously the community built all houses from natural materials, thereby not generating waste. However, enhanced road connectivity made the transportation of cement feasible. New homes built can potentially pollute the landscape. The move towards cement is caused by the lack of organic materials, expensive labour and an aspirational value of modernity.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

Crop and livestock biodiversity

After years of experimentation, the community has established its cropping system and selected a few crops and varieties that are essential for their daily needs. Since the beginning of their settlement, they have been using their own seeds.

The community grows a diversity of species per food groups. These include starches (6), pulses (6), nuts (1) such as walnut, dark leafy vegetables (2), vegetables (6), and fruits (4), all of which are part of their local cuisines. As indicated, kidney beans are the main crop of the village and the community cultivates three different varieties. Almost all households grow varieties of kidney beans and soybeans. The community cultivates traditional crops like kidney bean, potatoes, amaranth and buckwheat in large scale because the area's soil and climate are highly suitable for the cultivation of these crops. They also can be easily stored for a long period, and they have good barter rates. Spotted kidney bean is tastier than other varieties, and therefore popular in the market. The ratio between the cultivation of traditional and introduced crops is 60:40. Traditional crops are an important part of the food system, yet introduced crops grown by the community help to maintain the food variety for the entire year.

Livestock are the backbone of the agriculture and an integral part of the livelihoods of the communities in Namik village. The community mainly rears five species of livestock: sheep, goats, cows, buffaloes and mules. All of these, with the exception of buffalo, are traditional breeds. Two breeds of cows, ***badri*** cow and Jersey cow, are reared, along with one breed of buffalo, one breed of sheep, one breed of mule, and two breeds of goats, Indian goat and Changthangi goat. The reason for rearing traditional breeds is that they are hardier to the local conditions.

Out of these livestock, the community keeps cows, buffalos, goats and mules on their farms. Herds of sheep and goats mostly stay in the meadows and nearby forests with their caretakers. During monsoon, families also take other livestock for grazing due to high availability of green fodder. Every household has two to three cows and one to two buffaloes. Around 80 percent of households rear goats and sheep in good numbers.

Wild harvested plants and animals

Community members have solid traditional practices to ensure the regeneration of the harvested wild plants. They select and mark a large area of nearby forest after a common discussion and protect it for three to five years in the name of the local God ***Bhumiya Dev***, the God of jungle. During that period, no one from the same community or nearby communities is allowed to collect or harvest any kind of natural resource from that part of the forest. This practice naturally helps to regenerate and conserve all the important species within the protected area. After this time, they open the protected area and mark a new part as protected. This is a traditional and effective practice, which the Namik village and other nearby communities still follow.

In general, in their use of wild medicinal plants, community members do not overexploit the resource, as they only take the amount they require. Although the community has seen the introduction of new technologies and inventions, they still rely on natural resources, particularly for firewood, fodder, timber, water, wild products and medicinal plants. The community highly values the conservation of these resources for their sustainable livelihoods. For this reason, they have traditional practices of faith and conservation, which are more effective and followed by all as they involve local deities.

According to new governmental guidelines and state laws for forest conservation, cutting a tree from the forest is a punishable offence. Community members have their traditional rights over wild resources, but they are only allowed to collect fallen trees and their branches for firewood. This is applicable in the reserved forests, which are owned by the forest department. To cut trees, community members climb the trees to get dry fuelwood and use an iron axe. For timber, the dry tree is chopped with the help of an axe, and then logs and sleepers are prepared with the help of a manual saw.

Ecosystem conservation and protection

In addition to the rotational management practice, shepherds, who live in the meadows, keep migrating to different parts of the grazing grounds to prevent over-grazing. Cattle grazing is permitted by the Government in these areas. Every community has their declared grazing areas. Other communities also respect this traditional system. Whenever they go to an area that belongs to another community, they ask permission from that community for grazing. They also offer a limited amount of either money or goods such as vegetables or other crops as a trade-off.

Another traditional practice concerns protecting water sources from pollution. Related to this, senior members of the community tell a story of ***Masan***, a ghost who lives near water bodies. According to the tale, if someone throws garbage or pees anywhere near the water body, this ghost catches him or her and makes them ill. This tale is transferred from generation to generation. It is an effective way of protecting the water, as people strongly believe in such tales. Similarly, villagers never take their livestock to these water resources to drink water. Instead, they dig a big trench near the water bodies where cattle can drink water. Another reason behind these practices is that the community regards the water as sacred, and villagers worship the traditional water springs. They have therefore put statues of gods or goddesses near the water sources, so that the community does not waste water or pollute the springs. Using soap and washing clothes in the springs is strictly prohibited. Women and girls are not allowed to touch or even go near the water spring during their menstrual cycle.

Beekeeping in the village also contributes to ecosystem conservation and protection. Community members use traditional practices to rear bees. They rear them in locally available wooden logs in which the bees survive. The bees pollinate the community's cross-pollinating crops, and thereby help maintain the crops' productivity. The community's maintenance of agrobiodiversity helps the bees survive, which in turn provides better pollination services. The beekeepers also give sugar supplements such as sugar or sugar candies to the bees during winter when there is a deficiency of floral species in the area.

Changes in the conservation and protection of resources over time

For the last five to six years, cultivation of some traditional crops like finger millet, amaranth

Community member from Namik village standing in front of traditional beehives.

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and buckwheat has decreased as community members have started to buy processed wheat flour from the market for their consumption. Further, these crops are not considered good cash crops, thus decreasing interest in the community to cultivate them. However, for a long time, generations have passed traditional seeds to the following generations. Some of these seeds are considered special for the Namik village. Despite the decrease in cultivation of these traditional crops, the Namik community still grows them on a larger scale than other nearby villages such as Ratirkethi, Gogina and Liti. Therefore, Namik village can be considered as a seed bank or a place of *in situ* conservation of these traditional crops in the higher Himalayan region. In addition to traditional crops, the community cultivates vegetable crops such as daikon radish, cabbage, tomato and garlic, introduced six to seven years ago by the Government's Agriculture and Horticulture departments. In the village, the area for farmland has remained almost the same over time. However, in some hamlets, such as Junmari and Jugadhara, some families have migrated from the village and the community has therefore converted their farmland to forestlands.

The Namik community belongs to the traditional Himalayan sheep-rearing community. Earlier, only a few big sheep-rearing farmers lived in the community. However, slowly other villagers realized that sheep farming is a profitable livelihood option, and they started keeping small herds of sheep. Five years ago, scientists from the sheep farm and breeding centre, Liti-Shama village (established by the Government's Veterinary Department), introduced the Australian merino sheep to the Anwal of Namik village for cross-breeding with local sheep. However, merino sheep could not survive the climate, even when cross-bred with local sheep.

With the adoption of the Wildlife Conservation Act of 1972, the Biodiversity Act of 2002 and Uttarakhand Biodiversity Rules of 2015, the Government introduced strict wildlife and natural resource regulations. The intention was to ensure conservation and sustainable use of biological resources. They put most of the wild harvested species on the list of protected species. The exceptions were plants such as Indian pokeweed, perilla, Himalayan nettle, ***kutki***, Himalayan horse chestnut, golden Himalayan raspberry, Asian barberry, fiddlehead ferns, and some mushroom species like ***yarsagumba*** (*Ophiocordyceps sinensis*) and ***gucchi*** or common morel (*Morchella esculenta*). Hunting animals became restricted, leading to an increase in the wildlife population. The Namik community reported increased populations of Himalayan thar (*Hemitragus jemlahicus*), Himalayan blue sheep (*Pseudois nayaur*), kalij pheasant (*Lophura leucomelanos*), Himalayan monal (*Lophophorus impejanus*), wild boar (*Sus scrofa*) and Himalayan black bear (*Ursus thibetanus* G. [Baron] Cuvier, Ursidae). As the population of wild animals like wild boars, rabbits and porcupines increased, they have started destroying the croplands and the incidents of human-animal conflicts have risen in the area. Since the introduction of these acts, the community has become dependent on markets, in addition to their own cultivation, to meet all their daily needs.

Although the dependence on natural resources is high related to energy use, the slight increase in use of resources such as electricity, LPG and kerosene has somewhat released the pressure on natural resources. The forest cover around the village area is therefore becoming denser. Waste deposits are also affecting the ecosystem protection, as the village is located just above the Ramganaga River. During monsoon, there is high risk that the waste will flow down to the river, polluting the water. The volume of waste is still not excessive, yet it is a concern for the ecosystem that needs to be addressed, especially regarding the downstream river ecosystem.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of natural resources

Three types of governing bodies exist in India: central government, state government and local government. The local-level government, called ***gram panchayat***, executes Government schemes for food, construction and social development at the village level. The leader of this governing body is called ***gram pradhan***. ***Gram pradhan***, or community leader, is elected through a community voting system for five years. He/she makes all the legal decisions for the benefit of the community, after which community members are consulted during open meetings.

As far as the farmlands and other land in the village are concerned, the community has their own rights to these lands. The entire area of the village belongs to the community. In addition to the ***gram panchayat***, the village has another institution, the ***van panchayat***. The ***gram panchayat*** looks after resources and its management within the village, whilst the ***van panchayat*** focusses on the management of the community forest. The community elects the ***van panchayat*** for a period of five years. The ***van panchayat*** has written rules for grazing management, fuelwood, timber wood, green fodder and hay collection to which the entire village has to adhere. It also determines the rotational restoration practices in the forest followed by all community members and based on the faith and conservation approach. Punishments are foreseen in case these rules are violated. However, being dependent on the natural resources for their livelihoods, community members usually comply with the rules. This management practice is prevalent in majority parts of Uttarakhand State.

Sometimes after the monsoon, only dried firewood collection, and limited collection of green fodder from trees and hay, is allowed. The ***gram panchayat*** allots rights for forest use to each family. In addition, every year they allot one tree for production of timber to one family in the village. Although community members can collect firewood in large quantities, the collection of medicinal plants is only allowed in small quantities. The management committee of the ***van panchayat*** organises open meetings to discuss management issues with the community. When the community engages in plantation activities, one member from each household volunteers to contribute to the work.

Changes in governance of natural resources over time

Originally, the community mainly structured the governance of natural resources by social laws and norms involving all members of the community. Formal institutions such as ***van panchayats*** and the Forest Department progressively replaced these informal governance systems, bringing with them normative rules and regulations. This resulted in the implementation of the Forest Rights Act in 2006, which stated that village communities were to be involved in the conservation of their natural resources. The act allocates individual rights to cultivate land in forestland, and community rights over common property resources to tribal communities and forest dwellers. A further notification on the implementation of the Forest Rights Act 2006, issued on 1 January 2008, has been considered a final effort to undo the "historic injustice" done to tribal communities and other forest dwellers. The management of these community forest areas now lies with the community, thus providing villages with the right to extract a limited quantity of fallen or dried firewood, fodder, timber and some wild plants from the community forest. The rights of each family are determined based on the size of their farm and family.

However, as the Government now takes care of most ecosystem protection, the community's rights to land and other resources have decreased over time. Therefore, the community-based conservation of natural resources now primarily concerns community forestland. Indeed, since the 1972 Indian Wildlife Protection Act came into force, the Government has declared all forests, grazing grounds and water bodies such as lakes and rivers as national heritage. Thus, all wild species of plants and animals are now declared as protected. In the case of community grazing grounds, communities still have kept their traditional rights of grazing. The communities in the area have their own respective traditional grazing grounds. If someone from other communities uses their grounds, they must seek permission from the owner community and pay a fee.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

A summarized assessment of 13 indicators of resilience is presented below.

1. Exposed to disturbance: The community has observed impacts of the changes in climatic conditions, such as decline in snowfall and hotter average temperatures, both causing negative consequences for production such as an increase of pests and soil degradation. Community members also noticed a decreased abundance of wild plants such as berries in forest areas. Further, rainfall has become unpredictable, causing soil erosion and landslides, and damaging crops, insects and habitats for birds. Community members have further noticed early flowering of wild plants, like rhododendrons, as well as new species of birds in the region that are affecting the crops and killing the bees.

2. Globally autonomous and locally interdependent: The community grows approximately 60 percent of the food within the village, whilst obtaining 30 percent from outside sources, 5 percent from the wild and 5 percent from barter. Only 5 percent of the species are introduced. The villagers sell only a small portion of their food to earn cash, as most of the extra produce is exchanged with adjoining villages or with traders who come to the village. However, the dependency on external food sources is slowly increasing, affecting the social bonds in the village as community members are used to helping each other out in case of crop failure, deficiency of seeds or shortages of food.

3. Appropriately connected: The closest road is almost 6 km away, and the closest big market, Bageshwar, is nearly 85 km away. The construction of the road in 2016 allowed for more regularity in receiving government ration supplies. The communities bring their handicraft products to Bageshwar, whilst they mostly sell or exchange their food products within the village or in adjoining villages. Due to the village's remoteness, governmental authorities, research institutes, non-governmental organizations (NGOs) or private sector actors rarely reach out to the community with agricultural development programmes. Frequent landslides occur during monsoon season, which can isolate the village temporarily.

4. Socially self-organised: The ***gram panchayat*** and ***van panchayat*** are strong local institutions. Whilst managing the community forests and natural resources, the community also mobilizes its strong social customs, associated with the conservation of natural resources. Strong social support exists between community members and between communities on the regional level, as it relates to seed exchanges and food shortages, as well as cultivation, house construction and marriages.

5. Reflective and shared learning: Community members conduct experiments and adopt best practices for their food systems. They have their own varieties of seeds for various crops that can grow well in the local conditions. They also have local breeds of goat, sheep and cattle, which are well adapted to the local conditions.

6. Honours legacy: Elders are the decision makers for the selection of crops and seeds, sowing time, harvesting, barter negotiation and marketing. Involving young children and youth in cultivation and management of food and natural systems helps pass the learning to the next generations. However, the trend of increasing migration to urban areas amongst the youth is a concern for the continuity of transmission of traditional knowledge.

7. Builds human capital: Community members do almost all the work themselves. No institution or higher education centre exists in the village to disseminate traditional knowledge. The village only has a high school. There is neither health institutions nor institutions for other social services. However, a trained health worker provides polio drops and basic health information. Non-governmental organizations such as the Central Himalayan Institute for Nature and Applied Research (CHINAR) support the building of human capital in the village by conducting workshops to increase awareness of environmental and livelihood issues.

8. Coupled with local natural capital: There is efficient use and recycling of nutrients within the system, supported by a strong link between the forest ecosystem and agroecosystem. The biomass that goes into the farms comes from the forest. Traditional insecticides are used to prevent the attack of pests. The community has their own crop rotation to maintain the fertility of the soil, which they have been practising for generations. Community members rely on the local landscape for traditional medicine and various other uses, such as construction, handicraft and cloth weaving. There is low dependency on imported energy sources, imported electricity or imported water, as the community has a sufficient supply from local sources. The community's main challenge concerning ecosystem use and protection is the lack of waste disposals for inorganic waste.

9. Ecologically self-regulated: The forest ecosystem provides resources, whilst the agroecosystem also returns nutrients when herds of sheep, goats and cattle head to the meadows for grazing. The bees kept in log hives also provide pollination services to the forest ecosystem and maintain the forest biodiversity. Community members maintain biodiversity to control major pests, and they grow plants that are naturally insect repellent such as garlic and cannabis.

10. Functional diversity: The food system supplies various interrelated ecosystem services. Supporting services are noticeable through the recycling of nutrients between forest and agricultural land ecosystems. In addition to providing food, the forest also supplies timber and other raw material for fuel, construction, forage, medicinal resources and ornamental resources.

11. Optimally redundant: The diversity of forage and the storage capacity for most of the staple food indicates optimal redundancy for important food sources in the community. To meet their needs, the community maintains diversity in the forest as well as in the farmlands. The villagers have also developed a seed bank. They do not have many varieties of the crops for internal use, yet they have maintained various varieties of crops for barter and sale. As indicated, the villagers also have their own handicraft practices, using local natural resources.

12. Spatial and temporal heterogeneity: The landscape is composed of glaciers, water bodies, grassland, forest and agroecosystems. The higher landscape areas near the glaciers are used as pasture lands, whilst the land around the village is used for forest resources, and the agriculture land is in the centre. Thus, the landscape has diverse ecosystems. The community follows a definite rotation of crops, and practises land fallowing before growing potatoes, which take up lots of nutrients from the soil.

13. Reasonably profitable: Agriculture is the subsistence in the area and only a small portion of the traditional food products cultivated by the community are meant for the market. Still, most of the people, especially children and women, are malnourished. Some crops such as potato, kidney beans and garlic are bartered or marketed to get money. Men usually migrate to nearby villages for work or even to towns and cities to obtain small jobs to support their families.

SECTION 3 **CONCLUSIONS AND FUTURE PROJECTIONS**

1. FOOD SYSTEM SUMMARY

The Indigenous Peoples' food system of Namik not only depends on the village's farming system, but also on its forest, meadows, livestock and their handicraft. All of these are closely interlinked. The diversity in the food system helps the community survive in extreme conditions despite their remoteness to other communities. To obtain their desired outputs, the community has to provide some inputs to keep these systems sustainable.

Outputs

The main outputs are the diverse food products generated from the system such as potato, wheat, maize, kidney beans, buckwheat, black soy bean, amaranth, garlic, black gram, pigeon pea, adzuki bean, apple, plum, peach, lemon, golden Himalayan raspberry, Asian barberry, mustard and its leaves, cabbage, spinach, leafy mustard, daikon radish, taro, and fenugreek and its leaves. From livestock, they get milk, milk products such as buttermilk, clarified butter, butter, yoghurt, meat, dung, manure and wool. They obtain honey, medicinal plants, edible ferns and mushrooms from the forest. From wheat, buckwheat and corn flour, they prepare bread daily. They make pickle from garlic. Clothes are prepared from wool collected from sheep and goat hair. Traditional medicines are prepared from wild medicinal plants. Honey is also used as medicine.

Villagers either sell or barter crop produce like potato, kidney beans and garlic to get money or additional food items. Other produce like honey and clarified butter is also sold and bartered. Goats and sheep are sold for meat or wool at good prices.

Agriculture hardly produces any waste. All crop residues are used either as fodder or manure or burned to control pests. As indicated, the waste of concern is the one generated from processed and packaged food material from the market.

Inputs

The main input in the food system is human labour, which is required for agriculture, livestock rearing, handicraft confectioning, and collecting wild resources from the community forest. For cultivation, community members mainly use traditional varieties of seeds, tools made from locally sourced materials, and organic fertilization and pesticides sourced from the farm and landscape. Livestock is reared with fodder, fresh grass and dry grass from the landscape.

External inputs come in the form of seeds and seedlings of governmental crops. In addition, the Government provides food items such as rice, wheat and sugar at subsidized rates. Farmers now also purchase packaged and processed food from the market like chips, biscuits, pickles, wheat, sugar, pulses, jaggery, rice, salt, cooking oil, noodles and fruits. To supplement local energy sources, the Government provides kerosene oil at subsidized rates. They have also introduced lights run on solar energy.

2. HIGHLIGHTS OF SUSTAINABILITY ASSESSMENT

The agroecosystem presents many elements of sustainability. One of the main strengths of the food system are the traditional varieties that have been conserved by the community, and which are climate resilient and well adapted to local conditions. A significant proportion of crops grown can be stored for long duration, and the agroecosystem is diverse in its outputs for food and other by-products. The generation of food optimizes and enhances the functioning of the ecosystem, as it relies on crop rotation, organic cropping, strong linkages between the farm and forest ecosystems, and pollination. The community members benefit from a diverse and changing landscape, allowing different food production activities throughout the year. Finally, community members support each other through cooperation, especially in times of emergency and shortage of food. The transmission of knowledge allows the children to develop skills and to learn from the experience of the elders in ensuring the sustainability of the food system. By being dependent on the natural ecosystem for their livelihoods, community members have a strong self-organization in managing resources through their village institutions.

3. FUTURE PERSPECTIVES

The food system faces numerous challenges, the primary one being the migration of youth from the village, which puts the transmission of traditional knowledge at risk. Community members also face a decline in traditional practices, such as beekeeping, which is now practised by only a few farmers in the village. Similarly, land fallow is practised less often than in the past, which poses a threat to sustainability in the long term. Community members have seen the introduction of practices related to modern agriculture, including the use of inorganic fertilizers and pesticides. This has had an impact on micro-organisms in the soil, as well as on the population of bees. Goat and sheep rearing has diminished, resulting in less manure for agriculture.

Climate change is seen as an important threat. If snowfall continues to decrease, it will lead to scarcity of water in the springs.

In the future, community members hope to be able to continue collecting wild edibles such as fiddlehead ferns, mushrooms and medicinal plants, as these varieties are essential components of their diet and traditional medicine. The prospects for crops like potatoes and kidney beans are good, as these are both healthy and profitable. Further, other traditional crops are essential for certain dishes in their cuisine. Therefore, with respect to cultural obligations, these crops will likely remain in the village.

The transmission of traditional knowledge related to the food system is slowly changing over time. As the new generation becomes more exposed to the outside world, they are inspired to experiment and grow short rotation horticulture crops, which proves more profitable in monetary terms. People are slowly losing interest in livestock rearing, as it is a time-consuming activity. Although the older generation values their traditions and lifestyle in the village, students and the younger generation are fascinated by the modern world and are migrating from the village. They want to pursue higher education and work in urban areas. More men than women are migrating to urban areas. Increased contact with external societies further affects diet preferences of the new generations. They choose to include processed food, meat and eggs to a larger extent than before, potentially threatening the survival of traditional crops.

CHAPTER 7

Following the flooding cycles in the Amazon rainforest

Fishing, *chagra* and forest food system of the Tikuna, Cocama and Yagua peoples in Puerto Nariño, Colombia

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Indigenous women in the community performing ritual ceremony.

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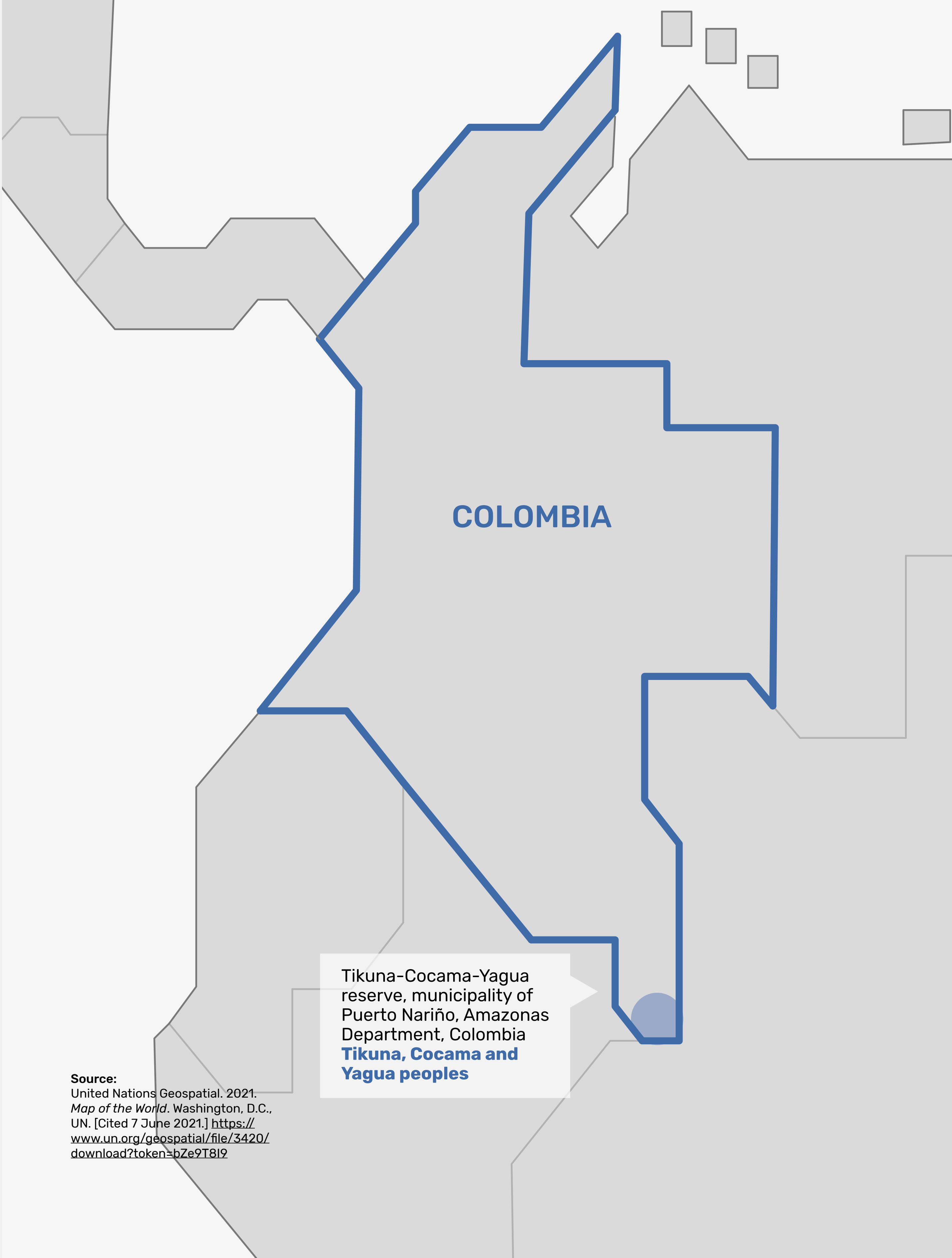


Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

"Producing our food is inherited from our parents, it is respect for nature and its future children."

Community member and participant to the thematic discussions in Puerto Nariño.

AT A GLANCE

This study characterises the food system of six communities in the Tikuna-Cocama-Yagua indigenous reserve in the municipality of Puerto Nariño, Amazonas Department, Colombia. The Tikuna, Cocama and Yagua peoples' food system is based on farming, fishing, hunting and gathering. Using ancestral knowledge, they cultivate a great diversity of species without chemical fertilizers, both in ***chagras*** – the diversified productive system – and gathered from the forest, which are amongst the foods generally consumed by families. However, half the average income comes from the sale of surpluses from agriculture and fishing, allowing families to purchase products they do not produce themselves. Additionally, some people are engaged in different activities such as tourism, crafts and construction work. Their diet is based on a variety of foods including fruits, fish, meat, vegetables, grains and, to a lesser extent, some dairy products. Nevertheless, they identified changes in the diet as a result of a rapid and unplanned integration of the Indigenous Peoples' food system into the market economy. Although the production of food in ***chagras*** has remained the primary activity for the provision of food along with fishing and hunting, these activities have undergone significant changes with respect to the techniques and products introduced, such as seeds, and nylon and hunting nets.

Note from the editors: Tikuna terms in the chapter are mentioned using the following transcription used for the Colombian riverside of the area of repartition of the Tikuna. High, medium and low tons are symbolized by ´ and `, respectively, and medium is expressed by absence of symbol. Laryngeal vowels (extra low tone) are marked as a̰. Oral and nasal vowels are marked as: a, e, i, o, u, ü, ã, ẽ, ĩ, õ, ũ, ü̃. Occlusive velar /k/ is marked as k; africada palatal /tʃ/ is marked as ch; nasal palatal /ɲ/ is marked as ñ. Glotal occlusions are not marked. Other consonants have the same transcription as in Spanish so that /p/, /b/, /f/, /t/, /d/, /ɟ/ or /ʤ/, /g/, /m/, /n/, /ɾ/, /l/ are noted, respectively, p, b, f, t, d, y, g, m, n, r, l (Goulard and Montes Rodríguez, 2016).

SECTION 1 COMMUNITY AND FOOD SYSTEM PROFILE

1. GEOGRAPHIC CONTEXT

The large biome of the Amazon basin, with 7.4 million km² shared by Brazil, Bolivia, Colombia, Ecuador, Guyana, French Guiana, Peru, Suriname and Venezuela, represents the equivalent of 4.9 percent of the world's continental area. The vast Amazon basin is home to the largest expanse of tropical rainforest on the planet, great ecosystem diversity and important water resources. The Amazon River runs nearly 7 000 km and has an extensive network of tributaries consisting of more than 1 100 rivers. Such characteristics make it guarantee approximately 20 percent of the volume of freshwater on the planet. Currently, more than 34 million human beings live in the basin, of which only 3.5 million are indigenous. This demography implies great challenges to ensure sustainable economic development and conservation of this great biome. Colombia has a surface area of 2 070 08 km² made up of 1 141 748 km² of continental area and 928 660 km² of maritime area. It is considered a mega-diverse country boasting a great wealth of species and ecosystems. The Colombian Amazonian region encompasses 483 163 km², which represents 42.3 percent of the country's continental territory (Instituto Amazónico de Investigaciones Científicas, 2018; Alonso *et al.*, 2007).

This research was conducted in Puerto Nariño, the second municipality of the Amazonas Department, in the southwestern part of the "Colombian Amazonian Trapeze", on a high ***tierra firme*** terrace. The municipality is located on the left bank of the Loretoyacu and Amazon rivers, between the coordinates 03°54' - 03°12'S and 70°17' - 70°42'W. It borders Peru to the northwest and south, and the municipality of Leticia to the east – situated 87 kilometres away. It is only accessible via the river. Puerto Nariño has an area of 1 704 km², of which only 2 km² are urban, 1 406.23 km² comprise the reserve, and 296 km² correspond to the forest reserve. The Tikuna-Cocama-Yagua (Ticoya) indigenous reserve is located in Puerto Nariño and inhabited by people belonging to these three Indigenous Peoples, from which the reserve takes its name. The population is distributed amongst 22 communities located on the banks of rivers or lakes, on flood plains and on ***tierra firme*** areas, with most of the settlements located in the area that is reserve territory. The Tikuna are one of the largest populations in the area called the "Colombian Amazonian Trapeze" to the south of the Amazon.

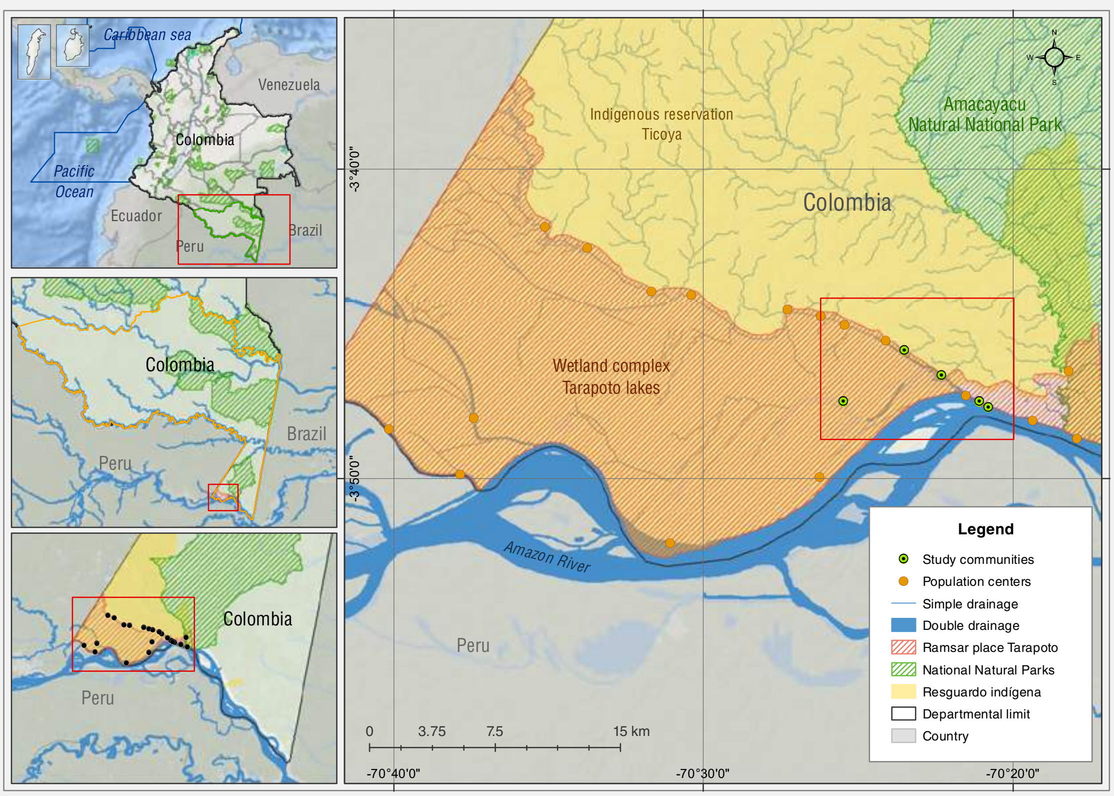
The climate is hot and humid. The average annual temperature is 26 °C. During the summer, it could reach a maximum temperature of 38 °C. During the middle of the year, it could reach a minimum of 13 °C when the southern winds arrive during the period known as ***friaje***. The average altitude is 40 metres above sea level, the relative humidity is 87 percent, and the average annual rainfall is 3 200 mm per year (Rangel and Luengas, 1997).

The amount of rainfall determines four hydrometric periods in the aquatic environments. The period of high waters, from February to April, corresponds to the time when the forest is most flooded, and the lake system is connected to the rivers. During the falling waters period, between May and July, the water flows from the plains, lakes and canals towards the river. The time of low waters between August and October is characterised by the decreasing level of water and a change of its composition due to activation of organic matter decomposition processes. This period is then followed by the time of rising waters, from November to January, during which lakes, plains and rivers begin to flood as a consequence of rainfall happening in the Upper Amazon.

The municipality is located in a tropical rainforest area, in which three types of forests have been identified. The first is the ***tierra firme*** forest,[33] which is not subjected to flooding cycles. The second is the ***várzea*** forest, which is subjected to periodic flooding by whitewater rivers. The third is the swamp or ***igapó*** forest, which is subjected to seasonal flooding by blackwater rivers (Trujillo and Duque, 2014). Puerto Nariño is located where the Lagos de Tarapoto Wetlands Complex is found. It corresponds to a river plain formed by the Amazon River and its confluence with the Loretoyacu River, in addition to a wetland system. This wetland is located in the lower area, with annual water-level variations of up to 14 metres. It comprises 21 lakes: Tarapoto Largo; Tarapoto Redondo; Cabezales 1, 2 and 3; Chimbillo; Chullo; Airuwé 1 and 2; Soledad; El Correo; San Juan del Socó; Chepetén; Mihuá; Mariano Cocha; Calzón Cocha; Cocha Larga; Garza Cocha; Charapacocha; Yolvino and El Sapo. The ecological and cultural importance of this area has been recognised at the international level with the designation of the Tarapoto Ramsar site in 2017, which covers 44 264 ha.

[33] These forests are located on plateaus (60-200 m) and on well-drained soils. Such lowland forest is characterised by a dense and uniform cover formed by trees of 30-40 m in height, which creates a humid and shady habitat that hosts a high diversity of species with a high density of individuals (Portaccio, 2013).

FIGURE 7.1. Landscape of the Lagos de Tarapoto Wetlands Complex (Tarapoto Ramsar place)



Source: Fundación Omacha, Instituto Geográfico Austín Codazzi, Instituto Colombiano de Desarrollo Rural, Parques Nacionales de Colombia, 2018, edited by Nicole Franco, Fundación Omacha, 2020.

Indigenous fishers on Lagos de Tarapoto Wetlands Complex.

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2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

Puerto Nariño has a total population of 6 983 inhabitants, of which 1 848 live in the urban area and 5 135 live in the rest of the municipality, according to the latest census of 2005 carried out by the National Administrative Department of Statistics (DANE, 2010).[34] Over the past 20 years, the population growth rate of Puerto Nariño has been 53 percent, with a birth rate of 28 per 1 000 inhabitants, exceeding the national average of 19 per 1 000 inhabitants (Trujillo and Laiseca, 2016). This growth has been accompanied by socio-cultural dynamics inherent to urban areas, therefore representing a challenge for the municipality's sustainability. The territory inhabited by the Indigenous Peoples corresponds to the area of the reserve, which is constitutionally defined as:

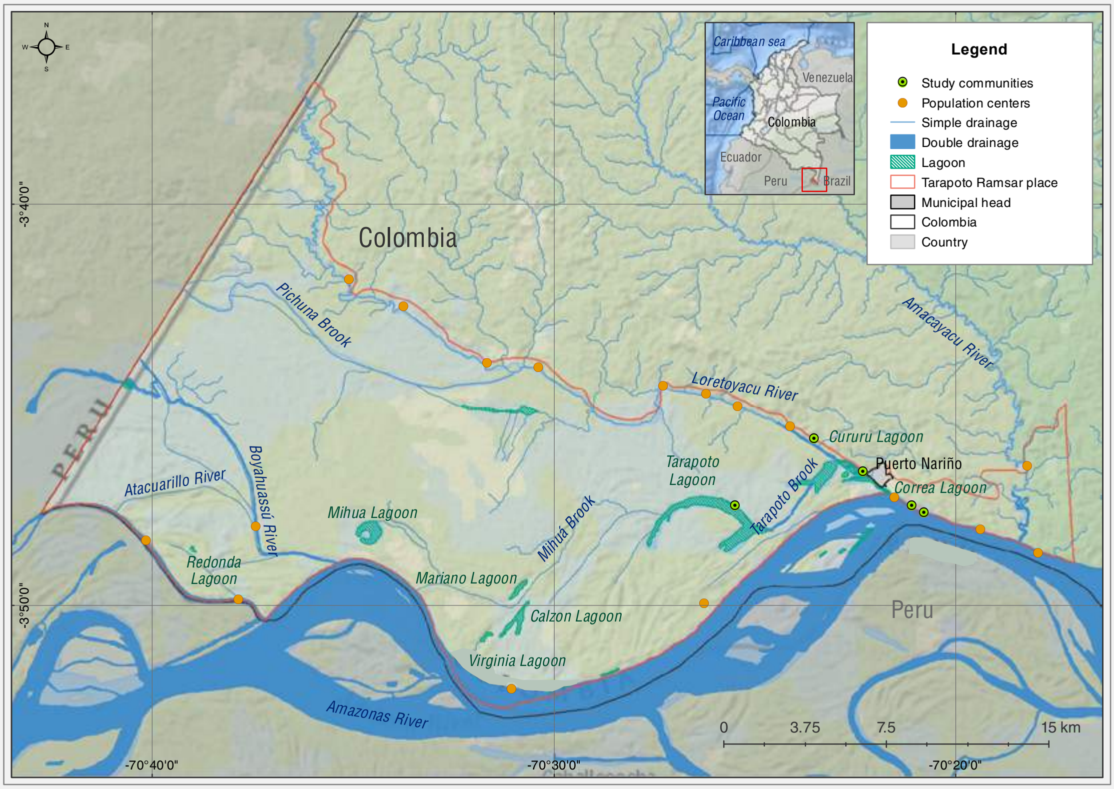
> "areas collectively owned by the indigenous communities, which are inalienable, imprescriptible and unseizable. They are a legal and socio-political institution of a special nature, formed by one or more indigenous communities, which – through collective ownership – enjoy the guarantees of private property, possess their territory and are governed by an autonomous organization protected by indigenous jurisdiction with its own normative system in managing the territory and life within its boundaries" (translated from Ministerio del Interior y de Justicia, 2013).

The Ticoya reserve's population is distributed amongst 22 communities or settlements. Each community has a leader known as ***curaca***, who is the representative of the settlement or community. The ***curaca*** is responsible for the community's legal affairs and conflict resolutions, as well as for representing the community at the reserve level in decision-making processes. In 2007, the Association of Indigenous Authorities of the Tikuna Cocama and Yagua was created. This association is made up of the 22 ***curacas*** as representatives of each community.

As the map shows, the communities are connected to each other along the river. The communities that participated in the profiling work live closest to the Tarapoto Largo and Tarapoto Redondo lakes, which are part of the Lagos de Tarapoto Wetlands Complex. They are recognised as ecosystems of great importance in terms of food, as they contain large stocks of fish. It is important to mention that aquatic ecosystems are crucial for these Indigenous Peoples as they symbolize their culture and way of life. For instance, the Tikuna people's stories about the origins of life tell how the human

[34] The most recent census in Colombia was carried out in 2018. The current demographic data are not available as of now; however, DANE forecasts 8 519 inhabitants for 2018.

FIGURE 7.2. Location of Puerto Nariño, the Tarapoto wetlands and the settlements in the Tikuna-Cocama-Yagua Reserve



Source: Modified by Nicole Franco, Fundación Omacha, 2020.

population comes from the fish that ***Yo'i*** – the father creator of the Tikuna – caught from the water and transformed into the first settlers.

The population of Puerto Nariño is mostly Tikuna, followed by the populations of Cocama and Yagua peoples. The most spoken language is Spanish, although each Indigenous People have their own native language that are of the same name – the Tikuna, the Cocama and the Yagua. As the Tikuna people comprise the majority, their language is the second most spoken in the reserve. The Cocama and Yagua languages are mostly spoken by the elders. Children and youth speak mostly Spanish in their daily lives as they use it in schools and colleges. Additionally, the Colombian educational system provides some basic English teaching, mainly motivated by the increasing tourism in the area that provides job opportunities, especially to the youth. The younger generations learn the Tikuna, Cocama and Yagua languages from their parents or grandparents.

Households consist of a nuclear family composed of the mother, the father, children and – in some cases – grandparents. The organisational structure of the population is strongly related to nature. The population is grouped into clans, which – in the case of the Tikuna people – have animal names, differentiating between air and land animals. The Tikuna people[35] have patrilineal

[35] As the Tikuna people are the majority of the Ticoya reserve and consituted most of the participants in the discussions, the findings presented in this report are representative of this Indigenous People.

relationships, where the male children inherit the clan from their father. In turn, the clans are exogamous, as unions were only formed between members of different clans. Nevertheless, at present, marriage is not strictly limited by clan, as the population today is the result not only of unions amongst the indigenous groups in the reserve but also between them and the settlers. The latter come from the rest of Colombia and from neighbouring countries. For this reason, it is possible to find families whose members speak Portuguese.

Despite the presence of Catholicism and Christianity, the communities' members do not identify with a dominant religious identity and there is no representative religious figure in the leadership of the participating communities. Their internal organization is determined by the Life Plan (Asociación de Autoridades Indígenas del Resguardo Tikuna-Cocama-Yagua, 2007), a document that reflects the population's thoughts on their identity and culture. It is used as a tool for planning their own development and public management through an indigenous political project. It constitutes a comprehensive proposal to ensure the way of life, continuity and survival as Indigenous Peoples. Some of the principles of the Life Plan are:

- respect and recognition for elders who are knowledge holders and for traditional authority figures as natural advisers.

- the Wone Congress[36] is recognised as the highest authority in the Ticoya reserve and its mandates as law within the territory of the reserve. The members of the Wone Assembly are mostly elected through a vote within each community.

- the Indigenous Authorities of the Tikuna, Cocama and Yagua (ATICOYA) is the Management Board of the reserve. It is recognised as the next-highest authority in the absence of the Wone Congress.

- recognition of the Indigenous Justice Regional Council: it is made up of elders designated by each community as traditional authority figures to exercise and uphold jurisdiction.

- autonomy rests on the collective mandate of the communities.

- the Traditional Authority Figure is composed of elder knowledge holders, shamans or traditional healers who know and understand the laws of nature. They are responsible for guiding, healing, directing and imparting justice in their respective communities.

For this reason, each community has a Council of Elders regulated and recognised by the Community Assembly of the reserve, or the Wone Congress. Such council is made up of the traditional authority figures to uphold indigenous jurisdiction. The elders and shamans or healers are the only authority figure who holds a position that is inherited or acquired by seniority.

3. LOCAL FOOD PRODUCTION

The activities that produce food are farming, fishing, hunting and gathering. All these activities depend on the water and forest systems. They provide not only the food but also any surplus intended for marketing that brings an income for purchasing other products not generated within the system. Therefore, there is a dual system that combines traditional subsistence with the market economy, based on the sale of surplus food at the local market. In addition, there is evidence that the communities' members are increasingly doing paid work activities that allow them to earn money for the purchase of products and food available in the shops – almost all of which are products not found in the traditional system.

Food can be classified according to the activity of the food system that generates it, such as: harvesting and gathering, live food, and fishing and hunting. It can also be classified according to the area where it is produced or obtained, such as ***tierra firme***, ***várzea*** or floodable area, and the time of year, as determined by flood pulses: low

[36] Wone refers to the name in Tikuna language of the tallest tree in the forest, the ***ceiba*** (*Ceiba pentandra* (L.) Gaertn., Malvaceae).

Indigenous woman from the community cooking fish with banana.

© Fundación Omacha/ Fernando Trujillo.

waters, rising waters, high waters, falling waters and all year round.

Crops

The community members source their plant edibles from the ***chagras*** and the forest (Tables 7.1 and 7.2). The farming activities are carried out in the ***chagra*** – the diversified productive system in which annual and perennial species are cultivated and where attempts to reproduce forest succession processes are made. Each family makes the ***chagras*** by selecting a specific site in the forest, where they selectively cut and burn trees for the subsequent planting of several species of plants that provide food for the family group. Besides being a food production system, the ***chagra*** is also considered a knowledge system for the family, representing the cultural heritage and identity of each family. More than half of the food consumed by the family is produced in the ***chagras***, giving the population a high degree of independence from the market. The ***chagra*** production system is considered sustainable because it produces enough per family for self-sufficiency, and chemicals such as fertilizers and pesticides are not used. Most of the products from the ***chagra*** are sold at the local market in the urban area or in the ports of each community. Nevertheless, the amounts for sale are the surplus from family production, thus these vary according to the harvesting and gathering periods of each product.

L: low waters; R: raising waters; H: high waters; F: falling waters

TABLE 7.1. List of cultivated foods: crops, planted trees and other cultivated foods, their seasonal availability and their growing area

Group	Tikuna name	Scientific name	English name	Seasonal availability				Growing area
				L	R	H	F	
Condiments, seasonings, snacks and sweeteners	***dene***	*Saccharum officinarum* L., Poaceae	Sugarcane	■				floodable area
Fruits and juices	***chinü***	*Ananas comosus* (L.) Merr., Bromeliaceae	Pineapple			■		***tierra firme***
	guanabana	*Annona muricata* L., Annonaceae	Soursop	■	■			floodable area
	õnane	*Artocarpus* spp. Forst., Moraceae	Breadfruit	■	■	■	■	floodable area
	ĩtü	*Bactris gasipaes* Kunth, Arecaceae	Peach palm		■	■		***tierra firme***
	popaya	*Carica papaya* L., Caricaceae	Papaya					
	naraña	*Citrus × aurantium* L., Rutaceae *Citrus triofliata* L., Rutaceae	Orange			■		***tierra firme***
	irímawa	*Citrus limon* (L.) Osbeck, Rutaceae	Lemon	■	■			floodable area, ***tierra firme***
	ngawe	*Crescentia cujete* L., Bignoniaceae	Calabash	■		■		floodable area
	taüchikü	*Eugenia stipitata* McVaugh,Myrtaceae	Araza	■	■	■		floodable area
	waira	*Euterpe oleracea* Mart., Arecaceae	Açaí palm	■	■	■		floodable area
	é	*Genipa americana* L., Rubiaceae	Jagua	■	■			floodable area

TABLE 7.1. List of cultivated foods: crops, planted trees and other cultivated foods, their seasonal availability and their growing area

Group	Tikuna name	Scientific name	English name	Seasonal availability				Growing area
				L	R	H	F	
Fruits and juices	***pamá***	*Inga vera* subsp. *spuria* (Willd.) J.Leon, Fabaceae	Guamo	■				***tierra firme***
	manga	*Mangifera indica* L., Anacardiaceae	Mango	■				floodable area
	tema	*Mauritia flexuosa* L., Arecaceae	Moriche palm	■	■	■		floodable area
	noni	*Morinda citrifolia* L., Rubiaceae	Noni	■	■	■	■	floodable area
	irú	*Musa acuminata* Colla, Musaceae	Dwarf banana	■	■			floodable area
	poi	*Musa* sp., Musaceae	Banana					***tierra firme***
	poi	*Musa* sp., Musaceae	Wild banana	■	■			floodable area
	camocamo	*Myrciaria dubia* (Kunth) McVaugh, Myrtaceae	Camu camu			■		floodable area
	maracuya	*Passiflora edulis* Sims, Passifloraceae	Passion fruit					***tierra firme***
	bora	*Passiflora quadrangularis* L., Passifloraceae	Sweet granadilla					***tierra firme***
	pocurí	*Platonia insignis* Mart., Clusiaceae	Bacuri	■	■	■		floodable area
	chia	*Pourouma cecropiifolia* L., Passifloraceae	Amazon grape	■				***tierra firme***
	tàü	*Pouteria caimito* (Ruiz & Pav.) Radlk., Sapotaceae	Abiu					***tierra firme***
	oracha	*Psidium guajava* L., Myrtaceae	Guava	■		■		floodable area
	otere	*Quararibea cordata* (Bonpl.) Vischer, Malvaceae	Sapote					***tierra firme***
		Syzygium malaccense (L.) Merr. & L.M. Perry, Myrtaceae	Malay apple					***tierra firme***
	ngü	*Theobroma bicolor* Bonpl., Malvaceae	Macambo					***tierra firme***
	cupu	*Theobroma grandiflorum* (Willd. ex Spreng.) K.Schum, Malvaceae	Cupuaçu			■		***tierra firme***
Nuts and seeds		*Arachis hypogaea* L., Fabaceae	Peanut					
	chigubü	*Bertholletia excelsa* Bonpl., Lecythidaceae	Chestnut			■		***tierra firme***
Starches	***ũí***	*Colocasia esculenta* (L.) Schott, Araceae	Taro	■				floodable area, ***tierra firme***
	moniaca (bitter variety), tüe	*Manihot esculenta* Crantz, Euphorbiaceae	Cassava (bitter and sweet varities)	■	■			floodable area
	aruchu	*Oryza sativa* L., Poaceae	Rice					várzea
	chawü	*Zea mays* L., Poaceae	Corn	■				***tierra firme***

TABLE 7.1. List of cultivated foods: crops, planted trees and other cultivated foods, their seasonal availability and their growing area

Group	Tikuna name	Scientific name	English name	Seasonal availability				Growing area
				L	R	H	F	
Vegetables	***mee***	*Capsicum annuum* L., Solanaceae	Hot chili	■	■			***várzea***
	mee arü maicura	*Capsicum annuum* L., Solanaceae	Chili	■	■			floodable area

TABLE 7.2. List of wild plants harvested from the forest (both for food and non-food uses), their seasonal availability and their growing area

Group	Tikuna name	Scientific name	English name	Seasonal availability				Growing area
				L	R	H	F	
Fruits and juices	***na-ũ̈***	*Annona amazonica* R.E. Fr., Annonaceae	Soursop (from the lake)			■		floodable area
	murumuru	*Astrocaryum murumuru* Mart., Arecaceae	Coquillo (from the lake)			■		floodable area
	tuchí	*Duguetia* sp., Annonaceae	Nejilla			■		floodable area
	taüchikü	*Eugenia stipitata* McVaugh, Myrtaceae	Wild araza			■		floodable area
	kowi	*Garcinia madruno* (Kunth) Hammel, Clusiaceae	Bacuri	■		■		floodable area
	é	*Genipa americana* L., Rubiaceae	Jagua		■	■		floodable area
	caure	*Inga nobilis* Willd., Fabaceae	Inga			■		floodable area
	paamá	*Inga pilosula* (Rich.) J.F.Macbr., Fabaceae	Guamillo			■		floodable area
	tema	*Mauritia flexuosa* L., Arecaceae	Moriche palm			■		floodable area
	camocamo	*Myrciaria dubia* (Kunth) McVaugh, Myrtaceae	Camu camu			■		floodable area
	oracha	*Psidium guajava* L., Myrtaceae	Guava (from the lake)			■		floodable area
	marapa	*Simarouba amara* Aubl., Simaroubaceae	Bitterwood		■	■		floodable area
	chatürau (variety of tawene)	*Theobroma cacao* L., Malvaceae	Cocoa			■		floodable area

Fishing

Fishing is done in the Amazon and Loretoyacu rivers, and in the Tarapoto Largo, Tarapoto Redondo and El Correo lakes, which are characterised by their high fish availability.

Studies carried out by Urbano *et al.* (2014) identified approximately 68 fish species consumed within the communities. The species consumed the most have been reported during the participatory workshops (Table 7.3).

Indigenous fishermen from the community catching fish.

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Due to direct interaction with water systems, fishing has always been an important activity, not only for the provision of food but also for the development of the way of life and culture of the Indigenous Peoples. The elders related that in the past, children learned everything related to fishing and the underwater world from their parents. Children spent long hours with their parents learning how to make and handle artisanal fishing gear, such as harpoons, arrows, rods and natural fibre rods.

Traditionally, fishing has been an activity carried out mostly by men, with the Tikuna standing out for their fishing skills. This activity, aside from being a vital way of providing food for the families, is also important as an entertainment activity. Historically, women have always been in charge of post-fishing activities related to the preparation of food for family consumption. With their recent integration into the market economy, the women are now responsible for selling in the market. In all households, at least one male member would go fishing at some time during the year. All households have at least one kind of fishing gear, with nylon nets and hooks as the most common.

Within the community, the inhabitants identified important differences between men who are considered "people who go fishing" and those who are "professional or full-time fisherfolk". "People who go fishing" refers to any member of the family who goes fishing for a short period of time in places close to the community with little or no mastery of traditional fishing gear, as nylon nets are mainly used. Unlike the former, professional or full-time fisherfolk are men who have great skill and mastery of artisanal fishing gear. They have in-depth knowledge on aquatic ecosystems and the landscape in which the different species of fish and other wetland animals are found, as well as their feeding habits and reproductive characteristics. In addition, this group is more actively involved in the decision-making processes related to fisheries management and ecosystem stewardship. An example of this is the creation of the calendar for responsible fishing, which was prepared by the fisherfolk and elder knowledge holders.

The expert fisherfolk consider themselves to be responsible for the fish supply in their communities. They are also recognised leaders in the fishing industry, a direct consequence of the widespread use of nylon nets, to meet the demand by Pan-Amazonians who began to arrive in the area. This situation led the artisanal fisherfolk to carry out educational work with the younger generations through the Community Fisheries Agreements of 2006 to promote responsible fishing.

L: low waters; R: raising waters; H: high waters; F: falling waters

TABLE 7.3. List of wildlife used as food and their seasonal availability: fishing

Group	Tikuna name	Scientific name	English name	Seasonal availability			
				L	R	H	F
Fish	***chauná***	*Ancistrus* spp. Kner, Loricariidae	Common bristlenose catfish	■	■		
	eneetü	*Auchenipterus ambyiacus* Fowler, Auchenipteridae	Lustrosa			■	■
	paá tachaküü	*Hemisorubim platyrhynchos* Valenciennes, Pimelodidae	Porthole shovelnose catfish			■	
	de	*Hoplias malabaricus* Bloch, Erythrinidae	Wolf fish	■			
	mapará	*Hypophthalmus edentatus* Spix & Agassiz, Hypophthalmidae	Highwaterman catfish			■	■
	warakú, otá, echakü	*Laemolyta* sp. Cope, Anostomidae	Headstander			■	
	pakú	*Mylossoma aureum* Spix & Agassiz, Serrasalmidae	Golden mylossoma			■	■
	arawana	*Osteoglossum bicirrhosum* Cuvier, Osteoglossidae	Silver arowana			■	
	kuyu kuyu	*Oxydoras niger* Valenciennes., Doradidae	Ripsaw catfish	■			■
	pua	*Phractocephalus hemioliopterus* Bloch & Schneider, Pimelodidae	Redtail catfish			■	
	poku	*Piaractus brachypomus* Cuvier, Serrasalmidae	Pacu	■		■	■
	tomakachi	*Piaractus brachypomus* Cuvier, Serrasalmidae	Pirapitinga			■	
	moni	*Pimelodus blochii* Valenciennes, Pimelodidae	Bloch's catfish			■	■
	yowarachi	*Potamorhina altamazonica* Cope, Curimatidae	Yahuarachi		■		■
	kaweya	*Prochilodus nigricans* Spix & Agassiz, Curimatidae	Black prochilodus			■	

TABLE 7.3. List of wildlife used as food and their seasonal availability: fishing

Group	Tikuna name	Scientific name	English name	Seasonal availability			
				L	R	H	F
Fish	***yutaá***	*Pseudoplatystoma fasciatum* L., Pimelodidae	Tiger shovelnose catfish		■		■
	ai arü yutaá	*Pseudoplatystoma tigrinum* Valenciennes, Pimelodidae	Tiger sorubim	■		■	
	owaru	*Pterygoplichthys* sp. T.N Gill, Loricariidae	Janitor fish	■			
	wainayu tara	*Rhaphiodon vulpinus* Spix & Agassiz, Cynodontidae	Biara			■	
	uchuma yachokü	*Serrasalmus rhombeus* L., Serrasalmidae	Redeye piranha		■		
	uchuma	*Serrasalmus* spp. Lacépède, Serrasalmidae	Piranha		■		
	chiripirá	*Sorubim lima* Bloch & Schneider, Pimelodidae	Duckbill catfish			■	■

Hunting and trapping

Hunting and trapping of forest animals are part of the traditional activities of the food system. At present, these practices remain important subsistence activities that provide for the family within the communities. However, because the carrying of firearms and the selling of bushmeat and wild animals outside the reserve areas is illegal, this activity has significantly decreased. Therefore, when hunters have a surplus, it cannot be sold in Puerto Nariño's urban area.

This situation, besides decreasing hunting as a practice to provide animal protein to families, has contributed to the gradual loss of the population's traditional knowledge and customs for obtaining food from nature. Men traditionally practise hunting, generally in groups and with an average frequency of once a week in the case of expert hunters, and twice a month in the case of those who hunt occasionally. Currently, some hunters from the participating communities engage in this activity affiliated with the Airumaküchi Hunters' Association, which was created by hunters from the different communities aiming to engage in this activity in a responsible manner. Although men traditionally practise hunting, females are not excluded from this activity. They, unlike men who use shotguns and traps, employ dogs.

Hunting takes place in the jungle, in the flooded forest and in areas close to water sources, better known as salt licks. Such places, mainly far from human activity, are the habitat of a large number of wild animals, a reason why communities' members consider them as sacred areas or sites that deserve special care and protection. Birds and primates are usually hunted close to the lakes and on the riverbanks, whereas middle- and big-sized mammals are hunted on ***tierra firme. Nga*** (*Cuniculus paca*, lowland paca) are hunted in the ***chagra*** that they often visit to eat the cassava. The meat is mostly for household consumption, although depending on the size of the animal, it can be sold within the communities to obtain some income. Species such as ***nga, chigu*** (*Dasyprocta fuliginosa*, black agouti), *Alouatta seniculus* (red howler monkey), ***ngobü*** (*Chelonoidis denticulatus*, yellow-footed tortoise) and ***nakü*** (*Tapirus terrestris*, lowland tapir) are reported to be the most important preys for consumption and commerce in Puerto Nariño (Quiceno, Cruz Antia and Moreno, 2014).

The meat is sold fresh by the kilogram. Hunting products do not generate added value, nor are they transformed into other items. Hunting is not a principal activity, but rather a complementary one to fishing, as it does not represent a significant percentage of the family group's total income.

TABLE 7.4. List of wildlife used as food, their seasonal availability and their living area: hunting and gathering

Group	Tikuna name	Scientific name	English name	Hunting season				Hunting area
				L	R	H	F	
Birds and poultry	***yorí***	*Anhinga anhinga* L., Anhingidae	Snakebird	■	■	■	■	open water, flooded forest
	cowara	*Ardea alba* L., Ardeidae	Great egret					
Birds and poultry	***ené***	*Brotogeris versicolurus* Statius Muller, Psittacidae	White-winged parakeet					
	patü naineüa	*Cairina moschata L., Anatidae*	Muscovy duck		■	■		open water, flooded forest
	múkutu	*Columbina talpacoti* Temminck, Columbidae	Ruddy ground dove					
	ngunü	*Crax globulosa* Spix, Cracidae	Wattled curassow					
Insects and insect products	***ngairé*** (mojojoí)	*Rhynchophorus* sp. Herbst, Dryophthoridae	Palm weevil	■	■	■	■	***várzea , tierra firme***
Mammals		*Alouatta seniculus* L., Atelidae	Red howler monkey	■		■	■	
	pohui	*Bradypus tridactylus* L., Bradypodidae	Pale-throated sloth	■	■	■	■	***tierra firme***
	maraekü	*Bradypus variegatus* Schinz, Bradypodidae	Brown-throated sloth	■	■	■	■	***tierra firme***
	ñaí	*Coendou prehensilis* L, Erethizontidae	Brazilian porcupine					
	nga	*Cuniculus paca* L., Cuniculidae	Lowland paca			■		
	chigu	*Dasyprocta fuliginosa* Wagler, Dasyproctidae	Black agouti	■		■		
	ĩkü	*Dasypus* sp. L., Dasypodidae	Long-nosed armadillo					***tierra firme***
	ngowá	*Didelphis marsupialis* L., Didelphidae	Common opossum				■	***tierra firme, várzea***
	kopiwara	*Hydrochoerus hydrochaeris* L., Caviidae	Capybara	■				***tierra firme***
	kowü	*Mazama americana* Erxleben, Cervidae	Little red brocket	■	■	■	■	***tierra firme***
	chate	*Nasua nasua* L., Procyonidae	South American coati					
	maiecha	*Saimiri sciureus* L., Cebidae	Common squirrel monkey	■	■	■	■	***tierra firme***
	yaü	*Sciurus igniventris* Wagner, Sciuridae	Northern Amazon red squirrel					***tierra firme***
	nakü	*Tapirus terrestris* L., Tapiridae	Lowland tapir					
Mammals	***ngawü***	Tayassu pecari Link., Tayassuidae	White-lipped peccary		■			***tierra firme***
	ũ̃ká	unidentified	Bristly mouse		■	■		***tierra firme***

TABLE 7.4. List of wildlife used as food, their seasonal availability and their living area: hunting and gathering

Group	Tikuna name	Scientific name	English name	Hunting season				Hunting area
				L	R	H	F	
Reptiles	***koyamare***	*Caiman crocodilus* L., Alligatoridae	Spectacled caiman	■		■		***várzea***
	ngobü	*Chelonoidis denticulatus* L., Testudinidae	Yellow-footed tortoise	■		■		***várzea***
Reptiles	***nayare***	*Chelus fimbriatus* Schneider, Chelidae	Mata mata	■				***várzea***
	koya	*Melanosuchus niger* Spix, Alligatoridae	Black caiman	■		■		***várzea***

4. OTHER LAND-BASED PRODUCTIVE ACTIVITIES

Aside from food production activities, the Tikuna, Cocama and Yagua communities' members use elements of the ecosystem for their livelihoods. In particular, 28 species of palms have been identified and the category of use has been reported for some of them (Table 7.5). Fourteen of them are used to construct houses, such as timber trees and palm leaves to weave the houses' roofs (Forero-Tocancipá and Córdoba, 2014). The use of wood for housing construction is a current practice in most of the settlements. However, in the past two years, housing construction projects promoted by the national government have been launched using construction materials. Furthermore, the use of palm leaves to roof houses is becoming less common, as people prefer to use zinc sheet metal for this to avoid the maintenance costs involved in installing palm thatch roofs. Fourteen species have also been identified that are used to elaborate handicraft. Weaving fabrics from natural fibres and carpentry are traditional activities. Commonly, women weave using natural fibres and men make wooden crafts. Nevertheless, nowadays these activities are carried out to sell the products to visitors and tourists. They are driven by government programmes and non-governmental organization (NGO) initiatives to mass-produce their products to promote the generation of income amongst the communities' population. Thirteen species are

L: leaves; F: fruit; S: seed; B: bud; T: tronc; R: root; W: palm weewil (mojojoí)

TABLE 7.5. Use of palm species according to category of use: food, crafts, rituals and festivals, kitchen utensils, and construction

Scientific name	English name	Category of use	L	F	S	B	T	R	W
Astrocaryum aculeatum G.Mey, Arecaceae	Tucuma palm	Food		■					
		Crafts			■				
Astrocaryum chambira Burret, Arecaceae	Chambira palm	Crafts			■				
		Construction					■		
		Fibers				■			
Astrocaryum jauari Mart., Arecaceae	Jauari	Construction					■		
		Crafts			■				
		Kitchen utensils	■						
Astrocaryum murumuru Mart., Arecaceae	Murumuru	Crafts			■				

TABLE 7.5. Use of palm species according to category of use: food, crafts, rituals and festivals, kitchen utensils, and construction

Scientific name	English name	Category of use	L	F	S	B	T	R	W
Attalea butyracea (Mutis ex L.f.) Wess. Boer, Arecaceae	Palla palm	Food							■
		Crafts			■				
		Construction	■				■		
Attalea sp., Arecaceae	Shapaja palm	Food		■					■
		Crafts			■				
		Construction	■						
Bactris concinna Mart., Arecaceae	Ñejilla palm	Crafts			■				
		Tools					■		
		Medicinal						■	
Bactris gasipaes Kunth, Arecaceae	Peach palm	Food		■					■
		Construction					■		
Bactris maraja Mart., Arecaceae	Maraja	Crafts			■				
		Tools					■		
		Medicinal						■	
Cocos nucifera L., Arecaceae	Coconut	Food			■				
		Crafts			■				
Euterpe precatoria Mart., Arecaceae	Lone açaí palm	Food		■					
		Crafts			■				
		Construction	■						
		Medicinal						■	
		Rituals and festivals	■				■		
		Kitchen utensils	■						
Euterpe sp., Arecaceae	Açai palm	Food		■					
		Medicinal						■	
Iriartea deltoidea Ruiz & Pav., Arecaceae	Pona palm	Food							■
		Crafts			■				
		Construction	■				■		
		Kitchen utensils					■		
Itaya amicorum H. E. Moore, Arecaceae		Construction	■						
Lepidocaryum tenue Mart., Arecaceae	Poktamui	Construction	■						
Mauritia flexuosa L., Arecaceae	Moriche palm	Food		■					■
		Crafts			■				
		Construction	■						
		Rituals and festivals	■						
		Kitchen utensils					■		
Mauritiella sp., Arecaceae	Aguajillo	Food		■					
		Construction	■				■		
Oenocarpus bacaba Mart., Arecaceae	Bacaba	Food			■				
		Crafts		■					
		Construction	■						
		Medicinal				■			
Oenocarpus bataua Mart., Arecaceae	Patawa	Food		■					
		Construction	■				■		

TABLE 7.5. Use of palm species according to category of use: food, crafts, rituals and festivals, kitchen utensils, and construction

Scientific name	English name	Category of use	L	F	S	B	T	R	W
Phytelephas macrocarpa Ruiz & Pav., Arecaceae	Ivory palm	Food		■					
		Crafts			■				
		Construction	■						

Source: Trujillo and Duque, 2014.

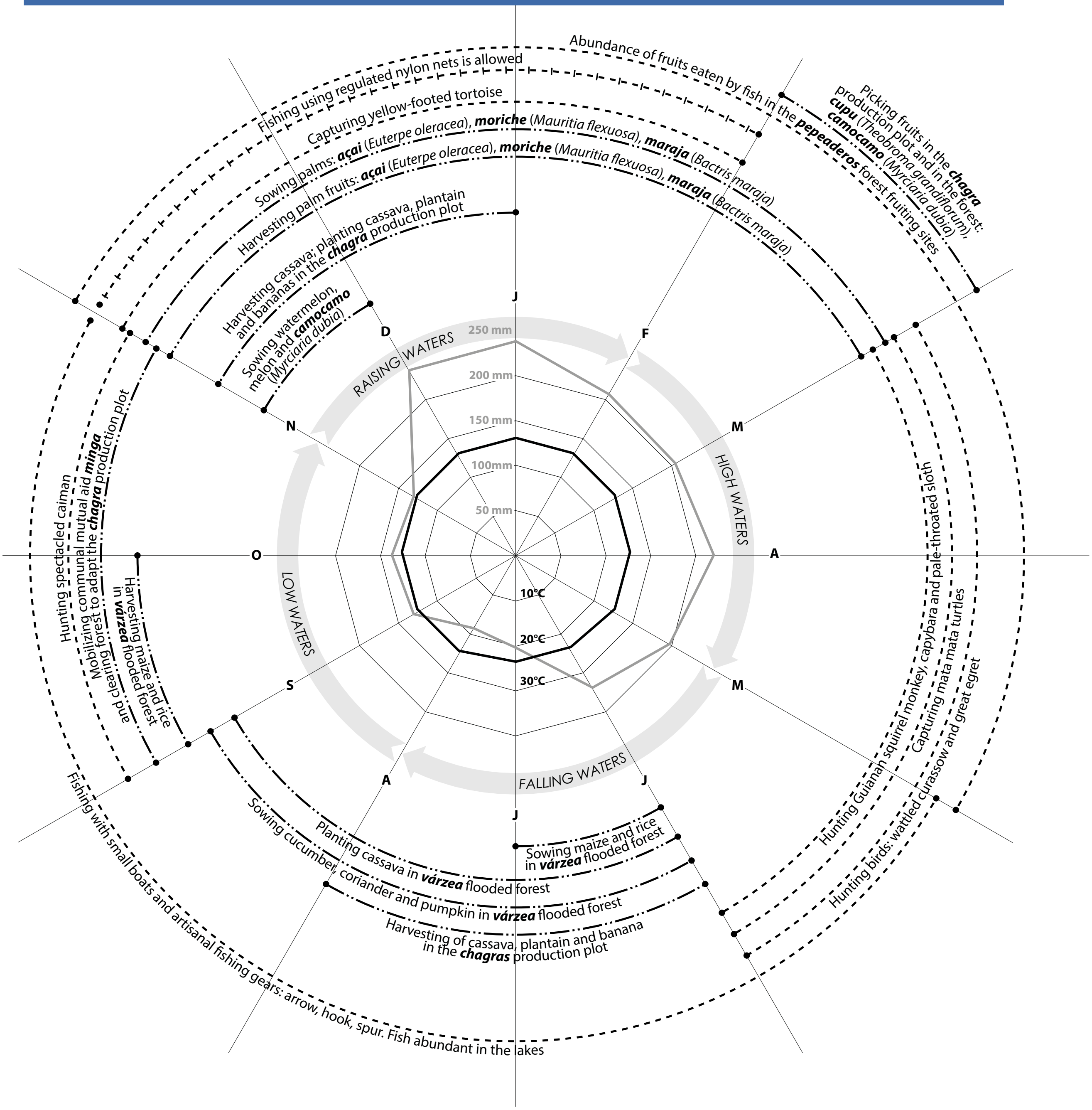
used for food, and seven for medicinal uses. Some species can host ***ngairé*** (*Rhynchophorus* sp., palm weevil or mojojoí), which is collected for food (Forero-Tocancipá and Córdoba, 2014). The seeds of ***annatto*** (*Bixa orellana* L., Bixaceae) and ***jagua*** (*Genipa americana*) are used for their pigments and cosmetics by the Tikuna to paint their skin black for celebrations and rituals, giving these fruits a high cultural value.

Livestock farming is an activity present in one of the six participating communities. However, it is not a representative activity for the food system, as it was introduced through national rural development initiatives, which the population consider unsuccessful due to low acceptance. The raising of some animal species as a source of food and protein has been identified amongst the practices with less relevance. Such is the case for the raising of chickens, pigs and ducks, from which meat and eggs are derived. Yet, their consumption is not considered significant. These products are mainly intended to either exchange amongst communities or to use as food during celebrations and festivals. Farmyard animals, such as chickens, pigs, ducks and, to a lesser extent, livestock are raised in small areas close to homes, such as backyards or pastures in the case of livestock. Finally, the sources of animal feed and fodder used are those available in the natural environment and organic household waste.

5. LOCAL CALENDAR

Puerto Nariño's food production calendar shows variations throughout the year due to seasonality, the water levels of bodies of water, changes in the landscape, and the movement and migration of animal species, especially fish. Flood season takes place at the beginning of the year from February to April. This is the time of year, called high waters, when the water level reaches its maximum height and the blackwater wetlands system is flooded by whitewater from the Amazon River. During this period, the forest is flooded, creating new feeding grounds for fish and giving rise to fishing areas within the forest, as the fish are dispersed along rivers, lakes and forests. This is when the different species of fish begin to spawn and species such as the Amazon river dolphin (*Inia geoffrensis* Blainville, Iniidae) enter the wetlands in search of food. Flooding fertilizes the soils with nutrients, preparing them for planting during the summer. May to July is the time of falling waters. The water level begins to drop, forcing many fish to leave the wetlands for the rivers, following the progressive appearance of ***tierra firme*** plains. The period of low waters begins in August and goes until October. The water reaches its lowest level, giving rise to sandy beaches and exposing ***tierra firme*** forests, whilst disconnecting the lakes from the rivers. This is when the presence of land mammals in the forest becomes evident. During this period, people fish more, as many fish that do not head towards the rivers become trapped in the lakes, making it easier to catch them. In the low water periods, paths providing access into the forest open up, making it easier for hunters to enter in search of land mammals or birds that provide them with animal protein. Food crops such as fruit trees and cassava (*Manihot esculenta*) are planted during this period. From November to January, the rising waters correspond with the Amazon River once again flooding the forests and wetlands system, marking the beginning of the flooding cycle. During this time, trees bloom, the fish begin to spawn and the fry are born. Fish enter the lagoon system as feeding sites for fish appear.

FIGURE 7.3. Average annual rainfall (mm) and temperature (°C) in Leticia, Amazonas Department, and seasonal activities by the Tikuna, Cocama and Yagua of Puerto Nariño (elaborated by Yanto Wahyantono, IRD, 2020)



Key:

- Activities related to cultivation
- Activities related to wild food (gathering, fishing, hunting)
- Activities mainly undertaken by men

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Familty members of the Ticoya reserve fishing together.

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6. MARKET SOURCING AND TRADE

Puerto Nariño has three main stores or local markets where the communities' members buy food as part of their diets. Primarily rice, oil, meat, frozen chicken,[37] beef, coffee and salt are sold, as well as processed foods such as pasta, sugar, panela, wheat flour, bread, canned sardines, dairy products, alcoholic beverages, soft drinks and sweets. Most of the products available at these stores are Peruvian and Brazilian brands, especially dairy products, canned meats and frozen chicken.

The stores are open daily. Nevertheless, the population living in the communities usually do their shopping on weekend mornings and buy a small proportion of all the food they consume at these markets as the rest is produced in the ***chagras***. This is particularly true for families of fisherfolk that also have access to a ***chagra*** as they have greater independence from the market in terms of obtaining food. Lastly, as there is no packaging system within the food system for fresh foods such as fish, the pulp of ripe fruit and bushmeat, any surplus production is sold as fresh products at the local market on the same day it is obtained. Other products such as tubers and some green fruits for ripening, such as bananas (*Musa* sp.) or wild bananas (*Musa acuminata*), are brought to the market on a weekly basis.

7. COMMUNITY HISTORY AND FOOD SYSTEM TRANSITIONS

Due to the wealth of natural resources of the Amazon ecosystem, the population has historically faced various highly complex

[37] "Frozen chicken" is the term used by the participants to name chicken that is not produced within the community. The participants stated that the frozen chicken available at the market is from Brazil, and it is cheaper than the frozen chicken produced in Colombia.

socio-economic and cultural processes. Similar to other areas of the Colombian Amazonian region, there have been several extractive bonanzas based on the exploitation and use of plants and animals in this area. Puerto Nariño was recognised as a ***corregimiento***[38] in 1961 to guarantee national sovereignty, as it did not have the number of inhabitants required to achieve municipality status at that time. It was only in 1984 that Decree No. 0106 of January 18 granted the status of municipality to Puerto Nariño. However, according to participants, due to population growth, evangelization and the arrival of missionaries around 1970, the population was grouped into 22 communities, which eventually became the settlements comprising the reserve today.

Throughout the history of the settlements' process, the region's natural and weather conditions reflected in the dynamics of the aquatic ecosystems and the levels of the bodies of water have had a huge impact on the settlements' geographical location, the peoples' way of life and food production. For instance, people migrate from floodable areas to ***tierra firme*** areas in search of a location that guarantees proximity to the river to carry out activities such as fishing, yet at the same time to ensure that houses are not susceptible to annual flood pulses. Another example is the community of Santa Clara de Tarapoto, located in a floodable area. Although important efforts are needed to maintain houses on stilts during periods of flooding, inhabitants benefit from having more fertile soils. These fertile soils are particularly exposed during the low-water period, and become the perfect sites to grow products such as cassava, some vegetables and fruit trees for human consumption and fish food. Consequently, such grouping processes gave rise to most of the rapid changes and modifications in the ways of life of the Indigenous Peoples.

Another important phenomenon was the process of evangelization of the Indigenous Peoples through the educational system and the imposition of the Spanish language by the missionaries and nuns of the Catholic Church. Indigenous Peoples were not allowed to speak their own languages and they would suffer physical punishment for doing otherwise. An important step forward was Resolution No. 21 of March 13, 1990, which allowed for the legal recognition of collective property rights to the Tikuna, Cocama and Yagua peoples. This was made possible with the recognition by the 1991 Political Constitution of Colombia that granted political, administrative and financial autonomy to Indigenous Peoples (see Political Constitution of Colombia, 1991, articles 286, 287, 328, 329). As a result, the elders noted that by the end of 1990, the restrictions on speaking their own languages were finally lifted. Nevertheless, participants pointed out that the period in which the restriction on speaking their own languages was in force was enough to weaken the younger generations' learning of these languages. Consequently, the traditional practices associated with their ways of life, which are highly dependent on oral tradition, were likewise weakened.

As a result of the rooted impositions made by the institutional educational system and the colonization processes over the past 50 years, during which the indigenous population was forced to use Spanish, Indigenous Peoples continue articulating their traditional ways of life but now within the context of the market economy. Such conditions give rise to new needs and consumption habits, for which it became necessary to generate income to meet them.

Although the production of food in ***chagras*** has remained the primary activity for the provision of food along with fishing and to a lesser extent hunting, techniques and products generated from these activities have significantly changed over time. For example, particularly from the 1980s onward, many seeds were introduced, coinciding with the establishment of Puerto Nariño as a municipality and urban area, and the subsequent arrival of State institutions. Such administrative organizations promoted productivity based on new seeds, especially vegetables, as well as aromatic and spice plants.

[38] A ***corregimiento*** is an administrative division of the rural area of a municipality, which includes a population core without reaching the category of municipality.

Likewise, the creation of the urban area increased the arrival of processed products to the markets, changing the population's eating habits with the inclusion of fried foods, processed foods and alcoholic drinks that replaced the fermented cassava ***chicha***. The consumption of frozen chicken from urban markets has become ubiquitous, as the price of chicken from Brazil is lower than the price of fish. Fishing intensification using nylon nets and hunting nets increased extraction pressure, deeply affecting hunting and fishing. The critical state of fisheries gave rise to the Community Fisheries Agreements as a sustainable use strategy (Trujillo, Escobar and Trujillo, 2017). Finally, the fishing crisis brought about a change in consumption habits. Previously, only adult fish and large fish were caught, and fishing operations were more rapid. At present, endemic fish species are scarce and difficult to catch. Fisherfolk devote more hours to fishing and it is common for their catch not to feed the family enough. The use of nylon nets has become a widespread practice.

Indigenous women in the community selling fresh foods on the market.

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SECTION 2 **SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM**

1. PROVISION OF LOCAL LIVELIHOODS AND SOCIAL WELL-BEING

Although planting, growing and caring for the ***chagra*** involve joint and equal participation of both men and women, the ***chagra*** is considered to be a woman's domain as it constitutes a family information system that allows the personal fulfillment of family members through the generation of knowledge. The participants believe that women are represented in the ***chagra*** as a centre of knowledge. Mothers use the ***chagra*** system to educate their children by teaching them skills to obtain food for the family and transmit values and knowledge to achieve social welfare and survive as distinct peoples. Whether women are involved in post-fishing and post-hunting activities, the performance of these tasks is mostly associated with men, as in the specific case of fishing. Being a man with good fishing skills is considered an important quality when forming a family, as he can thus guarantee the supply of protein to the family group. In this way, learning and acknowledging their own food production constitutes an important basis for the population's survival and generational well-being.

Adequacy of income opportunities

Communities' members do not consider that producing food exclusively for sale is profitable, the reason being the high costs of transportation from the community to the urban area. In addition, marketing opportunities are limited to Puerto Nariño's urban area, which further discourages this selling activity. Indeed, there are only a small number of permanent buyers, consisting of some restaurants, hotels, tourists and the population of the urban area. For all these reasons, income generation is based on the sale of surpluses, which allows families to obtain other products that they do not produce themselves. Families that spend less time in the ***chagra*** or those who live in the urban area tend to spend more time on other activities within the market economy, depending on the generation of income to satisfy their food needs. At present, the population is engaged in different income-generating activities such as tourism, crafts, and construction work or service provision to the government institutions in Puerto Nariño.

Following the seasonality of the ecosystem, the population adapts the way they generate income, since more than half the average income comes from the sale of surpluses from agriculture and fishing. In the case of the ***chagra***, cassava is the product that has the greatest potential for transformation. Together with its derivatives, such as starch and farina, they are in greatest demand at urban markets. The economic contribution of fishing represents the second most important item for families in the reserve, since 24 percent of the total income of an average family comes from fishing, with self-consumption being more than half of this value. In other words, the contribution of fishing is highly significant if we consider the cost of the fish products consumed within each household throughout the year. Fish products intended for marketing are sold at the local market of Puerto Nariño's urban area. They are sold immediately upon returning to the urban area or the communities. The fish is bought fresh every day and for immediate consumption, thus the product is not packaged and does not gain any added value arising from the transformation. Nevertheless, it is important to point out that the population living in the urban area generates income from the sale of prepared fish, which is offered at small food stalls or restaurants, adding value to the fish during preparation.

Amongst the foods produced and processed specifically for the market, the cultivation and production of ***sacha inchi*** (*Plukenetia volubilis* L., Euphorbiaceae, Inca peanut) was identified. This nut is, however, not part of the local food system. It was introduced in the last three years as part of a national government initiative to encourage farming and the generation of income for communities. Nevertheless, despite being a high-yielding crop on Amazonian soil, the introduction of this crop has resulted in great challenges for the families that planted it in the ***chagras***. As it is not a traditional product, adequate strategies to manage pests and fungi are not known by the communities' members. Furthermore, potential buyers were limited to one or two who set the purchase price, which at times did not even cover production costs. The participants related believing that agricultural production projects requiring the introduction of crops dependent on fertilizers and pesticides to obtain acceptable yields were an inefficient strategy for income generation and food production. Instead, they alter the food-generating system and its sustainability towards self-consumption. One of the reasons is that production is not consumed locally, which leads to the gradual loss of diversity of farms, food diversity itself, and the families' self-sufficiency in feeding themselves. Such context jeopardizes the ***chagras'*** diversity and the knowledge about food production supporting the population's traditional ways of life.

Adequacy of diets

The diet of the communities' members is based on a variety of foods including fruits, fish, meat, vegetables, grains and, to a lesser extent, some dairy products. All the participants reported that they would rather consume more of their own food, such as fish, cassava and its derivatives, fruits from the ***chagra***, and bushmeat than other products available at the urban markets. In general, the population considers that the good quality of their food is due mainly to the fact that they use ancestral knowledge to produce it. This allows them to produce food without chemical fertilizers, which ultimately reduces health risks and avoids water and soil contamination.

The products that are consumed the most as part of the diet of both children and adults are identified and classified into larger groups according to their origin: products from the ***chagra*** and the forest; fish and proteins produced by the community, such as bushmeat and eggs; and products acquired from the market, such as canned meats, powdered milk, eggs, pasta, grains, tuna and frozen chicken. In the case of adults, food sourced from the ***chagra*** and the forest represent 50 percent of the diet. Another 25 percent of the total diet is sourced from the local landscape and it represents protein-rich food items such as fish, bushmeat, eggs and other food produced in the community. Out of these protein-rich items, studies carried out by Trujillo and Laiseca (2016) show that fish represents 81 percent of the family protein intake. In the case of the Ticoya reserve, it is equivalent to approximately 2.6 kg per person/month or 31 kg per person/year, thus tripling national average consumption (Autoridad Nacional de Acuicultura y Pesca, 2018a). The proportions of food sourced from the ***chagra*** and the forest, and from the local landscape, remain similar when it comes to children aged 6 to 11 years. These two sources correspond to 40 percent and 30 percent of the diet, respectively. The remaining 25 percent and 30 percent of the respective diets of older adults and children is sourced from the market. Older adults preferably consume canned meat, milk powder and purchased eggs (15 percent of the diet), as well as food items such as pasta and other grains (10 percent of the diet) from the market. The children, however, preferably consume frozen chicken and canned tuna (20 percent of the diet), but also pasta, lentils, beans and chickpeas (10 percent of the diet). The adults noted that the children show a preference for market products, such as canned goods and pasta, as those products are often provided in school.

With regard to the food needs of specific groups in the communities, such as the elderly, community solutions are being sought. For instance, networks of solidarity amongst families or friends have been built to meet the food needs of those who have special nutritional requirements. Additionally, there is a Senior Assistance Centre in the urban area that provides support through a Senior Feeding Programme. Regarding children, this centre offers food assistance through the educational institutions by providing school meals consisting of a snack and lunch on school days. In addition to this, the Colombian Family Welfare Institute (ICBF) exercises its mandate to improve the nutrition status and proper development of children under 5 years of age. However, all the participating parents expressed their dissatisfaction regarding the nutrition programmes implemented. They argued that the meals provided by the Institute to the children are not adequate for their healthy growth. They explained that the portions neither include foods that are part of the traditional indigenous diet nor are the quantities adequate. The parents also stated that the food provided by the ICBF contained a high level of preservatives and artificial sweeteners that could have harmful effects on health.

Changes in the provision of livelihoods and social well-being over time

The parents said that buying proteins, such as canned meats and frozen chicken, is part of their new eating habits, with the communities' members having increased their activities related to the market. They argued that the more they are integrated into "outside" activities from Government and other actors, the less time they have for growing and preparing traditional foods. They also stated that the children's participation in school feeding programmes has gradually decreased the children's liking for traditional foods, and increased their preference for processed products. Although the participants did not report any phenomena of food insecurity, they did state that in the last five years, diets have significantly changed in regard to animal protein intake. Fish are increasingly scarce, leading to higher prices, especially during the high-water period as fish abundance is reduced. In response to the fish deficit, the consumption of chicken, bought at a lower price than fish, has increased. Nevertheless, the culinary preference for fish over chicken prevails.

This decreased availability of traditional foods can also have repercussions on the cultural practices of the Tikuna, Cocama and Yagua. ***Pelazon*** is an important celebration that can occur any time of the year and which celebrates the passing from a girl to a woman. Parties organised usually last three days at least, and anyone in the community is welcome. However, the diminished quantity of traditional food such as bushmeat and fish to share affect the practising of this ritual.

The primary cause of the changes in the diet, culinary traditions and lifestyle of the communities' members is their rapid and unplanned integration into the market economy. Over the past 10 years, this process has increased the need for families to generate income to guarantee the availability of food and to cover the new needs that are arising with the market economy. Based on this exercise, the participants concluded that it is necessary to (1) promote the consumption and production of their own products within families; (2) involve the children in food production activities, especially protein food sources, such as fishing; and (3) create strategies to restructure government programmes – for example, adapting school meal plans to the Indigenous Peoples' diets.

2. EFFICIENCY IN THE USE OF RESOURCES

Land and soil

Despite the soils' low fertility, communities' members consider the soil apt for their families' food production. They compensate for the lack of nutrients by decomposing organic matter resulting from the selective felling of forests, burning wood, and using fruit and vegetable peels, as well as fish guts. This process generates compost and natural organic fertilizer, making the soil suitable for planting. The communities' inhabitants are able to identify good soil by observing its characteristics and results after planting. For instance, the colour and texture are indicators of good soil, as well as the production of food of a good size and colour. For the population, good soil – which makes a bountiful harvest of products possible – is black, sandy, loose and easy to plant. Conversely, soil inadequate for cultivation tends to be clayey and dry.

Labour and fuel energy

Food production requires long hours of dedication, especially in the initial phase of selective felling and burning of trees to create new ***chagras***. Afterwards, cleaning and planting are the most labour-intensive activities. The ***minga***, as a mechanism of communal solidarity work, consists of gathering friends and family members together to help carry out these activities during a full day of work. The ***minga*** is an important activity that constitutes a network of support available for any type of work requiring physical strength and labour. It also establishes reciprocity amongst the community so that others can also benefit in the future. The family that calls the ***minga*** together is responsible for providing enough food to those who come to work.

The main source of energy of the participating communities, except for the community of Santa Clara de Tarapoto, is the electric power service provided by the private company Energía para el Amazonas (ENAM). It makes community lighting possible, as well as allowing the refrigerators, televisions and cellphones to work in homes. Energía para el Amazonas generates electricity through the combustion of diesel fuel, not only in Puerto Nariño but also in the entire Amazonas Department. Propane gas is used for cooking and heating food in all the communities, although the use of firewood is still common. Firewood is commonly used in the communities for cooking and is one of the resources directly obtained from the forest.

Fossil fuels are linked with river transportation as they are used for boat engines. Although not all families can afford having a motorboat, community members use small motors that are cheaper. At the community level, people are in charge of providing transportation services. Gasoline is used to run some power tools, such as sawmills or chainsaws, electric graters, and, to a lesser extent, some tools for wood polishing and carpentry. In the case of the community of

Santa Clara de Tarapoto, as it is not connected to the electricity service provided by ENAM, fossil fuels are used to power electric generators. Solar energy is the primary source of light. As part of a State-funded programme, solar panels were installed in the communities of 20 de Julio, Valencia, Palmeras and San Martín de Amacayacu,[39] but they are not yet operational due to the lack of resources to have a company in charge of their operation and maintenance.

Water

Freshwater sources include rainfall, streams, lakes and rivers. Rainwater is commonly used for drinking, cooking and in farming. Water from the river is used for bathing, washing clothes and other domestic cleaning activities. In the summer season, due to the scarcity of rainfall, communities lack water. Consequently, it is necessary to use water from streams, which is boiled before drinking. In turn, the ***várzea*** areas are subject to annual flooding when the water levels rise in bodies of water. As a result, inhabitants experience a change in landscape and way of life. Such circumstances have driven them to adopt measures such as building houses on stilts to withstand the flood season.

With respect to the time allocated to collecting water for consumption, people stressed that they devote considerable time and effort to this activity, particularly at the end of winter and at the beginning of summer. It is common to install plastic tanks in the courtyards to collect rainwater from roofs and gutters, which is then filtered using mosquito nets.[40] In the summer, people go to the banks of rivers and lakes to collect water. This takes them anywhere between 3 and 15 minutes on foot depending on the location of the houses.

Waste

Most adult participants do not consider organic remains as "waste" but as part of the natural cycle. They reintegrate these remains into the ecosystem as fertilizer or as fish food in the case of seeds. This supports the efficiency of their food system, since most of the waste produced in the communities is organic and only a minimal amount is non-biodegradable material, which is considered "unpleasant" or "unusable". This consists mainly of packaging used for products purchased at the market, as well as batteries, electronic waste and chemical residues, such as oils, soap or detergent.

One phenomenon that concerns participants is the increasing accumulation of plastic waste in the landscape, particularly bottles. In the urban area, the municipality is in charge of waste collection and management. The participants noted that urban waste management is better than it is in the communities. However, the Comprehensive Municipal Solid Waste Management Plan (Municipio de Puerto Nariño, 2015) concluded that the municipality of Puerto Nariño does not have a sustainable plastic waste management strategy in place. It forecasted that in the next 20 years, its plastic accumulation capacity will be less than the plastic waste generation rate due to increases in tourist activity, which is considered a high-polluting activity that threatens the ecosystem's sustainability. Although some plastic is recycled for use as garden and orchard decorations, these strategies are not capable of absorbing all the plastic that is generated, so the communities burn plastic that accumulates. The participants emphasized that new waste that generates rust, such as batteries, nails, cans, staples and sheets, are considered "harmful" or "very toxic for the environment", given their limited use and inability to be reintegrated into the ecosystem.

Changes in resource use efficiency over time

Land use intensity has changed mainly due to population growth, integration into the market economy, and the influence of programmes by the Ministry of Environment and Rural Development, which aim to stimulate agricultural production in areas larger than those traditionally cultivated by introducing new

[39] The community of San Martín de Amacayacu was not among the communities that took part in the thematic panel discussions.

[40] The process of filtering using mosquito nets is aimed at removing objects such as leaves or plant debris found on the roofs of houses.

Indigenous women in the community participating in the thematic discussions.

planting and cultivation techniques requiring agrochemicals. In the case of the community of Puerto Esperanza, programmes have been implemented, with little success, to produce ***sacha inchi*** (*Plukenetia volubilis*, Inca peanut) and cocoa (*Theobroma cacao*). In terms of changes over time in labor efficiency and energy consumption, external and non-renewable energy sources have become more and more important over the past 40 years. Previously, the communities did not have power plants and motorboats were uncommon. However, work done directly by people, without the aid of any external energy sources, remains highly common.

The use of powered tools is limited to those activities that are more difficult and are not directly associated with food production, such as transportation or logging. The latter, when carried out as a business activity, requires mechanical tools other than the machetes and axes used in subsistence activities. Regarding the use of water, people are consuming filtered water by using filters made by hand or with activated carbon. Conversely, the consumption of packaged water is a practice that is gaining popularity amongst families with higher incomes, particularly those in settlements near the urban area.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

Crop and livestock biodiversity

The population of the Ticoya reserve cultivates a great diversity of species, both in ***chagras*** and gathered from the forest, which are amongst the foods consumed the most by the families. The list includes: fruits (47), tubers and roots (2), vegetables (3), nuts and seeds (3), cereals (2) and others (7). Fruits and nuts are gathered according to their seasonal availability. In the case of garden-grown species, most of them are introduced seeds, especially aromatic herbs, peppers and tomatoes. Cassava is the most common product in the ***chagras*** as all families cultivate it. The banana is another essential food in the diet as it is consumed almost daily and can therefore be found in every ***chagra***.

Wild harvested animals and fish

Amongst the 68 most consumed fish species reported by Urbano-Bonilla *et al.* (2014), 22 were identified as the highest current consumption in households. Since endemic fish species, such as tiger catfish (*Pseudoplatystoma* sp.) and ***pirarucú*** (*Arapaima gigas* Schinz, Osteoglossidae), fall into the "vulnerable" category, the communities have been implementing a fishery monitoring system for more than 10 years through Community Fisheries Agreements (Autoridad Nacional de Acuicultura y Pesca, 2018b). Those agreements have contributed significantly to the recovery of these species. The calendar for responsible fishing[41] prepared by the fisherfolk and elder knowledge holders is one of the outcomes of the Community Fisheries Agreements for the good use of the Lakes of Tarapoto. Amongst others, it provides recommendations on the daily limit of catch of fish, the tools that can be used and the ones that are prohibited, and the use of regulated nets depending on the area and the season. It also recommends preserving the food source of fish by prohibiting cutting down seed trees in the ***pepeaderos*** forest fruiting sites.

Regarding hunting, 24 species were identified as the most hunted and consumed by the population. The Airumakuchi (loosely translated as "Tigers of the Water") Hunters' Association was created in 2015 to seek a more sustainable form of hunting within the reserve. However, no activities carried out by the association were identified. It was found that hunting sustainability depends on a combination of community and institutional efforts to limit hunting and commercialisation within the reserve.

Ecosystem conservation and protection

According to their traditional lifestyle, members of the communities simultaneously take part in different activities regarding their food system, such as farming in which the entire family group participates, or fishing where parents and children alike play different roles during the fishing and post-catch activities. Hunting and gathering are essential to maintain the food system. These activities not only generate food but are also important moments of social interaction in which ecological, cultural and traditional knowledge is shared and transmitted, ensuring the sustainability of the food system itself.

At a socio-ecological level, fishing has remained important across generations, not only as a source of food and protein but also because of the cultural and social significance that embeds fishing and the fishing areas. According to the stories of the Tikuna people, their cosmogony and storytelling about the underwater world, the origin of life, and the origin of human beings is rooted on the fishing areas and banks of the Amazon River as well as the Lagos de Tarapoto Wetlands Complex.

Figure 7.4 shows different areas within the reserve identified according to their use within the framework of the Tarapoto wetlands management plan as the first Ramsar Site in the Colombian Amazonian area.

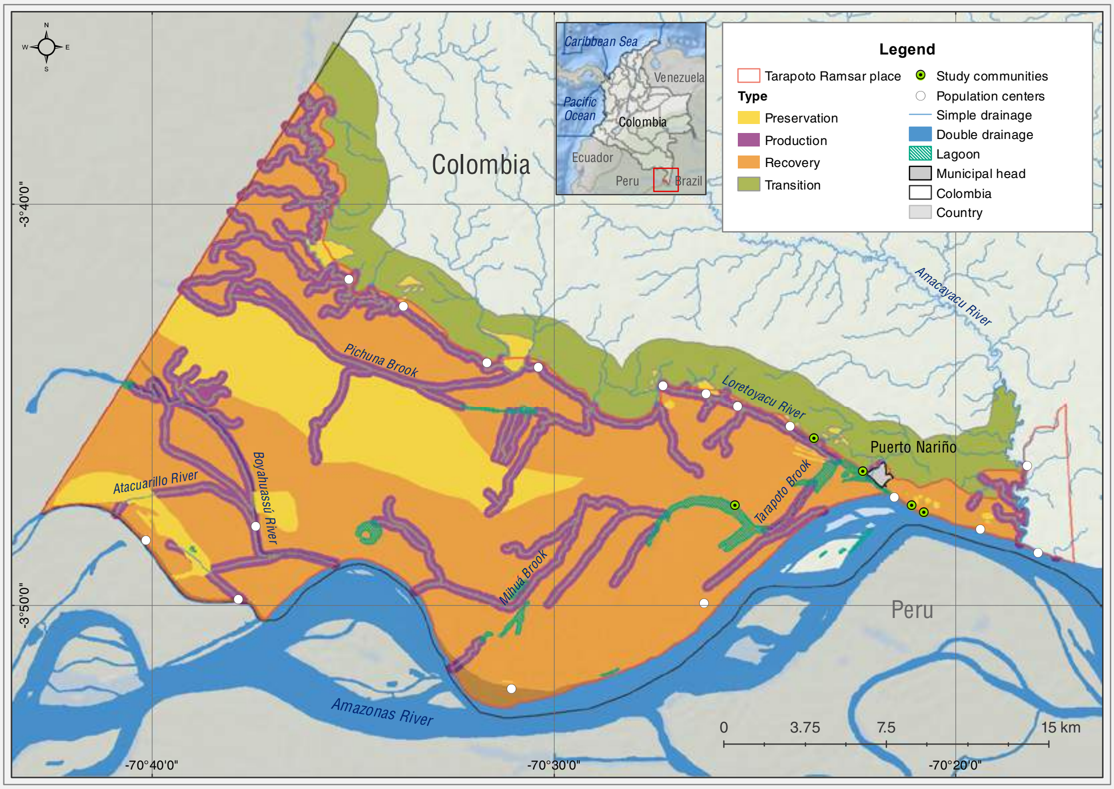
Along with the Puerto Nariño urban area and the water bodies, an area of about 93.5 km^2 is allocated for production. This area comprises the ***chagras***, the conservation areas of the ***várzea*** forests, and the fruiting sites called ***pepeaderos*** used to breed minor and native fish species. In addition, areas are dedicated for eco-tourism and other conservation initiatives such as REDD+ (Reducing Emissions from Deforestation and Forest Degradation), which receives payments for ecosystem services, as well as to reduce greenhouse gas emissions and protect forests and trees.

Figure 7.4 also shows a total area under ecological restoration and local research, equivalent to 306.6 km^2. This area has been degraded by different uses and now sees a variety of conservation and restoration initiatives by the communities, such as reforestation, ***pepeaderos***, tourism, hunting and fishing regulated under the Tarapoto Lakes Fishing Agreements and initiatives under REDD+ to stop forest logging. In the preservation area, research and tourism without authorization are prohibited.

Finally, outside these areas high terraces of the mainland are used for sustainable farming, either through ***chagras*** or communal environmental initiatives.

[41] For further information, see https://omacha.org/wp-content/uploads/2019/06/calendario-acuerdos_de_pesca_responsable_para_el_buen_uso_de_los_lagos_de_tarapoto.jpg.

FIGURE 7.4. Zoning of the Lagos de Tarapoto Wetlands Complex



Source: Modified by Nicole Franco, Fundación Omacha, 2020.

Changes in the conservation and protection of resources over time

The main changes in the use of forests and landscapes are related to changes in how the ecosystem is used, which has moved from a traditionally sustainable use to one more focussed on the extraction and commercial use of animal and plant species. One of the phenomena identified occurred between 1960 and 1970 with regard to the increasing extraction of fish and wild fauna, which involved capturing species intended for marketing. These included the ***pirarucú*** (*Arapaima gigas*), the black caiman (*Melanosuchus niger*) from which only the skin was extracted for commercial purposes, as well as the jaguar and its skin (*Panthera onca* L., Felidae) and otters (*Pteronura brasiliensis* Gmelin, Mustelidae and *Lontra longicaudis* Olfers, Mustelidae). Such fauna markets caused the greatest negative impact on the people. The participants associated this period of extraction with a weakening of traditional practices related to fishing and hunting, as the increase in extraction levels was based on technology and the use of firearms and nylon nets. The inhabitants mentioned that at that time, many fishing areas within Tarapoto Lake were difficult to access due to greater forest density, the abundance of animals considered dangerous (snakes and caimans), and the cultural beliefs associated with beings of nature responsible for caring for the ecosystems, which happen to be the protagonists of several stories about the origin of animals. For instance, the mother of the lakes is represented by a large snake or anaconda (*Eunectes murinus* L., Boidae) that lives at the bottom of the lake and in the flooded forests. Furthermore, there is a story regarding the Amazon river dolphins (*Inia geoffrensis*), which turn into men and captivate women to take with them to live in the underwater world called ***Natütama*** in the Tikuna language.

Trends show that due to the adverse effects of the extractive boom, people always go back to mechanisms based on traditional knowledge and sustainable use of natural resources to recover previously affected areas. Furthermore, whilst this extractive boom led to a decrease in several animal and plant species in the landscape, it also generated a process of protection and recovery of species at risk from both the communities and the State to counterbalance. This is what led to the initiative of having the Tarapoto wetlands within the Ramsar Convention.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of natural resources

The current governance system of natural resources has taken shape with the adoption of the Colombian Constitution in 1991. This constitution recognised rights of indigenous populations as well as territorial autonomy. On the basis of this recognition, the government began to promote the protection of cultural diversity as the nation's intangible heritage. The State also adopted actions aimed at strengthening the culture and well-being of Indigenous Peoples. However, in some cases, the adoption and implementation of ambiguous policies have undermined the right of indigenous communities to fully exercise their autonomy and govern themselves.

The current governance system encompasses the highest number of actors involved in ecosystem management in the history of the community (Table 7.6). Nevertheless, it is evident that the presence of more institutions does not necessarily imply better organization of the population or more efficient use of natural resources. The participants consider that the arrival of initiatives and projects from NGOs or government institutions focussed on conservation and natural resource management do not ensure the transmission of traditional knowledge amongst the Indigenous Peoples.

Communities' members are concerned by the lack of environmental education based on traditional knowledge, as well as a lack of initiatives to revitalize and strengthen the language. Throughout generational changes, indigenous languages are being taught and used less and less. This is one of the main challenges for each community, family and generation as languages are an avenue to maintain and preserve their traditional knowledge and the management practices of their territory and ecosystems. A mother of a Tikuna family stated:

> "A Tikuna should know how to speak the language, how to work the ***chagra,*** and how to produce their food so as not to die of hunger. They should know their traditions. A Tikuna who doesn't speak the language is not a good Tikuna. And we should teach this to our children."

On one hand, the communities recognised that institutional dialogue is needed, as well as support from the State and the private sector to face the different socio-economic changes. However, they also highlighted the need to implement their own processes according to their own organizational and governance structure. Although there are more leaders representing the communities today, the population reported dissatisfaction with the decisions made by some leaders on behalf of the communities. Moreover, the recently formed association of indigenous councils, which performs functions related to the management of the General Participation System's resources,[42] has in recent years triggered conflicts over mismanagement of these resources.

[42] The General Participation System refers to the constitution of the resources that the Nation transfers to the territorial entities that are departments, districts and municipalities, for the funding of the services under their responsibility, as defined in Article 76 of Law n° 715 of 2001.

TABLE 7.6. Actors involved in the management and use of natural resources and their functions for the period from 1991 to now

Actors involved in the management and use of natural resources	Functions
The community and the families	They struggle to maintain ancestral practices in their lifestyles. They have a dual economic system: subsistence economy and integration into the market economy. The new generations pose a challenge for the transmission of knowledge. They are beginning to create their own processes based on community participation and collective actions. They live within indigenous reserve territory, over which they have use rights.
The shamans	Only a few of them are left. They do not hold significant authority in the management of natural resources.
Beings of nature	They are present in the stories told by the elders. The new generations do not have enough knowledge about the sacred areas that these beings inhabit.
The traders	Their activity is mainly aimed at meeting the demands of the urban population, especially tourists and visitors. They contribute to the municipality's economic integration process.
The church and the missionaries	There is a greater presence of various religious associations. They do not have a vote in the reserve's decision-making. They do not give rise to direct processes involving duress on the reserve's forms of social organization.
The State	It does not have a strong enough presence to provide support for conflict resolution within the reserve. It tries to create spaces for dialogue and agreement, whilst at the same time promoting actions that are contradictory to the population's way of life though productive market projects.
Leaders, ***curacas*** and representatives of the reserve	They legally represent the communities, but not all are considered legitimate leaders by the community. They are responsible for leading community decision-making.
Private sector, NGO and academia	They offer a bridge for dialogue between the communities and the State. They provide technical and/or financial support in the implementation of projects and initiatives with the communities. They promote environmental education processes and support collective action processes in the communities.

Source: Adapted from Escobar, 2019.

In accordance with the above, it is clear that there is a need to create spaces for dialogue and agreement that allow finding solutions based on a common approach. Communities' members are also open to new governance strategies to improve the governance of nature as well as the well-being of the municipality members. These governance strategies aim to better integrate indigenous communities into the systems and services of the market economy without affecting their traditions and ways of life.

Finally, municipality members highlighted the community organising processes that have given rise to new institutions legitimized by the community and which have reached a good level of trust and credibility, such as Community Fisheries Agreements and Agricultural Producer Associations. The need to generate greater interaction between the communities, academia, the State and NGOs is emphasized. This interaction aims to strengthen the exchange of knowledge and the necessary participatory mechanisms to allow the communities to comprehensively manage their territory and resources based on their empowerment and self-governance.

View on the Ticoya reserve, Amazonas Department.

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Changes in governance of natural resources over time

Based on the research methodology applied by Escobar (2019) in her research on fisheries and governance in the area, thematic discussions held were aimed at identifying changes in the governance of natural resources over time. Escobar (2019) identified changes in traditional practices regarding natural resource management in the Tarapoto wetlands area. Particular attention was paid to the changes in fishery resources because, aside from being the main source of protein, fishing also has historically determined the population's lifestyles and their way of relating to the ecosystem and adapting to changes over time. Furthermore, the study showed that the fishery crisis and fishery management have had an impact on the legitimate institutions that for many years allowed the sustainable management not only of fisheries, but also of the ecosystems that the populations have historically used collectively. Therefore, the legitimate and legal institutions governing the use of resources are weak, as they have failed to sustainably manage the ecosystem.

It was noted that throughout history, the communities' members of the Tikuna-Cocama-Yagua reserve have faced diverse phenomena directly related to the use of ecosystem resources. The author identified two moments in history in which significant changes occurred in the way natural resources were managed and used, influenced by the presence of new actors.

In the first period from background history to 1950, Indigenous Peoples used to live in small communities, having an efficient and sustainable livelihood relying on the forest (Table 7.7). The entire family was involved as a means to transmit traditional knowledge.

During the period from 1950 to 1991 before the current governance system, noticeable changes marked the beginning of the integration of the population into the market economy (Table 7.8). Subsequently, those conditions gave rise to new dynamics of consumption and new forms of using natural resources to generate monetary income. The concept of nature as an economic resource was thus established. The Catholic Church and its educational processes came on the scene, making it compulsory to learn Spanish and to organise the population into community settlements.

TABLE 7.7. Actors involved in the management and use of natural resources and their functions from background history to 1950, corresponding to the time of ancestors

Actors involved in the management and use of natural resources	Functions
The community and the families	They inhabit the forest in a scattered manner, mainly the ***tierra firme*** areas. They have subsistence economy. They produce only for self-consumption. They fish and hunt by hand for self-consumption, community exchange and gifts. They pass on knowledge from generations to generations and preserve the legacy of their ancestors. They speak their native tongue.
The shamans	They are members of a family and leaders of the population. They have great knowledge about the forests and the elements that cure diseases. They seek solutions to problems related to society/nature.
Beings of nature	They take care of the forests and lakes. They interact with people and monitor possible damage that human activity may cause. They live in sacred places that are respected by people.

Source: Adapted from Escobar, 2019.

TABLE 7.8. Actors involved in the management and use of natural resources and their functions from 1950 to 1990, corresponding to the beginning of trade

Actors involved in the management and use of natural resources	Functions
The community and the families	They are grouped into community settlements, mainly on the banks of the rivers. They initiate the process of integration into the market economy. They are integrated into the market economy thanks to the arrival of traders, who in turn encourage greater use of money. They fish and hunt in large numbers, mostly for commercial purposes, changing their traditional fishing techniques. The transmission of traditional knowledge for food production is weakened.
The shamans	Their position as leaders and knowledge holders is weakened.
Beings of nature	The population loses its fear of beings of nature. The sacred places where they live are disturbed by human activity.
The traders	Their arrival marks the integration of the population into the market economy. They create new needs in the population, such as making money and acquiring consumer goods. They mark the era of extractive activities (fishing, wildlife, forest resources).
The church and the missionaries	They impose new forms of social organizations as community settlements. They contribute to the weakening of ancestral knowledge, mainly through the imposition of Spanish as the language and the school education system.

Source: Adapted from Escobar, 2019.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

A summarized assessment of 13 indicators of resilience is presented below. Throughout the thematic discussions, the resilience of the communities was presented as the keystone. Each indicator evaluated by communities' members is rated from 1 to 5, with 1 as the lowest score and 5 the highest (Table 7.9).

TABLE 7.9. Assessment of resilience indicators

Resilience Indicators	Assigned Score
1. Exposed to Disturbance	4
2. Globally Autonomous and Locally Interdependent	5
3. Appropriately Connected	3
4. Socially Self-Organized	4
5. Reflective and Shared Learning	4.5
6. Honours Legacy	4
7. Builds Human Capital	3
8. Coupled with Local Nature Capital	5
9. Ecologically Self-Regulated	5
10. Functional Diversity	5
11. Optimally Redundant	5
12. Spatial and Temporal Heterogeneity	5
13. Reasonably Profitable	3

The indicators with the lowest scores were number 3 (appropriately connected), number 7 (builds human capital) and number 13 (reasonably profitable). The participants concluded that there was a high correlation between the results of the three indicators, as they considered that the food system would not be profitable in the future. They argued that it would be necessary to develop community cooperation systems, which in turn would imply the strengthening of human capital and the population's capacities to develop more efficient food systems. As a result, self-sufficiency and optimal production of surpluses would be ensured. It could ultimately be integrated into the market under fair conditions, allowing for a better price based on the differential recognition of products. The participants referred to profitability both at the economic and cultural levels, stating that at the economic level, there was no strategy at present ensuring the fair inclusion of their food in the market economy. However, they recognised that the creation of legal associations, such as the Taü Women's Association in the community of Puerto Esperanza, are an example of collective effort, and initiatives as such should be supported in the long term.

Indicators 1 (exposed to disturbance), 4 (socially self-organised) and 6 (honours legacy) had an assigned score equivalent to 4. In those cases, the communities found that these aspects have been the key to keeping their ancestors' legacy alive after making a historical reflection on their ways of life. They stated that even though they do not have an efficient community organization at the reserve level, there are forms of internal organization at the family, family group and friends' level as channels to transmit and generate knowledge.

Indicator 5 (reflective and shared learning) can be considered as one of the best attributes of the communities' food system as it was assigned a score of 4.5. It is evident that over time, traditional food production practices have been maintained and adapted to changes in the environment. The reflective learning that has taken place as a result of the community fisheries management of the Lakes of Tarapoto is particularly noteworthy. Even though these lakes have been impacted by extractive phenomena throughout history, there is currently a process of reflection amongst communities' members that has contributed to the gradual recovery of the ecosystem.

Indicators 2 (globally autonomous and locally interdependent), 8 (coupled with local natural capital), 9 (ecologically self-regulated), 10 (functional diversity), 11 (optimally redundant) and 12 (spatial and temporal heterogeneity) had the highest score. The participants made a brief comparison between their food system and the one used by the urban population. Based on this exercise, they recognised their autonomous production of food and the need to maintain a low level of market dependence. They also recognised that their ways of life were sustainable, even though they identified some non-adequate practices, such as the generation of plastic waste. Additionally, they acknowledge the need to improve the mechanism of processing, transporting and storing food, as well as the need to include drinking water and electric power services.

In relation to the use of local varieties, the products cultivated in the ***chagra*** have been diversified as new seeds have been introduced, some of which are Amazonian but not native to their food system, as is the case of ***sacha inchi***. The species fished have varied both in weight and size. Currently, they are smaller than they were 40 years ago. Nevertheless, if we were to compare the same variables for the past 10 years,[43] there has been a significant increase in the size and weight of species such as ***pirarucú*** (*Arapaima gigas*) and tiger catfish (*Pseudoplatystoma* sp.), which are now protected thanks to the Community Fisheries Agreements.

It is our conclusion that the transmission of knowledge remains at high levels, especially for knowledge associated with food production in ***chagras***, considering the time dedicated to it by families as well as the high degree of inclusion of children in these activities. In contrast, regarding fishing and hunting, there is greater difficulty in transmitting knowledge. These activities require working up to several days within the aquatic systems and in the forest, therefore it is less common for parents to involve their children considering their need to attend school or government apprenticeship programmes.

[43] The statements are based on discussions led by artisanal fisherfolk, who using their perception and experience reflect on the changes in fishery resources over time.

SECTION 3 CONCLUSIONS AND FUTURE PROJECTIONS

Many academia and research centres document knowledge and life forms in the area studied. The participants confirmed that there has been a long list of research and knowledge-generation projects in which the communities have participated over the past 10 years. Nevertheless, they emphasized the need for appropriation of the knowledge generated, because despite the volume of information and findings made from the ecosystems in their territory and local knowledge, there is no evidence of community feedback strategies. Likewise, they highlighted the need to train their own human capital in the medium and long term as the best strategy to integrate into the market economy and to increase their capacity to manage their territory.

We conclude that it is necessary to create spaces for dialogue between the different actors that currently play a role in the management and governance of natural resources. A dialogue of knowledge and an exchange of knowledge, both within the communities and between the community and external actors, such as State institutions and the private sector, are necessary to agree on adequate ecosystem management strategies in adequation to the context and needs of the population. In addition, it is necessary to implement and strengthen participatory mechanisms in decision-making by the local population, as well as to create training tools aimed at strengthening governance and the local economy. An interesting example could be the Ramsar committee created in 2017 that includes governmental organizations in coordination with the Ticoya reserve representatives.

Finally, the communities' members consider that the lack of knowledge of their native tongue represents a great weakness for new generations, as the transmission of traditional knowledge, cosmovision, and the way of relating to the ecosystem is done through the language and oral traditions. Consequently, this represents the biggest challenge for both the older and younger generations.

BOX 4. Perceptions of communities' members on their food system

Question to the participants: for you, what are the key strengths of your food system and the challenges for sustainability?

"In terms of food, we don't need to buy anything. We have more than enough food… Nor do we need to produce a lot, because then the food goes to waste, and we have to sell it at a ridiculous price." Juan Ramos, fisherman from the community of Ticoya.

"Not all of us are clear about the roles of our leaders, and not even the leaders themselves are clear. The problem is that we remain silent." Sergio Silva, Comunidad Ticoya council.

"We need the money to buy things that make our lives easier. If I had money, I would buy an engine to be able to transport myself faster… we also want to do things more comfortably, like anyone else." Urbano Ferreira, fisherman from the community of San Francisco.

"Living here has its advantages. We have many things that the people outside do not have. The pure air we breathe here, for example, cannot be found anywhere else. All the beauty around us is ours." Ubaldo Valerio, fisherman from the community of 20 de Julio.

CHAPTER 8

The maize people in the Mesoamerican dry corridor

Milpa food system of the Maya Ch'orti' people in Chiquimula, Guatemala

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Maya Ch'orti' women prepare for the thematic discussion in La Ceiba.
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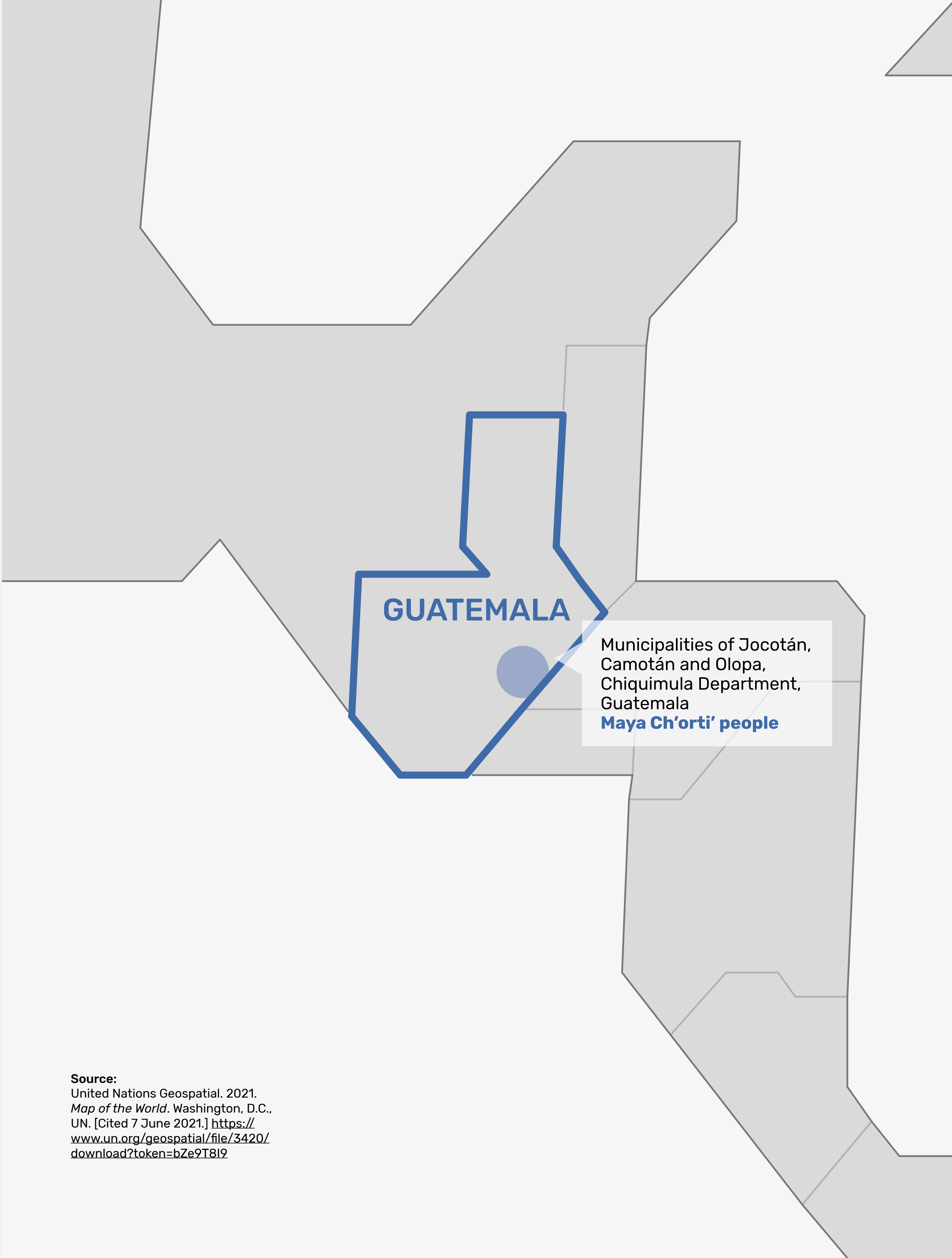


Source:
United Nations Geospatial. 2021. *Map of the World*. Washington, D.C., UN. [Cited 7 June 2021.] https://www.un.org/geospatial/file/3420/download?token=bZe9T8I9

"If we want to maintain our customs and traditions, we need to teach our children all our knowledge, so that the new generation does not lose the community values of customs and traditions and our language. If we do not teach them little by little, all the good of our times will be lost and forgotten."

Reflections by community members during the thematic discussions

AT A GLANCE

This study characterised the food system of the Maya Ch'orti' in eastern Guatemala who refer to themselves as a ***campesino pueblo***, which is also the name of the rural farming villages in which they live. The Maya Ch'orti' are one of the ancestral Maya ethnic groups in the area. The current food system has evolved under an ancestral model based on respect for life in all its forms and natural resources. The diets of Ch'orti' communities are largely sustained by mixed agroforestry, home gardens, ***milpa*** production systems and the gathering of wild foods. Communities are custodians of local agrobiodiversity, continue to have closed-loop systems of biodegradable household waste cycling, and maintain a profound knowledge of multi-use plant species. The Ch'orti' face many challenges, including those created by climate change, that are contributing to the breakdown of traditional ways and increasing instances of crop loss. Notably, a transition of the ***milpa*** system from an ecologically self-regulating plot with multiple yields to a low-diversity model with high off-farm inputs has reduced the availability of food for household nutrition. Strong values based in community well-being, trust, respect of natural resources and alternative trade networks have helped provide safety nets in times of scarcity. Inclusive self-organization bolsters sustainability of the system using ancestral principles, where decisions are made through community consultation and voluntary leaders who are elected based on merit and focus on the collective welfare. This system has increased representation of rural villages at a regional scale to protect and manage communal forests, rivers and other natural resources. Perspectives for a brighter future rest with young generations and their active engagement in building inclusive communities with better livelihoods and enough resources to have a ***"buen vivir"*** (good living).

SECTION 1 COMMUNITY AND FOOD SYSTEM PROFILE

1. GEOGRAPHIC CONTEXT

This study was conducted in the Department of Chiquimula, Guatemala with six Maya Ch'orti' communities situated in three municipalities – Camotán, Jocotán and Olopa (Figure 8.1). The Department of Chiquimula falls within the dry corridor of Central America. The vegetation in the study area is a mix of tropical temperate rainforest (100 percent of Olopa), subtropical humid forest (75 percent of Camotán and 80 percent of Jocotán), subtropical dry forest (15 percent of Jocotán and 25 percent of Camotán), and subtropical thorn bush (5 percent of Jocotán). Rainfall in the tropical temperate rainforest zones is around 1 300 mm annually with temperatures around 15 °C. The subtropical humid forest zones receive between 1 100 mm and 1 350 mm precipitation annually and have temperatures ranging between 20 °C and 26 °C. Areas of subtropical dry forest receive much less rainfall, from 500 mm to 855 mm annually, with temperatures ranging from 19 °C to 34 °C. The subtropical thorn bush has annual rainfall of 400 mm to 600 mm and temperatures ranging from 24 °C to 36 °C.

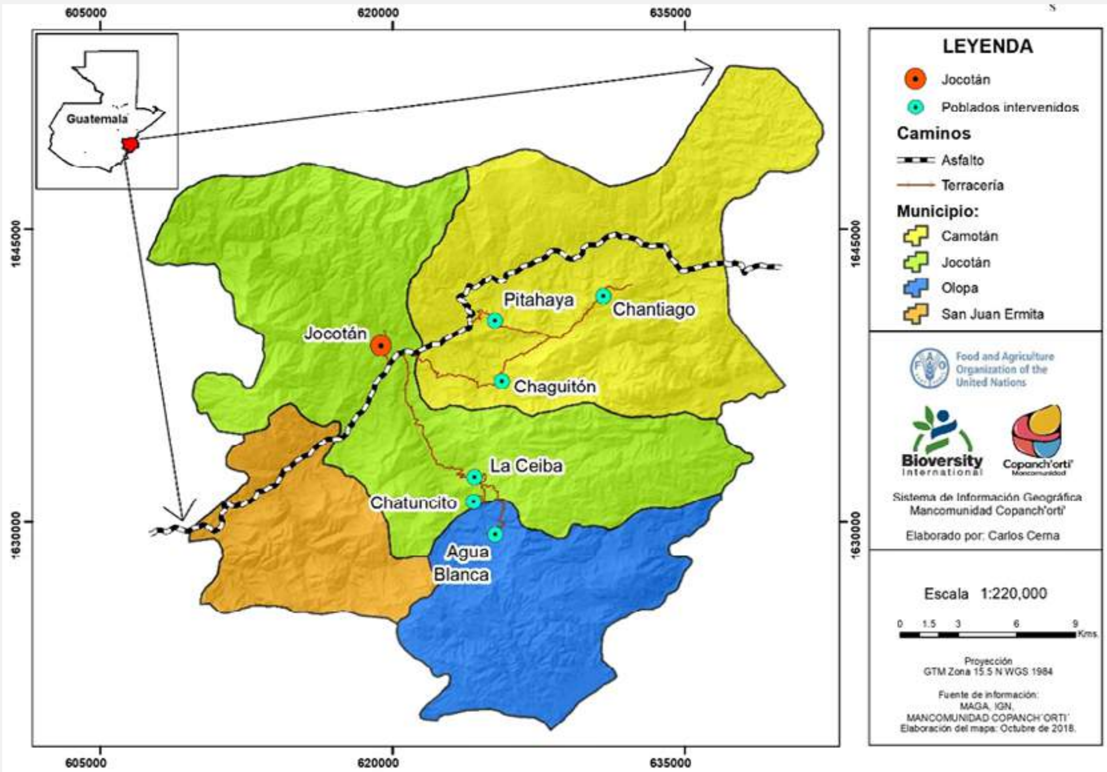
The topography of Chiquimula is rugged, consisting of a combination of hills and mountains sloping steeply down into river valleys. Despite frequently experiencing drought conditions, the Ch'orti' region is considered to have abundant water resources. The municipality of Jocotán has five rivers and 30 tributaries, the most important being the Rio Grande. The participating communities were situated in different altitudinal zones ranging from the lowlands situated below 760 metres above sea level (masl) to the highlands located above 1 200 masl: Caserío Pitahaya, Nearar (hereon referred to as Pitahaya) at 760 masl; Caserío Chagüitón, Dos Quebradas (hereon referred to as Chagüitón) at 815 masl; Caserío Chantiago, El Rodeo (hereon referred to as Chantiago) at 880 masl; Caserío Chatuncito, Tunucó Arriba (hereon referred to as Chatuncito) at 1 000 masl; Caserío La Ceiba, Tunucó Arriba (hereon referred to as La Ceiba) at 1 050 masl; and Agua Blanca at 1 550 masl.

2. LOCAL DEMOGRAPHICS AND SOCIAL ORGANIZATION

At present, the Ch'orti' population of Guatemala is based almost entirely in the Department of Chiquimula spanning across the municipalities of Jocotán, Camotán, Olopa, San Juan Hermitage and Quetzaltepeque. Of the municipalities participating in the study, Jocotán is the most populous (69 519 people; 80 percent Ch'orti'), followed by Camotán (51 940 people; 60 percent Ch'orti') and Olopa (28 268 people; 65 percent Ch'orti'). Ch'orti' populations tend to live in rural areas, whilst the urban centres are dominated by Ladino populations. The dominant language in the Ch'orti' region is Spanish, whilst the Ch'orti' ancestral languages, such as Ch'orti' or Apay, are spoken almost exclusively in remote villages and homesteads. The religion in Ch'orti' villages is mostly Catholic, though many continue to practise ceremonies of their traditional Maya cosmovision regardless of religious affiliations.

A typical Ch'orti' household consists of a couple, man and wife, and their dependent children who live together in one house and commonly as part of a cooperating multi-household unit where each family is entitled to an equal share of their ancestral land. Whilst there are economic and social differences amongst individuals and households, the Ch'orti' communities do not have a distinct social class system. Social standing is primarily based on merit; therefore highly skilled artisans and those with special knowledge, such as healers and midwives,

FIGURE 8.1. Map of the six collaborating sites with municipal borders



Source: MAGA, 2018. Modified by Carlos Cerna and the authors, 2019.

are respected members of society. The highest authority of each community is the President of the Consejos Comunitarios de Desarrollo Rural (COCODES) or the elected auxiliary mayor who represents the community to the municipality.

3. LOCAL FOOD PRODUCTION

The Ch'orti' call themselves a ***campesino pueblo*** who have been dedicated for millennia to agricultural production of the basic foods in the diet, primarily ***maíz*** (*Zea mays*, maize), ***frijoles*** (*Phaseolus vulgaris*, beans) and squashes (*Cucurbita* spp.). The main ways in which the community generates food is from the ***milpa***, the patios (home gardens), productive live fences and maintained communal forest areas.

Crops

Ch'orti' communities consider the ***milpa*** the most important part of the food system as it is the primary source for the staples of their diet: maize and beans. The importance of the ***milpa*** is grounded in the creation myth of the Maya, which states that humanity was created from maize. The defining characteristics of the ***milpa*** are the production of maize, beans and squashes on a cleared plot. Practices in ***milpa*** production vary within the territory from more "modern" high-input, homogeneous models to more traditional methods that integrate other production elements. Traditional techniques include the use of alley cropping with trees or shrubs such as ***madre de cacao*** (*Gliricidia sepium*, gliricidia), ***chipilín*** (*Crotalaria longirostrata*,

Diverse ***milpa*** in Jocotán.

© Universidad del Valle de Guatemala/Silvana Maselli.

chipilin), ***chatate*** (*Cnidoscolus aconitifoliustree*, spinach) and ***izote*** (*Yucca gigantea* Lem., Asparagaceae) to encourage an understory of wild edible and medicinal plants, as well as interplanting with a variety of species such as ***güisquil*** (*Sechium edule*, chayote), ***palo de pito*** (*Erythrina berteroana*), ***muta*** (*Bromelia* spp.), ***piña*** (*Ananas comosus*, pineapple), a variety of chilies (*Capsicum* sp.), ***sandia*** (*Citrullus lanatus*, watermelon) and ***camote*** (*Ipomoea batatas*, sweet potato). Productive living fences are composed of multipurpose trees, bushes and thorny plants (*Bromelia* spp. and/or *Agavaceae* spp.) that provide a barrier to delineate between ***milpas*** and households, whilst also including species with food uses.

Analogous to a home garden, the patios are located in close proximity to the home and vary in size depending on the availability of land and number of family members. Patios tend to have four levels of production. The first level includes tubers and underground bulbs such as ***malanga*** (*Xanthosoma sagittifolium*, arrowleaf elephant ear), sweet potato and chayote. The second level consists of low plants, including bush beans, ***garbanzo*** (*Cicer arietinum*, chickpea), ***hierba mora*** (*Solanum americanum* and *Solanum nigrescens*, black nightshade), ***bledo*** (*Amaranthus viridis*, slender amaranth), tomato (*Solanum lycopersicum*), chilies, herbs, and small ***milpas*** from which fresh ears of maize may be eaten. The third level includes shrubs and medium-sized trees such as ***café*** (*Coffea* spp., coffee), tree spinach, chipilin, ***higos*** (*Ficus carica*, fig), ***anona*** (*Annona reticulata*, custard-apple), citrus fruits (*Citrus* sp.), papaya (*Carica papaya*), guava (*Psidium guajava*) and cacao (*Theobroma cacao*). The fourth level includes high canopy trees such as ***zapote*** (*Pouteria sapota*), ***sunza*** (*Licania platypus*), tamarind (*Tamarindus indica*), ***conacaste*** (*Enterolobium cyclocarpum* (Jacq.) Griseb., Fabaceae), teak (*Tectona grandis* L.f., Lamiaceae), ceiba (*Ceiba* sp., Malvaceae) and roof palms (*Attalea cohune* Mart., Arecaceae).

TABLE 8.1. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Local name	Scientific name	English name
Condiments, seasonings, snacks, and sweeteners	***chili***	*Capsicum* sp. L., Solanaceae	Chilis
	cilantro	*Coriandrum sativum* L., Apiaceae	Coriander
	te de limon	*Cymbopogon* spp., Poaceae	Lemongrass
	culantro de tripa	*Eryngium foetidum* L., Apiaceae	Mexican coriander
	orégano mexicano	*Lippia graveolens* Kunth, Verbenaceae	Mexican oregano
	hierba buenabuena	*Mentha spicata* L., Lamiaceae	Mint
	albahaca de monte	*Ocimum campechianum* Mill., Lamiaceae	Mountain basil
	orégano de castillo	*Origanum vulgare* L., Lamiaceae	Oregano
	orégano cubano	*Plectranthus amboinicus* (Lour.) Spreng., Lamiaceae	Cuban oregano
	cana de azucar	*Saccharum officinarum* L., Poaceae	Sugar cane
	salvia	*Salvia divinorum* Epling & Játiva, Lamiaceae	Seer's sage
Fruits and juices	***coyol***	*Acrocomia aculeata* (Jacq.) Lodd. ex Mart., Arecaceae	Coyol palm
	guanava	*Annona muricata* L., Annonaceae	Soursop
	sincuya	*Annona purpurea* Moc. & Sessé ex Dunal, Annonaceae	Sincuya
	anona blanca	*Annona reticulata* L., Annonaceae	Custard apple
	piñuela	*Bromelia pinguin* L., Bromeliaceae	–
	nance	*Byrsonima crassifolia* (L.) Kunth, Malpighiaceae	Nance, craboo
	papaya criolla*	*Carica papaya* L., Caricaceae	Papaya
	matasano	*Casimiroa edulis* La Llave, Rutaceae	Mexican apple
	sandia	*Citrullus lanatus* (Thunb.) Matsum. & Nakai, Cucurbitaceae	Watermelon
	limon criollo	*Citrus aurantiifolia* (Christm.) Swingle, Rutaceae	Lime
	naranja agria	*Citrus × aurantium* L., Rutaceae	Bitter orange
	limon persa	*Citrus × latifolia* (Yu.Tanaka) Yu.Tanaka, Rutaceae	Persian lime
	limon real	*Citrus limon* (L.) Osbeck, Rutaceae	Lemon
	mandarina	*Citrus reticulata* Blanco, Rutaceae	Mandarine
	naranja	*Citrus sinensis* (L.) Osbeck, Rutaceae	Orange
	cocos	*Cocos nucifera* L., Arecaceae	Coconut
	melón*	*Cucumis melo* L., Cucurbitaceae	Melon
	níspero*	*Eriobotrya japonica* (Thunb.) Lindl., Rosaceae	Loquat
	higos	*Ficus carica* L., Moraceae	Fig
	paternas	*Inga edulis* Mart., Fabaceae	Ice cream bean
	sunza*	*Licania platypus* (Hemsl.) Fritsch, Chrysobalanaceae	Sunza
	mamey*	*Mammea americana* L., Calophyllaceae	Mamey apple
	mango*	*Mangifera indica* L., Anacardiaceae	Mango
	chicosapote	*Manilkara zapota* (L.) P.Royen, Sapotaceae	Sapodilla
	mamon	*Melicoccus bijugatus* Jacq., Sapindaceae	Spanish lime
	noni	*Morinda citrifolia* L., Rubiaceae	Indian mulberry
	tuna	*Opuntia ficus-indica* (L.) Mill., Cactaceae	Prickly Pear
	granadilla criollo	*Passiflora ligularis* Juss., Passifloraceae	Sweet granadilla

TABLE 8.1. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Local name	Scientific name	English name
Fruits and juices	***aguacate***	*Persea americana* Mill., Lauraceae	Avocado
	chucte	*Persea schiedeana* Nees, Lauraceae	Coyo
	zapote amarillo*	*Pouteria campechiana* (Kunth) Baehni, Sapotaceae	Egg fruit
	sapotillo*	*Pouteria durlandii* (Standl.) Baehni, Sapotaceae	-
	mamey zapote	*Pouteria sapota* (Jacq.) H.E.Moore & Stearn, Sapotaceae	Mamey sapote
	guava	*Psidium guajava* L., Myrtaceae	Yellow guava
	coyol de gato	*Solanum ferox* L., Solanaceae	Indian nightshade
	jocote*	*Spondias mombin* L., Anacardiaceae	Hog plum
	pitaya	*Stenocereus queretaroensis* (F.A.C.Weber ex Mathes.) Buxb., Cactaceae	Pitaya
	tamarindo	*Tamarindus indica* L., Fabaceae	Tamarind
	cacao	*Theobroma cacao* L., Malvaceae	Cacao
Mushrooms	***sharas***	*Lactarius deliciosus* (L.) Gray, Russulaceae	Saffron milkcap mushroom
	sosa	*Ustilago maydis* (DC.) Corda, Ustilaginaceae	Maize smut
Nuts and seeds	***marañón***	*Anacardium excelsum* (Bertero ex Kunth) Skeels, Anacardiaceae	Cashew
	mani	*Arachis hypogaea* L., Fabaceae	Peanut
	achiote	*Bixa orellana* L., Bixaceae	Annatto
	morro	*Crescentia alata* Kunth, Bignoniaceae	Winged calabash
	pepitoria	*Cucurbita* sp., Cucurbitaceae	Pumpkin seed
	chan	*Salvia hispanica* L., Lamiaceae	Chia
	almendro malabar	*Terminalia catappa* L., Combretaceae	Sea almond
Pulses	***frijol de palo***	*Cajanus cajan* (L.) Millsp., Fabaceae	Pigeon pea
	garbanzo	*Cicer arietinum* L., Fabaceae	Chickpea
	frijol furuna or ***piloy***	*Phaseolus lunatus* L., Fabaceae	Lima bean
	frijoles	*Phaseolus vulgaris* L., Fabaceae	Common bean
	haba	*Vicia faba* L., Fabaceae	Fava bean
	frijol arroz	*Vigna umbellata* (Thunb.) Ohwi & H.Ohashi, Fabaceae	Rice bean
	frijol perome	*Vigna unguiculata* (L.) Walp., Fabaceae	Cowpea
Starches	***amaranto***	*Amaranthus cruentus* L., Amaranthaceae	Amaranth
	camote^	*Ipomoea batatas* (L.) Lam., Convolvulaceae	Sweet potato
	yuca	*Manihot esculenta* Crantz, Euphorbiaceae	Cassava
	arroz	*Oryza sativa* L., Poaceae	Rice
	ichintal, güisquil	*Sechium edule* (Jacq.) Sw., Cucurbitaceae	Chayote root
	papas	*Solanum tuberosum* L., Solanaceae	Potato
	sorgo	*Sorghum bicolor* (L.) Moench, Poaceae	Sorghum
	malanga	*Xanthosoma sagittifolium* (L.) Schott, Araceae	Arrowleaf elephant ear
	maíz	*Zea mays* L., Poaceae	Maize, corn
Stimulants	***café***	*Coffea* spp., Rubiaceae	Coffee

TABLE 8.1. List of cultivated foods: crops, planted trees and other cultivated foods

Group	Local name	Scientific name	English name
Vegetables	***okra***	*Abelmoschus esculentus* (L.) Moench, Malvaceae	Okra
	cebolla	*Allium cepa* L., Amaryllidaceae	Onion
	ajo	*Allium sativum* L., Amaryllidaceae	Garlic
	guisquilete	*Amaranthus dubius* Mart. ex Thell., Amaranthaceae	Spleen amaranth
	dante, white quilete	*Amaranthus hybridus* L., Amaranthaceae	Slim amaranth
	amarantho	*Amaranthus* sp. L., Amaranthaceae	Amaranth leaves
	bledo	*Amaranthus viridis* L., Amaranthaceae	Slender amaranth
	apio	*Apium graveolens* L., Apiaceae	Celery
	palmito	*Attalea* sp., Arecaceae	Heart of palm
	remolacha	*Beta vulgaris* L., Amaranthaceae	Beet
	piñuela	*Bromelia pinguin* L., Bromeliaceae	Bromelia heart
	chili*	*Capsicum* sp. L., Solanaceae	Chilis, peppers
	pacaya de palma	*Chamaedorea elegans* Mart., Areaceae	Palm inflorescence
	chatate	*Cnidoscolus aconitifolius* (Mill.) I.M.Johnst., Euphorbiaceae	Mayan spinach; tree spinach; chaya
	chipilín	*Crotalaria longirostrata* Hook. & Arn., Fabaceae	Chipilin
	chili cayote	*Cucurbita ficifolia* Bouché, Cucurbitaceae	Fig leaf gourd
	ayote	*Cucurbita* sp., Cucurbitaceae	Squash leaves, shoots
	ayote*	*Cucurbita* sp., Cucurbitaceae	Pumpkin, squash
	flor de ayote	*Cucurbita* sp., Cucurbitaceae	Pumpkin flower
	zanahoria*	*Daucus carota* L., Apiaceae	Carrot
	apasote	*Dysphania ambrosioides* (L.) Mosyakin & Clemants, Amaranthaceae	Wormseed
	flor y palo de pito	*Erythrina berteroana* Urb., Fabaceae	Coraltree flower, shoots
	loroco	*Fernaldia pandurata* (A.DC.) Woodson, Apocynaceae	Loroco flowers
	madre de cacao	*Gliricidia sepium* (Jacq.) Walp., Fabaceae	Gliricidia flower
	moringa	*Moringa oleifera* Lam., Moringaceae	Moringa
	nopal	*Opuntia ficus-indica* (L.) Mill., Cactaceae	Prickly pear pad
	miltomates*	*Physalis ixocarpa* Brot. ex Hornem., Solanaceae	Tomatillo
	santa maria	*Piper auritum* Kunth, Piperaceae	Mexican pepperleaf
	quisquil	*Sechium edule* (Jacq.) Sw., Cucurbitaceae	Chayote leaves, shoots
	guisquil, chayote	*Sechium edule* (Jacq.) Sw., Cucurbitaceae	Chayote
	hierba mora	*Solanum americanum* Mill., Solanaceae and *Solanum nigrescens M. Martens & Galeotti*	Black nightshade
	tomate fino^	*Solanum lycopersicum* L., Solanaceae	Cherry tomato

*Part of "other Vitamin-A-rich" food group; ˆ includes Vitamin-A-rich varieties

Livestock

In productive patios, families keep several domestic animals, such as ***gallina*** (*Gallus gallus domesticus*, chicken), ***pato*** and ***pato criollo*** (*Anas platyrhynchos; Cairina moschata*, ducks) and ***pijije*** (*Dendrocygna autumnalis*, black-bellied whistling-duck), ***chompipe*** (*Meleagris gallopavo*, turkey) and ***cerdo*** (*Sus scrofa domesticus*, pig), as well as hives of ***meliponas*** (*Melipona* spp., stingless honeybees). Bee swarms are collected in the landscape to keep in the patio or even in the house. In rare cases, families may have one or more ruminant such as cows (*Bos taurus*), goats (*Capra hircus aegagrus*) or sheep (*Ovis aries*). The meat obtained from domestic animals is mostly consumed fresh with the exception of pig lard and some that is salted and dried in the sun. Pig blood is sometimes collected during slaughter then boiled with ***cebolla*** (*Allium cepa*, onions), ***ajo*** (*Allium sativum*, garlic) and other spices and encased in the intestines like sausage. Animals are free to forage in the patios and are mostly fed household food scraps. Households also gather available leaves and grasses for forage from live fences, patios and communal lands next to roads, especially of ***moringa*** (*Moringa oleifera*), ***madre de cacao***, tree spinach, ***malanga***, Mexican sunflower (*Tithonia diversifolia* (Hemsl.) A. Gray, Asteraceae), and ***bejuco campanilla*** (*Ipomoea grandifolia* (Dammer) O'Donell, Convolvulaceae). Forage is complemented by fallen fruits and fresh or nixtamalized maize.

TABLE 8.2. List of livestock

Group	Local name	Scientific name	English name
Birds and poultry	***pato***	*Anas platyrhynchos domesticus* L., Anatidae	Domestic ducks
	pato criollo	*Cairina moschata* L., Anatidae	Muscovy duck
	palomas	*Columba livia* Gmelin, Columbidae	Rock dove
	tortolitas	*Columbina talpacoti* Temminck, Columbidae	Ground dove
	codorniz	*Coturnix coturnix* L., Phasianidae	Quail
	pijije	*Dendrocygna autumnalis* L., Anatidae	Black-bellied whistling-duck
	gallina	*Gallus gallus domesticus* L., Phasianidae	Chicken
	chompipe	*Meleagris gallopavo* L., Phasianidae	Turkey
	coquechas	*Numida meleagris* L., Numididae	Guinea fowl
Insects and insect products (beekeeping)	***abeja***	*Apis mellifera* L., Apidae	Honey bees
	meliponas	*Melipona* spp. Illiger, Apidae	Stingless honeybees
Mammals	***vaca***	*Bos taurus* L., Bovidae	Cow
	cabra	*Capra hircus aegagrus* Erxleben., Bovidae	Goat
	pelibuey	*Ovis aries* L., Bovidae	Pelibuey sheep
	cerdo	*Sus scrofa domesticus* Erxleben, Suidae	Pig

Aquaculture

Whilst it is not common practice, rarely patios will have small aquaculture systems that produce freshwater snails or fish for household consumption and trade. One household in La Marimba, a village next to Chagüitón, produces ***tilapia*** (*Oreochromis niloticus*) in a patio aquaculture system for sale in the community. Another aquatic production method used by a community member in their patio diverts grey water into various filtration pools at different levels to raise ***jute*** and ***caracol*** (*Bithynia tentaculata; Pomacea maculate*, snails), ***tilapia, berro de agua*** (*Nasturtium officinale*, watercress) and ***santa maria*** (*Piper auritum*, Mexican pepperleaf).

TABLE 8.3. List of species from aquaculture system: fish, invertebrates and leafy vegetables

Group	Local name	Scientific name	English name
Fish	***tilapia***	*Oreochromis niloticus* L., Cichlidae	Tilapia
Molluscs and crustaceans	***jute***	*Bithynia tentaculata* L., Bithyniidae	Faucet snails
	caracol	*Pomacea maculata* Perry, Ampullariidae	Freshwater snail
Vegetables	***berro de agua***	*Nasturtium officinale* W.T. Aiton, Brassicaceae	Watercress
	santa maria	*Piper auritum* Kunth, Piperaceae	Mexican pepperleaf

Wild edibles

Wild gathered plants have a vital importance to everyday life in Ch'orti' communities. Locally gathered crops, and especially green leafy vegetables, are considered to be of superior quality and value is placed on them in markets, where they cost more than cultivated crops. Wild edibles are collected from the wild, from patios or living fences, and along the edges of walking paths and roadsides. Women specialized in wild mushroom harvesting maintain rich knowledge of the place and time when fruiting occurs. Given the perishability and quantity of mushrooms harvested at one time, they are often shared in the community or taken to the market of Jocotán. Honey is also collected from the landscape where bees have established hives.

TABLE 8.4. List of wild edibles

Group	Local name	Scientific name	English name
Fruits and juices	***sincuya***	*Annona purpurea* Moc. & Sessé ex Dunal, Annonaceae	Sincuya
	nance	*Byrsonima crassifolia* (L.) Kunth, Malpighiaceae	Nance, craboo
	papaya silvestre*	*Carica quercifolia* (A.St.Hil.) Hieron., Caricaceae	Oak leaved papaya
	cuje	*Inga vera* subsp. *spuria* (Willd.) J.Leon, Fabaceae	Ice cream bean
	mamon	*Melicoccus oliviformis* Kunth, Sapindaceae	Wild guaya
	aguacate	*Persea americana* Mill., Lauraceae	Avocado
	chuctes	*Persea schiedeana* Nees, Lauraceae	Coyo
	guayava	*Psidium guajava* L., Myrtaceae	Yellow guava
Mushroomst	***hongos de San Juan***	*Amanita caesarea* (Scop.) Pers., Amanitaceae	Caesar's mushroom
	canturul, xaras	*Cantharellus* sp. *Adans* ex Fr., Cantharellaceae	Chanterelle mushroom
	azadones	*Pseudofistulina radicata* (Schwein.) Burds., Fistulinaceae	-
	pata de gallo	*Ramaria botrytis* (Pers.) Bourdot, Gomphaceae	Clustered coral mushroom
Starches	***yuca silvestre***	*Manihot esculenta* Crantz, Euphorbiaceae	Wild cassava
	malanga	*Xanthosoma sagittifolium* (L.) Schott, Araceae	Arrowleaf elephant ear
Vegetables	***guisquilete***	*Amaranthus dubius* Mart. ex Thell., Amaranthaceae	Spleen amaranth
	dante, white quilete	*Amaranthus hybridus* L., Amaranthaceae	Slim amaranth
	bledo	*Amaranthus viridis* L., Amaranthaceae	Slender amaranth
	chufle	*Calathea macrosepala* K.Schum., Marantaceae	-

TABLE 8.4. List of wild edibles

Group	Local name	Scientific name	English name
Vegetables	***pacaya montaña***	*Chamaedorea elegans* Mart., Arecaceae	Palm shoots
	chatate	*Cnidoscolus aconitifolius* (Mill.) I.M.Johnst., Euphorbiaceae	Mayan spinach; tree spinach; chaya
	chipilín	*Crotalaria longirostrata* Hook. & Arn., Fabaceae	Chipilin
	loroco	*Fernaldia pandurata* (A.DC.) Woodson, Apocynaceae	Loroco flowers
	hierba mora	*Solanum americanum* Mill., Solanaceae	Black nightshade
	lechuga de conejo	*Sonchus oleraceus* (L.) L., Compositae	Common sowthistle

*Part of "other Vitamin-A-rich" food group; † part of the "other vegetables" food group

Fishing, hunting and trapping

Fishing is seldom practised in the villages but in the summer months, when the water is clear, some young people go out in groups to practise diving and fishing by hand in pools along larger rivers and tributaries. Usually the fish caught are shared amongst the members of the group to be used for family consumption. If more fish are caught than necessary, the catch is shared with neighbours who often return the favour with surplus fruit or other goods later on in the season. The Ch'orti' are a culture specialized in hunting with blowguns, different types of traps, and poisons derived from plant, mineral and animal sources. These practices have nearly completely disappeared and persist only in isolated communities. Though hunting and trapping are now considered more of a hobby, it is still possible to buy the meat of iguanas (*Iguana iguana*), ***tacuazin*** (*Didelphis marsupialis*, opossum) and ***cusuco*** (*Dasypodidae* sp., armadillos) at local markets.

TABLE 8.5. List of wildlife used as food

Group	Local name	Scientific name	English name
Birds and poultry	***palomas***	*Columbidae* spp.	Pigeon
Fish	***guabina***	*Hoplias malabaricus* Bloch, Erythrinidae	Tiger fish
Insects and insects products	***melipona***	*Melipona* spp. Illiger, Apidae	Stingless honeybees
Mammals	***tepezcuintle***	*Cuniculus paca* L., Cuniculidae	Lowland paca
	cusuco	Dasypodidae sp.	Armadillo
	cotuza	*Dasyprocta punctata* Gray, Dasyproctidae	Agouti
	tacuazin	*Didelphis marsupialis* L., Didelphidae	Opossum
	mapache	*Procyon lotor* L., Procyonidae	Raccoon
	ardilla	*Sciurus carolinensis* Gmelin, Sciuridae	Squirrel
Molluscs and crustaceans	***jutes***	*Bithynia tentaculata L., Bithyniidae*	Faucet snail
	congrejo	*Cambarellus spp. Ortmann, Cambaridae*	Freshwater crayfish
	camarón gigante de agua dulce	*Macrobrachium rosenbergii* De Man, Palaemonidae	Giant river prawn
	caracol	*Pomacea maculata* Perry, Ampullariidae	Freshwater snail

TABLE 8.5. List of wildlife used as food

Group	Local name	Scientific name	English name
Reptiles	***garrobo***	*Ctenosaura similis* Gray, Iguanidae	Black iguana
	iguana	*Iguana iguana* L., Iguanidae	Green iguana

4. OTHER LAND-BASED PRODUCTIVE ACTIVITIES

Ch'orti' families produce handicrafts from five main types of material: palm (*Arecaceae* spp.), ***maguey*** (*Agave americana* L., Asparagaceae), ***carrizo*** (*Arundo donax* L., Poaceae), ***tul*** (*Schoenoplectus acutus* (Muhl.) Á.Löve & D.Löve, Cyperaceae), and sand or clay pottery. Palm products include mats, hats, brooms, ropes, bags, fans, baskets, and covers for bottles made from the leaves and buds of palms. Fibres from ***maguey*** leaves are used to make ***pita*** (thread or yarn), with which different handicrafts are made such as hammocks, ropes, nets and bags. ***Carrizo*** is a raw material widely used by artisans in the Ch'orti' region to make baskets of various sizes and containers for weighing basic grains. ***Tul*** is a reed from which the heart, stem and rind are used to create products such as jewelry and mats. Sand and clay are used to make pottery products for domestic use such as pots, ***comales*** (griddles) and jars.

The extraction of natural dyes is a long-held tradition in Ch'orti' communities. Plant-based dyes include indigo (*Indigofera tinctoria* L., Fabaceae) and yellow (*Erythrina berteroana*). Clay-based dyes are red, green, dark yellow and brown. A carmine (dark red) dye is made from cochineal (*Dactylopius coccus* Costa, Dactylopiidae). In remote villages, all the material used for houses is sourced from living fences, patios, ***milpas*** and surrounding forests. Minerals such as adobe and ***bahareque*** (mud or earth) are used as construction materials integrated with wood such as ***cualote*** (*Guazuma ulmifolia* Lam., Malvaceae) and ***zapote*** beams and woven palm. Roofs are often made using roof palm, although metal roofs are becoming more common.

Medicines and poisons are obtained using different plants, animals and minerals measured in carefully determined doses. The crushed leaves from ***madre de cacao*** are used both as poison for rodents and as a remedy for botfly (*Dermatobia hominis* L., Oestridae). Sometimes wild toads are collected to extract bufotoxin as a medicine and to produce poisoned darts for hunting. The mineral calcium oxide is essential for nixtamalization of grains (primarily maize) to improve their digestibility and nutritional content assimilation. Now produced on an industrial scale, the home collection of calcium oxide continues by processing wood ash or stones. This compound is also widely used in the production of clay and pottery.

5. LOCAL CALENDAR

The seasonal calendar of the Ch'orti' is deeply tied to agricultural activities throughout the year. Currently the Ch'orti' use the Gregorian calendar and they recognise two main seasons: the rainy winter season that runs from May to November, with a dry period called the ***canícula*** from June or July until August or even early September, and a dry summer season that runs from December until April. During the year, agricultural activities of Ch'ort'i women focus on the household patios and harvesting of wild mushrooms, and men undertake most of the fieldwork.

The dry summer months are the most difficult for families of the Ch'orti' region because much of the vegetation is desiccated and water sources can be limited if rains were insufficient. During this time, many men and young people will migrate to find sources of employment to sustain their households and earn money to purchase farm inputs for the next planting season. After the migration to neighbouring municipalities such as Camotán, Olopa, Esquipulas, Chiquimula, La Unión in Zacapa and Honduras to harvest coffee, ***naranja*** (*Citrus sinensis*, orange) and ***caña de azucar*** (*Saccharum officinarum*, sugar cane), they return in April to prepare the ***milpas***.

Maya Ch'orti' woman harvesting wild taro at the end of the ***canícula*** season.

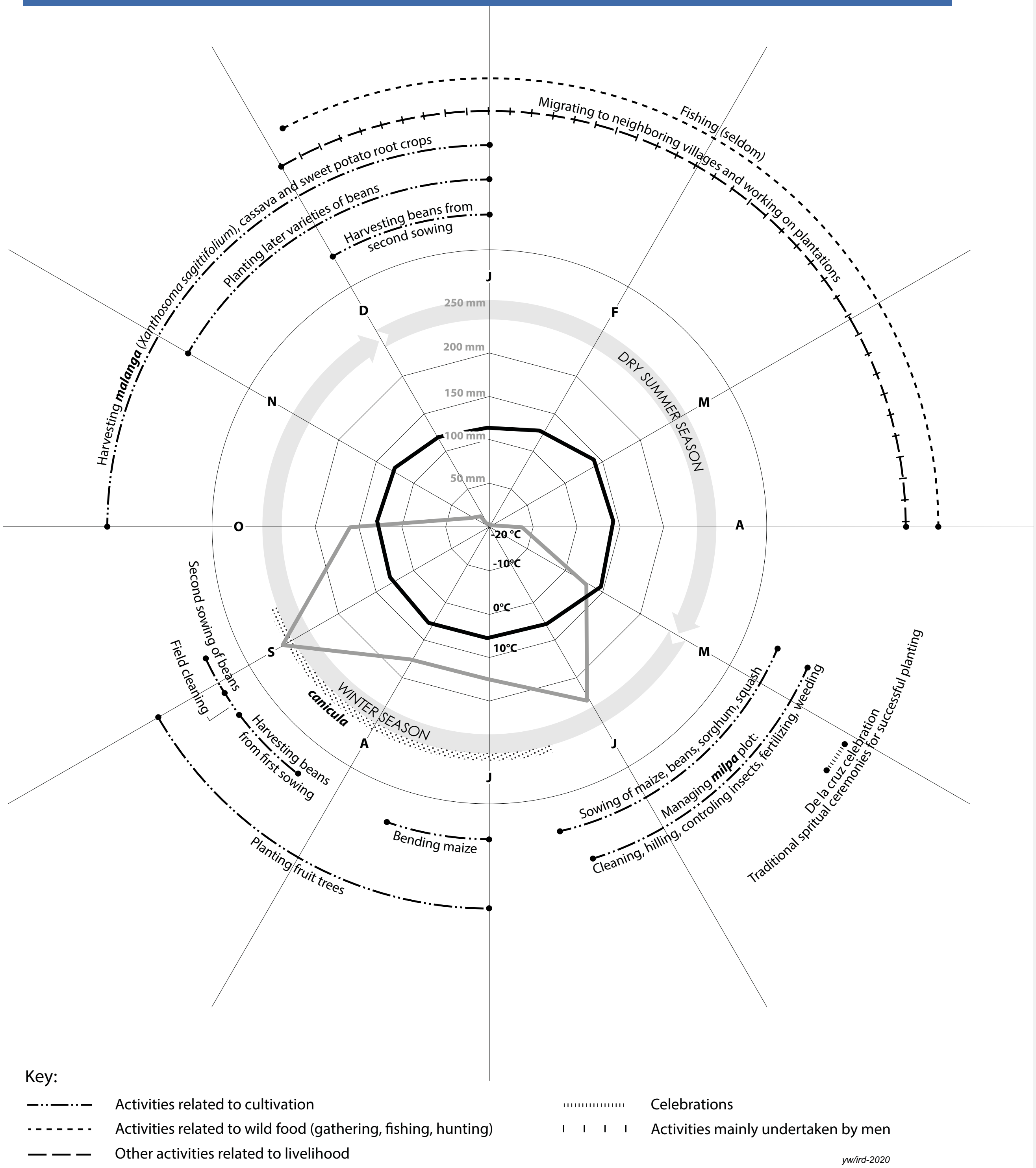
© Alliance of Bioversity International and CIAT/ Carlos Lira.

The song of cicadas in March or April and the emergence of black ants from their hills in April or May are signs of the arrival of the rainy season. Cloud patterns in the skies (for example, when they occur in a woven form or settle on top of mountains and hills) also signify the coming of rains. When a "wheel" is seen around the sun, the people know that the rains will begin in three to five days. The rains typically start in April or May and are crucial for establishing annual crops. Households plan their planting cycles depending on when the initial rains fall. Most villagers wait for two heavy rainfalls so that the soil has enough moisture for the maize seed to germinate. Others follow the moon phases for planting, regardless of soil moisture.

On the third day of May, many residents hold a "De La Cruz" celebration at church to ensure a successful planting and sufficient production in the rainy season. During this time, households also perform traditional spiritual ceremonies for the same purpose that consist of feeding the earth so it has the strength to produce; they dig a hole and deposit an offering of traditional toasted maize called ***chilate***. The first sowing of maize, beans, ***sorgo*** (*Sorghum bicolor*, sorghum) and squash in the ***milpa*** usually takes place at the end of April or May, but it can take place as late as June. Cooler weather and rains in the winter season stimulate growth of local spontaneous herbs. During this time, the whole family keeps busy, with men working at least four days a week to manage the ***milpa*** by cleaning, hilling, controlling insects, applying fertilizer, or weeding and helping other families as well.

With the arrival of the ***canícula*** in July and August, lowland farmers bend the maize plants in the ***milpa*** so that resuming rains cannot penetrate the husks and rot the grains. Signs indicating the end of the ***canícula*** are observed in clouds and insects. During this time, farmers harvest the beans from the first sowing and clean the land for the second sowing in the alleys of the maize furrows. Fruit trees are also planted during the ***canícula***, as the soil has moisture and the longest period of rains will follow. In October to December, root crops like ***malanga***, ***yuca*** (*Manihot esculenta*, cassava) and sweet potato can be harvested; from December to January, the second bean crop is harvested. Later varieties of dry beans are planted through November and December. The end of winter in November is signified either by a dark cloud formation known as ***argenia*** or by the song of the ***guaco*** bird (*Herpetotheres cachinnans* L., Falconidae).

FIGURE 8.2. Average annual rainfall (mm) and temperature (°C) in Camotán and seasonal activities by the Ch'orti' in the six collaborating sites (elaborated by Yanto Wahyantono, IRD, 2020)



6. MARKET SOURCING AND TRADE

Currently households purchase almost half of what is consumed in the home. The Jocotán market is the commercial centre of the food system, as it is the only market within a reasonable distance to the communities. Goods from surrounding villages are offered every day in the main square and especially on Sundays, as after mass it is customary to purchase food for the week. The Jocotán market offers a wide selection of products that come from the municipalities of Camotán, Jocotán, San Juan Ermita and Olopa, as well as from Guatemala City, Honduras and El Salvador. Two supermarkets in Jocotán – El Oasis and the Family Pantry – offer processed food products. The products fabricated with industrial processes come primarily from Guatemala City. Market-sourced food products ranked as having the highest importance to households are salt, ***limon persa*** (*Citrus × latifolia*, lime), maize, beans, onions, carrots, ***rapollo*** (*Brassica oleracea*, cabbage), oil, soap and detergent. In addition to foods, shops in Jocotán offer products for construction, tools, medicines, agroindustry, shoes, clothes, appliances and technological products.

TABLE 8.6. List of edibles sourced from the market

Group	Local name	Scientific name	English name
Birds and poultry	***pollo***	*Gallus gallus domesticus* L., Phasianidae	Chicken
	chompipe	*Meleagris gallopavo* L., Phasianidae	Turkey
Condiments, seasonings, snacks and sweeteners	***azúcar***	*Beta vulgaris* L., Amaranthaceae or *Saccharum officinarum* L., Poaceae	Sugar cane
	aceites	*Helianthus annuus* L., Compositae and *Glycine max* (L.) Merr., Fabaceae	Cooking oils
	sal		Salt
Dairy	***crema, queso***	*Bos taurus* L., Bovidae	Cheese, curds, crème fraîche
Fruits and juices	***piña***	*Ananas comosus* (L.) Merr., Bromeliaceae	Pineapple
	sandia	*Citrullus lanatus* (Thunb.) Matsum. & Nakai, Cucurbitaceae	Watermelon
	limón persa	*Citrus × latifolia* (Yu.Tanaka) Yu.Tanaka, Rutaceae	Persian lime
	Manzana	*Malus domestica* Borkh., Rosaceae	Apple
	lichas	*Nephelium lappaceum* L., Sapindaceae	Rambután
Mammals	***res***	*Bos taurus* L., Bovidae	Beef
	cusuco	Dasypodidae sp.	Armadillo
	tacuazin	*Didelphis marsupialis* L., Didelphidae	Opossum
Pulses	***frijoles***	*Phaseolus vulgaris* L., Fabaceae	Common bean
Reptiles	***iguana***	*Iguana iguana* L., Iguanidae	Green iguana
Starches	***yuca silvestre***	*Manihot esculenta* Crantz, Euphorbiaceae	Wild cassava
	pan	*Triticum aestivum* L., Poaceae	Bread
	malanga	*Xanthosoma sagittifolium* (L.) Schott, Araceae	Arrowleaf elephant ear
	maíz	*Zea mays* L., Poaceae	Maize, corn
Vegetables	***remolacha***	*Beta vulgaris* L., Amaranthaceae	Beet
	repollo brocoli*	*Brassica oleracea* L., Brassicaceae	Cabbage, broccoli
	zanahoria*	*Daucus carota* L., Apiaceae	Carrot

*Vitamin-A-rich

Whilst Maya Ch'orti' communities are relatively close to the market in Jocotán, transportation costs depend on the remoteness of the village or hamlet, and physical barriers such as road quality can be prohibitive to move products and people with regularity. Self-determined travel on back roads is conducted almost exclusively by walking or taking unregulated, privately owned pickup trucks that act as an informal bus system, allowing villagers to ride in the back for a fee. The towns of Olopa, Quetzaltepeque, Esquipulas and Chiquimula also have small municipal markets but, as they are further, the transport prices increase by approximately GTQ 20–30[44] round trip, making the trip less feasible. Informal trade for goods and services in the communities is common, and gifting and loans of goods and services are common practices depending on availability and need.

TABLE 8.7. Travel time and cost from villages to the principle market of Jocotán

Community	Time to travel to Jocotán	Cost per person (round trip)
Chagüitón	45 minutes	GTQ 20
Pitahaya	30 minutes	GTQ 25
Chantiago	80 minutes	GTQ 30
La Ceiba	60 minutes	GTQ 30
Chatuncito	100 minutes	GTQ 45
Agua Blanca	110 minutes	GTQ 50

Equivalent to: USD 2.6 (GTQ 20); USD 3.2 (GTQ 25); USD 3.9 (GTQ 30); USD 5.8 (GTQ 45); USD 6.5 (GTQ 50).

7. COMMUNITY HISTORY AND FOOD SYSTEM TRANSITIONS

Through interpretation of ancient artifacts such as the glyphs on stelae, vessels and inscriptions, as well as oral and written histories, it is known that the ancestral territory of the Maya was divided by its cardinal points into four large territories. The eastern territory was known as the Señorio Ch'orti', or Señorio de Payaqui, or Chiquimulja and it had its cultural centre in the city of Copantl – the modern-day city of Copan in Honduras (Christenson, 2007). Ch'orti' is the name that currently describes the Indigenous People of this extensive eastern territory, now divided by modern political borders and spanning three countries of Central America – Guatemala, Honduras and El Salvador. The Ch'orti' are closely related to the lowland Maya (in the Yucatán Peninsula and Belize) and considered united under the Classic Maya culture (Metz, McNeil and Hull, 2009).

It is hypothesized that prior to colonization, Ch'orti' populations had started farming at higher elevations in the mountains to increase production (Metz, McNeil and Hull, 2009; Sanders and Murdy, 1982; Veblen, 1982). The Señorío Ch'orti' was formidable in resisting the Spanish until around 1530, when the Spanish conquest of Copantl broke the territorial alliance and placed colonists in positions of power. The Spanish system forced local populations to become labourers, sharecroppers or indentured servants, or to flee into the mountains (Girard, 1949; Terga Citrón, 1980). The Ch'orti' were heavily taxed and received lower wages than mestizos and creoles (Melchor Toledo, 2011). Despite colonialization, the Ch'orti' people remained organised as evidenced by their ability to purchase back 635 cavalries (70 000 hectares) of their seized territory from the King of Spain (Mendoza Lopez, 2017).

The court of Cadiz in Spain suspended all taxation on Indigenous Peoples in 1820, releasing Ch'orti' people from imposed obligations. In

[44] Equivalent to USD 2.6-3.9. Applying the UN Operational Rate of Exchange of 1 October 2018 (1 USD = 7.70245 GTQ). This rate will apply throughout the entire chapter.

1821, Guatemala became independent from Spain and by 1825 in present day Izabal, the Louisiana Treaty divided the Ch'orti' ancestral territory across the borders of Guatemala, Honduras and El Salvador. In 1837, an attempt was made to restore taxes to the Indigenous Peoples that was rejected by Rafael Carrera and his supporters, leading to a revolution with broad support from the Mayan peoples, including the Ch'orti'. Carrera, who was half indigenous and half mestizo, established protective measures for indigenous territory with the foundation of the Republic of Guatemala on 21 March 1847 and he governed until his death in 1865. There was political chaos for the next five years until 1871, when the liberals led by Justo Rufino Barrios and Miguel García Granados came into political power. This period brought the development of large industry and primarily agricultural exports, leading to seizure of communal and rented lands for large-scale production of coffee, tobacco, sugar, rice, maize and fibres (Dary, Elias and Reyna, 1998).

Despite continuing political shifts, following the death of Barrios in 1885, the Ch'orti' supported and maintained a robust local economy with knowledge and values of their culture, as evidenced by the writings of Charles Wisdom in The Ch'orti' Indians of Guatemala (1940). Despite facing many challenges, Wisdom recounts that in 1930, the Ch'orti' were almost completely self-sufficient and religiously independent. A testament to the resilience and economic value of the Ch'orti' is demonstrated by Wisdom's observation that although the Government of Guatemala had retired the silver peso in favour of the paper quetzal in 1925, it was not accepted by the Ch'orti' and the government continued to allow a duel currency through 1933 because of their need to trade and their productive power (Wisdom, 1940, pp. 33-34).

Soon after, in 1931, the brutal 13-year military regime of Jorge Ubico began. The years under Ubico were a dark period for the Ch'orti', forcing them to retreat to the mountains and avoid urban centres (Girard, 1949). The end of the Ubico regime was followed by a time of peace under Juan Jose Arevalo, which continued under Jacobo Arbenz (1944-1954). Both leaders supported land reform, labour standards, social services and local democracy, challenging the unequal land distribution particularly of corporations based in the United States of America (Woodward, 1993). It was the issue of land reform that sparked a coup supported by the United States of America, which overthrew Arbenz and led to lengthy civil war from 1960 to 1996, affecting indigenous populations all over the country.

The end of the civil war in the 1990s brought shifts in industry that impacted local landscapes, for example, increasing coffee production, which replaced sugar cane and panela (unrefined cane sugar) production in the temperate zones. To recognise the voice of indigenous populations and increase community representation in development, the COCODES were initiated in the early 2000s as a form of governance. The COCODES have been instrumental in improving roads to allow for increased traffic. It was only around 2014 that electricity reached the more remote villages in the study. A court case in 2016 returned the aforementioned 70 000 hectares purchased during Spanish rule, proving that they were indeed property of the Ch'orti' (Mendoza Lopez, 2017).

In recent years, the Ch'orti' food system has experienced several disturbances, observed as changes in seasonal patterns and increasing shocks. Since 2000, the community experienced change in the climate, noting large storms outside of the typical rainy seasons and an increase in instances of drought or prolonged dry ***canículas***. These conditions are detrimental to staple crop production and have created a partial or in some cases complete loss of the crop of maize and beans in 2010, 2015, 2016 and 2018. Of the observed changes, the most noticeable is the shift of the winter period, which is associated with the first rains. Usually beginning in May, the shifting of these crucial rains into June also moves the first sowing of staple crops to the end of May or June and the second sowing to the end of September.

SECTION 2
SUSTAINABILITY OF THE INDIGENOUS PEOPLE'S FOOD SYSTEM

1. PROVISION OF LIVELIHOODS, EQUITY AND SOCIAL WELL-BEING

Adequacy of income opportunities

The main livelihood activities in the communities are agricultural work, handicrafts and wage labour. Different professions are found, such as labour jobs, making traditional construction (mud buildings and palm roofs), planting productive fences, midwives, teachers, nurses, priests, pastors, drivers, carpenters, blacksmiths, artisans and electricians. The Ch'orti' communities have various skilled artisans who engage in woodworking, pottery, natural fibre crafts, shoemaking, handicrafts and construction.

Despite the myriad of professions that exist within the communities, there are generally not enough opportunities to provide adequate monetary incomes to households and this has forced many community members, primarily men, to migrate to find work. There is work during the sowing seasons and for crop management in the community or in nearby villages, but nearly everyone is doing the same activities, so the local labour market easily becomes saturated. The most regular and abundant employment is found in cutting and cleaning coffee, cutting sugar cane, and cleaning fields for planting. Yet, even with these jobs, most often men are still forced to migrate to earn enough money to meet their expenses. Community members migrate to neighbouring villages, regions or even greater distances to work as labourers on coffee, orange and sugar cane plantations during the summer months, over periods of four to six weeks.

Income is used mostly to purchase food items, agro-industrial products, medicine, processed foods and goods to maintain personal hygiene. The main source of calories in the food system, maize and beans, are also the greatest household expense as community members invest considerable amounts for inputs into the ***milpa*** each year. Overall, the communities queried estimated that local production covers about half of household needs whilst the remaining half is purchased or obtained through barter and trade. The majority of household food production is consumed (on average 95 percent) but about 5 percent of the harvest is reserved to either be sold to the market or used to barter and trade for other goods and services. Whilst these practices do not significantly contribute to incomes, they do provide some means by which to procure desired items or to buffer incomes during times of scarcity. Due to poor market connectivity, intermediary buyers and resellers tend to offer low purchase prices for goods from the communities and ask high prices for goods on sale to increase their profit margins as much as possible. Whilst markets provide a large variety of fresh produce, due to the price of traveling to the market and scarcity of monetary resources in the communities, only specific species are purchased and households are sometimes forced to purchase only low-quality foods or those that are beginning to spoil.

In villages there is a minimal capacity to buy and sell products for monetary currency, therefore commonly people engage in alternative economic exchanges of goods and services. In an economy with limited income, it is considered a good opportunity to work for a few weeks in exchange for a little bit more than 10 kg of beans or maize, as in the community of La Ceiba, where this is a common practice. Women acknowledged that these types of exchanges are less frequent amongst men, a fact that could be in part due to migration, but both men and women do participate in the informal economy. Amongst women, common trades include handicrafts or livestock for maize, beans or other foodstuffs, or alternatively services such as labour or midwifery for foodstuffs, animals or handicrafts. The midwives of Agua Blanca help deliver children in exchange for goods and accept whatever the family can give at the time, even if the payment is delayed until after the harvest.

Adequacy of diets

The traditional Ch'orti' diet of maize and beans enriched by native herbs, fruits, seeds and occasionally meat is still the preferred diet. Women prepare several traditional dishes that normally include five or more food groups, for example a sauce made with chilis, tomatoes, squash and seeds served with legumes, native herbs, ***tortillas*** (unleavened flatbread prepared from nixtamalized maize), ***arroz*** (*Oryza sativa*, rice) and sometimes meat. A variety of dishes are consumed nearly every day, contributing to diet diversity. Foods are considered to have more life-sustaining energy if they have been harvested at different times in the Maya calendar, have been transported from one area to another by foot, or if they have been processed using ancestral recipes. In these areas, wild foods are considered more nutritious than domesticated or imported foods. They are valued for their taste and use in traditional dishes such as pinol (hot beverage based on corn flour similar to an ***atol***), ***chuchitos*** (a small ***tamale***; maize dough with a variety of fillings such as chipilin and frijoles steamed in a corn husk), and ***caldo*** (broth).

Local production and wild sourcing offer 10 distinct food groups. The communities do not produce dairy but it is available in the market and is seldomly consumed due to high prices and perishability. Vegetable oils are considered a necessary product in the household but remain cost prohibitive. When asked if all people could meet their dietary needs, community members acknowledged that not all households have that capacity. A household is considered food insecure when there is a lack of beans and maize. Food insecurity is experienced in connection with local climate events, especially during dry summer months of January to May. Whilst a diversity of foods is produced and sourced locally, a significant barrier to food security and diet quality is access to sufficient land to ensure adequate production. The challenge of migration also often makes the Ch'orti' unable to labour in their familial plots.

In times of food shortage, neighbours support families to ensure that everyone has enough food. On a multi-household scale, neighbours identify action plans for the challenges they face together and agree upon decisions for development in the villages' communities. If there is a harvest loss for one community member, the harvests from all neighbouring plots are shared and, if necessary, the community requests support from nearby communities or municipal authorities. It is also during periods of food shortage that local diets depend on native plants gathered in the local environment, such as leafy vegetables and roots. Community members feel that food security can be achieved within their current landscape and production systems by capitalizing on what are considered nutritious, medicinal and culturally acceptable foods. For example, Chagüitón with the Mancomunidad Ch'orti' has been involved in the promotion of processed tree spinach flour to naturally enrich the nutritional content of prepared foods and there is an intention to expand these initiatives to reach more communities.

Changes in the provision of livelihoods and social well-being over time

From ancestral times, Jocotán has been the main square for sale and exchange of products, as it continues to be today. The market consistently offers fresh foods, staple foods and crafts sourced from surrounding villages but now also offers industrial products and processed products. The Ch'orti' food system has been strongly affected by the rise of industrial production and export markets that have decreased income opportunities based on local value chains. The urban markets in the food system are flooded with industrial products sold at low prices.

Soup with chaya.

Women note that the substitution of products, such as natural fibres and handicrafts for synthetic fibres and industrially made plastics, as well as natural dyes for chemical dyes, has undercut the traditional market.

Research in the Ch'orti' region reveals that malnutrition has risen with the increasing frequency and severity of drought (FAO, 2016; OXFAM, 2012; Chicas, Vanegas and García, 2014). Shifts from the traditional ***milpa*** to a more homogenous and input-intensive model also underlie problems of food insecurity and diet quality. Previously this diverse production system of maize, beans and squash created the conditions for a rich understory with a variety of native herbs, wild tomatoes, chili, tubers and fruits. The ***milpa*** gradually transformed with the introduction of chemical fertilizer, herbicides, pesticides and fungicides from a production system that promotes diversity to one that inhibits the growth of spontaneous and intercropped foods. At the same time, it is evident that the diversity of diets has decreased. For example, currently maize is consumed daily and bread is consumed occasionally. Historically, households would also eat sorghum, teosinte (*Zea perennis* (Hitchc.) Reeves & Mangelsd., Poaceae), and amaranth grain (*Amaranthus* spp.), amongst other foods. Decreasing quantity of food available in the ***milpa*** lays the burden of maintaining household subsistence on smaller production areas such as the patio, live fences and landscape. As another factor, community members noted that the role of meat in the diet has decreased over past decades with the loss of the hunting practice and declining availability of game animals. In addition, other traditional food sources have been eliminated from the diet such as edible molluscs from local aquaculture and reared insects such as the ***chapulin*** (*Sphenarium purpurascens* Charpentier, Pyrgomorphidae).

2. RESOURCE USE EFFICIENCY

Land and soil

Soils in Jocotán, Camotán and Olopa are composed of clay, loamy-clay, and clay and stony silt, all of which are used for crop production. In the communities, soil typology is determined by colour, which varies between soft and hard yellow and black fertile soils. The yellow areas are considered to be sandy with the colour darkening depending on the percentage of clay. Land is considered good quality if it has black soil with little stone and sand, as it has been observed that these areas absorb and retain water. As a result of the need to expand cultivation to marginal soils and plots with steep slopes, the community now engages in some practices to protect ecosystem functions such as planting on contour lines, reforestation of mountain areas, sowing trees as functional fences and creating "dead barriers". These "dead barriers" are made from branches and other dead plant materials that are collected and piled into mounded fences to capture fertile soil from the rains. To adapt to the various soils in the landscape, households make small plots to engage in trial and error sowings, which allows them to verify the performance of any crop before developing a larger area.

There are different approaches to soil management in each distinct production zone of the Ch'orti' food system. Soil amendments are determined based on soil type and use different preparations of locally available materials and minerals that also help control pests and diseases. The patios and living fences are maintained by the female head of house, who applies natural fertilizers made from kitchen scraps, ashes and manure from their animals. The use of household ash and lime in the compost helps improve the soil potential of hydrogen (pH). Living fences in the landscape are planted strategically to stabilize soil, whilst also providing green materials for composting, such as ***madre de cacao*** leaves, ***palo de pito*** leaves, branches and others. The patios and living fences in the domicile do not require any inputs from outside of the household to maintain soil quality and the community considers the soils in these areas to be healthy and productive. All community members agreed that although soils in the ***milpa*** appear to be in good condition, production is only possible using synthetic fertilizers. Other local techniques to maintain soil quality include using crop rotations, interplanting of perennials, planting on contours, and fallow periods. To prepare for sowing crops, most households burn their plot and seldomly use other methods such as chop and drop or allowing herds of cattle or horses to eat the crop residues and fertilize the fields.

Labour and fuel energy

The main energy source in the food system is firewood for cooking. It is only in the municipal capitals and some peri-urban communities where households have access to propane gas as fuel for cooking. All of the communities that participated in this study have access to electricity and some communities in the region have participated in projects to develop household solar and wind units. Electricity is used primarily for religious services and celebrations, educational activities, refrigeration of foods in stores, and lighting homes. Electric mills are also used to grind nixtamalized maize into dough. Whilst only some individuals own motor vehicles (primarily all-wheel-drive pickup trucks and motorcycles), most if not all of the population uses fossil-fuel vehicles by paying for passage service. Vehicles are crucial for transferring supplies, such as fertilizers, insecticides and herbicides, as well as transporting harvested products to the marketplace. In addition, tractors or other fossil-fuel-driven machines are used for field preparation, though they are seldom owned and instead rented, or the field preparation traded for other goods or services. Tractors are used primarily for planting vegetables for the market and the ***milpa***.

The activities in the Ch'orti' food system are labour intensive with few options or innovations for minimizing drudgery. Tasks are generally gender specific, with the men's tasks being agricultural or outside of the household and women labouring primarily in the household. Younger boys help the men with traditional construction trades of the village. As they grow up, they participate in the ***milpa*** fields, and when they become older, they will migrate to look for work in the agricultural sector or as unskilled labour. Women spend the majority of their time making ***tortillas*** (unleavened flatbread), cooking and washing clothes with their daughters. Women are also responsible for collecting water for the household, which is carried out with both male and female children. All family members are responsible for collecting wood, though often women and children collect firewood as a result of the men migrating for work.

Traditional planting patterns make use of ecological functions to increase harvests and decrease labour demands, for example dry beans fix nitrogen to support the growth of maize, whilst the maize acts as a natural trellis for climbing beans and spiny dense squashes planted along the field perimeter serve as a natural pest barrier. Albeit, now it is more common that chemicals, in particular herbicides, are used as a strategy to save time and human labour. Those who use herbicides are able to work an area of land four times greater than those who weed with a machete. A few communities use mules or horses to support agricultural activities.

Because of the volume of their production, some communities have community mills or machinery that can be used to minimise drudgery, such as maize huskers, coffee pulpers, mincers for zacate (herbaceous material) and nixtamal mills, which are usually owned by individuals but are available for use by everyone in the community for maize or other payments. Processing fibres for handicrafts is another labour-intensive task. In the case of ***maguey*** handcrafts, special tools are angled to extract the fibres by scratching the plant pulp, which is a process that usually irritates the artisan's skin. In Olopa, the Ch'orti' communities of Tituque have innovated their ancient processes for producing ***maguey*** fibre and developed a low-technology bicycle-driven machine that reduces labour whilst still creating a high-quality product.

Water

The Ch'orti' consider water to be the key to food security. As most production sites are rain-fed, water availability is a major limiting factor in the agroecosystem. According to the Municipal Information System for Food Security and Nutrition (SIMSAN), the Ch'orti' region, including its urban centres, has a 60 percent coverage of residential water. For domestic water consumption, many households depend on local water resources such as springs, wells and streams that are usually more available in the rainy winter months. In summer, some of these water sources disappear or diminish in quantity and quality, forcing inhabitants of the communities to travel several kilometres to find potable water. Communities that have better water availability are in the medium elevations of the landscape. When water sources dry up, people have to travel to other communities, which can take up to two hours every two days to transport 30 litres of water. When at the water collection site, household members will bathe and women will wash clothes.

The primary use of water is for food preparation, although if water were used to irrigate agricultural plots, it would hypothetically have a higher demand. Despite the reoccurring drought conditions faced by the communities, few houses engage in rainwater collection. In the rare cases when rainwater is collected, it is primarily used for cleaning, domesticated animals and, in some cases, as drinking water. Other homes recycle grey water from the kitchen or ***pila*** (sink usually situated in the patio) for the production of plants that require more water in the patio. Some traditional forms of passive water capture in the landscape can still be seen in the Ch'orti' communities. Strategies include planting on terraces, constructing stone barriers, constructing ditches on hillsides, planting on contours, chopping and dropping residues from crops, digging pits in fields to increase water absorption, and maintaining agroforestry systems that increase soil humidity.

Due to the importance of water in the community, the need for organised management of resources has created the Water Committee, which acts as a branch of the COCODE. Members of the community come together to manage, purchase and distribute water resources to any household that is able to contribute. The cost of contributing can be as low as GTQ 3 (equivalent to USD 0.4) a month to help maintain water sources and ensure equitable distribution for all members.

Waste

In the patios and communal forests where medicinal plants and food are sourced, the Ch'orti' interact efficiently with local resources. Residues from raising animals, ash from the kitchen, and lime are used to fertilize the patios. Some homes also engage in vermiculture or use leaves from the living fences as green fertilizers.

All non-biodegradable waste products are produced outside of the food system and are largely imported from urban centres to small shops or the municipal markets for purchase. All the chemicals used in the ***milpa*** come in plastic packaging and are difficult to dispose, as any residues cannot be treated as hazardous waste. In the urban centres of municipalities and surrounding peri-urban communities, a service transports the garbage generated in the homes to a municipal landfill. In rural communities, this service is not available and consequently it is the responsibility of each household to eliminate all organic and inorganic waste. Families collect some products, such as aluminum, iron, plastic bottles and copper, to sell. For non-recyclable items, many use an area around the house to deposit waste generated in the home and often this material is either burned or buried. Plastic bottles from soda industries, packages from herbicides, pesticides and other industrial rubbish are visible in the landscape of the communities. Some non-biodegradable products are commonly repurposed. For example, pet food bags are used to transport water, store items, transport agricultural products or handicrafts, or as planting bags. Local non-profit organizations such as the church-run Caritas and campesino organization Nueva Día try to motivate people in nearby communities to upcycle non-biodegradable waste products by using them to produce handicrafts but few have adopted these practices.

Changes in resource use efficiency over time

With advancements in technology, there have been changes in labour demands and energy efficiency in the Ch'orti' food system. The Ch'orti' ancestors used hand tools, such as machetes and hoes, to work the land and organic insecticides and/or traps for pest control. The current dominant form of agriculture in the ***milpa*** is more dependent on chemical inputs, which reduces labour demands. It also has been associated with degradation of soil quality and community members noted that if they are not using chemical inputs in the ***milpa*** they are unable to have a good harvest. In addition, farmers now have some access to machinery to work their fields, which has also reduced labour demands. However, as money is required to purchase the inputs and hire the machines, and income is most commonly earned via migrant labour, it is difficult to understand whether these advances have actually reduced the amount of labour necessary or just moved the work opportunities outside of their communities. Additional changes in energy use are primarily a result of the increased use of mechanized transport, lighting, electric food processors, irrigation and communal mills for maize. For example, before refrigeration it was common for pig or cow meats to be dried for preservation using a process of heavily salting the meat and hanging it in the sun. These advances all help reduce labour demands, but they are not universally accessible due to distance or monetary constraints, and they increase dependence on external inputs.

According to village residents, the use of water has become more efficient in recent years due to the scarcity of this resource throughout the year. This necessity has driven villages to generate efficiency strategies to reduce water waste. In villages that have domestic water, the community holds meetings for all members to ensure that water is appropriately used for housework and not for irrigation.

Community members shared that there has been little change in waste management compared to the past. However, they note that recycling is practised more often because waste that previously had no value now fetches a price for being recycled commercially. Due to technological advances, however, many more pollutants, such as agrochemicals, plastic bags and bottles, are entering the local waste stream and need to disposed of properly, a task the community is not well equipped to manage with traditional methods.

3. CONSERVATION, PROTECTION AND ENHANCEMENT OF NATURAL RESOURCES

Crop and livestock biodiversity

In total, over 100 crop species are cultivated by the Ch'orti' communities. Most of these are fruits and vegetables (approximately 80 percent) that are maintained in the patio. The species cultivated include some native to the Americas like maize, beans, avocado, nance (*Byrsonima crassifolia*), ***jocote*** (*Spondias mombin*, hog plum), custard-apple, guava, chayote, tree spinach, loroco, potatoes and cassava, as well as species that have been introduced to the Americas at different points of time since colonization by the Spanish, including mango (*Mangifera indica*), banana (*Musa* sp.), orange, lemon (*Citrus limon*), mandarins (*Citrus reticulata*), onions, ***brócoli*** (*Brassica oleracea*, broccoli) and ***remolacha*** (*Beta vulgaris*, beets). Some introduced species, such as sugar cane, have a long history of cultivation and culinary use in the region and are now considered traditional crops by the communities. The crops grown in the largest areas in the food system are maize and beans, as they are the most consumed in the households in the Ch'orti' region. Households maintain varieties year after year, primarily for flavour and quality for culinary uses but also for short maturation periods and drought tolerance.

The communities are largely seed sovereign, growing and preserving seeds from the patio and ***milpa*** within the household and sharing or trading them within the community. Seeds are not received from institutions or research centres, rather, in the rare case they are needed, seeds are exchanged with neighbouring communities and more seldomly obtained in the market in Jocotán. The seeds available in the market are primarily native varieties including those of maize, ***perome*** (*Vigna unguiculata*, cowpea), chipilin, black nightshade, cilantro (*Coriandrum sativum*), rice, and pumpkins or squash. The farmer selects the plants that comply with the features that his next crop wants to see. For example, because of the strong winds that affect the land in the village of Agua Blanca, farmers select plants with a combination of low plant height and high production. Whilst some varieties are also kept for their drought tolerance, such as early maize, culinary merit is still the main selection factor in preferred varieties. The selection of the bean seed is usually ranked first by flavour, second by cooking time, and finally by its level of production in the respective growing zone.

Amongst the animals found in the community, only turkeys were originally domesticated in the Americas, although traditional breeds of horses, pigs, chickens, ducks, turkeys, goats and cattle are found in the Ch'orti' region. A chicken breed has been introduced recently that is cross-bred with traditional breeds to be resilient to drought conditions. Municipal technical agents provide this breed of chicken to members in some communities, along with a regiment of vaccines. Animal breeds kept in the community are favoured for productivity, disease resistance and low resource demand. The maintenance of smaller animal species with less input and space requirements is common as the average family gives preference for cultivating maize and beans on available land.

Wild harvested plants and animals

The Ch'orti' collect a number of wild resources from within the boundaries of their communities. Edible plants are gathered along the edges of walking paths and roadsides, although they are primarily harvested from household plots where spontaneous growth is managed and encouraged. Forested parcels called ***astilleros*** between villages and hamlets are considered

Turkey with mixed poultry in the patio.

communal and provide shared spaces where community members can find firewood, manage communal agricultural plots, and gather mushrooms and useful materials such as wood, clays, honey and other raw fibres. The few hunters in the region use modern traps, rifles and hunting dogs, whilst the few fishers use modern hooks.

The ***astilleros*** are managed cooperatively by community laws and under the supervision of the COCODES. Action is being taken to address the issue of deforestation in the Ch'orti' region to protect and enhance forest resources. The commercial harvest of wood is managed at the level of the central government and requires a forest exploitation license, which enforces a maximum sustained yield evaluated by technicians of the National Institute of Forests (INAB). At the municipal level, it is required that landowners possess a license to harvest any amount of wood and they risk spending time in jail for not complying with municipal law. The community enforces regulations for timber extraction and there are some communities where villagers are obligated to request permission from the communal COCODES authorities to cut trees. The COCODES can appeal to the national, civil or military police if these procedures are not followed. The collection of firewood is allowed but communities take care not to harvest more than what is needed. There are no actions to maintain and promote the population of ***tul***, ***carrizo*** and ***maguey***, which are becoming scarce and raising the price for artisan handicrafts.

Ecosystem conservation and protection

Some communities maintain communal conservation areas in the landscape, primarily for forests and water sources. In these areas, inhabitants work together for reforestation, removing refuse and protecting against natural disasters. Management is not frequent but routine. To reduce the risk of forest fires, the community will assemble local fire brigades and clean the forest floor of deadwood to be used as communal firewood. For the management of water sources, the community gathers once or twice a year to clean the surroundings and to plant trees that allow that resource to continue to be productive by reducing erosion and supporting water filtration. Living fences are also maintained to contribute to the firewood demands of the household, for erosion control, and to act as natural barriers. The community recognises that where green fences are maintained in the landscape, there are no issues with soil degradation or erosion. Other measures taken by villagers to protect water sources include making boxes from concrete or stones to seal the source from contamination from domesticated and non-domesticated animals, household soap, and/or agrochemical products. Some communities with communal lands have also entered the national Programa de incentivos forestales para poseedores de pequeñas extensiones de tierra de vocación forestal o agroforestal (PINPEP), which is a Guatemalan Payment for Ecosystem Services Programme incentive programme to help legally protect the area from extraction and to receive monetary incentives for maintaining forested areas.

Changes in the conservation and protection of resources over time

The Ch'orti' have seen a loss of traditional practices, which has contributed to the disappearance of crop species and varieties from production fields. Historically, the ***milpa*** was designed to be a circular rather than square plot to maximize the edge space for useful spontaneous plants and to create opportunity for more diverse planting schemes. Now, the ***milpa*** is sown in furrows and chemical application inhibits the growth of traditional crops. Ancestral diversified plots still occur but in smaller proportion compared with more intensive and monoculture productions. Traditional varieties of grains such as maize and sorghum that depend less on fertilizers for their production are maintained but no longer in sizeable amounts and therefore are not highly available. Some custodian farmers continue to maintain rare native varieties that would otherwise be lost. Recently, the municipal commonwealth has been promoting drought-tolerant species to increase food security.

Historically the Ch'orti' were actively hunting and gathering in their landscape but resources have become more scarce over time. Generally, forest cover in the Ch'orti' region has been decreasing due to deforestation and the advance of the agricultural frontier throughout the national territory. Due to the absence of a proper management strategy, wild populations of plants and animals harvested in the landscape have decreased over time. For the practice of hunting, this has been particularly devastating as populations of species such as the ***conejo de monte*** (*Sylvilagus brasiliensis* L., Leporidae, tapeti), the ***tepezcuintle*** (*Cuniculus paca*, lowland paca), deer (*Odocoileus virginianus* Zimmermann, Cervidae), and armadillo decreased considerably. As a result, hunting is no longer considered a viable food source for households and is seldom practised. With the help of institutions such as the Copanch'orti' Mancomunidad and PINPEP, communities have been organising to mitigate the impacts of this trend.

4. RESPONSIBLE AND EFFECTIVE GOVERNANCE MECHANISMS

Governance of natural resources

There are different organised groups at various scales for consensus and participatory decision-making regarding natural resources in the communities. The main form of governance for small villages is the COCODE, a body recognised by the constitutional laws of Guatemala, which operates as an assembly of citizens with an executive committee, composed of a board of directors formed by a president, a vice president, a treasurer and a secretary. The COCODE is in charge of the management and the realization of specific works, as municipal activities require community consultation. The principle functions of the COCODE are to: (1) promote the economic, social and cultural development of the community; (2) promote the effective participation of the population in the identification and solution of their problems; (3) identify and inventory the needs of the community and determine the corresponding priorities for the formulation of programmes and projects; (4) propose to the municipal development council needs for the execution of programmes and projects, when these cannot be resolved by their respective community; (5) coordinate activities promoted or carried out by community groups to avoid duplication of efforts; and (6) manage the economic resources they require for their local development programmes and projects. Other community groups that relate to the food system include the Water Committee, which acts as a branch of the COCODE, and the Committee of Parents, which is charged with organising the local school feeding programmes, trainings for those serving food in the schools, and activities related to formal education. Those who have vocations that provide valuable services to the greater community such as religious leaders or teachers are perceived as authority figures and also play an important role in the resolution of conflicts and decision-making.

In rural villages, community members are in charge of ensuring the protection of the resources of their respective plots and any problem must be resolved with the local government. For many remote villages it is difficult to maintain contact with the municipality, therefore communities assign or appoint an auxiliary or community mayor to act as an ombudsman. Auxiliary mayors receive community complaints or requests and resolve them with higher levels of governance. The auxiliary mayor works directly with the mayor of the municipality and acts as the representative of the community. If the community is not large enough to have an auxiliary mayor, the entity that is responsible for management and community organization is the COCODE. Larger communities have a COCODE as well as an auxiliary mayor. The role of the COCODE and the auxiliary mayor are grounded in the traditional values of the communities and are an adaptation of the Maya ancestral system of governance to a modern style of governance.

Authorities of the community are part of an institutionalized system of voluntary service, without salary and permanence. Any member of the community can be elected as the highest authority of the COCODE, but they must be selected based on merit and their capacity to collaborate. Of the six communities studied, four communities were led by men and two COCODE were led by women. Auxiliary mayors serve for a period of two years with possibility of re-election. To participate in the Committee of Parents, one must be a parent of one or more children in the local school.

TABLE 8.8. Local institutions in Chagüitón

Institution	Established	Activities, processes and rules	Participants
CADER	2013	Agricultural production	Community members
COMUNDICH	1940	Coordinating the communities	Community members
Local parish Committee	1960	Religious activities	Community members
Seed bank	2014	Protecting seeds	Community members
Water Committee	2000	Ensure water quality	Community members
Committee of Parents	1998	Ensure quality of education	Parents of the school children

At the national level, the National Council of Protected Areas (CONAP) is the institution charged with managing and protecting the species of flora and fauna and their habitats that are in danger of extinction. There is also INAB, which has a programme that provides economic incentives to support small and medium landowners to conserve their forested land and/or promotes the planting of new forests in an agroforestry or agroecological system. At the municipal level, organizations such as the Copan Ch'orti' Mancomunidad support national programmes that allow farmers interested in these processes to participate.

The Mancomunidad also participates in creating waste management plans at the urban and rural levels to minimise pollution and ensure protection of water sources, as well as supporting the diversification of plots to protect flora and fauna of economic interest in the region, and fire prevention plans. Other institutions in the Ch'orti' region such as La Asociación Regional Campesina Ch'orti' (ASORECH), la Asociación de Servicios y Desarrollo Socioeconómico de Chiquimula (ASEDECHI), and la Asociación para la Coordinación del Desarrollo Rural de San Juan Ermita (ACODERJE) have implemented projects that include the governance of natural resources, particularly the management of water resources and forested areas. Organizations such as Nueva Día, the Agrarian Platform and the Coordinator of Communities and Associations for the Integral Development of the Ch'orti' People (COMUNDICH) have been in charge of promoting and protecting the rights of the Ch'orti' community over their nature resources.

Under the management of the national initiative El Programa de Familiar para el Fortalacimiento de la Economia Campesina (PAFFEC), some communities participate in the Programa de Agricultura Familiar y Centros de Aprendizaje para el Desarrollo Rural (CADER) through which they receive help with sourcing seeds, capacity-building with technical agents and technical packages for the ***milpa***. Funding is also received from outside of the community to develop locally managed institutions such as seed banks that are built with the help of non-governmental organizations (NGOs) and international partners, such as the Swedish Embassy in Chagüitón. The community takes ownership of the initiatives supported by outside research centres, governmental organizations or NGOs that organise capacity-building workshops to train community members to manage their local institutions. The aim of many of these initiatives is to increase the strength of the food system as a whole and provide greater means on a local scale to maintain food security. The authorities of the communities hold village meetings to determine if projects are acceptable to members of the community.

Changes in governance of natural resources over time

The mode of and need for governing natural resources has changed markedly over time in the Ch'orti' territory. Community members recall that previously there was no need for the governance of natural resources because they were used respectfully and managed properly by those who depended on them. An example of this is the need for managing hunting and wild animal populations. From the Ch'orti' point of view, animals are considered to be brothers; therefore, individuals would only hunt if it was necessary for household security. If one did hunt, they would only harvest what was necessary to meet their needs. Ceremony was also part of the process to ask the forest for permission and give thanks to the animal for its sustaining life energy. As a result of this cultural management, the communities maintained an abundance of wildlife resources and there was no need for controls through national, municipal and community initiatives. The exploitation of forested lands by outside entities and the lack of access to previous communally managed forests also contribute to the current need for management.

5. RESILIENCE OF PEOPLE, COMMUNITIES AND ECOSYSTEMS

The Ch'orti' food system is dynamic and complex. Below is a summarized assessment of 13 indicators of resilience. It is noted that for even the weakest indicators, there may be some aspects of community life or households that maintain practices that run counter to these trends.

1. Exposed to disturbance: The food system is regularly exposed to climatic events that have become increasingly more disruptive to the agricultural calendar. Due to the increase of strength and frequency of these events in the last 50 years, food system collapse has occurred in many villages, attracting the attention of the scientific community, which has focussed resources and energy into strengthening food security. In spite of climatic events that have devastated planting seasons and harvests, the Ch'orti' have been using locally adapted resources such as animals that tolerate low water availability and crop varieties with short maturation periods to strengthen the resilience of their production system.

2. Globally autonomous and locally interdependent: The community is an interdependent system that promotes barter, trade, loans, and gifting of goods and services, which relies on the communication between local village networks. The food system enforces cooperation amongst community members to maintain food security by the collective lack of markets and income opportunities. The community safeguards traditional seeds and therefore, if necessary, the recovery of lost varieties and seeds is possible. Communities are now becoming more dependent on outside inputs for their primary production areas, which is a trend that could weaken an otherwise strong local system of trade.

3. Appropriately connected: Generally, the communities in the Ch'orti' territory are becoming more connected to nearby villages and municipal capitals due to the expansion and quality of roads between communities, reducing travel times. However, due to the distances that different communities and hamlets have to travel, paired with the costs of transporting people and products to the market, the Ch'orti' communities are not appropriately connected to each other or urban centres.

4. Socially self-organised: The Ch'orti' have strong organization in local communities with high representation and participation, which helps to defend the territory against any outside threats. Villages and hamlets have achieved development through community consultations, consensus and collective decision-making. Participation of these meetings is not mandatory but rather open so that the people of the community who are dedicated to serving and have earned the respect of fellow community members can take part in non-permanent and non-paid leadership positions. Maya cosmology promotes being of service to others and the community, referred to in villages as "mística de servicio", which is a key element in the Ch'orti' governance providing services that are free, voluntary and permanent for the benefit of the community.

5. Reflective and shared learning: This indicator is constantly progressing and evolving with the experiences of the community. Patios are a living system where each year women will experiment with new crops, crop combinations and growing practices. Often beneficial plants are allowed to grow spontaneously or can be collected from other areas and replanted in the patio. As there is often no chemical application, the resilience of plants or planting combinations can be observed in light of weather conditions. Responsibilities to innovate are shared amongst women and they will gather to exchange findings or observations in the interest of optimizing production. Aquaculture techniques are both ancestral and innovative, being passed down by observing nature or other villagers. Neighbourhood meetings that are scheduled periodically to discuss political topics are also used as a space to discuss observations and the results of experiments carried out in their fields and patios. In these meetings, representatives who have participated in capacity-building workshops share the content of the trainings with their fellow community members and answer questions regarding these respective initiatives.

6. Honours legacy: The communities chosen for this study have strong cultural continuity and continue to demonstrate an ancestral way of life that is highly dependent on the landscape. The community has actively conserved several aspects of the ancestral food system by passing information from generation to generation through the active practice of these traditions. The traditional diet, rich in nutritional native plants, reveals the importance of honouring the legacy of ancestors in production practices. As there are no written manuals for any expertise to standardize the practices, artisans are free to maintain, modify or update the methods of production. During the armed conflict in Guatemala, there was a decrease in knowledge of ancestral practices in the region. The Ch'orti' experienced the loss of knowledgeable individuals in part due to the recruitment by the military to act as patrols in other parts of Guatemala and the murder of intellectual leaders of the communities. They have effectively lost the local language, which is now only preserved in more isolated villages, and they use more industrial materials for house construction than previously, amongst other changes in their production systems, diets and livelihoods.

7. Builds human capital: The community transmits traditional knowledge through observation and practice with the conviction that learning should be a personal decision, though children are inevitably involved from a young age in the food system. As traditional practices become less marketable, there has been a loss of capacity-building of skilled artisans in the community. In addition, schooling that would prepare young adults for other professions is not available in some communities. Formalized schools for children in the local areas also do not honour the Ch'orti' legacy, discouraging the use of the language and many traditional practices. In recent years, capacity-building workshops have been held by the municipal government and outside institutions to train leaders in the community in post-harvest processing, sustainable production and living techniques. Whilst there are some local practitioners in the communities, such as midwives, and medicines that are grown locally or collected in the landscape, community members must travel to urban centres to access most medical and dental services.

8. Coupled with local natural capital: Traditionally the food system was completely integrated with the local natural capital. Currently the live fences and patios of the house are maintained using traditional knowledge and practices. These production areas continue to promote the spontaneous growth of local plants for multiple purposes and provide products for use in food, construction, crafts, medicine or fuel. Unfortunately, the management of the communities' natural resources has decreased over time with the advent of political borders and the privatizing of land. Outside production has created cheaper products outside of the traditional closed-loop system and has led to pollution in the landscape.

9. Ecologically self-regulated: Ecosystem functions from many aspects of the landscape and production systems help regulate degradation in the community. Traditional planting schemes of trees and perennials are still viable in current agricultural systems, including contour plantings for erosion control and water retention, as well as canopy cover for temperature regulation of the household and around water resources to improve quality and function of water resources. Conversely, the high-input ***milpa*** system no longer uses traditional methods and consequently is becoming less ecologically self-regulated.

10. Functional diversity: Overall, the Ch'orti' production system supplies a high diversity of food groups with an average cultivation of eight food groups. The highest number of food groups is grown in the diverse patio production system and the lowest number (two to four food groups) is grown in the ***milpa***. Taking into consideration the collection of wild edibles, the wild environment and other parts of the landscape, the system can provide nine food groups.

11. Optimally redundant: Multiple species are produced and sourced from wild areas within all nine food groups, including many species of fruits and vegetables. In the past, the Ch'orti' food system had more redundancy. Traditionally the ***milpa***, patio, living fences and the wild would have more overlapping food sources such as native herbs, animal-derived foods and fruits. The patio currently provides the greatest diversity of foods amongst the production areas and is an essential compliment to the ***milpa***, where only two to three species are regularly cultivated and harvests are more susceptible to crop failure due to climate, pests, weeds or natural disasters. The patio has a smaller production of legumes and starches to protect against complete crop failure in the ***milpa***. Traditionally wild areas provided more meat products but due to deforestation and resource extraction, hunting is no longer a strong food source for the household.

12. Spatial and temporal heterogeneity: Overall, some significant shifts in the landscape have led to less heterogeneity in the Ch'orti' territory. Deforestation, the establishment of coffee plantations, and the increasing homogeneity of the ***milpa*** have contributed to a simpler land-use mosaic. The impacts of shifting more land into agricultural production and increased extraction has motivated efforts by the community and municipality to actively work to reforest land. In villages, heterogeneous landscapes are actively maintained using traditional planting patterns and land-use schemes.

13. Reasonably profitable: At present, the connection of the food system to the market is inadequate to support current household demands for income. Few reasonable opportunities exist to generate income in the food system within the communities and it is necessary to migrate to the cities to find work. The traditional trade-and-barter economy in Ch'orti' communities has persisted since ancient times and helps compensate for the lack of local monetary resources. In this ancestral paradigm, the many goods and services offered are accessible because they are traded through a flexible economy of loans and exchanges between families. Yet the increase of household dependence on the market increases demand for monetary resources and challenges the traditional methods of exchange that have customarily sustained the communities.

SECTION 3
CONCLUSIONS AND FUTURE PROJECTIONS

The six Ch'orti' villages profiled in this study are indigenous and ***campesinos*** who have engaged in subsistence agriculture in the mountainous regions of Jocotán, Camotán and Olopa since before colonial times. The study shows that the Ch'orti' produce a large number of foods from their production systems and gathering of wild foods in the communal areas. Some households continue to supplement their diets with hunting or fishing but to a lesser extent due to loss of natural resource capital. Communities gain income primarily by working with local materials as artisans and as labourers. High-quality goods from villages are sold to the municipal market at relatively low prices and at the time they are resold, they become cost-prohibitive for the average household. To cope, communities engage in alternative trade and barter networks that provide the opportunity to source goods and services without monetary currency.

1. HIGHLIGHTS OF SUSTAINABILITY ASSESSMENT

This study revealed a rich variety of sustainable aspects of the Ch'orti' food system as well as the many challenges that it faces. Whilst there are sustainable elements of the Ch'orti' food system, overall communities are not able to meet their needs with local production.

The patio and live fences are diversified production areas managed by women that demonstrate many sustainable practices. These production areas act as *in situ* conservation sites where diversity and seeds are protected in each household. The majority of the species found in the patios and live fences are nutritious, including dark green leafy vegetables, Vitamin-A-rich fruits and vegetables, and other vegetables, which provide the family with important nutrients. The soil fertility and plant health in these zones are maintained by recycling household waste, such as kitchen scraps, ash, leaves from the live fences, and manure from household animals. As water is scare in this region, the strategic location of these diverse plots around the household also allows women to make use of grey water for irrigation and small aquaculture systems.

The Ch'orti' have a cultural legacy coupled with natural resource capital, specializing in diversified and stacked planting schemes to benefit from multi-use plants. Native and criollo varieties are the dominant crops of the Ch'orti' region. Year after year each family saves their seeds along with the knowledge of cultivation, harvest, preparation and use of local species, particularly of maize, beans and squash. To ensure a diverse temporal availability of species, the communities grow in various harvest zones, encouraging continuous harvests that provide nutrition throughout the year. Food production in Ch'orti' patios and fences play a strategic role in nutrition security and increase resilience, especially during periods of stresses. An additional benefit of this diversity is local access to other products such as medicines, firewood, and materials for crafts and construction available in the production landscape. The vegetation canopy levels of the patios and living fences are often planted strategically to serve multiple purposes such as providing fuel, moderating temperature and climate impacts such as providing a canopy shade layer and erosion control, having a mix of microclimates varying from full shade to full sun, medicine, and to support any artisan activities. The use of off-farm inputs is very low in these areas, which are managed by hand with machetes. Other sustainable techniques still observed in some households in ***milpas*** and reforested plots include crop rotations, interplanting of perennials and annuals, planting on contours, and allowing for fallow periods.

Communal plots and roadside areas supplement the household food supply with wild plants such as spontaneous herbs and mushrooms, as well as providing firewood, medicinal plants, and materials for crafts such as clays. These areas are maintained collectively and provide goods to households in need. Some communities also have communal land for ***milpa*** plots and forested areas in the community that are managed by the COCODE. Community assemblies take place once or twice a month and help maintain strong ties between members of the community, providing a space to share field observations and innovations and resolve conflicts. These local mechanisms are also used to manage natural resources, particularly water, communal forested areas, and mixed use of communal lands. These communal areas provide a form of equality and safe access for households that have limited land or other resources.

Goods produced by the community are plant-based materials found in the landscape or hand-processed minerals like clay, stone and limestone, which are non-toxic and biodegradable. Waste generated inside the system is easy to manage and often has positive reapplications in the landscape, such as the use of household waste in patios as fertilizers. As a consequence, without assistance, non-biodegradable waste is largely managed by methods familiar to the community such as burning or is freely disposed of in the landscape. Low-cost industrial non-biodegradable goods are becoming more prevalent in the community, undercutting the market for Ch'orti' products like ***tul*** and ***carrizo*** bags and baskets from regional artisans. Innovation and assistance should accompany this shift of waste management for products that have different life cycles and do not pollute the environment. As ***milpa*** production has become more input intensive, it is also generating a large source of non-biodegradable waste in the communities.

The complexity of the community value system is an aspect of the Ch'orti' food system that connects communities to their natural resources. The cosmology of the Maya is shared throughout Mesoamerica, including the Ch'orti', and is a basis for understanding daily life and attitudes. Though the ***milpa*** has become an area with practices that are largely unsustainable, its importance is grounded in a creation myth of the Maya, which states that humanity was created from maize. This crop has evolved under the stewardship of households that have in turn been sustained by this food; therefore, it becomes a priority of the household, regardless of additional labour or costs, to maintain production. Foods are also valued by the embedded energy that is perceived by the community, in a metaphysical sense. For example, foods are considered to have more life-sustaining energy if they have been harvested at different times in the Maya calendar, have been transported from one area to another by foot, or if they have been processed using ancestral recipes. Maya cosmogony also promotes being of service to others and the community. This altruistic concept, referred to in villages as "mística de servicio", is a key element in the Ch'orti' governance, providing services that are free, voluntary and permanent for the benefit of the community. This value is instilled in children from a young age, creating strong bonds between individuals and leadership based on community service. The "mística de servicio" focusses largely not on the individual strength of households but on the community as a whole.

2. FUTURE PERSPECTIVES

Communities place their hope for the future in the hands of the next generations. Parents believe in the power of the youth to continue and improve current conditions if they engage in traditional practices. Under the guidance of local authorities, future generations are thought to have the ability to bring increased food quality and production, greater crop diversity and seed resources, as well as the return of traditional hunting and fishing.

When asked to predict what the food system would look like in 20 years' time, community members were optimistic that current trends would continue. They envisioned a food system where the same traditional foods are consumed but with all of the production coming from the community without the need to import products from outside the system. In the future, communities predict being able to meet 100 percent of their dietary needs through local production and the collection of wild foods, hunting and fishing without the need to rely on urban markets. Community members envision local markets and plazas where they can trade freely with one another and access high-quality food products. It is predicted that the dominant land use will continue to be agriculture but they hope cultivation expands with the improved access and availability of seeds for different vegetable and other crop varieties to build their production diversity. It is not desired that community activities are contingent on outside sources such as NGOs but rather that they are able to fund, sustain and maintain ownership of their own initiatives.

To meet the predicted challenges of climate change, diversifying production can supplement losses of maize and beans with other traditional foods that have been lost over time. It is expected that within 20 years the community will continue to produce the foods that are currently harvested in addition to the increased production of crops that used to have a robust local use but have been lost, such as ***malanga***, sweet potato or sugar cane. The use of traditional crops and animals will increase only if traditional knowledge continues to be transmitted from parents to children. Community members note that a failure of the youth to improve livelihoods with the traditional ways in the next 20 years will lead to more malnutrition, sicker children and less food sources to support the family.

The perspectives for a brighter future rest with young generations and their active engagement in building communities with better livelihoods and enough resources to have a ***buen vivir***. In this vision of a largely non-competitive, community-oriented society, a ***buen vivir*** is when all households are able to meet their basic needs with local food production, adequate local income opportunities and adequate housing. On a community level, ***buen vivir*** also means having access to a vibrant community life with entertainment, communal space, cultural ceremonies and time to meet as a whole, in addition to adequate services such as health care and local education.

3. CONCLUSIONS

As descendants of the Maya of Copan, the Ch’orti’ have evolved under a participatory and inclusive ancestral model of community development based on respect for life in all its forms and natural resources. The Ch’orti’ produce a large number of species on multiple production sites, have closed-loop systems of biodegradable household waste cycling, and maintain a profound knowledge of multi-use plant species in their communities. Socially, strong values based in community well-being, trust, respect for natural resources and alternative trade networks have helped provide safety nets in times of scarcity. Concluding remarks will combine comments from participants as well as observations and insights from the field, forming recommendations for potential pathways forward and needs for the future.

Inclusive self-organization bolsters sustainability of the system using ancestral principles, where decisions are made through community consultation and voluntary leaders who are elected based on merit and focus on the collective welfare. This system has managed to govern a union of several villages to protect and manage communal forests, rivers and other natural resources. The food system is partially autonomous, using the ancestral practices of production and knowledge of sourcing food throughout the landscape. Traditions such as the barter and exchange of goods and services, the production of handicrafts, and preparation of ancestral dishes generate an interactive economy that strengthens the trust between community members.

The Ch’orti’ are also facing many challenges. Climate change in particular contributes to the breakdown of traditional ways with increasing instances of crop loss as a result of extreme weather, pests and diseases, as well as the disruption of traditional phenology. Communities have also observed the transition of the ***milpa*** system from an ecologically self-regulating design with multiple yields to a low-diversity model with high off-farm inputs. Using herbicides has reduced the number of species found in the ***milpa*** that play key roles in traditional intercropping schemes for household nutrition. In addition to these challenges, communities often suffer from a lack of services such as schooling and health care.

The Ch'orti' develop intelligence by learning through observation, trial and error until they master their craft to become the teachers for the next generations. This system instills personal development into traditional crafts and promotes constant innovation to allow traditional knowledge to become a living system, open to learning, evolving and adapting over time. Yet it also limits the continuity of traditional practices as there are no available manuals or records to protect the many skilled professions represented in the communities. Paired with inadequate opportunities to receive reasonable incomes for the production of traditional goods, this has resulted in the gradual loss of traditional skills. In addition, communities only have elementary-level education. To receive higher levels of education, children must leave their villages and attend school in the urban centres. Youth miss the opportunity to engage in village activities, disrupting the passing of knowledge, and are instead immersed in a culture that does not support the local language or culture.

Recommendations

Despite current challenges, community members envision a future in which they have achieved local self-sufficiency. When asked how communities could reach their goals, the concept of an elder's school, proposed by a midwife elder, was unanimously considered the strongest suggestion. Communities need to develop new forms of transmitting knowledge to the next generations on which they place their hopes for the future. As community gatherings are already common, developing a time when elders and children can meet to share knowledge is feasible with current resources. Developing practicums or apprenticeships with elders or local artisans that can become part of urban schools' curriculums has the potential to increase knowledge transmission, document local traditions and elevate the perception of local arts.

The communities in this study have an abundance of fresh products, particularly fruits, that are produced with what could be considered an agroecological approach. It was noted that during the high season, the Jocotán market was flooded with such goods, too many for vendors to be able to sell for a reasonable income. Connecting communities to other markets could enhance incomes and funnel high-quality products into other municipal, national or international markets. It is possible that a labeling scheme or assistance with certification in ecological, biological or agroecological farming could provide greater market opportunities. In addition, developing methods of local post-harvest processing, conservation and storage could help to provide local food security or diversify offerings at the Jocotán market with value-added products. The concept of local food banks that house, store and distribute surplus goods from the community could provide an infrastructure that is beyond the normal capacity of households.

To encourage temporal diversity in the food systems approach of the Ch'orti', it is also recommended that communities work with the village COCODES at different altitudes and growing zones to develop a collaboration within communal lands. Providing access to plots at different altitudes can help to build harvest security in the case of local crop failure, whilst strengthening trade networks and knowledge sharing between communities. In light of the erratic weather conditions due to climate change, it would be valuable to expand the use of water capture to take advantage of the winter rains to help sustain households during periods of drought.

This rapid profile provides a glimpse into a complex and dynamic system that varies across Ch'orti' territory. Additional research and characterizing of varietal diversity kept in households, efficacy of local phenology, and the development of alternative natural fertilizers and pest deterrents for the ***milpa*** to ease the dependence on outside inputs is needed. A characterisation of the sustainable practices of the Ch'orti' patios and live fences could be expanded upon within the context of research regarding Maya home garden design. Promoting best practices and facilitating knowledge exchange with other Maya groups can build overall resilience and sustainability, particularly in the dry corridor.

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GLOSSARY

The glossary does not aim to provide definitions, rather clarifications on the terms used in the publication. These are gathered from a variety of sources, including FAO terms, the online IPBES[1] and A4NH[2] glossaries. If the definition is not an FAO term, a reference is cited. These definitions provide an interpretation of the terms to which they refer, that relates to indigenous peoples' food systems.

- **Agrobiodiversity:** Agricultural biodiversity is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems, also named agroecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agroecosystem, its structure and processes (CBD, 2000).

- **Agrochemicals:** Chemical compounds used in farming including fertilizers, pesticides, hormones and other growth agents, and soil conditioners.

- **Agroecology:** The study of agricultural systems in the context of their entire environments over space and over time. It studies agricultural systems as ecological systems first and foremost, rather than simply as industrial food factories. It thus shades into landscape studies and agricultural geography but with more emphasis on biological factors and measures. It has become a holistic approach at odds with partial and sectored views that led early agricultural science (Altieri, 1995).

- **Agroecosystem:** A semi-natural or modified natural system managed by humans for food and agricultural production purposes.

[1] Available at https://ipbes.net/glossary

[2] Available at https://a4nh.cgiar.org/2020/01/26/glossary-food-systems/

- **Agroforestry system:** Any agricultural system (agroecosystem) in which planted or protected trees are seen as economically, socially, or ecologically integral to the system.

- **Balanced diet:** A diet that provides an adequate amount and variety of food to meet a person's macro and micro nutrient needs for a healthy, active life.

- **Biocultural diversity:** The diversity exhibited by interacting natural systems and human cultures. The concept rests on three propositions: firstly, that the diversity of life includes human cultures and languages; secondly, that links exist between biodiversity and human cultural diversity; and finally, that these links have developed over time through mutual adaptation and possibly co-evolution between humans, plants and animals.

- **Biodiversity:** The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

- **Biofertilizer, biological fertilizer, organic fertilizer:** A biofertilizer is a natural fertilizer that helps to provide all the nutrients required by the plants and to increase the quality of the soil with a natural microorganism environment. For instance, the production and use of biofertilizer (such as seaweed products; compost) is proposed to improve crop yields by using root nodule bacteria (rhizobia), mycorrhizal fungi, and other microorganisms that are able to increase the accessibility of plant nutrients from the soils.

- **Biological pest control:** Biological control is a method of controlling pests, diseases and weeds in agriculture that relies on natural predation, parasitism or other natural mechanisms that restrain the development of pathogenic organisms.

- **Biome:** Global-scale zones, generally defined by the type of plant life that they support in response to average rainfall and temperature patterns. For example, tundra, coral reefs or savannas.

- **Breed:** Either a subspecific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species, or a group for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity.

- **Bushmeat:** Meat for human consumption derived from wild animals.

- **Community seed bank:** A community seed system is based on seed saving and aims to conserve existing varieties and make them available to the local community.

- **Compost:** A mixture of decaying organic matter, as from leaves and manure, used to improve soil structure and provide nutrients.

- **Conservation:** Includes protection, maintenance, rehabilitation, restoration and enhancement of populations and ecosystems. This implies sound biosphere management within given social and economic constraints, producing goods and services without depleting natural ecosystem diversity.

- **Crop:** A cultivated plant grown to be harvested either to be used or to be sold (adapted from FAO TERM).

- **Crop rotation:** The practice of alternating the species or families of annual and/or biannual crops grown on a specific field in a planned pattern or sequence so as to break weed, pest and disease cycles and to maintain or improve soil fertility and organic matter content.

- **Cultivar:** A plant or grouping of plants selected for desirable characteristics that can be maintained by propagation. Most cultivars have arisen in cultivation, but a few are special selections from the wild (Bioversity International, 2017).

- **Cultural heritage:** Traditions or living expressions inherited from ancestors and passed on to descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts.

- **Cultural transmission:** Cultural transmission is the acquisition of the various competences and pieces of information that a human society acquaints to its members and that forge its own traditions. Human traditions are meant to last because societies possess outstanding capacities for imitation, sufficient to trigger the evolution of cumulative cultures (Callan and Coleman, eds., 2018).

- **Customary tenure:** Rules and norms which communities devise and uphold to regulate how their lands are acquired, owned, used and transferred. Many rules and norms are tested over generations (hence 'traditions' or 'customs').

- **Customary use of biological resources:** Uses of biological resources in accordance with traditional cultural practices that are compatible with conservation and sustainable use requirements.

- **Diet:** The kinds of food that follow a particular pattern that a person or community eats.

- **Dietary diversity:** A measure of the variety of food from different food groups consumed over a reference period.

- **Ecoregion:** A large area of land or water that contains a geographically distinct assemblage of natural communities that:

  (a) Share a large majority of their species and ecological dynamics;

  (b) Share similar environmental conditions, and;

  (c) Interact ecologically in ways that are critical for their long-term persistence.

  In contrast to biomes, an ecoregion is generally geographically specific, at a much finer scale. For example, the "East African Montane Forest" eco-region of Kenya (WWF ecoregion classification) is a geographically specific and coherent example of the globally occurring "tropical and subtropical forest" biome.

- **Ecosystem:** A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (CBD, 1992).

- **Ecosystem function:** An intrinsic ecosystem characteristic related to the set of conditions and processes whereby an ecosystem maintains its integrity (such as primary productivity, food chain, biogeochemical cycles). Ecosystem functions include such processes as decomposition, production, nutrient cycling, and fluxes of nutrients and energy.

- **Ecosystem services:** The benefits people obtain from ecosystems. These include provisioning services such as food and water; pollination of crops; regulating services such as flood and disease control; cultural services such as spiritual, recreational and cultural benefits; and supporting services, such as the nutrient cycling that maintains the conditions for life on Earth.

- **Efficiency:** The ratio of a system's output (or production) to the inputs that it requires, as in the useful energy produced by a system compared with the energy put into that system.

- **Food biodiversity:** The diversity of plant, animal and other sources used for food, covering the genetic resources within species and between species.

- **Food security:** Food security takes place when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. The multidimensional nature of food security includes food availability, access, stability and utilization.

- **Food sovereignty:** Right of peoples to define their own policies and strategies for the sustainable production, distribution and consumption of food, with respect for their own cultures and their own systems of managing natural resources and rural areas, and is considered to be a precondition for food security.

- **Global (environmental) change:** A major environmental and worldwide concern for the time being, global change combines systemic and cumulative dimensions. It is systemic where environmental change in any place directly affects the characteristics of the environment elsewhere, or even of the whole earth system. It is cumulative when change results from the accumulation of local and regional changes occurring around the world (Callan and Coleman, eds., 2018).

- **Green manure:** A cover crop grown to help maintain soil organic matter and increase nitrogen availability. Legumes are often used because they have rhizobial bacteria living in their root nodules that are able to fix nitrogen from the air and add it to the soil. Green manure is incorporated into the soil for the purpose of soil improvement. May include spontaneous crops, plants or weeds.

- **Habitat:** The place or type of site where species and communities normally live or grow, usually characterized by relatively uniform physical features or by consistent plant forms, e.g. deserts, lakes and forest are all habitats.

- **Habitat degradation:** A general term describing the set of processes by which habitat quality is reduced. Habitat degradation may occur through natural processes (e.g. drought, heat, cold) and through human activities (forestry, agriculture, urbanization).

- **Healthy diet:** Healthy diets contain adequate food energy and sufficient amounts of macro- and micronutrients; limit overconsumption, particularly of nutrient-poor foods high in energy, saturated and trans fats, added sugars and salt; include a variety of nutrient-dense foods from basic food groupings; and are safe to consume (Adapted from HLPE, 2017).

- **Hunter-gatherers (present-day):** A term used to refer to small scale, mostly egalitarian, societies that subsist primarily from food that has been obtained directly from the environment – through hunting animals, gathering plant food, fishing, or scavenging. A more general term for this is 'foraging' and such peoples are also sometimes referred to as 'foragers' – or often 'post-foragers', given that most such societies no longer survive through these subsistence techniques alone. They constitute a tiny fraction (less than 1 percent) of the 476 million peoples referred to as indigenous (Lee R.B., Heywood Daly R. and Daly R., 1999).

• **Indigenous peoples' food system:** See elements of characterization in the Methodology section.

• **Indigenous peoples' knowledge:** Cumulative body of knowledge (for example know-how), practices and manifestations maintained and developed by people with long histories of interaction with their natural environment. It forms the basis for local-level decision-making, especially for the poor, and provides problem-solving strategies for communities.

• ***In situ* conservation:** The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

• **Institution:** A structure of social order governing the behaviour of a set of individuals and that shape human interactions by serving collectively valued goals. The term includes formal institutions (e.g. public institutions, nongovernmental and private organizations, training and educational institutions such as universities and research institutes) and informal institutions (e.g. village committees, community groups, farmer groups).

• **Intercropping:** Growing two or more crops as a mixture in the same field at the same time. Intercropping can be one way of adding diversity to a crop system.

• **Land race:** A crop variety, often harbouring some genetic variability, yet, with a certain genetic integrity that has evolved in cultivation, usually in a traditional agricultural system over long periods, and has adapted to a specific local environment or purpose (Bioversity International, 2017).

• **Landscape:** A landscape can be defined as a socioecological system made up of natural and/or human-modified ecosystems.

• **Livelihood:** A combination of the resources used and the activities undertaken in order to live. The resources might consist of individual skills and abilities (human capital), land, savings and equipment (natural, financial and physical capital, respectively), and formal support groups or informal networks that assist in the activities being undertaken (social capital).

• **Local food:** Local food refers to food that is produced near its point of consumption.

• **Manure:** Organic material that is used to fertilize land, usually consisting of the faeces and urine of domestic livestock, with or without litter such as straw, hay, or bedding.

• **Mineral fertilizer, nitrogen fertilizer, synthetic fertilizer, synthetic input:** Fertlizers manufactured by chemical and industrial processes. May include products not found in nature, or simulation of products from natural sources (but not extracted from natural raw materials). It refers to agricultural substances produced through chemical processes, including nitrogen-fertilizers.

• **Natural resource:** Any portion of the natural environment, such as air, water, soil, botanical and zoological resources and minerals. A renewable resource can potentially last indefinitely without reducing the available supply because it is replaced through natural processes or because it recycles rapidly as water does.

• **Non-Timber Forest Product:** Goods derived from forests that are tangible and physical objects of biological origin other than wood.

• **Non-communicable diseases (NCDs):** Also known as chronic diseases, these are generally of long duration and are the result of a combination of genetic, physiological, environmental, dietary, and behavioural factors. The main types of NCDs are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes. NCDs are the leading cause of death worldwide (adapted from WHO, 2018).

• **Nutrition:** The intake of food, and the interplay of biological, social, and economic processes that influence the growth, function and repair of the body.

• **Nutrition security:** A situation that exists when secure access to an appropriately nutritious diet is coupled with a sanitary environment and adequate health services and care, in order to ensure a healthy and active life for all household members. Nutrition security differs from food security in that it also considers the aspects of adequate caregiving practices, health and hygiene, in addition to dietary adequacy.

• **Oral tradition:** Variety of spoken forms including proverbs, riddles, tales, nursery rhymes, legends, myths, epic songs and poems, charms, prayers, chants, songs, dramatic performances and more used to pass on knowledge, cultural and social values and collective memory. They play a crucial part in keeping cultures alive.

• **Organic manure:** Organic manure covers manures made from cattle dung, excreta of other animals, rural and urban composts, other animal wastes, crop residues and green manures. Organic manure is time tested materials for improving the fertility and productivity of soils.

• **Pastoralism:** Wide family of livestock-based, livelihood/food production systems, which are specialized in improving the animals' diet and welfare through different forms of mobility (from short movements to nomadism), thus managing their grazing itineraries at a variety of scales in time and space (FAO, forthcoming).

• **Pest:** Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products, livestock, food and storage products.

• **Pesticide:** Any substance intended for preventing, destroying, attracting, repelling, or controlling any pest including unwanted species of plants or animals during the production, storage, transport, distribution, and processing of food, agricultural commodities, or animal feeds or which may be administered to animals for the control of ectoparasites. The term includes substances intended for use as a plant-growth regulator, defoliant, desiccant, fruit thinning agent, or sprouting inhibitor and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport. The term normally excludes fertilizers, plant and animal nutrients, food additives and animal drugs. (Note: "Agricultural commodities" refers to commodities such as raw cereals, sugar beet, and cottonseed which might not, in the general sense, be considered food).

• **Resilience:** The capacity of a system to deal with change and continue to develop; withstanding shocks and disturbances and using such events to catalyze renewal and innovation. (Adapted from the Stockholm Resilience Institute)

• **Self-sufficiency:** A group is considered self-sufficient by its ability to produce all the materials it consumes and to consume what it produces. Self-sufficiency refers to a closed loop from production to consumption to production. It is a model, sometimes an ideal, that is never achieved. Economic self-sufficiency is in total contrast to complete market economy in which everything produced is traded and everything consumed is secured through trade (Callan and Coleman, eds., 2018).

• **Shifting cultivation:** A way of farming that involves the clearing of natural or largely natural vegetation, usually using fire, to plant crops for one or two years and then allowing natural vegetation to regenerate on the plot for a long period of time referred to as fallowing, before clearing and cropping it again. Shifting cultivation is also known as "slash and burn" or "swidden cultivation" and by a variety of local names specific to each place in which it is practiced (Callan and Coleman, eds., 2018).

• **Social-ecological system:** "Social" or "socio" ecological systems" are complex and evolving systems in which humans are part of nature. Social, economic, ecological, cultural, political, technological, and other components are strongly linked and the ecological component provides essential services to society such as supply of food, fiber, energy, and drinking water (Berkes and Folke, eds., 1998).

• **Soil erosion:** The process of removal and transport of soil and rock by weathering, mass wasting, and the action of streams, glaciers, waves, winds, and underground water.

• **Soil fertility:** The ability of a soil to sustain plant growth by providing essential plant nutrients and favorable chemical, physical, and biological characteristics as a habitat for plant growth.

• **Species:** An interbreeding group of organisms that is reproductively isolated from all other organisms, although there are many partial exceptions to this rule in particular taxa. Operationally, the term species is a generally agreed fundamental taxonomic unit, based on morphological or genetic similarity, that once described and accepted is associated with a unique scientific name.

• **Species diversity:** A measure of the number of different species within a biological community, and relative abundance of individual in that community.

• **Staple food:** Food that is eaten commonly and regularly in a country or community and in such quantities as to constitute the dominant part of the diet and supply a major proportion of energy needs.

• **Subsistence:** Subsistence is the process whereby people supply themselves with the necessities of life, such as food and shelter. Subsistence relates primarily to self-provisioning by small productive units, often families. These groups are referred to as autarkic for being able to supply all their own needs with no dependence on interaction with others to obtain necessities (Callan and Coleman, eds., 2018).

• **Sustainability:** A characteristic or state whereby the needs of the present and local population can be met without compromising the ability of future generations or populations in other locations to meet their needs.

• **Sustainable Diet:** Diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.

• **Territory:** Lands, and waters traditionally occupied, or used by indigenous and local communities.

• **Traditional knowledge:** Knowledge, innovations and practices of indigenous and local communities around the world developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation.

• **Value chain:** The set of actors (private, public, and including service providers) and the sequence of value-adding activities involved in bringing a product from production to the final consumer. In agriculture they can be thought of as a 'farm to fork' set of processes and flows.

• **Variety:** A plant or group of plants selected for desirable characteristics and maintained in cultivation. It may be traditional and maintained by farmers, or modern and developed as a result of deliberate breeding programmes (Bioversity International, 2017)

• **Well-being:** A context - and situation - dependent state, comprising basic material for a good life, freedom and choice, health, good social relations, and security.

• **Wild food:** Wild plants, animals and insects that are not cultivated or reared in captivity. They are part of the minor crops and underutilized species, and include roots and tubers, vegetables and leafy vegetables, fruits, insects, amphibians, reptiles, birds and mammals gathered for food (Bioversity International, 2017).

SPECIES INDEXES

SCIENTIFIC NAMES

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Aquaculture	Fish	*Oreochromis niloticus* L., Cichlidae	Maya Ch'orti'	Table 8.3
		Molluscs and crustaceans	*Bithynia tentaculata* L., Bithyniidae	Maya Ch'orti'	Table 8.3
			Pomacea maculata Perry, Ampullariidae	Maya Ch'orti'	Table 8.3
		Vegetables	*Nasturtium officinale* W.T. Aiton, Brassicaceae	Maya Ch'orti'	Table 8.3
			Piper auritum Kunth, Piperaceae	Maya Ch'orti'	Table 8.3
	Cultivated foods: crops, planted trees and other cultivated foods	Condiments, seasonings, snacks and sweeteners	*Capsicum* sp. L., Solanaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
			Capsicum frutescens L., Solanaceae	Khasi	Table 3.6
			Coriandrum sativum L., Apiaceae	Maya Ch'orti'	Table 8.1
			Curcuma longa L., Zingiberaceae	Khasi	Table 3.1
			Cymbopogon spp., Poaceae	Maya Ch'orti'	Table 8.1
			Eryngium foetidum L., Apiaceae	Maya Ch'orti'	Table 8.1
			Laurus nobilis L., Lauraceae	Khasi	Table 3.1
			Lippia graveolens Kunth, Verbenaceae	Maya Ch'orti'	Table 8.1
			Mentha sp., Lamiaceae	Khasi	Table 3.1
			Mentha spicata L., Lamiaceae	Maya Ch'orti'	Table 8.1
			Ocimum campechianum Mill., Lamiaceae	Maya Ch'orti'	Table 8.1
			Origanum vulgare L., Lamiaceae	Maya Ch'orti'	Table 8.1
			Plectranthus amboinicus (Lour.) Spreng., Lamiaceae	Maya Ch'orti'	Table 8.1
			Rhus chinensis Mill., Anacardiaceae	Khasi	Table 3.1
			Saccharum officinarum L., Poaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
				Tikuna, Cocama and Yagua	Table 7.1
			Salvia divinorum Epling & Játiva, Lamiaceae	Maya Ch'orti'	Table 8.1
			Zingiber officinale Roscoe, Zingiberaceae	Khasi	Table 3.1
				Melanesians[SI]	Table 4.1
			Zingiber officinale var. *rubrum* Theilade, Zingiberaceae	Melanesians[SI]	Table 4.1
			Zingiber rubens Roxb., Zingiberaceae	Khasi	Table 3.1
		Fruits and juices	*Acrocomia aculeata* (Jacq.) Lodd. ex Mart., Arecaceae	Maya Ch'orti'	Table 8.1
			Ananas comosus (L.) Merr., Bromeliaceae	Baka	Table 1.3
				Khasi	Table 3.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	Fruits and juices	*Annona muricata* L., Annonaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1
			Annona purpurea Moc. & Sessé ex Dunal, Annonaceae	Maya Ch'orti'	Table 8.1
			Annona reticulata L., Annonaceae	Maya Ch'orti'	Table 8.1
			Artocarpus altilis (Parkinson) Fosberg, Moraceae	Melanesians[SI]	Table 4.1
			Artocarpus heterophyllus Lam., Moraceae	Khasi	Table 3.1
			Artocarpus spp. Forst. , Moraceae	Tikuna, Cocama and Yagua	Table 7.1
			Averrhoa carambola L., Oxalidaceae	Melanesians[SI]	Table 4.1
			Bactris gasipaes Kunth, Arecaceae	Tikuna, Cocama and Yagua	Table 7.1
			Bromelia pinguin L., Bromeliaceae	Maya Ch'orti'	Table 8.1
			Bruguiera gymnorhiza (L.) Savigny, Rhizophoraceae	Melanesians[SI]	Table 4.1
			Byrsonima crassifolia (L.) Kunth, Malpighiaceae	Maya Ch'orti'	Table 8.1
			Carica papaya L., Caricaceae	Baka	Table 1.3
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1
			Casimiroa edulis La Llave, Rutaceae	Maya Ch'orti'	Table 8.1
			Citrullus lanatus (Thunb.) Matsum. & Nakai, Cucurbitaceae	Kel Tamasheq	Table 5.2
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Citrus × aurantium L., Rutaceae	Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Citrus × latifolia (Yu.Tanaka) Yu.Tanaka, Rutaceae	Maya Ch'orti'	Table 8.1
			Citrus aurantiifolia (Christm.) Swingle, Rutaceae	Maya Ch'orti'	Table 8.1
			Citrus grandis (L.) Osbeck, Rutaceae	Melanesians[SI]	Table 4.1
			Citrus limon (L.) Osbeck, Rutaceae	Bhotia and Anwal	Table 6.1
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Tikuna, Cocama and Yagua	Table 7.1
			Citrus maxima (Burm.) Merr., Rutaceae	Khasi	Table 3.1
			Citrus medica L., Rutaceae	Khasi	Table 3.1
			Citrus paradisi Macfad., Rutaceae	Baka	Table 1.3

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	**Fruits and juices**	*Citrus reticulata* Blanco, Rutaceae	Baka	Table 1.3
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Citrus sinensis (L.) Osbeck, Rutaceae	Baka	Table 1.3
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Citrus trifoliata L., Rutaceae	Tikuna, Cocama and Yagua	Table 7.1
			Citrus x aurantium L., Rutaceae	Tikuna, Cocama and Yagua	Table 7.1
			Cocos nucifera L., Arecaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
			Crescentia cujete L., Bignoniaceae	Tikuna, Cocama and Yagua	Table 7.1
			Cucumis melo L., Cucurbitaceae	Maya Ch'orti'	Table 8.1
			Cyphomandra betacea (Cav.) Sendtn., Solanaceae	Khasi	Table 3.1
			Elaeagnus latifolia L., Elaeagnaceae	Khasi	Table 3.1
			Eriobotrya japonica (Thunb.) Lindl., Rosaceae	Maya Ch'orti'	Table 8.1
			Eugenia stipitata McVaugh, Myrtaceae	Tikuna, Cocama and Yagua	Table 7.1
			Euterpe oleracea Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.1
			Ficus carica L., Moraceae	Maya Ch'orti'	Table 8.1
			Genipa americana L., Rubiaceae	Tikuna, Cocama and Yagua	Table 7.1
			Inga edulis Mart., Fabaceae	Maya Ch'orti'	Table 8.1
			Inga vera subsp. *spuria* (Willd.) J.Leon, Fabaceae	Tikuna, Cocama and Yagua	Table 7.1
			Licania platypus (Hemsl.) Fritsch, Chrysobalanaceae	Maya Ch'orti'	Table 8.1
			Mammea americana L., Calophyllaceae	mus	Table 8.1
			Mangifera indica L., Anacardiaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1
			Manilkara zapota (L.) P.Royen, Sapotaceae	Maya Ch'orti'	Table 8.1
			Mauritia flexuosa L., Arecaceae	Tikuna, Cocama and Yagua	Table 7.1
			Melicoccus bijugatus Jacq., Sapindaceae	Maya Ch'orti'	Table 8.1
			Morinda citrifolia L., Rubiaceae	Maya Ch'orti'	Table 8.1
				Tikuna, Cocama and Yagua	Table 7.1
			Morus australis Poir., Moraceae	Khasi	Table 3.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	Fruits and juices	*Musa acuminata* Colla, Musaceae	Baka	Table 1.3
				Khasi	Table 3.1
				Tikuna, Cocama and Yagua	Table 7.1
			Musa sp., Musaceae	Khasi	Table 3.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1
			Myrciaria dubia (Kunth) McVaugh, Myrtaceae	Tikuna, Cocama and Yagua	Table 7.1
			Myrica esculenta Buch.-Ham. ex D. Don, Myricaceae	Khasi	Table 3.1
			Nephelium lappaceum L., Sapindaceae	Melanesians[SI]	Table 4.1
			Opuntia ficus-indica (L.) Mill., Cactaceae	Maya Ch'orti'	Table 8.1
			Passiflora edulis Sims, Passifloraceae	Khasi	Table 3.1
				Tikuna, Cocama and Yagua	Table 7.1
			Passiflora ligularis Juss., Passifloraceae	Maya Ch'orti'	Table 8.1
			Passiflora quadrangularis L., Passifloraceae	Tikuna, Cocama and Yagua	Table 7.1
			Persea americana Mill., Lauraceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Persea schiedeana Nees, Lauraceae	Maya Ch'orti'	Table 8.1
			Platonia insignis Mart., Clusiaceae	Tikuna, Cocama and Yagua	Table 7.1
			Pometia pinnata J.R.Forst. & G.Forst., Sapindaceae	Melanesians[SI]	Table 4.1
			Pourouma cecropiifolia Mart., Urticaceae	Tikuna, Cocama and Yagua	Table 7.1
			Pouteria caimito (Ruiz & Pav.) Radlk., Sapotaceae	Tikuna, Cocama and Yagua	Table 7.1
			Pouteria campechiana (Kunth) Baehni, Sapotaceae	Maya Ch'orti'	Table 8.1
			Pouteria durlandii (Standl.) Baehni, Sapotaceae	Maya Ch'orti'	Table 8.1
			Pouteria sapota (Jacq.) H.E.Moore & Stearn, Sapotaceae	Maya Ch'orti'	Table 8.1
			Prunus domestica L., Rosaceae	Bhotia and Anwal	Table 6.1
				Khasi	Table 3.1
			Prunus nepaulensis (Ser.) Steud, Rosaceae	Khasi	Table 3.1
			Prunus persica (L.) Batsch, Rosaceae	Bhotia and Anwal	Table 6.1
				Khasi	Table 3.1
			Psidium guajava L., Myrtaceae	Baka	Table 1.3
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	Fruits and juices	*Pyrus communis* L., Rosaceae	Khasi	Table 3.1
			Quararibea cordata (Bonpl.) Vischer, Malvaceae	Tikuna, Cocama and Yagua	Table 7.1
			Saccharum officinarum L., Poaceae	Khasi	Table 3.1
			Solanum americanum Mill., Solanaceae	Khasi	Table 3.1
			Solanum ferox L., Solanaceae	Maya Ch'orti'	Table 8.1
			Spondias dulcis Soland. ex Forst. fil., Anacardiaceae	Baka	Table 1.3
				Melanesians[SI]	Table 4.1
			Spondias mombin L., Anacardiaceae	Maya Ch'orti'	Table 8.1
			Stenocereus queretaroensis (F.A.C.Weber ex Mathes.) Buxb., Cactaceae	Maya Ch'orti'	Table 8.1
			Syzygium aqueum (Burm.f.) Alston, Myrtaceae	Melanesians[SI]	Table 4.1
			Syzygium malaccense (L.) Merr. & L. M. Perry, Myrtaceae	Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1
			Tamarindus indica L., Fabaceae	Maya Ch'orti'	Table 8.1
			Theobroma bicolor Bonpl., Malvaceae	Tikuna, Cocama and Yagua	Table 7.1
			Theobroma cacao L., Malvaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
			Theobroma grandiflorum (Willd. ex Spreng.) K.Schum, Malvaceae	Tikuna, Cocama and Yagua	Table 7.1
			Ziziphus sp., Rhamnaceae	Kel Tamasheq	Table 5.2
		Mushrooms	*Lactarius deliciosus* (L.) Gray, Russulaceae	Maya Ch'orti'	Table 8.1
			Ustilago maydis (DC.) Corda, Ustilaginaceae	Maya Ch'orti'	Table 8.1
		Nuts and seeds	*Anacardium excelsum* (Bertero ex Kunth) Skeels, Anacardiaceae	Maya Ch'orti'	Table 8.1
			Arachis hypogaea L., Fabaceae	Kel Tamasheq	Table 5.2
				Maya Ch'orti'	Table 8.1
				Tikuna, Cocama and Yagua	Table 7.1
			Barringtonia edulis Seem., Lecythidaceae	Melanesians[SI]	Table 4.1
			Barringtonia novae-hibernae Lauterb., Lecythidaceae	Melanesians[SI]	Table 4.1
			Barringtonia procera (Miers) R. Knuth, Lecythidaceae	Melanesians[SI]	Table 4.1
			Bertholletia excelsa Bonpl., Lecythidaceae	Tikuna, Cocama and Yagua	Table 7.1
			Bixa orellana L., Bixaceae	Maya Ch'orti'	Table 8.1
			Canarium harveyi Seem, Burseraceae	Melanesians[SI]	Table 4.1
			Canarium indicum L., Burseraceae	Melanesians[SI]	Table 4.1
			Canarium solomonense B.L.Burtt, Burseraceae	Melanesians[SI]	Table 4.1
			Cocos nucifera L., Arecaceae	Melanesians[SI]	Table 4.1
			Crescentia alata Kunth, Bignoniaceae	Maya Ch'orti'	Table 8.1
			Cucumeropsis mannii Naudin, Cucurbitaceae	Baka	Table 1.3
			Cucurbita sp., Cucurbitaceae	Maya Ch'orti'	Table 8.1
			Elaeis guineensis Jacq., Arecaceae	Baka	Table 1.3

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	Nuts and seeds	*Perilla frutescens* (L.) Britton, Lamiaceae	Khasi	Table 3.1
			Salvia hispanica L., Lamiaceae	Maya Ch'orti'	Table 8.1
			Terminalia catappa L., Combretaceae	Maya Ch'orti'	Table 8.1
		Pulses	*Arachis hypogaea* L., Fabaceae	Baka	Table 1.3
				Melanesians[SI]	Table 4.1
			Benincasa hispida (Thunb.) Cogn., Cucurbitaceae	Melanesians[SI]	Table 4.1
			Cajanus cajan (L.) Millsp., Fabaceae	Bhotia and Anwal	Table 6.1
				Maya Ch'orti'	Table 8.1
			Cicer arietinum L., Fabaceae	Maya Ch'orti'	Table 8.1
			Glycine max (L.) Merr., Fabaceae	Bhotia and Anwal	Table 6.1
			Phaseolus lunatus L., Fabaceae	Maya Ch'orti'	Table 8.1
			Phaseolus vulgaris L., Fabaceae	Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
			Pisum sativum L., Fabaceae	Khasi	Table 3.1
			Psophocarpus tetragonolobus (L.) DC., Fabaceae	Melanesians[SI]	Table 4.1
			Trichosanthes cucumerina L., Cucurbitaceae	Melanesians[SI]	Table 4.1
			Trichosanthes cucumerina subsp. *anguina* (L.) I. Grebenscikov Haines, Cucurbitaceae	Melanesians[SI]	Table 4.1
			Vicia faba L., Fabaceae	Maya Ch'orti'	Table 8.1
			Vigna angularis (Willd.) Ohwi & H. Ohashi, Fabaceae	Bhotia and Anwal	Table 6.1
			Vigna mungo (L.) Hepper, Fabaceae	Bhotia and Anwal	Table 6.1
			Vigna umbellata (Thunb.) Ohwi & H. Ohashi, Fabaceae	Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
			Vigna unguiculata (L.) Walp, Fabaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Vigna unguiculata subsp. *sesquipedalis* (L.) Verdc, Fabaceae	Melanesians[SI]	Table 4.1
		Starches	*Alocasia macrorrhizos* (L.) G.Don, Araceae	Melanesians[SI]	Table 4.1
			Amaranthus cruentus L., Amaranthaceae	Maya Ch'orti'	Table 8.1
			Cenchrus americanus (L.) Morrone, Poaceae	Kel Tamasheq	Table 5.2
			Coix lacryma-jobi L., Poaceae	Khasi	Table 3.1
			Colocasia esculenta (L.) Schott, Araceae	Baka	Table 1.3
				Khasi	Table 3.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1
			Cyrtosperma merkusii (Hassk.) Schott., Araceae	Melanesians[SI]	Table 4.1
			Dioscorea alata L., Dioscoreaceae	Melanesians[SI]	Table 4.1
			Dioscorea cayenensis subsp. *rotundata* (Poir.) J.Miège, Dioscoreaceae	Melanesians[SI]	Table 4.1
			Dioscorea esculenta (Lour.) Burkill, Dioscoreaceae	Melanesians[SI]	Table 4.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	Starches	*Dioscorea* sp. L., Dioscoreaceae	Baka	Table 1.3
				Melanesians[SI]	Table 4.1
			Eleusine coracana (L.) Gaertn, Poaceae	Bhotia and Anwal	Table 6.1
				Khasi	Table 3.1
			Fagopyrum acutatum (Lehm.) Mansf. ex K. Hammer, Polygonaceae	Bhotia and Anwal	Table 6.1
			Ipomoea batatas (L.) Lam, Convolvulaceae	Baka	Table 1.3
				Kel Tamasheq	Table 5.2
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Manihot esculenta Crantz, Euphorbiaceae	Baka	Table 1.3
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
				Tikuna, Cocama and Yagua	Table 7.1
			Maranta arundinacea L., Marantaceae	Khasi	Table 3.1
			Musa sp., Musaceae	Baka	Table 1.3
			Oryza sativa L., Poaceae	Maya Ch'orti'	Table 8.1
				Tikuna, Cocama and Yagua	Table 7.1
			Oryza glaberrima Steud, Poaceae	Kel Tamasheq	Table 5.2
			Sechium edule (Jacq.) Sw., Cucurbitaceae	Maya Ch'orti'	Table 8.1
			Solanum sp., Solanaceae	Khasi	Table 3.1
			Solanum tuberosum L., Solanaceae	Bhotia and Anwal	Table 6.1
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
			Sorghum bicolor (L.) Moench, Poaceae	Kel Tamasheq	Table 5.2
				Maya Ch'orti'	Table 8.1
			Xanthosoma sagittifolium (L.) Schott, Araceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
				Melanesians[SI]	Table 4.1
			Zea mays L., Poaceae	Baka	Table 1.3
				Bhotia and Anwal	Table 6.1
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
				Tikuna, Cocama and Yagua	Table 7.1
			Zea perennis (Hitchc.) Reeves & Mangelsd., Poaceae	Maya Ch'orti'	Page 337
		Vegetables	*Abelmoschus esculentus* (L.) Moench, Malvaceae	Baka	Table 1.3
				Maya Ch'orti'	Table 8.1
			Abelmoschus manihot (L.) Medik., Malvaceae	Melanesians[SI]	Table 4.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	**Vegetables**	*Abelmoschus* sp., Malvaceae	Kel Tamasheq	Table 5.2
			Allium cepa L., Amaryllidaceae	Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
			Allium cepa var. *aggregatum* G.Don., Amaryllidaceae	Melanesians[SI]	Table 4.1
			Allium sativum L., Amaryllidaceae	Bhotia and Anwal	Table 6.1
				Kel Tamasheq	Table 5.2
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
			Amaranthus dubius Mart. ex Thell., Amaranthaceae	Maya Ch'orti'	Table 8.1
			Amaranthus hybridus L., Amaranthaceae	Maya Ch'orti'	Table 8.1
			Amaranthus sp. L., Amaranthaceae	Baka	Table 1.3
				Bhotia and Anwal	Table 6.1
				Maya Ch'orti'	Table 8.1
			Amaranthus viridis L., Amaranthaceae	Maya Ch'orti'	Table 8.1
			Apium graveolens L., Apiaceae	Maya Ch'orti'	Table 8.1
			Attalea sp., Arecaceae	Maya Ch'orti'	Table 8.1
			Beta vulgaris L., Amaranthaceae	Kel Tamasheq	Table 5.2
				Maya Ch'orti'	Table 8.1
			Brassica juncea (L.) Czern., Brassicaceae	Khasi	Table 3.1
			Brassica oleracea L., Brassicaceae	Bhotia and Anwal	Table 6.1
				Khasi	Table 3.1
			Brassica oleracea var. capitata L., Brassicaceae	Kel Tamasheq	Table 5.2
			Brassica rapa L., Brassicaceae	Melanesians[SI]	Table 4.1
			Brassica rapa subsp. *oleifera* (DC.) Metzg., Brassicaceae	Melanesians[SI]	Table 4.1
			Bromelia pinguin L., Bromeliaceae	Maya Ch'orti'	Table 8.1
			Capsicum annuum L., Solanaceae	Tikuna, Cocama and Yagua	Table 7.1
			Capsicum sp. L., Solanaceae	Maya Ch'orti'	Table 8.1
			Chamaedorea elegans Mart., Arecaceae	Maya Ch'orti'	Table 8.1
			Cnidoscolus aconitifolius (Mill.) I.M.Johnst., Euphorbiaceae	Maya Ch'orti'	Table 8.1
			Corchorus olitorius L., Malvaceae	Baka	Table 1.3
			Coriandrum sativum L., Apiaceae	Khasi	Table 3.1
			Crotalaria longirostrata Hook. & Arn., Fabaceae	Maya Ch'orti'	Table 8.1
			Cucumis sativus L., Cucurbitaceae	Kel Tamasheq	Table 5.2
				Khasi	Table 3.1
				Melanesians[SI]	Table 4.1
			Cucurbita ficifolia Bouché, Cucurbitaceae	Maya Ch'orti'	Table 8.1
			Cucurbita maxima Duchesne, Cucurbitaceae	Baka	Table 1.3
				Melanesians[SI]	Table 4.1
			Cucurbita moschata Duchesne, Cucurbitaceae	Khasi	Table 3.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	Vegetables	*Cucurbita* sp., Cucurbitaceae	Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
			Daucus carota L., Apiaceae	Kel Tamasheq	Table 5.2
				Maya Ch'orti'	Table 8.1
			Dysphania ambrosioides (L.) Mosyakin & Clemants, Amaranthaceae	Maya Ch'orti'	Table 8.1
			Erythrina berteroana Urb., Fabaceae	Maya Ch'orti'	Table 8.1
			Fernaldia pandurata (A.DC.) Woodson, Apocynaceae	Maya Ch'orti'	Table 8.1
			Gliricidia sepium (Jacq.) Walp., Fabaceae	Maya Ch'orti'	Table 8.1
			Ipomoea aquatica Forssk., Convolvulaceae	Melanesians[SI]	Table 4.1
			Lactuca sativa L., Asteraceae	Kel Tamasheq	Table 5.2
				Khasi	Table 3.1
			Lagenaria siceraria (Molina) Standl., Cucurbitaceae	Khasi	Table 3.1
			Moringa oleifera Lam., Moringaceae	Maya Ch'orti'	Table 8.1
			Nasturtium officinale W.T. Aiton, Brassicaceae	Melanesians[SI]	Table 4.1
			Opuntia ficus-indica (L.) Mill., Cactaceae	Maya Ch'orti'	Table 8.1
			Physalis ixocarpa Brot. ex Hornem., Solanaceae	Maya Ch'orti'	Table 8.1
			Piper auritum Kunth, Piperaceae	Maya Ch'orti'	Table 8.1
			Raphanus raphanistrum L., Brassicaceae	Bhotia and Anwal	Table 6.1
			Sauropus androgynus (L.) Merr, Phyllanthaceae	Melanesians[SI]	Table 4.1
			Sechium edule (Jacq.) Sw., Cucurbitaceae	Maya Ch'orti'	Table 8.1
			Smilax perfoliata Lour., Smilacaceae	Khasi	Table 3.1
			Solanum aethiopicum L., Solanaceae	Baka	Table 1.3
			Solanum americanum Mill., Solanaceae	Maya Ch'orti'	Table 8.1
			Solanum lycopersicum L., Solanaceae	Baka	Table 1.3
				Bhotia and Anwal	Table 6.1
				Kel Tamasheq	Table 5.2
				Khasi	Table 3.1
				Maya Ch'orti'	Table 8.1
			Solanum melongena L., Solanaceae	Khasi	Table 3.1
				Melanesians[SI]	Table 4.1
			Solanum nigrescens M. Martens & Galeotti, Solanaceae	Maya Ch'orti'	Table 8.1
			Xanthosoma sagittifolium (L.) Schott, Araceae	Melanesians[SI]	Table 4.1
			Yucca gigantea Lem., Asparagaceae	Maya Ch'orti'	Page 322
			Zea mays L., Poaceae	Melanesians[SI]	Table 4.1
	Edibles sourced from the market	Birds and poultry	*Gallus gallus domesticus* L., Phasianidae	Maya Ch'orti'	Table 8.6
			Meleagris gallopavo L., Phasianidae	Maya Ch'orti'	Table 8.6
		Condiments, seasonings, snacks and sweeteners	*Beta vulgaris* L., Amaranthaceae	Maya Ch'orti'	Table 8.6
			Glycine max (L.) Merr., Fabaceae	Maya Ch'orti'	Table 8.6
			Helianthus annuus L., Compositae	Maya Ch'orti'	Table 8.6
			Saccharum officinarum L., Poaceae	Maya Ch'orti'	Table 8.6

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Edibles sourced from the market	Fruits and juices	*Ananas comosus* (L.) Merr., Bromeliaceae	Maya Ch'orti'	Table 8.6
			Citrullus lanatus (Thunb.) Matsum. & Nakai, Cucurbitaceae	Maya Ch'orti'	Table 8.6
			Citrus × latifolia (Yu.Tanaka) Yu.Tanaka, Rutaceae	Maya Ch'orti'	Table 8.6
			Malus domestica Borkh., Rosaceae	Maya Ch'orti'	Table 8.6
			Malus sp., Rosaceae	Khasi	Table 3.5
			Mangifera indica L., Anacardiaceae	Khasi	Table 3.5
			Nephelium lappaceum L., Sapindaceae	Maya Ch'orti'	Table 8.6
			Ribes uva-crispa L., Grossulariaceae	Khasi	Table 3.5
			Viburnum foetidum Wall., Viburnaceae	Khasi	Table 3.5
			Vitis vinifera L., Vitaceae	Khasi	Table 3.5
		Mammals	*Bos taurus* L., Bovidae	Maya Ch'orti'	Table 8.6
			Dasypodidae sp., Dasypodidae	Maya Ch'orti'	Table 8.6
			Didelphis marsupialis L., Didelphidae	Maya Ch'orti'	Table 8.6
		Pulses	*Lens culinaris* Medik., Fabaceae	Khasi	Table 3.5
			Phaseolus vulgaris L., Fabaceae	Maya Ch'orti'	Table 8.6
		Reptiles	*Iguana iguana* L., Iguanidae	Maya Ch'orti'	Table 8.6
		Starches	*Manihot esculenta* Crantz, Euphorbiaceae	Maya Ch'orti'	Table 8.6
			Triticum aestivum L., Poaceae	Maya Ch'orti'	Table 8.6
			Triticum sp., Poaceae	Khasi	Table 3.5
			Xanthosoma sagittifolium (L.) Schott, Araceae	Maya Ch'orti'	Table 8.6
			Zea mays L., Poaceae	Maya Ch'orti'	Table 8.6
		Vegetables	*Beta vulgaris* L., Amaranthaceae	Khasi	Table 3.5
				Maya Ch'orti'	Table 8.6
			Brassica oleracea L., Brassicaceae	Maya Ch'orti'	Table 8.6
			Brassica rapa L., Brassicaceae	Khasi	Table 3.5
			Daucus carota L., Apiaceae	Khasi	Table 3.5
				Maya Ch'orti'	Table 8.6
			Raphanus raphanistrum L., Brassicaceae	Khasi	Table 3.5
	Livestock	Birds and poultry	*Anas platyrhynchos domesticus* L., Anatidae	Maya Ch'orti'	Table 8.2
			Cairina moschata L., Anatidae	Maya Ch'orti'	Table 8.2
			Columba livia Gmelin, Columbidae	Maya Ch'orti'	Table 8.2
			Columbina talpacoti Temminck, Columbidae	Maya Ch'orti'	Table 8.2
			Coturnix coturnix L., Phasianidae	Maya Ch'orti'	Table 8.2
			Dendrocygna autumnalis L., Anatidae	Maya Ch'orti'	Table 8.2
			Gallus gallus domesticus L., Phasianidae	Maya Ch'orti'	Table 8.2
				Melanesians[SI]	Table 4.2
			Gallus gallus L., Phasianidae	Khasi	Page 151
			Meleagris gallopavo L., Phasianidae	Maya Ch'orti'	Table 8.2
			Numida meleagris L., Numididae	Maya Ch'orti'	Table 8.2
			Phasianidae sp., Phasianidae	Kel Tamasheq	Table 5.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Livestock	Insects and insect products	*Apis mellifera* L., Apidae	Maya Ch'orti'	Table 8.2
			Melipona spp. Illiger, Apidae	Maya Ch'orti'	Table 8.2
			Sphenarium purpurascens Charpentier, Pyrgomorphidae	Maya Ch'orti'	Page 337
		Mammals	*Bos taurus indicus* L., Bovidae	Kel Tamasheq	Table 5.1
			Bos taurus L., Bovidae	Maya Ch'orti'	Table 8.2
			Camelus dromedarius L., Camelidae	Kel Tamasheq	Table 5.1
			Capra hircus aegagrus Erxleben, Bovidae	Kel Tamasheq	Table 5.1
				Maya Ch'orti'	Table 8.2
			Equus asinus L., Equidae	Kel Tamasheq	Table 5.1
			Ovis aries L., Bovidae	Kel Tamasheq	Table 5.1
				Maya Ch'orti'	Table 8.2
			Rangifer tarandus L., Cervidae	Inari Sámi	Page 118
			Sus scrofa domesticus Erxleben, Suidae	Maya Ch'orti'	Table 8.2
				Melanesians[SI]	Table 4.2
			Sus scrofa L., Suidae	Khasi	Page 151
	Wild edibles	Condiments, seasonings, snacks and sweeteners	*Afrostyrax lepidophyllus* Mildbr., Huaceae	Baka	Table 1.2
			Amomum aromaticum Roxb., Zingiberaceae	Khasi	Table 3.2
			Astrocaryum aculeatum G.Mey, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Attalea sp., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Beilschmiedia louisii Robyns & Wilczek, Lauraceae	Baka	Table 1.2
			Calpocalyx dinklagei Harms, Fabaceae	Baka	Table 1.2
			Chytranthus atroviolaceus E.G.Baker ex Hutchinson & Dalziel, Sapindaceae	Baka	Table 1.2
			Dioscoreophyllum cumminsii (Stapf) Diels, Menispermaceae	Baka	Table 1.2
			Elaeis guineensis Jacq., Arecaceae	Baka	Table 1.2
			Gilbertiodendron dewevrei (De Wild.) J.Leonard, Fabaceae	Baka	Table 1.2
			Haumania danckelmaniana (J.Braun & K.Schum) Milne- Redh., Marantaceae	Baka	Table 1.2
			Irvingia excelsa Mildbr., Irvingiaceae	Baka	Table 1.2
			Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill., Irvingiaceae	Baka	Table 1.2
			Irvingia grandifolia (Engl.) Engl., Irvingiaceae	Baka	Table 1.2
			Irvingia robur Mildbr., Irvingiaceae	Baka	Table 1.2
			Irvingia tenuinucleata Tiegh., Irvingiaceae	Baka	Table 1.2
			Klainedoxa gabonensis Pierre, Irvingiaceae	Baka	Table 1.2
			Klainedoxa trillesii Pierre ex Tiegh., Irvingiaceae	Baka	Table 1.2
			Mauritia flexuosa L., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Oenocarpus bataua Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Panda oleosa Pierre, Pandaceae	Baka	Table 1.2

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wild edibles	Condiments, seasonings, snacks and sweeteners	*Perilla* sp., Lamiaceae	Bhotia and Anwal	Table 6.2
			Phytolacca acinosa Roxb., Phytolaccaceae	Bhotia and Anwal	Table 6.2
			Plukenetia conophora Müll.Arg., Euphorbiaceae	Baka	Table 1.2
			Ricinodendron heudelotii (Baill.) Heckel, Euphorbiaceae	Baka	Table 1.2
			Scorodophloeus zenkeri Harms, Fabaceae	Baka	Table 1.2
			Sterculia oblonga Mast. , Malvaceae	Baka	Table 1.2
			Telfairia occidentalis Hook.f., Cucurbitaceae	Baka	Table 1.2
			Tetrapleura tetraptera (Schumach. & Thonn.) Taub., Fabaceae	Baka	Table 1.2
		Fruits and juices	*Aframomum* sp. K.Schum, Zingiberaceae	Baka	Table 1.2
			Amphimas pterocarpoides Harms, Fabaceae	Baka	Table 1.2
			Annona amazonica R.E. Fr., Annonaceae	Tikuna, Cocama and Yagua	Table 7.2
			Annona purpurea Moc. & Sessé ex Dunal, Annonaceae	Maya Ch'orti'	Table 8.4
			Anonidium mannii Oliv., Annonaceae	Baka	Table 1.2
			Artocarpus altilis (Parkinson) Fosberg, Moraceae	Melanesians[SI]	Table 4.7
			Astrocaryum murumuru Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.2
			Attalea butyracea (Mutis ex L.f.) Wess.Boer, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Bactris gasipaes Kunth, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Baillonella toxisperma Pierre, Sapotaceae	Baka	Table 1.2
			Balanites aegyptiaca (L.) Delile, Zygophyllaceae	Kel Tamasheq	Table 5.3
			Berberis asiatica Roxb. ex DC., Berberidaceae	Bhotia and Anwal	Table 6.2
			Burckella obovata (G.Forst.) Pierre, Sapotaceae	Melanesians[SI]	Table 4.7
			Byrsonima crassifolia (L.) Kunth, Malpighiaceae	Maya Ch'orti'	Table 8.4
			Calamus erectus Roxb., Arecaceae	Khasi	Table 3.2
			Carica quercifolia (A.St.Hil.) Hieron., Caricaceae	Maya Ch'orti'	Table 8.4
			Castanopsis indica (J. Roxb. ex Lindl.) A. DC., Fagaceae	Khasi	Table 3.2
			Chrysophyllum lacourtianum De Wild., Sapotaceae	Baka	Table 1.2
			Chrysophyllum sp. L., Sapotaceae	Baka	Table 1.2
			Citrus medica L., Rutaceae	Khasi	Table 3.2
			Cocos nucifera L., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Cyanococcus sp., Ericaceae	Inari Sámi	Table 2.5
			Drypetes ituriensis Pax & K.Hoffm., Putranjivaceae	Baka	Table 1.2
			Drypetes sp. Vahl, Putranjivaceae	Baka	Table 1.2
			Duchesnea indica (Andrews) Teschem., Rosaceae	Khasi	Table 3.2
			Duguetia sp., Annonaceae	Tikuna, Cocama and Yagua	Table 7.2
			Eriosema himalaicum H.Ohashi, Fabaceae	Khasi	Table 3.2

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wild edibles	Fruits and juices	*Eugenia stipitata* McVaugh, Myrtaceae	Tikuna, Cocama and Yagua	Table 7.2
			Euterpe sp., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Euterpe precatoria Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Garcinia madruno (Kunth) Hammel, Cluciaceae	Tikuna, Cocama and Yagua	Table 7.2
			Gnetum gnemon L., Gnetaceae	Melanesians[SI]	Table 4.7
			Inga nobilis Willd. , Fabaceae	Tikuna, Cocama and Yagua	Table 7.2
			Inga pilosula (Rich.) J.F.Macbr., Fabaceae	Tikuna, Cocama and Yagua	Table 7.2
			Inga vera subsp. *spuria* (Willd.)J.Leon, Fabaceae	Maya Ch'orti'	Table 8.4
			Inocarpus fagifer (Parkinson) Fosberg, Fabaceae	Melanesians[SI]	Table 4.7
			Iriartea deltoidea Ruiz & Pav., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill., Irvingiaceae	Baka	Table 1.2
			Landolphia sp. P.Beauv., Apocynaceae	Baka	Table 1.2
			Mangifera indica L., Anacardiaceae	Melanesians[SI]	Table 4.7
			Mauritia flexuosa L., Arecaceae	Tikuna, Cocama and Yagua	Table 7.2
			Mauritiella sp., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Melicoccus oliviformis Kunth, Sapindaceae	Maya Ch'orti'	Table 8.4
			Myrciaria dubia (Kunth) McVaugh, Myrtaceae	Tikuna, Cocama and Yagua	Table 7.2
			Myrianthus arboreus P.Beauv., Urticaceae	Baka	Table 1.2
			Myrica nagi Thunb., Myricaceae	Khasi	Table 3.2
			Nauclea pobeguinii (Pellegr.) Merr. L., Rubiaceae	Baka	Table 1.2
			Oenocarpus bacaba Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Oenocarpus bataua Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Persea americana Mill., Lauraceae	Maya Ch'orti'	Table 8.4
			Persea schiedeana Nees, Lauraceae	Maya Ch'orti'	Table 8.4
			Phytelephas macrocarpa Ruiz & Pav., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Psidium guajava L., Myrtaceae	Maya Ch'orti'	Table 8.4
				Tikuna, Cocama and Yagua	Table 7.2
			Rubus chamaemorus L., Rosaceae	Inari Sámi	Table 2.5
			Rubus ellipticus Sm., Rosaceae	Bhotia and Anwal	Table 6.2
				Khasi	Table 3.2
			Rubus niveus Thunb., Rosaceae	Khasi	Table 3.2
			Simarouba amara Aubl., Simaroubaceae	Tikuna, Cocama and Yagua	Table 7.2
			Solanum myriacanthum Dunal, Solanaceae	Khasi	Table 3.2

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wild edibles	Fruits and juices	*Syzygium cumini* (L.) Skeels, Myrtaceae	Khasi	Table 3.2
			Syzygium malaccense (L.) Merr. & L. M. Perry, Myrtaceae	Melanesians[SI]	Table 4.7
			Tetrastigma obovatum (M.A. Lawson) Gagnep., Vitaceae	Khasi	Table 3.2
			Trichoscypha acuminata Engl., Anacardiaceae	Baka	Table 1.2
			Vaccinium vitis-idaea L., Ericaceae	Inari Sámi	Table 2.5
			Vitex doniana Sweet, Lamiaceae	Baka	Table 1.2
			Ziziphus sp., Rhamnaceae	Kel Tamasheq	Table 5.3
		Insects and insect products	*Lepidoptera* sp.	Khasi	Table 3.2
		Mushrooms	*Amanita caesarea* (Scop.) Pers., Amanitaceae	Maya Ch'orti'	Table 8.4
			Boletus edulis Bull., Boletaceae	Inari Sámi	Table 2.5
			Cantharellus sp. Adans. ex Fr., Cantharellaceae	Maya Ch'orti'	Table 8.4
			Lactarius deliciosus (L.) Gray, Russulaceae	Inari Sámi	Table 2.5
			Lactifluus volemus (Fr.) Kuntze, Russulaceae	Khasi	Table 3.2
			Morchella esculenta (L.) Pers., Morchellaceae	Bhotia and Anwal	Table 6.2
			Pseudofistulina radicata (Schwein.) Burds., Fistulinaceae	Maya Ch'orti'	Table 8.4
			Ramaria botrytis (Pers.) Bourdot, Gomphaceae	Maya Ch'orti'	Table 8.4
			Russula sanguinaria (Schumach.) Rauschert, Russulaceae	Inari Sámi	Table 2.5
			Termitomyces sp. R.Heim, Lyophillaceae	Baka	Table 1.2
			Turbinellus floccosus (Schwein.) Earle ex Giachini & Castellano, Gomphaceae	Khasi	Table 3.2
		Saline matter	*Haumania danckelmaniana* (J.Braun & K.Schum) Milne- Redh., Marantaceae	Baka	Table 1.2
			Triplochiton scleroxylon K.Schum., Malvaceae	Baka	Table 1.2
		Seaweed	*Caulerpa lentillifera* J. Ag., Caulerpaceae	Melanesians[SI]	Table 4.7
		Source of oil	*Baillonella toxisperma* Pierre, Sapotaceae	Baka	Table 1.2
			Elaeis guineensis Jacq., Arecaceae	Baka	Table 1.2
			Pentaclethra macrophylla Benth., Fabaceae	Baka	Table 1.2
		Starches	*Cenchrus biflorus* Roxb., Poaceae	Kel Tamasheq	Table 5.3
			Dioscorea burkilliana Miège, Dioscoreaceae	Baka	Table 1.2
			Dioscorea mangenotiana J. Miège, Dioscoreaceae	Baka	Table 1.2
			Dioscorea minutiflora Engler, Dioscoreaceae	Baka	Table 1.2
			Dioscorea praehensilis Benth, Dioscoreaceae	Baka	Table 1.2
			Dioscorea semperflorens Uline, Dioscoreaceae	Baka	Table 1.2
			Dioscorea smilacifolia De Wild. &T.Durand, Dioscoreaceae	Baka	Table 1.2
			Dioscorea sp. L., Dioscoreaceae	Baka	Table 1.2
			Dioscoreophyllum cumminsii (Stapf) Diels, Menispermaceae	Baka	Table 1.2
			Elaeis guineensis Jacq., Arecaceae	Baka	Table 1.2
			Manihot esculenta Crantz, Euphorbiaceae	Maya Ch'orti'	Table 8.4

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wild edibles	Starches	*Oryza glaberrima* Steud, Poaceae	Kel Tamasheq	Table 5.3
			Panicum laetum Kunth, Poaceae	Kel Tamasheq	Table 5.3
			Raphia hookeri G.Mann & H.Wendl., Arecaceae	Baka	Table 1.2
			Raphia monbuttorum Drude, Arecaceae	Baka	Table 1.2
			Xanthosoma sagittifolium (L.) Schott, Araceae	Maya Ch'orti'	Table 8.4
		Sweet drinks	*Elaeis guineensis* Jacq., Arecaceae	Baka	Table 1.2
			Raphia monbuttorum Drude, Arecaceae	Baka	Table 1.2
		Vegetables	*Abelmoschus* sp., Malvaceae	Kel Tamasheq	Table 5.3
			Allium hookeri Thwaites, Amaryllidaceae	Khasi	Table 3.2
			Allium tuberosum Rottler ex Spreng., Amaryllidaceae	Khasi	Table 3.2
			Alsophila hornei Bak., Cyatheaceae	Melanesians[SI]	Table 4.7
			Amaranthus dubius Mart. ex Thell., Amaranthaceae	Maya Ch'orti'	Table 8.4
			Amaranthus hybridus L., Amaranthaceae	Maya Ch'orti'	Table 8.4
			Amaranthus viridis L., Amaranthaceae	Maya Ch'orti'	Table 8.4
			Begonia roxburghii A. DC., Begoniaceae	Khasi	Table 3.2
			Calathea macrosepala K.Schum., Marantaceae	Maya Ch'orti'	Table 8.4
			Chamaedorea elegans Mart., Arecaceae	Maya Ch'orti'	Table 8.4
			Cnidoscolus aconitifolius (Mill.) I.M.Johnst., Euphorbiaceae	Maya Ch'orti'	Table 8.4
			Colocasia esculenta (L.) Schott, Araceae	Melanesians[SI]	Table 4.7
			Corchorus tridens L., Malvaceae	Kel Tamasheq	Table 5.3
			Crotalaria longirostrata Hook. & Arn., Fabaceae	Maya Ch'orti'	Table 8.4
			Cyclea bicristata Diels, Menispermaceae	Khasi	Table 3.2
			Dendrocalamus hamiltonii Nees & Arn. ex Munro, Poaceae	Khasi	Table 3.2
			Dewevrea bilabiata Micheli, Fabaceae	Baka	Table 1.2
			Diplazium esculentum (Retz.) Sw., Athyriaceae	Melanesians[SI]	Table 4.7
			Diplazium spp., Athyriaceae	Melanesians[SI]	Table 4.7
			Fagopyrum acutatum (Lehm.) Mansf. ex K. Hammer, Polygonaceae	Khasi	Table 3.2
			Fernaldia pandurata (A.DC.) Woodson, Apocynaceae	Maya Ch'orti'	Table 8.4
			Ficus copiosa (Roxb.) Steud., Moraceae	Melanesians[SI]	Table 4.7
			Gnetum africanum Welw., Gnetaceae	Baka	Table 1.2
			Gynura nepalensis DC., Asteraceae	Khasi	Table 3.2
			Hilleria latifolia (Lam.) H.Walt., Phytolaccaceae	Baka	Table 1.2
			Houttuynia cordata Thunb., Saururaceae	Khasi	Table 3.2
			Matteuccia struthiopteris (L.) Tod., Onocleaceae	Bhotia and Anwal	Table 6.2
			Nephrolepis cordifolia (L.) C. Presl, Nephrolepidaceae	Khasi	Table 3.2
			Oenanthe javanica DC., Apiaceae	Khasi	Table 3.2
			Polyscias fruticosa (L.) Harms, Araliaceae	Melanesians[SI]	Table 4.7
			Polyscias verticillata B. C. Stone, Araliaceae	Melanesians[SI]	Table 4.7
			Rhynchotechum ellipticum (Wall. ex D. Dietr.) A. DC., Gesneriaceae	Khasi	Table 3.2
			Rubus ellipticus Sm., Rosaceae	Khasi	Table 3.2

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wild edibles	Vegetables	*Sloetiopsis usambarensis* Engl., Moraceae	Baka	Table 1.2
			Solanum americanum Mill., Solanaceae	Maya Ch'orti'	Table 8.4
			Sonchus oleraceus L., Compositae	Maya Ch'orti'	Table 8.4
			Stenochlaena palustris (Burm.f.) Bedd, Blechnaceae	Melanesians[SI]	Table 4.7
			Tabernaemontana sp. Plum. Ex L., Apocynaceae	Baka	Table 1.2
			Urtica ardens Link, Urticaceae	Bhotia and Anwal	Table 6.2
	Wildlife used as food	Amphibians	Anura sp.	Khasi	Table 3.4
		Birds and poultry	*Anas platyrhynchos* L., Anatidae	Inari Sámi	Table 2.4
			Anas superciliosa Gmelin, Anatidae	Melanesians[SI]	Table 4.5
			Anhinga anhinga L., Anhingidae	Tikuna, Cocama and Yagua	Table 7.4
			Anser fabalis Latham, Anatidae	Inari Sámi	Table 2.4
			Ardea alba L., Ardeidae	Tikuna, Cocama and Yagua	Table 7.4
			Brotogeris versicolurus Statius Muller, Psittacidae	Tikuna, Cocama and Yagua	Table 7.4
			Cairina moschata L., Anatidae	Tikuna, Cocama and Yagua	Table 7.4
			Caprimulgus sp. L., Caprimulgidae	Baka	Table 1.1
			Centropus sp. Illiger, Cuculidae	Baka	Table 1.1
			Circaetus spectabilis Schlegel, Accipitridae	Baka	Table 1.1
			Columbidae sp., Columbidae	Maya Ch'orti'	Table 8.5
			Columbina talpacoti Temminck, Columbidae	Tikuna, Cocama and Yagua	Table 7.4
			Crax globulosa Spix, Cracidae	Tikuna, Cocama and Yagua	Table 7.4
			Ducula rubricera Bonaparte, Columbidae	Melanesians[SI]	Table 4.5
			Egretta sacra Gmelin, Ardeidae	Melanesians[SI]	Table 4.5
			Fregata minor Gmelin, Fregatidae	Melanesians[SI]	Table 4.5
			Gallus gallus L., Phasianidae	Khasi	Table 3.3
			Guttera plumifera Cassin, Numididae	Baka	Table 1.1
			Himantornis haematopus Hartlaub, Rallidae	Baka	Table 1.1
			Lagopus lagopus L., Phasianidae	Inari Sámi	Table 2.4
			Larus spp. L., Laridae	Melanesians[SI]	Table 4.5
			Nectarinia sp. Illiger, Nectariniidae	Baka	Table 1.1
			Porphyrio porphyrio L., Rallidae	Melanesians[SI]	Table 4.5
			Psittaciformes sp.	Melanesians[SI]	Table 4.5
			Rhyticeros plicatus J. R. Forster, Bucerotidae	Melanesians[SI]	Table 4.5
			Tetrao urogallus L., Phasianidae	Inari Sámi	Table 2.4
		Eggs	*Anas superciliosa* Gmelin, Anatidae	Melanesians[SI]	Table 4.6
			Birgus latro L., Diogenidae	Melanesians[SI]	Table 4.4
			Chelonia mydas L., Cheloniidae	Melanesians[SI]	Table 4.4
			Dermochelys coriacea Vandelli, Dermochelyidae	Melanesians[SI]	Table 4.4
			Ducula pistrinaria Bonaparte, Columbidae	Melanesians[SI]	Table 4.6

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wildlife used as food	Eggs	*Ducula rubricera* Bonaparte, Columbidae	Melanesians[SI]	Table 4.6
			Megapodius eremita Hartlaub, Megapodiidae	Melanesians[SI]	Table 4.6
			Panulirus penicillatus Olivier, Palinuridae	Melanesians[SI]	Table 4.4
			Porphyrio porphyrio L., Rallidae	Melanesians[SI]	Table 4.6
		Fish	*Acanthurus gahhm* Forsskål, Acanthuridae	Melanesians[SI]	Table 4.3
			Acanthurus lineatus L., Acanthuridae	Melanesians[SI]	Table 4.3
			Acanthurus nigrofuscus Forsskål, Acanthuridae	Melanesians[SI]	Table 4.3
			Acanthurus xanthopterus Valenciennes, Acanthuridae	Melanesians[SI]	Table 4.3
			Ancistrus spp. Kner, Loricariidae	Tikuna, Cocama and Yagua	Table 7.3
			Anguilla marmorata Quoy & Gaimard, Anguillidae	Melanesians[SI]	Table 4.3
			Auchenipterus ambyiacus Fowler, Auchenipteridae	Tikuna, Cocama and Yagua	Table 7.3
			Balistidae sp., Balistidae	Melanesians[SI]	Table 4.3
			Balistoides viridescens Block & Schneider, Balistidae	Melanesians[SI]	Table 4.3
			Bolbometopon muricatum Valenciennes, Scaridae	Melanesians[SI]	Table 4.3
			Caranx spp. Lacépède, Carangidae	Melanesians[SI]	Table 4.3
			Channa orientalis Bloch & Schneider, Channidae	Khasi	Table 3.4
			Coregonus albula L., Salmonidae	Inari Sámi	Table 2.3
			Coregonus lavaretus L., Salmonidae	Inari Sámi	Table 2.3
			Elagatis bipinnulata Quoy & Gaimard, Carangidae	Melanesians[SI]	Table 4.3
			Encrasicholina punctifer Fowler, Engraulidae	Melanesians[SI]	Table 4.3
			Epinephelus hexagonatus Forster, Serranidae	Melanesians[SI]	Table 4.3
			Epinephelus lanceolatus Bloch, Serranidae	Melanesians[SI]	Table 4.3
			Epinephelus spp. Bloch, Serranidae	Melanesians[SI]	Table 4.3
			Esox lucius L., Esocidae	Inari Sámi	Table 2.3
			Etelis spp. Cuvier, Lutjanidae	Melanesians[SI]	Table 4.3
			Garra lissorhynchus McClelland, Cyprinidae	Khasi	Table 3.4
			Gazza achlamys Jordan & Starks, Leiognathidae	Melanesians[SI]	Table 4.3
			Gnathonemus sp. T.N. Gill, Mormyridae	Baka	Page 87
			Halichoeres argus Bloch & Schneider, Labridae	Melanesians[SI]	Table 4.3
			Hemisorubim platyrhynchos Valenciennes, Pimelodidae	Tikuna, Cocama and Yagua	Table 7.3
			Hoplias malabaricus Bloch, Erythrinidae	Maya Ch'orti'	Table 8.5
				Tikuna, Cocama and Yagua	Table 7.3
			Hypophthalmus edentatus Spix & Agassiz, Hypophthalmidae	Tikuna, Cocama and Yagua	Table 7.3
			Istiophoridae sp., Istiophoridae	Melanesians[SI]	Table 4.3
			Katsuwonus pelamis L., Scombridae	Melanesians[SI]	Table 4.3
			Kuhlia marginata Cuvier, Kuhliidae	Melanesians[SI]	Table 4.3
			Laemolyta sp. Cope, Anostomidae	Tikuna, Cocama and Yagua	Table 7.3
			Lethrinus miniatus Forster, Lethrinidae	Melanesians[SI]	Table 4.3
			Lota lota L., Lotidae	Inari Sámi	Table 2.3

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wildlife used as food	Fish	*Mylossoma aureum* Spix & Agassiz, Serrasalmidae	Tikuna, Cocama and Yagua	Table 7.3
			Myripristis spp. Cuvier, Holocentridae	Melanesians[SI]	Table 4.3
			Naso brevirostris Cuvier, Acanthuridae	Melanesians[SI]	Table 4.3
			Neolissochilus hexagonolepis McClelland, Cyprinidae	Khasi	Table 3.4
			Osteoglossum bicirrhosum Cuvier, Osteoglossidae	Tikuna, Cocama and Yagua	Table 7.3
			Oxydoras niger Valenciennes, Doradidae	Tikuna, Cocama and Yagua	Table 7.3
			Perca fluviatilis L. , Percidae	Inari Sámi	Table 2.3
			Philypnodon grandiceps Krefft, Eleotridae	Melanesians[SI]	Table 4.3
			Phractocephalus hemioliopterus Bloch & Schneider, Pimelodidae	Tikuna, Cocama and Yagua	Table 7.3
			Piaractus brachypomus Cuvier, Serrasalmidae	Tikuna, Cocama and Yagua	Table 7.3
			Pimelodus blochii Valenciennes, Pimelodidae	Tikuna, Cocama and Yagua	Table 7.3
			Plectorhinchus lineatus L., Haemulidae	Melanesians[SI]	Table 4.3
			Potamorhina altamazonica Cope, Curimatidae	Tikuna, Cocama and Yagua	Table 7.3
			Prochilodus nigricans Spix & Agassiz, Curimatidae	Tikuna, Cocama and Yagua	Table 7.3
			Pseudomyxus capensis Valenciennes, Mugilidae	Melanesians[SI]	Table 4.3
			Pseudoplatystoma sp., Pimelodidae	Tikuna, Cocama and Yagua	Pages 306, 313
			Pseudoplatystoma tigrinum Valenciennes, Pimelodidae	Tikuna, Cocama and Yagua	Table 7.3
			Pseudoplatystoma fasciatum L., Pimelodidae	Tikuna, Cocama and Yagua	Table 7.3
			Pterygoplichthys sp. T.N. Gill, Loricariidae	Tikuna, Cocama and Yagua	Table 7.3
			Rhaphiodon vulpinus Spix & Agassiz, Cynodontidae	Tikuna, Cocama and Yagua	Table 7.3
			Salmo trutta L., Salmonidae	Inari Sámi	Table 2.3
			Salvelinus alpinus L., Salmonidae	Inari Sámi	Table 2.3
			Sardinella spp. Valenciennes, Clupeidae	Melanesians[SI]	Table 4.3
			Sargocentron tiereoides Bleeker, Holocentridae	Melanesians[SI]	Table 4.3
			Scarus spp. Forsskål, Scaridae	Melanesians[SI]	Table 4.3
			Scomberoides lysan Forsskål, Carangidae	Melanesians[SI]	Table 4.3
			Scomberomorus cavalla Cuvier, Scombridae	Melanesians[SI]	Table 4.3
			Selachimorpha sp., Unknown	Melanesians[SI]	Table 4.3
			Serrasalmus rhombeus L., Serrasalmidae	Tikuna, Cocama and Yagua	Table 7.3
			Serrasalmus spp. Lacepède, Serrasalmidae	Tikuna, Cocama and Yagua	Table 7.3
			Siganus corallinus Valenciennes, Siganidae	Melanesians[SI]	Table 4.3
			Siganus lineatus Valenciennes, Siganidae	Melanesians[SI]	Table 4.3
			Sorubim lima Bloch & Schneider, Pimelodidae	Tikuna, Cocama and Yagua	Table 7.3

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wildlife used as food	Fish	*Sphyraena barracuda* Edwards, Sphyraenidae	Melanesians[SI]	Table 4.3
			Thunnus albacares Bonnaterre, Scombridae	Melanesians[SI]	Table 4.3
			Thymallus thymallus L., Salmonidae	Inari Sámi	Table 2.3
			Toxotes jaculatrix Pallas, Toxotidae	Melanesians[SI]	Table 4.3
			Trachinotus baillonii Lacepède, Carangidae	Melanesians[SI]	Table 4.3
			Tylosurus crocodilus Péron & Lesueur, Belonidae	Melanesians[SI]	Table 4.3
		Insects and insect products	*Anaphe* sp. Walker, Notodontidae	Baka	Table 1.2
			Anaphe venata Butler, Notodontidae	Baka	Table 1.2
			Apis mellifera adansonii Latreille, Apidae	Baka	Table 1.2
			Elaphrodes lactea Gaede, Notodontidae	Baka	Table 1.2
			Imbrasia epimethea Drury, Saturniidae	Baka	Table 1.2
			Imbrasia oyemensis Rougeot, Saturniidae	Baka	Table 1.2
			Macrotermes sp. Holmgren, Termitidae	Baka	Table 1.2
			Melipona spp. Illiger, Apidae	Maya Ch'orti'	Table 8.5
			Meliponini sp., Apidae	Baka	Table 1.2
			Pseudantheraea discrepans Butler, Saturniidae	Baka	Table 1.2
			Rhynchophorus phoenicis Fabricius, Dryophthoridae	Baka	Table 1.2
			Rhynchophorus sp. Herbst, Dryophthoridae	Tikuna, Cocama and Yagua	Table 7.4
		Mammals	*Alces alces* L., Cervidae	Inari Sámi	Table 2.4
			Alouatta seniculus L., Atelidae	Tikuna, Cocama and Yagua	Table 7.4
			Anomalurus spp. Waterhouse, Anomaluridae	Baka	Table 1.1
			Aonyx capensis congicus Lönnberg, Mustelidae	Baka	Table 1.1
			Atherurus africanus Gray, Hystricidaes	Baka	Table 1.1
			Atilax paludinosus G. Cuvier, Herpsestidae	Baka	Table 1.1
			Axis porcinus Zimmermann, Cervidae	Khasi	Table 3.3
			Bdeogale nigripes Pucheran, Herpsestidae	Baka	Table 1.1
			Bradypus variegatus Schinz, Bradypodidae	Tikuna, Cocama and Yagua	Table 7.4
			Bradypus tridactylus L., Bradypodidae	Tikuna, Cocama and Yagua	Table 7.4
			Cephalophus callipygus Peters, Bovidae	Baka	Table 1.1
			Cephalophus dorsalis Gray, Bovidae	Baka	Table 1.1
			Cephalophus leucogaster Gray, Bovidae	Baka	Table 1.1
			Cephalophus nigrifrons Gray, Bovidae	Baka	Table 1.1
			Cephalophus silvicultor Afzelius, Bovidae	Baka	Table 1.1
			Cercocebus agilis A. Milne-Edwards, Cercopithecidae	Baka	Table 1.1
			Cercopithecus cephus L., Cercopithecidae	Baka	Table 1.1
			Cercopithecus nictitans L., Cercopithecidae	Baka	Table 1.1
			Cercopithecus pogonias Bennett, Cercopithecidae	Baka	Table 1.1
			Chiroptera sp.	Khasi	Table 3.3
			Coendou prehensilis L, Erethizontidae	Tikuna, Cocama and Yagua	Table 7.4
			Cricetomys emini Wroughton, Nesomyidae	Baka	Table 1.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wildlife used as food	**Mammals**	*Cuniculus paca* L., Cuniculidae	Maya Ch'orti'	Table 8.5
				Tikuna, Cocama and Yagua	Table 7.4
			Dasypodidae sp., Dasypodidae	Maya Ch'orti'	Table 8.5
			Dasyprocta punctata Gray, Dasyproctidae	Maya Ch'orti'	Table 8.5
			Dasyprocta fuliginosa Wagler, Dasyproctidae	Tikuna, Cocama and Yagua	Table 7.4
			Dasypus sp. L., Dasypodidae	Tikuna, Cocama and Yagua	Table 7.4
			Dendrohyrax arboreus A. Smith, Procaviidae	Baka	Table 1.1
			Didelphis marsupialis L., Didelphidae	Maya Ch'orti'	Table 8.5
				Tikuna, Cocama and Yagua	Table 7.4
			Dremomys lokriah Hodgson, Sciuridae	Khasi	Table 3.3
			Funisciurus sp. Trouessart, Sciuridae	Baka	Table 1.1
			Genetta servalina Pucheran, Viverridae	Baka	Table 1.1
			Gorilla gorilla gorilla Savage and Wyman, Hominidae	Baka	Table 1.1
			Herpestes naso de Winton, Herpestidae	Baka	Table 1.1
			Heterocephalus sp. Rüppell, Phanodermatidae	Khasi	Table 3.3
			Hydrochoerus hydrochaeris L., Caviidae	Tikuna, Cocama and Yagua	Table 7.4
			Hyemoschus aquaticus Ogilby, Tragulidae	Baka	Table 1.1
			Hylochoerus meinertzhageni Thomas, Suidae	Baka	Table 1.1
			Lepus timidus L., Leporidae	Inari Sámi	Table 2.4
			Lophocebus albigena Gray, Cercopithecidae	Baka	Table 1.1
			Loxodonta africana Blumenbach, Elephantidae	Baka	Table 1.1
			Mazama americana Erxleben, Cervidae	Tikuna, Cocama and Yagua	Table 7.4
			Megaloglossus woermanni Pagenstecher, Pteropodidae	Baka	Table 1.1
			Mellivora capensis Schreber, Mustelidae	Baka	Table 1.1
			Mustela sp. L., Mustelidae	Khasi	Table 3.3
			Nandinia binotata Gray, Nandiniidae	Baka	Table 1.1
			Nasua nasua L., Procyonidae	Tikuna, Cocama and Yagua	Table 7.4
			Neotragus batesi de Winton, Bovidae	Baka	Table 1.1
			Oenomys sp. Thomas, Muridae	Baka	Table 1.1
			Orycteropus afer Pallas, Orycteropodidae	Baka	Table 1.1
			Pan troglodytes Blumenbach, Hominidae	Baka	Table 1.1
			Panthera pardus L., Felidae	Baka	Table 1.1
			Perodicticus potto Müller, Lorisidae	Baka	Table 1.1
			Petaurista philippensis Elliot, Sciuridae	Khasi	Table 3.3
			Phalangeriformes sp.	Melanesians[SI]	Table 4.5
			Phataginus spp. Rafinesque, Manidae	Baka	Table 1.1
			Philantomba monticola Thunberg, Bovidae	Baka	Table 1.1
			Poiana richardsonii Thomson, Viverridae	Baka	Table 1.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wildlife used as food	Mammals	*Potamochoerus porcus* L., Suidae	Baka	Table 1.1
			Potamogale velox Du Chaillu, Tenrecidae	Baka	Table 1.1
			Prionailurus bengalensis Kerr, Felidae	Khasi	Table 3.3
			Procyon lotor L., Procyonidae	Maya Ch'orti'	Table 8.5
			Protoxerus stangeri Waterhouse, Sciuridae	Baka	Table 1.1
			Pteropus vampyrus L., Pteropodidae	Melanesians[SI]	Table 4.5
			Rousettus aegyptiacus E. Geoffroy, Pteropodidae	Baka	Table 1.1
			Saimiri sciureus L., Cebidae	Tikuna, Cocama and Yagua	Table 7.4
			Sciurus carolinensis Gmelin, Sciuridae	Maya Ch'orti'	Table 8.5
			Sciurus igniventris Wagner, Sciuridae	Tikuna, Cocama and Yagua	Table 7.4
			Smutsia gigantea Illiger, Manidae	Baka	Table 1.1
			Sundamys infraluteus Thomas, Muridae	Khasi	Table 3.3
			Sundamys sp. Musser & Newcomb, Muridae	Khasi	Table 3.3
			Sus scrofa L., Suidae	Melanesians[SI]	Table 4.5
			Syncerus caffer Sparrman, Bovidae	Baka	Table 1.1
			Tapirus terrestris L., Tapiridae	Tikuna, Cocama and Yagua	Table 7.4
			Tayassu pecari Link., Tayassuidae	Tikuna, Cocama and Yagua	Table 7.4
			Thryonomys swinderianus Temminck, Thryonomyidae	Baka	Table 1.1
			Tragelaphus eurycerus Ogilby, Bovidae	Baka	Table 1.1
			Tragelaphus spekii Speke, Bovidae	Baka	Table 1.1
			Ursidae sp., Ursidae	Inari Sámi	Table 2.4
			Viverra zibetha L., Viverridae	Khasi	Table 3.3
		Molluscs and crustaceans	*Achatina fulica* Férussac, Achatinidae	Baka	Table 1.2
			Anadara antiquata L., Arcidae	Melanesians[SI]	Table 4.3
			Atactodea striata Gmelin, Mesodesmatidae	Melanesians[SI]	Table 4.3
			Birgus latro L., Diogenidae	Melanesians[SI]	Table 4.3
			Bithynia tentaculata L., Bithyniidae	Maya Ch'orti'	Table 8.5
			Cambarellus spp. Ortmann, Cambaridae	Maya Ch'orti'	Table 8.5
			Cambarus spp. Erichson, Cambaridae	Melanesians[SI]	Table 4.3
			Cerithidea quadrata G. B. Sowerby II, Potamididae	Melanesians[SI]	Table 4.3
			Macrobrachium lar J.C.Fabricius, Palaemonidae	Melanesians[SI]	Table 4.3
			Macrobrachium rosenbergii De Man, Palaemonidae	Maya Ch'orti'	Table 8.5
			Octopus cyanea Gray, Octopodidae	Melanesians[SI]	Table 4.3
			Pinctada margaritifera L., Pteriidae	Melanesians[SI]	Table 4.3
			Pomacea maculata Perry, Ampullariidae	Maya Ch'orti'	Table 8.5
			Scylla serrata Forskål, Portunidae	Melanesians[SI]	Table 4.3
			Sepioteuthis lessoniana d'Orbigny, Loliginidae	Melanesians[SI]	Table 4.3
			Uca sp. Leach, Ocypodidae	Khasi	Table 3.4
		Reptiles	*Bitis gabonica* Duméril, Viperidae	Baka	Table 1.1
			Bitis nasicornis Shaw, Viperidae	Baka	Table 1.1

Use	Type	Group	Scientific name	People	Table/ Page number
Food	Wildlife used as food	Reptiles	*Caiman crocodilus* L., Alligatoridae	Tikuna, Cocama and Yagua	Table 7.4
			Chelonia mydas L., Cheloniidae	Melanesians[SI]	Table 4.3
			Chelonoidis denticulatus L., Testudinidae	Tikuna, Cocama and Yagua	Table 7.4
			Chelus fimbriatus Schneider, Chelidae	Tikuna, Cocama and Yagua	Table 7.4
			Crocodylidae sp., Crocodylidae	Baka	Table 1.1
			Ctenosaura similis Gray, Iguanidae	Maya Ch'orti'	Table 8.5
			Dermochelys coriacea Vandelli, Dermochelyidae	Melanesians[SI]	Table 4.3
			Iguana iguana L., Iguanidae	Maya Ch'orti'	Table 8.5
			Kinixys erosa Schweiger, TestudinidaeHyracoidea	Baka	Table 1.1
			Melanosuchus niger Spix, Alligatoridae	Tikuna, Cocama and Yagua	Table 7.4
			Naja melanoleuca Hallowell, Elapidae	Baka	Table 1.1
			Osteolaemus tetraspis Cope, Crocodylidae	Baka	Table 1.1
			Pelusios sp. Wagler, Pelomedusidae	Baka	Table 1.1
			Python sebae Gmelin, Pythonidae	Baka	Table 1.1
			Varanus niloticus L., Varanidae	Baka	Table 1.1
Non-food	Cultivated foods: crops, planted trees and other cultivated foods	Extractivism	*Plukenetia volubilis* L., Euphorbiaceae	Tikuna, Cocama and Yagua	Pages 26, 301, 305
			Theobroma cacao L., Malvaceae	Tikuna, Cocama and Yagua	Page 301
		Fodder	*Gliricidia sepium* (Jacq.) Walp., Fabaceae	Maya Ch'orti'	Page 321
			Moringa oleifera Lam., Moringaceae	Maya Ch'orti'	Page 326
		Fruits and juices	*Theobroma cacao* L., Malvaceae	Tikuna, Cocama and Yagua	Table 7.2
		Stimulants	*Coffea* spp., Rubiaceae	Maya Ch'orti'	Table 8.1
			Nicotiana tabacum L., Solanaceae	Baka	Table 1.3
				Khasi	Page 156
	Wild edibles	Condiments, seasonings, snacks and sweeteners	*Cannabis sativa* L., Cannabaceae	Bhotia and Anwal	Table 6.2
		Fruits and juices	*Genipa americana* L., Rubiaceae	Tikuna, Cocama and Yagua	Table 7.2
		Stimulants	*Cola acuminata* (P.Beauv.) Schott & Endl., Malvaceae	Baka	Table 1.2
			Cola rostrata K.Schum, Malvaceae	Baka	Table 1.2
			Cola sp. Schott & Endl., Malvaceae	Baka	Table 1.2
	Wild plants for other uses than food	Construction materials	*Astrocaryum chambira* Burret, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Astrocaryum jauari Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Attalea butyracea (Mutis ex L.f.) Wess.Boer, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Attalea sp., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Bactris gasipaes Kunth, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5

Use	Type	Group	Scientific name	People	Table/ Page number
Non-food	Wild plants for other uses than food	Construction materials	*Bambusa pallida* Munro, Poaceae	Khasi	Page 156
			Euterpe precatoria Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Guazuma ulmifolia Lam., Malvaceae	Maya Ch'orti'	Page 329
			Hypselodelphys zenkeriana (K.Schum.) Milne-Redh., Marantaceae	Baka	Page 90
			Iriartea deltoidea Ruiz & Pav., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Itaya amicorum H. E. Moore, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Lepidocaryum tenue Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Mauritia flexuosa L., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Mauritiella sp., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Oenocarpus bacaba Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Oenocarpus bataua Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Phytelephas macrocarpa Ruiz & Pav., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Pometia pinnata J.R.Forst. & G.Forst., Sapindaceae	Melanesians[SI]	Page 201
			Taxus baccata L., Taxaceae	Bhotia and Anwal	Pages 254, 258
			Toona ciliate M.Roem., Meliaceae	Bhotia and Anwal	Page 254
		Cosmetic, accessories, lighting and other uses	*Aconitum heterophyllum* Wall., Ranunculaceae	Bhotia and Anwal	Page 254
			Adenia tricostata Wilde., Passifloraceae	Baka	Page 90
			Agave americana L., Asparagaceae	Maya Ch'orti'	Page 329
			Amstrocaryum murumuru Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Arundo donax L., Poaceae	Maya Ch'orti'	Page 329
			Astrocaryum chambira Burret, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Astrocaryum aculeatum G.Mey, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Astrocaryum jauari Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Attalea butyracea (Mutis ex L.f.) Wess.Boer, Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Attalea sp., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Bactris concinna Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Bactris maraja Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Bixa orellana L., Bixaceae	Baka	Page 90
				Tikuna, Cocama and Yagua	Page 295
			Canarium schweinfurthii Engl., Burseraceae	Baka	Page 100

Use	Type	Group	Scientific name	People	Table/ Page number
Non-food	Wild plants for other uses than food	Cosmetic, accessories, lighting and other uses	*Cannabis sativa* L., Cannabaceae	Bhotia and Anwal	Page 253
			Cleistopholis patens (Benth.) Engl. & Diels, Annonaceae	Baka	Page 90
			Cocos nucifera L., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Commiphora wightii (Arn.) Bhandari, Burseraceae	Bhotia and Anwal	Page 253
			Copaifera mildbraedii Harms, Caesalpiniaceae	Baka	Page 100
			Diospyros canaliculata De Wild., Ebenaceae	Baka	Page 90
			Entandrophragma cylindricum (Sprague) Sprague, Meliaceae	Baka	Pages 90, 98, 103
			Eremospatha haullevilleana Mann & H.Wendl., Arecaceae	Baka	Page 90
			Erythrina berteroana Urb., Fabaceae	Maya Ch'orti'	Pages 322, 329
			Euterpe precatoria Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Ficus sp. L., Moraceae	Baka	Page 90
			Grewia sp. L., Malvaceae	Baka	Page 90
			Guibourtia demeusei L., Fabaceae	Baka	Page 100
			Indigofera tinctoria L., Fabaceae	Maya Ch'orti'	Page 329
			Iriartea deltoidea Ruiz & Pav., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Laccosperma secundiflorum (P.Beauv.) Kuntze, Arecaceae	Baka	Page 90
			Manniophyton fulvum Müll. Arg., Euphorbiaceae	Baka	Page 90
			Marantochloa congensis (K.Schum.) J. Léonard & Mullend., Marantaceae	Baka	Page 90
			Mauritia flexuosa L., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Megaphrynium macrostachyum (K.Schum.) Milne-Redh., Marantaceae	Baka	Page 90
			Musa sp., Musaceae	Khasi	Page 156
			Nardostachys jatamansi DC., Caprifoliaceae	Bhotia and Anwal	Page 254
			Oenocarpus bacaba Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Pentadesma butyracea Sabine, Clusiaceae	Baka	Page 100
			Perilla sp., Lamiaceae	Bhotia and Anwal	Pages 253, 270
			Phytelephas macrocarpa Ruiz & Pav., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Pleiocarpa bicarpellata Stapf., Apocynaceae	Baka	Page 90
			Pterocarpus soyauxii Hooker , Fabaceae	Baka	Pages 90, 92
			Schoenoplectus acutus (Muhl.) Á.Löve & D.Löve, Cyperaceae	Maya Ch'orti'	Page 329
			Strophanthus gratus (Wall. & Hook.) Baill., Apocynaceae	Baka	Page 92
			Strychnos aculeata Soler., Loganiaceae	Baka	Page 90
			Terminalia superba Engl. & Diels, Combretaceae	Baka	Page 90

Use	Type	Group	Scientific name	People	Table/ Page number
Non-food	Wild plants for other uses than food	Cosmetic, accessories, lighting and other uses	*Urtica ardens* Link, Urticaceae	Bhotia and Anwal	Page 253
			Vitex cofassus Reinw. ex Blume, Lamiaceae	Melanesians[SI]	Page 201
		Extractivism	*Aframomum* sp. K.Schum, Zingiberaceae	Baka	Table 1.2
			Piper guineense Schumach. & Thonn., Piperaceae	Baka	Table 1.2
			Thysanolaena latifolia (Roxb. ex Hornem.) Honda, Poaceae	Khasi	Page 156
		Fodder	*Aesculus indica* (Wall. ex Cambess.) Hook., Sapindaceae	Bhotia and Anwal	Page 252
			Celtis australis L., Cannabaceae	Bhotia and Anwal	Page 252
			Drepanostachyum falcatum (Nees) Keng f. , Poaceae	Bhotia and Anwal	Page 252
			Echinochloa stagnina (Retz.) P. Beauv., Poaceae	Kel Tamasheq	Page 226
			Ipomoea grandifolia (Dammer) O'Donell, Convolvulaceae	Maya Ch'orti'	Page 326
			Quercus oblongata D.Don, Fagaceae	Bhotia and Anwal	Page 252
			Quercus semecarpifolia Sm., Fagaceae	Bhotia and Anwal	Page 252
			Rhododendron arboreum Sm., Ericaceae	Bhotia and Anwal	Page 252
			Synotis rufinervis (DC.) C. Jeffrey & Y. L. Chen, Asteraceae	Bhotia and Anwal	Page 252
			Tithonia diversifolia (Hemsl.) A. Gray, Asteraceae	Maya Ch'orti'	Page 326
		Medicinal	*Acacia nilotica* (L.) Willd. ex Delile, Fabaceae	Kel Tamasheq	Page 229, 237
			Angelica glauca Edgew., Apiaceae	Bhotia and Anwal	Table 6.2
			Bactris concinna Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Bactris maraja Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Berberis asiatica Roxb. ex DC., Berberidaceae	Bhotia and Anwal	Table 6.2
			Bryophyllum pinnatum (Lam.) Oken, Crassulaceae	Khasi	Page 153
			Cannabis sativa L., Cannabaceae	Bhotia and Anwal	Table 6.2
			Dioscorea bulbifera L., Dioscoreaceae	Bhotia and Anwal	Table 6.2
			Eucalyptus tereticornis Sm., Myrtaceae	Khasi	Page 153
			Euterpe sp., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Euterpe precatoria Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Inonotus obliquus (Fr.) Pilát, Hymenochaetaceae	Inari Sámi	Page 122
			Oenocarpus bacaba Mart., Arecaceae	Tikuna, Cocama and Yagua	Table 7.5
			Ophiocordyceps sinensis (Berk.) G.H.Sung, Ophiocordycipitaceae	Bhotia and Anwal	Table 6.2
			Picrorhiza kurroa Royle ex Benth., Scrophulariaceae	Bhotia and Anwal	Table 6.2

Use	Type	Group	Scientific name	People	Table/ Page number
Non-food	Wild plants for other uses than food	Medicinal	*Sida rhombifolia* L., Malvaceae	Khasi	Page 153
			Vitex negundo L., Lamiaceae	Khasi	Page 153
		Others (landscape, etc.)	*Acacia dealbata* Link, Fabaceae	Khasi	Page 146
			Acacia sp., Fabaceae	Kel Tamasheq	Page 225
			Attalea cohune Mart., Arecaceae	Maya Ch'orti'	Page 322
			Bambusa bambos (L.) Voss, Poaceae	Khasi	Page 146
			Betula pendula Roth, Betulaceae	Inari Sámi	Page 116
			Calotropis sp., Apocynaceae	Kel Tamasheq	Page 225
			Castanopsis spp., Fagaceae	Khasi	Page 146
			Ceiba pentandra (L.) Gaertn., Malvaceae	Tikuna, Cocama and Yagua	Page 284
			Ceiba sp., Malvaceae	Maya Ch'orti'	Page 322
			Daphne involucrata Wall., Thymelaeaceae	Khasi	Page 146
			Dendrocalamus giganteus Wall. ex Munro, Poaceae	Khasi	Page 146
			Enterolobium cyclocarpum (Jacq.) Griseb., Fabaceae	Maya Ch'orti'	Page 322
			Euphorbia sp., Euphorbiaceae	Kel Tamasheq	Page 225
			Grewia damine Gaertn., Malvaceae	Kel Tamasheq	Page 238
			Grewia tenax (forssk.) Fiori, Malvaceae	Kel Tamasheq	Page 238
			Grewia villosa Willd., Malvaceae	Kel Tamasheq	Page 238
			Gynandropsis gynandra (L.) Briq., Cleomaceae	Kel Tamasheq	Page 238
			Haldina cordifolia (Roxb.) Ridsdale, Rubiaceae	Khasi	Page 146
			Herpetotheres cachinnans L., Falconidae	Maya Ch'orti'	Page 330
			Lithocarpus elegans (Blume) Hatus. ex Soepadmo, Fagaceae	Khasi	Page 146
			Magnolia insignis Wall., Magnoliaceae	Khasi	Page 146
			Millettia glaucescens Kurz, Fabaceae	Khasi	Page 146
			Petersianthus macrocarpus P.Beauv. Liben, Lecythidaceae	Baka	Page 92
			Picea abies (L.) H. Karst. subsp. Abies, Pinaceae	Inari Sámi	Page 116
			Pinus sylvestris L., Pinaceae	Inari Sámi	Page 116
			Pinus kesiya Royle ex Gordon, Pinaceae	Khasi	Page 146
			Quercus griffithii Hook. f. & Thomson ex Miq., Fagaceae	Khasi	Page 146
			Schima sp., Theaceae	Khasi	Page 146
			Sclerocroton cornutus (Pax) Kruijt & Roebers, Euphorbiaceae	Baka	Page 98
			Tectona grandis L.f., Lamiaceae	Maya Ch'orti'	Page 322
			Vitex spp., Lamiaceae	Khasi	Page 146
		Stimulants	*Areca catechu* L., Areaceae	Melanesians[SI]	Page 192
			Nicotiana tabacum L., Solanaceae	Khasi	Page 156
	Wildlife for other uses than food	Cosmetic, accessories, lighting and other uses	*Dactylopius coccus* Costa, Dactylopiidae	Maya Ch'orti'	Page 329
		Others (landscape, etc.)	*Arapaima gigas* Schinz, Osteoglossidae	Tikuna, Cocama and Yagua	Pages 37, 306, 307, 313

SPECIES INDEXES

Use	Type	Group	Scientific name	People	Table/ Page number
Non-food	Wildlife for other uses than food	**Others (landscape, etc.)**	Cicadas sp.	Maya Ch'orti'	Page 330
			Dermatobia hominis L., Oestridae	Maya Ch'orti'	Page 329
			Eunectes murinus L., Boidae	Tikuna, Cocama and Yagua	Page 308
			Hemitragus jemlahicus C.H.Smith, Bovidae	Bhotia and Anwal	Pages 262, 270
			Inia geoffrensis Blainville, Iniidae	Tikuna, Cocama and Yagua	Pages 295, 308
			Lophophorus impejanus Latham, Phasianidae	Bhotia and Anwal	Pages 262, 270
			Lophura leucomelanos Latham, Phasianidae	Bhotia and Anwal	Pages 262, 270
			Naemorhedus goral Hardwicke, Bovidae	Bhotia and Anwal	Page 262
			Odocoileus virginianus Zimmermann, Cervidae	Maya Ch'orti'	Page 343
			Pseudois nayaur Hodgson, Bovidae	Bhotia and Anwal	Pages 262, 270
			Sus scrofa L., Suidae	Bhotia and Anwal	Pages 262, 270
			Sylvilagus brasiliensis L., Leporidae	Maya Ch'orti'	Page 343
			Tragopan satyra L., Phasianidae	Bhotia and Anwal	Page 262
			Ursus thibetanus G.[Baron] Cuvier, Ursidae	Bhotia and Anwal	Page 270

INDIGENOUS NAMES

Use	Type	Group	Indigenous name	Common name	People	Table/Page number
Food	Cultivated foods: crops, planted trees and other cultivated foods	Fruits and juices	***sohbuitrieh***	unknown	Khasi	Table 3.1
			sohkpu	unknown	Khasi	Table 3.1
			sohkyrwiat	unknown	Khasi	Table 3.1
			sohmyndong	unknown	Khasi	Table 3.1
		Starches	***sohlal***	wild potato	Khasi	Table 3.1
		Stimulant	***tangduma***	smoking pipe plant	Khasi	Page 156
	Wild edibles	Fruits and juices	***bie***	unidentified	Melanesians[SI]	Table 4.7
			gima	unidentified	Melanesians[SI]	Table 4.7
			sohjriamshia	unknown	Khasi	Table 3.2
			sohkhlot	unknown	Khasi	Table 3.2
			sohkhyrwiah	unknown	Khasi	Table 3.2
			sohkyrsiew	unknown	Khasi	Table 3.2
			sohkyrwoh	unknown	Khasi	Table 3.2
			sohliangkiang	unknown	Khasi	Table 3.2
			sohlymwai	unknown	Khasi	Table 3.2
			sohlyngksang	unknown	Khasi	Table 3.2
			sohnub	unknown	Khasi	Table 3.2
			sohpong	unknown	Khasi	Table 3.2
			sohsameh	unknown	Khasi	Table 3.2
			sohthylliang	unknown	Khasi	Table 3.2
			voh	sweet and juicy yellow flesh fruit	Melanesians[SI]	Table 4.7
		Mushrooms	***bòtoto***	unknown	Baka	Table 1.2
			dedele	unknown	Baka	Table 1.2
			dὲngbὲ	unknown	Baka	Table 1.2
			jokàbukà	unknown	Baka	Table 1.2
			jókàlànù	unknown	Baka	Table 1.2
			kòtomòlesèko	unknown	Baka	Table 1.2
			kútù	unknown	Baka	Table 1.2
			màwɔ̀luwɔ́lù	unknown	Baka	Table 1.2
			mòmbùjàmbùnjà	unknown	Baka	Table 1.2
			mundungùlà	unknown	Baka	Table 1.2

Use	Type	Group	Indigenous name	Common name	People	Table/Page number
Food	Wild edibles	Mushrooms	***sákùsa***	unknown	Baka	Table 1.2
			sámɔ̀ni	unknown	Baka	Table 1.2
			tókpolì	unknown	Baka	Table 1.2
			túlúkàngò	unknown	Baka	Table 1.2
			túlútìmi	unknown	Baka	Table 1.2
		Vegetables	***jaïing***	unknown	Khasi	Table 3.2
			jakhi	unknown	Khasi	Table 3.2
			jalyngiar	unknown	Khasi	Table 3.2; Page 169
			jasim	unknown	Khasi	Table 3.2
			jatwat	unknown	Khasi	Table 3.2
			ka nub	unknown	Khasi	Table 3.2
			khritwait	unknown	Khasi	Table 3.2
			latyrkaiñ	unknown	Khasi	Table 3.2
			pashor kait	wild banana	Khasi	Table 3.2
			sohlah	unknown	Khasi	Table 3.2
			sohlah	unknown	Khasi	Table 3.2
			trykhang	unknown	Khasi	Page 169
			tyrkhang iong	edible ferns	Khasi	Page 151
	Wildlife used as food	Birds and poultry	***doh sim***	unknown	Khasi	Table 3.3
		Fish	***dohsher iong***	unknown	Khasi	Table 3.4
			sher syngkai	unknown	Khasi	Table 3.4
		Insects and insect products	***dkhew***	unknown	Khasi	Table 3.2
			kber	unknown	Khasi	Table 3.2
			kir	unknown	Khasi	Table 3.2
			lwai	unknown	Khasi	Table 3.2
			niang kait	unknown	Khasi	Table 3.2
			niang krai	unknown	Khasi	Table 3.2
			niang ktang	unknown	Khasi	Table 3.2
			niang sbai	unknown	Khasi	Table 3.2
			niang sohriew	unknown	Khasi	Table 3.2
			niangkynthah	unknown	Khasi	Table 3.2
			nianglhur	unknwon	Khasi	Table 3.2
			nianglyngkta	unknwon	Khasi	Table 3.2
			shalyngur	unknown	Khasi	Table 3.2
			sùsu	winged termite imagos	Baka	Page 82

Use	Type	Group	Indigenous name	Common name	People	Table/Page number
Food	Wildlife used as food	Mammals	*dngiem*	bear	Khasi	Table 3.3
			khiat	bigger deer	Khasi	Table 3.3
			ũká	bristly mouse	Tikuna, Cocama and Yagua	Table 7.4
		Reptiles	*ngàndo*	African crocodile	Baka	Table 1.1
Non-food	Wild plants for other uses than food	Construction materials	*phlang tylli*	grass variety	Khasi	Page 156
		Cosmetic, accessories, lighting and other uses	*ɓɔ̀njìngà*	unknown	Baka	Page 90
			nalé	unknown	Baka	Page 90
		Fodder	*hote*	white ants	Melanesians[SI]	Page 196
			jakhi	unknown	Khasi	Page 151
			jasim	unknown	Khasi	Page 151
			jatwat	unknown	Khasi	Page 151
		Medicinal	*khnaing*	unknown	Khasi	Page 153
			mebteng	unknown	Khasi	Page 153
			pangat	unknown	Khasi	Page 153
			sla pata	unknown	Khasi	Page 153
			sla rynsi	unknown	Khasi	Page 153
			soh jalu	unknown	Khasi	Page 153
		Others (landscape, etc.)	*ktang*	bigger bamboo	Khasi	Pages 174, 177, 179
			phlang riat	unknown	Khasi	Page 156
			phlang saw	unknown	Khasi	Page 156
			phlang sharait	unknown	Khasi	Page 156
			prut	unknown	Khasi	Page 156
			rynai	medium size bamboo	Khasi	Pages 177, 179
			sla kait	unknown	Khasi	Page 156
			tiew maitong	unknown	Khasi	Page 156
		Stimulant	*tangduma*	smoking pipe plant	Khasi	Page 156
	Wildlife for other uses than food	Others (landscape, etc.)	*niang kseng*	stinkbugs	Khasi	Page 156
			shalymmen	unknown	Khasi	Page 156

Tikuna-Cocama-Yagua reserve in the Lagos de Tarapoto Wetland Complex in Puerto Nariño, Colombia.

Considered as some of the most sustainable on the planet, Indigenous Peoples' food systems are about the future of food. They can play a significant role in informing the transformation of food systems, making them more sustainable and respectful of nature.

This publication seeks to provide scientific insights into the global debate on sustainable food systems, and to highlight the unique and common characteristics of sustainability and climate resilience of 8 Indigenous Peoples' food systems from different parts of the world.

It acknowledges the contributions that Indigenous Peoples can make to achieve the 2030 Sustainable Development Goals (SDGs), and advocates for these contributions and associated food systems to be taken into consideration in ongoing discussions about sustainable food systems.

Co-published together with the Alliance of Bioversity International and CIAT, the publication is the third volume of books on Indigenous Peoples' food systems released by FAO. It comes after the books (1) "Indigenous Peoples' Food Systems: The many dimensions of culture, diversity and environment for nutrition and health" (2009), and, (2) "Indigenous Peoples' food systems & well-being: interventions & policies for healthy communities" (2013) co-published with the Centre for Indigenous Peoples' Nutrition and Environment (CINE) at McGill University.

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