



GARDENS *of* BIODIVERSITY

*Conservation of
genetic resources and their use in
traditional food production systems
by small farmers of
the Southern Caucasus*









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Photographs by Marzio Marzot

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FOREWORD

With admiration, this book is dedicated to the people of the Southern Caucasus, and to the wealth of genetic resources resulting from their inspiration and work over the centuries. In managing their natural resources, these people have made an outstanding contribution to maintaining biodiversity and, as a consequence, to global food security.

The Southern Caucasus region was paramount in the evolution and differentiation of various domesticated plant and animal species; moreover, the region saw the beginnings of farmers' and pastoralists' settlements in the early stages of agriculture. Throughout the ages, the region was home to many populations who learned how to make a living out of a rugged land, by developing skills and locally adapting techniques – such as selecting a wide range of crop varieties, livestock breeds and integrated crop-livestock systems – to adapt to cold winters, dry summers, pests, diseases and the introduction of alien species.

The valued genetic resources and variety of agricultural practices (from production to preservation) in family gardens support year-round household food security. Together, these ensure yields over the longer term, and contribute to sustainable agricultural production intensification, farmers' livelihoods, healthy and diversified diets, healthy ecosystems and sociocultural stability.

Yet this sustainability, achieved through agricultural practices based on the conservation and sustainable use of local genetic resources in the Southern Caucasus, is at risk of being lost. Over the last few decades, changing biophysical and socio-economic pressures have increased risks from poor management of natural resources, loss of biodiversity, soil and water pollution and degradation, and vulnerability to climate change.

This book describes selected genetic resources and traditional management practices maintained by farmers and pastoralists in the gardens and landscapes of the Southern Caucasus, showing that understanding and building on local traditions can help these to be

Эта книга посвящается – с восхищением – людям Южного Кавказа и богатству генетических ресурсов, являющемуся плодом их вдохновения и труда на протяжении столетий. Умело распоряжаясь своими природными ресурсами, эти люди внесли выдающийся вклад в поддержание биоразнообразия и, как следствие, в глобальную продовольственную безопасность.

Регион Южного Кавказа сыграл важнейшую роль в эволюции и изменении различных одомашненных видов растений и пород животных; более того, на ранних стадиях развития сельского хозяйства регион стал свидетелем появления поселений земледельцев и скотоводов. На протяжении веков регион служил домом для многих групп населения, которые научились добывать средства к существованию на холмистой земле, вырабатывая навыки и приспособлявая к местным условиям такие технологии, как селекция широкого спектра разнообразных сельскохозяйственных культур, пород домашнего скота и интегрированных систем сельскохозяйственных культур и домашнего скота, с целью приспособиться к холодной зиме, жаркому лету, сельскохозяйственным вредителям, болезням и внедрению чужеродных видов.

Ценные генетические ресурсы и разнообразие сельскохозяйственных практик (от производства до сохранения) на приусадебных участках поддерживают продовольственную безопасность домашних хозяйств круглый год. Сообща они обеспечивают урожаи в более длительной перспективе и способствуют интенсификации устойчивого сельскохозяйственного производства, средствам к существованию, здоровому и разнообразному питанию фермеров, жизнестойким экосистемам и социокультурной стабильности.

Однако, возникла опасность, что эта устойчивость, достигнутая благодаря сельскохозяйственным практикам, основанным на сохранении и устойчивом использовании местных генетических ресурсов на Южном Кавказе, будет утрачена. В течение нескольких последних десятилетий изменение биофизического и социально-экономического давления привело к возрастанию рисков, связанных с неудовлетворительным управлением природными ресурсами, утратой биоразнообразия, загрязнением и деградацией почвы и воды, а также с уязвимостью по отношению к изменению климата.



valued, and also help to capitalize on what they have to offer. A close, detailed study of local agro-ecological and social conditions can contribute to identifying solutions for global problems; in short, it is possible to build on the knowledge and selection of the best genetic resources and local practices combined with efficient technologies and science to transform and increase options for agriculture in the Southern Caucasus towards sustainable development.

The genetic material treasured in the Southern Caucasus is essential for the achievement of Millennium Development Goals 1 and 7 in the region and for the entire world; collective efforts need to be made to preserve and use it.

Special thanks must be given to the many Armenian, Azeri and Georgian contributors to the book. The material they have collected, as well as that collected by the authors, was so extensive and rich that the editors have had the uneasy task of making a rigid selection – as diversified and as balanced as possible – of the many examples of plant and animal genetic resources that farmers and pastoralists have maintained, and of their traditional management practices. Additional and more detailed information on each subject can be found in the bibliography at the end of each chapter and at the following link: www.fao.org/agriculture/gardens_of_biodiversity

Thanks must also be given to the FAO Regional Office for Europe and Central Asia, the FAO Subregional Office for Central Asia, the FAO Commission on Genetic Resources for Food and Agriculture,

В книге описываются отдельные генетические ресурсы и традиционные агротехнические приемы, применяемые земледельцами и скотоводами на Южном Кавказе, и показано, что понимание местных традиций и опора на них может помочь правильно их оценить, а также с пользой задействовать их потенциал. Тщательное, детальное изучение местных агро-экологических и социальных условий может содействовать поиску решения глобальных проблем. Короче говоря, имеется шанс опереться на знание и выбор наилучших местных ресурсов, практик и эффективных технологий на Южном Кавказе с целью изменить и расширить возможности сельского хозяйства в плане устойчивого развития.

Генетический материал, бережно сохраненный на Южном Кавказе, существенно важен для достижения как в регионе, так и во всем мире Целей развития, сформулированных в Декларации Тысячелетия (Цели # 1 и # 7); нужны коллективные усилия для сохранения и использования этого материала.

Особую благодарность следует выразить многим специалистам из Армении, Азербайджана и Грузии, которые внесли свой вклад в создание этой книги. Собранный ими материал, как и материал, собранный авторами, был настолько обширным и богатым, что перед редакторами встала нелегкая задача провести строгий отбор – максимально возможно разносторонний и сбалансированный – среди множества примеров генетических ресурсов растений и животных, сохраненных земледельцами и скотоводами, и среди их традиционных агротехнических приемов. Дополнительную и более подробную информацию по каждому предмету можно найти в библиографии и на сайте www.fao.org/agriculture/gardens_of_biodiversity



the International Treaty on Plant Genetic Resources for Food and Agriculture and the Government of Switzerland for their generous support to this book, as one of FAO's contributions to the 2010 International Year of Biodiversity.

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Modibo T. Traoré

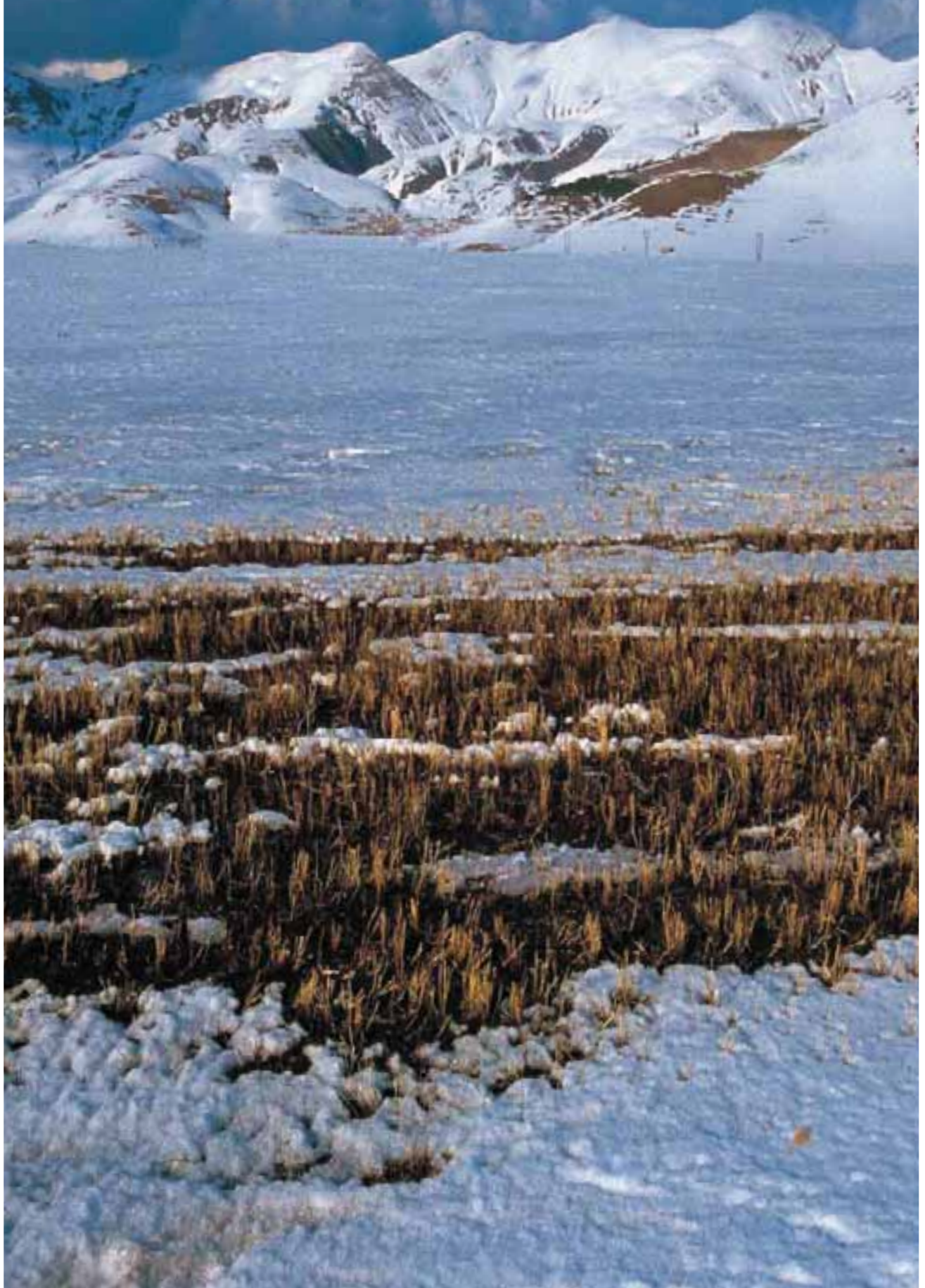
Assistant Director-General
Department of Agriculture and Consumer Protection

Следует выразить благодарность также и Региональному Бюро ФАО по Европе и Центральной Азии, Субрегиональному офису ФАО по Центральной Азии, Комиссии ФАО по генетическим ресурсам для производства продовольствия и ведения сельского хозяйства, Международному договору о генетических ресурсах растений для производства продовольствия и ведения сельского хозяйства и Правительству Швейцарии за их щедрую поддержку этой книги - в качестве одного из вкладов ФАО в отмечаемый в 2010 г. Международный год биоразнообразия.

Далее, мы также хотели бы выразить признательность за работу и консультации Фернанде Герриери, Заместителю Генерального Секретаря и Региональному представителю в Региональном Бюро ФАО по Европе, Мустафе Синакеру, Субрегиональному Координатору офиса ФАО по Центральной Азии, Гансу-Йоргу Леманну, Постоянному Представителю Швейцарии в ФАО, Шакиль Бхатти, Секретарю Международного договора о генетических ресурсах растений для производства продовольствия и ведения сельского хозяйства, Дэну Лескину, Старшему сотруднику по связям, Комиссия ФАО по генетическим ресурсам для производства продовольствия и ведения сельского хозяйства, Шиванджи Панджей, Директору Управления ФАО по производству и защите сельскохозяйственных культур, а также многим коллегам из ФАО, чьи имена указаны в списке лиц, внесших свой вклад в создание этой книги.

Модибо Т. Траоре

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PREFACE

GENETIC RESOURCES: LINKING FOOD, AGRICULTURE AND ECOSYSTEMS

There are still over a billion hungry people in the world today, and the resources with which to feed these people are becoming scarcer. Agricultural production systems need to focus more on the effective management of biodiversity and ecosystem services in order to conserve biodiversity and safeguard the environment, while feeding the global population. This is especially true in light of global challenges such as ensuring food security, climate change, shifts in population distribution and consumer preferences for food as well as potentially rising energy prices. Well-managed ecosystems are essential for ensuring a healthy resource base on which to intensify sustainably, to ensure that enough food is produced from now until 2050 – and beyond.

Biodiversity and its sustainable use and management are fundamental not only for providing food, but for maintaining and enhancing well-managed agro-ecosystems which in turn are necessary for healthy food production.

The role of biodiversity and the genetic resources it carries is essential for ensuring food security, sustainable livelihoods, ecosystem resilience, coping strategies for climate change, adequate nutritional requirements, insurance for the future (for example, for crop and animal breeding) and the management of biological processes needed for sustainable agricultural production.

With farming practices shifting away from heavy dependency on non-renewable inputs and chemical-based intensification (such as monocultures or the overuse of pesticides and fertilizers), the management of biological processes (such as pest regulation and control, soil biological processes and pollination) is increasingly becoming a recognized option for sustainable agricultural production intensification.

Agricultural systems are by far the largest managed ecosystems in the world. This gives farmers an ever-increasing role in maintaining and enhancing agricultural biodiversity and in providing the wider community with a range of ecosystem services. Farmers are the largest group of natural resource managers on the Earth. They both depend on and generate a wide array of biodiversity and ecosystem services. Their actions can enhance or degrade ecosystems. Farmers' knowledge is therefore very important in understanding what drives their decisions in all aspects of agricultural production, the sustainable use of biodiversity, the role of the biological process in sustainable agricultural production intensification, and the enhancement of ecosystem functions.

Globally, conserving genetic diversity both *in situ* and *ex situ*, and managing biodiversity *in situ*, are important, in order to capitalize on those traits that are adapted to specific conditions.

The biodiversity maintained in the Southern Caucasus is important for national food security, but also for the wider globe (for example, traits that are found in locally adapted species in the Caucasus can be adapted to suit similar climatic conditions in other geographic areas). The genetic resources found in the Southern Caucasus also play an important role in local culture, traditions and society. Despite the fact that many farmers, scientists, policy-makers and non-governmental organizations (NGOs) in the Southern Caucasus are struggling to preserve these genetic resources, their work is not sufficiently known and they are insufficiently connected with the many farmers, scientists and policy-makers of other countries who could share the benefits deriving from using these genetic resources for their agriculture.

One of the greatest challenges to achieving food security is recognizing – and internalizing into concrete action – the longer-term perspective of environmental sustainability. This is important for farmers, but also critical for policy-makers (at all levels – national, regional and international), to make informed decisions that have a positive impact on farmers' livelihoods, the health of the population, the health of the environment and, ultimately, food security.

Effective policy should provide an enabling environment for different sectors to have a favourable impact on sustainable agricultural production intensification, and therefore also on farmers. Hence, the management of natural resources, including biological processes, biodiversity and the ecosystem services it provides, becomes essential not only at the farm level, but also at the policy level.

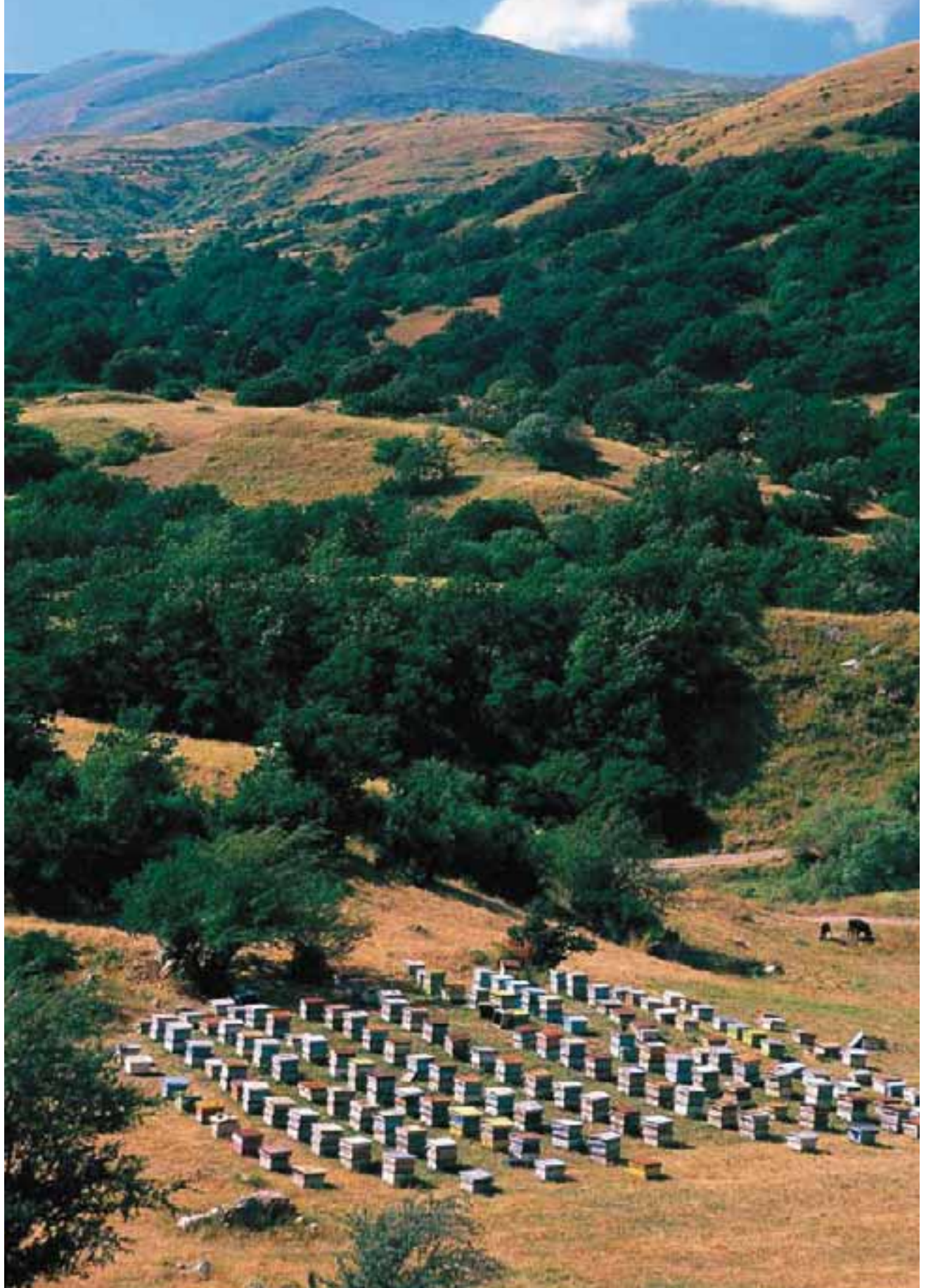
In a world of global changes, a collective effort is necessary to recognize the geographic interdependence between countries and regions.

There is a need to expand beyond national boundaries and promote international collaboration, develop joint research and breeding programmes, promote exchange and develop and strengthen collaboration programmes. This is particularly salient when facing the need to intensify agricultural production sustainably through applying ecosystem approaches.

Peter Kenmore and Linda Collette

Co-chairs

FAO Interdepartmental Working Group on Biodiversity





ABOUT THIS BOOK

THIS BOOK DESCRIBES HOW FARMERS AND RURAL PEOPLE IN THE SOUTHERN CAUCASUS MAINTAIN BIODIVERSITY AND APPLY THE ECOSYSTEM APPROACH IN THEIR DAILY LIVES AND AGRICULTURAL PRACTICES. THESE PRACTICES CONTRIBUTE TO THEIR FOOD SECURITY AND LIVELIHOODS WHILE ALSO MAINTAINING LOCAL GENETIC RESOURCES.

This book does not claim to offer a definitive prescription for sustainable agriculture and is not an exhaustive study. It puts forth a collection of concrete examples showing how genetic resources are maintained and used by small farmers for food security in the Southern Caucasus. These examples show that the livelihoods and prospects of rural people can be improved and consolidated in a sustainable manner to face important

environmental, social and economic challenges without sacrificing the prosperity of future generations. The book would like to stimulate further debate, research and policies in the hope that bridges can be built between the sustainable use of biodiversity and genetic resources, traditional practices and ways of life, and the new technologies, demands and challenges of today's society.

THE BOOK IS DIVIDED INTO NINE CHAPTERS THAT FOLLOW A SHORT STORY IN THE FORM OF A VERSE.

At the crossroads between East and West, in three hospitable countries, agriculture and breeding have been developed since the Neolithic,

Coping with the rhythms of the seasons, a treasury of genetic resources is maintained in gardens to make bread, cheese and wine.

Pastoralists and farmers manage the landscapes, and rural people know and use wild plants and animals,

Combining biodiversity, healthy ecosystems and smallholders' dedication: a pathway into the future.

Արևելքի և Արևմուտքի քառուղիներում Երեք հյուրընկալ երկրներում Հողագործությունը և անասնապահությունը զարգացել են մոր քարեդարյան ժամանակներից ի վեր

Հաղբահարելով տարվա եղանակների վայրիվերումները Այգիներում պահպանվում է գենետիկ պաշարների ողջ հարստությունը

Հացի, պանրի և զինու պատրաստման համար Երկրագործներն ու անասնապահները կառավարում են իրենց հողակտորները Գյուղացիները քաջատեղյակ են վայրի բույսերի ու կենդանիների օգտագործման գաղտնիքներին

Էկոհամակարգային մոտեցումը կարող է հիմնարար դեր խաղալ

Տարածված զբոսայգիներում Այգի գոնազրեթեք օլկադա Զինչիլիկ և սեկսիյա նեոլիտ ժամանակներից արտադրված է

Fəsilələrin ahənginə uyğunlaşma Genetik ehtiyatlar xəzinəsi bağlarda saxlanılır Çörək, pendir və şərab hazırlanması

Otlaq istifadəçiləri və fermerlər landşaftı idarə edirlər Kənd əhalisi yabanı bitkiləri və vəhşi heyvanları tanyur və onlardan istifadə edir

Biomüxtəlifliyin, sağlam ekosistemlərin və xırda fermer öhdəliklərinin məcmusu: gələcəyə aparın yol

առնչվածության և արևելքի և արևմուտքի երեք հյուրընկալ երկրներում Հողագործությունը և անասնապահությունը զարգացել են մոր քարեդարյան ժամանակներից ի վեր

Սեզոնային օրինակների համար արտադրվում է հաց, պանիր և շաբաբ Գյուղացիները պահպանում են իրենց հողակտորները

միջավայրի և ֆերմերների կողմից արտադրվող հաց, պանիր և շաբաբ Գյուղացիները քաջատեղյակ են վայրի բույսերի ու կենդանիների օգտագործման գաղտնիքներին

Բիոբազմազանության, առողջ էկոհամակարգերի և փոքր ֆերմերների պարտավորությունները: Գաղտնիքները օգտագործելու ճանապարհը





1 AT THE CROSSROADS BETWEEN EAST AND WEST

The Caucasus is a geographic hinge that connects Europe and Asia. It is characterized by the imposing mountain ranges that give their name to the region. This book focuses on the southern slopes of the Caucasus range and the nearby areas located between the Black and the Caspian Seas. The high mountains (over 5 000 m) provide protection from the excesses of the northern continental climate, but the variety of lands and soils (mountains, plains, lowlands and seashores) creates a unique combination of different climates, ranging from dry to humid and from subtropical to alpine. Due also to these features, the Southern Caucasus has been identified as one of the centres of origin of many plant species, such as soft wheat, and a centre of genetic differentiation. Like other areas in the world, the Southern Caucasus is experiencing the negative effects of weak past policies and ecosystem management, pollution, overexploitation and, more recently, climate change. But the Southern Caucasus is also a land of hope: throughout its varied territories, people and institutions are willing to restore and maintain their resources and biodiversity.

2 IN THREE HOSPITABLE COUNTRIES

The territory of the Southern Caucasus is shared by three countries: Armenia, Azerbaijan and Georgia (throughout the book the names of the three countries are generally listed in alphabetical order). Their identities are closely linked with the characteristics of the region: they are different yet similar. They share common features but have their individual properties; all three are rich in history, culture and natural resources. Armenia is in the centre of the region, and is the smallest of the three countries. It is landlocked but hosts the largest freshwater reservoir of the region (Lake Sevan). Azerbaijan lies to the east and south and faces the Caspian Sea. It is the largest country of the three. Georgia lies to the northwest, facing the Black Sea. It has the highest peak in the Southern Caucasus (Mount Shkhara, 5 201 m). Population density is comparable for the three countries (80–100 inhabitants/km²).

3 AGRICULTURE AND BREEDING HAVE BEEN DEVELOPED SINCE THE NEOLITHIC


Besides being one of the centres of origin and of differentiation of plant species, the Southern Caucasus is also an area in which agriculture and breeding were first developed, about 10 000 to 5 000 years ago, in the Neolithic. There is significant evidence of such an early presence of farmers and cattle breeders throughout the region. The cultivated species found include several varieties of wheat, apples, apricots, pears, grapes, peas and beans. Agriculture and breeding flourished over the centuries, but many local varieties are currently at risk of extinction. It is important to maintain the genetic resources and integrate state-of-the-art information and technologies with traditional practices that proved to be so efficient in the past.

4 COPING WITH THE RHYTHMS OF THE SEASONS

The Southern Caucasus stretches from west to east along a narrow range of latitudes, between 38° and 43° north. As a result, its many different climatic patterns, determined by the variety of chorography, influence of seas, etc., share the common rhythm of the four yearly seasons. Over the centuries, plants and animals have adapted to this rhythm and to the different climates, and people have had to adapt their farming practices to cope with these changes for a sustainable living. For example, in colder climates, specific varieties have been selected, such as the winter apple, and many methods of preserving food (such as jams, syrups, dry meat and dry bread – the *lavash*) have been developed in order to withstand the long winters. The rich biodiversity of the Southern Caucasus, concentrated in such a small territory, could become a natural laboratory for the maintenance and diffusion of precious genetic material and to face climate changes.

5 A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS

Historically, the family garden represents the basis of agricultural production in the region. The rugged territory and the presence of a significant rural population have presented perfect conditions for the diffusion of an agricultural system based on these gardens. Yet the garden is even more: it is the symbol of a lifestyle, of the deep knowledge of a territory and its resources, a continuous search for balance between exploitation and maintenance of the resources,



and adaptation to varying conditions in the short, medium and long terms. It is the guardian of biodiversity, of family life and culture. In an area of less than a hectare there are different varieties of fruit trees, vegetables, a few cows, sheep or goats, poultry, and possibly some beehives. Whoever owns and manages a garden has a treasure of knowledge and experience that must be preserved and shared. This knowledge is reflected in the consideration that farmers have for education and the commitment to allow their children to study. As a result, the three Caucasian countries, although they rank low in the world list of per capita gross domestic product, are at the top in literacy and culture indicators. The generally high level of education in the Southern Caucasus may help the success of any sustainable development policy, because it enables the people for whom it is directed to play leading roles.

TO MAKE BREAD, CHEESE AND WINE

Local transformation of agricultural products is another significant feature of the rural Caucasus. The region has an impressive range of food products that in turn form the basis of a rich and diversified cuisine. Bread is an example of how a simple chain production–transformation–consumption can help preserve biodiversity and the environment. It has been said that the Caucasus is rich in wheat and other cereal varieties, as a centre of origin and differentiation. People use these to make many kinds of bread, which are much appreciated and always part of Caucasian meals. In this sense, the circle closes: consumption sustains production. Similarly, many different types of cheese (from cow, buffalo, sheep, goat and mixed milk) are produced and consumed. Not to mention the social importance of wine, as testified by the widespread tradition of toasting.

PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES

Many landscapes in the Southern Caucasus bear signs of unsustainable agricultural and breeding intensification policies, such as degradation of soils, salinization and loss of landscape heterogeneity and of biodiversity. Nevertheless, several factors could induce optimism towards the improvement of the environment, such as the widespread presence of pastoralists and farmers (about 46 percent of the population is rural). Their knowledge of traditional practices has survived over the centuries, and their good cultural level enables them to introduce, adapt and diffuse new technologies. But they need understanding and support. Conserving and using biodiversity sustainably need to become integral components of

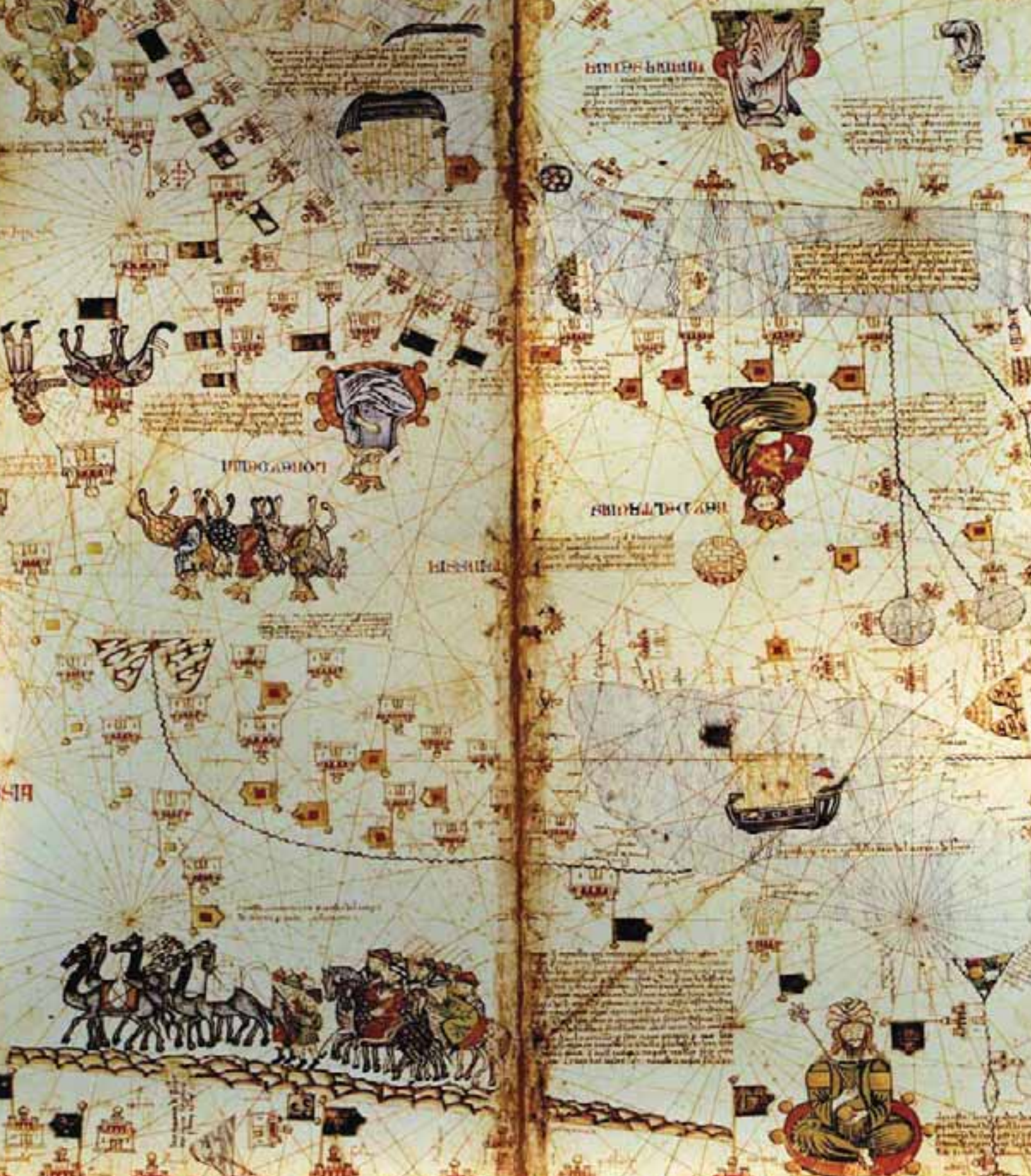
social and economic development in order to correct past policy and market failures. However, the central focus must remain on pastoralists and farmers. Their understanding of the landscapes in which they live and operate must be the starting-point for the application of modern technologies and policies.

RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

The system based on garden production is not a closed one. Cultivation and breeding are often integrated with collecting wild species and hunting. This contributes to nutritional diversity in diets and helps people overcome times of hardship such as economic, food and energy crises. Grasslands play an important role in this scenario, as they provide the right environmental conditions for the development of wild flora and fauna and represent the bridge between agriculture, animal production and nature conservation, protection and sustainable management. The Southern Caucasus is rich in grasslands, but today too many are degraded because of overexploitation and pollution. Rural populations wisely use natural resources: they just need to be supported by adequate policies.

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION: A PATHWAY INTO THE FUTURE

The ecosystem approach is the framework for action under the Convention on Biological Diversity (CBD). It identifies 12 principles that represent the guidelines for the conservation and sustainable use of natural resources. Each principle is summarized in this chapter and connections are made to subjects developed in this book. The role of biodiversity and its genetic resources is essential for ensuring food sovereignty and food security; sustainable livelihoods; ecosystem resilience; coping strategies for climate change; and sustainable agricultural production. The Food and Agriculture Organization of the United Nations (FAO) provides a platform for dialogue and negotiation through its Commission on Genetic Resources for Food and Agriculture, to reach global consensus on policies relevant to biodiversity for food and agriculture and hosts the Secretariat for the International Treaty on Plant Genetic Resources for Food and Agriculture. FAO is assisting countries in strengthening their policies on the matter as well as in providing technical capacity to address the dual needs of food security and environmental sustainability through the ecosystem approach.



INTELLIGENTIA

LORENZUS

INTELLIGENTIA

INTELLIGENTIA

BIS



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IN THREE HOSPITABLE COUNTRIES

AGRICULTURE AND BREEDING HAVE BEEN DEVELOPED SINCE THE NEOLITHIC

COPING WITH THE RHYTHMS OF THE SEASON

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COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Արևելքի և Արևմուտքի քառուղիներում

Şərqiñ və qərbiñ yolayrıcında

აღმოსავლეთისა და დასავლეთის გზასაყარზე

1

INTRODUCTION

WHEN LOOKING AT A MAP OF EURASIA, IT IS QUITE EASY TO IDENTIFY THE CAUCASUS REGION: IT IS THE LARGE CORRIDOR THAT LIES BETWEEN THE BLACK AND THE CASPIAN SEAS – A SORT OF GEOGRAPHIC HINGE THAT CONNECTS ASIA IN THE EAST TO EUROPE IN THE WEST. THE CAUCASUS IS ALSO LOCATED IN THE MIDDLE OF THE TRANSITION ZONE BETWEEN TEMPERATE AND SUBTROPICAL CLIMATE ZONES, WHICH CREATES FAVOURABLE CONDITIONS FOR THE GENETIC EVOLUTION OF A WIDE RANGE OF FLORA AND FAUNA.

*T*his unique situation has made it possible for the Caucasus to be a bridge between eastern and western flora, a centre of genetic differentiation that has created new endemic varieties and, at the same time, a door that has diffused the precious genetic material from east to west and from north to south and vice versa. This explains why, in some areas of the Caucasus, species of European or Asian origin grow next to endemic species, adapted to continental, Mediterranean and subtropical climates.

In the lowlands along the Caspian seashores, characterized by significant pedoclimatic variability, non-endemic species such as tobacco, potatoes, tea, maize, cotton and citrus fruits are perfectly adapted and thrive together with species that have long been cultivated such as wheat, figs, almonds, pistachios, olives and pomegranates.

The region is also situated along the main routes that have been used for thousands of years to connect the East to the West and Asia to Europe, and this is reflected in the different populations, languages, cultures and religions that characterize it. Nevertheless, this rich biodiversity is now at risk because of overexploitation of natural resources, mass production of just a few species and varieties, and the effects of climate change.

The result is that a region which once provided world agriculture with several major crops is currently experiencing a food deficit. It is important to spread awareness of the value of the rich heritage of genetic resources in the Southern Caucasus and sustain policies for its correct maintenance, both at the local and international level.

The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers. Names in the maps are mainly those of places mentioned in the book.



The Southern Caucasus is the region of interest discussed in this book. It is a large corridor that lies between the Black and the Caspian Seas – a sort of geographic hinge that connects Asia in the east to Europe in the west. It is dominated by the great mountain ranges that give their name to the region and divide it into the Northern and Southern Caucasus

TERRITORY

The Caucasus is dominated by the great mountain ranges that give their name to the region. Its morphology and climate are extremely diverse. Within a few hundred kilometres, altitudes vary from zero to over 5 000 m and down again to the –30 m of the depression along the western coast of the Caspian Sea. The result of these dramatic changes is that the climate varies from continental in the north, to alpine in the inner mountainous areas, to subtropical in the west and to dry steppe in the southeast. In a fairly limited area, most of the world's major ecoregions can be found. Rainfall ranges from as little as 200 mm per year in the eastern lowlands to more than 2 500 mm per year on the Black Sea shore.





The Greater Caucasus range seen from the neighbourhood of Kish, Azerbaijan. The territory of the Southern Caucasus is highly differentiated, with altitudes ranging from over 5 000 m down to –30 m. >>Right: the multiple colours of the eroded shale formations of the “Candy Cane” mountains, Xizi region, Azerbaijan

The Caucasus region comprises the following:

- ❁ the plains and hills along the northern slopes of the Greater Caucasus range;
- ❁ the Greater Caucasus range, which is more than 1 000 km long, and lies between the eastern shores of the Black Sea at about 44° latitude north and the western shores of the Caspian Sea at about 41° latitude north. It is more than 5 000 m high (the highest peak is Mount Elbrus, in the Russian Federation, at 5 642 m; Mount Shkhara, in Georgia, is 5 201 m high);
- ❁ the plains and hills along the eastern shores of the Black Sea in Georgia;
- ❁ the Lesser Caucasus range, which is approximately 500 km long, and lies between the eastern shores of the Black Sea at about 42° latitude north and the River Araz at

approximately 39° latitude north. It is more than 4 000 m high (the highest peak is Mount Aragats, in Armenia, at 4 095 m);

- ❁ the hills, plains and lowlands along the shores of the Caspian Sea in Azerbaijan;
- ❁ the highlands of the Armenian plateau, located between the southwestern slopes of the Lesser Caucasus range and the River Araz.

The territory to the north of the Greater Caucasus range (the “Northern Caucasus”) belongs to the Russian Federation and, more precisely, to the regions of Krasnodar and Stavropol, and to the autonomous republics of Adygea, Karachay-Cherkessia, Kabardino-Balkaria, North Ossetia, Ingushetia, Chechnya and Dagestan.

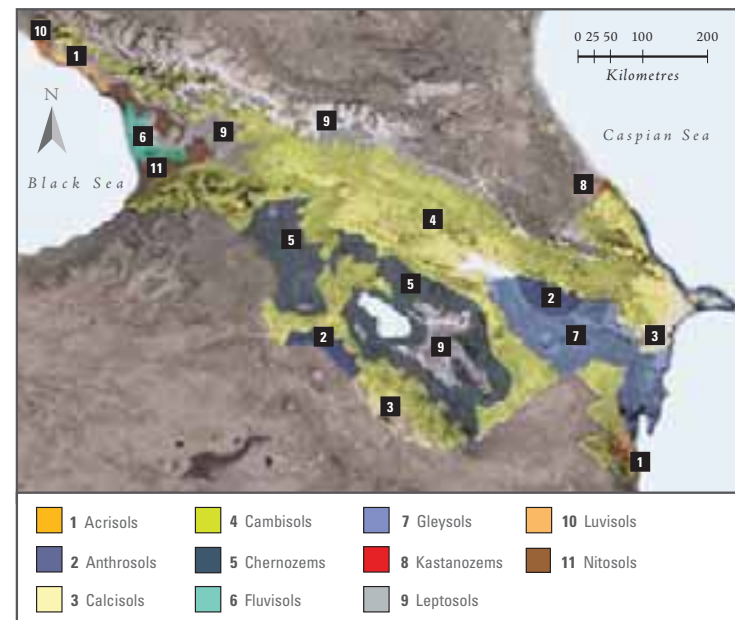


The rest of the Caucasus region (the “Southern Caucasus”) is the focus of this book and belongs to Armenia, Azerbaijan and Georgia; at the southern borders of the Caucasus are Turkey to the west and the Islamic Republic of Iran to the east.

SURFACE AREA AND INHABITANTS OF THE CAUCASUS REGION			
	Surface (km ²)	Inhabitants	Density (inhabitants/km ²)
Caucasus region	440 400	30 756 000	70
Northern Caucasus (Russian Federation)	254 300	14 506 000	57
Southern Caucasus (Armenia, Azerbaijan and Georgia)	186 100	16 250 000	87

Source: State Statistical Services of Armenia, Azerbaijan and Georgia (2009), and of the Russian Federation (2004)

MAP OF SOILS



Adapted from Harmonized World Soil Database and derived SRTM DEM (FAO/ CAS / IIASA / ISRIC / JRC)



Lake Sevan, in Armenia, is the largest lake in the Southern Caucasus. Below: the confluence of the Aragvi and Mtkvari rivers in Georgia
>>Right: the River Mtkvari then flows into Azerbaijan, where it is called Kür



The main rivers in the Southern Caucasus are the following:

- ❁ River Kür (Mtkvari): 1 364 km long. It springs on the Turkish side of the Armenian plateau near Kars and flows through Georgia and Azerbaijan into the Caspian Sea at Neftçala;
- ❁ River Araz: 1 072 km long. It springs near Erzurum (Turkey) and flows along the border between Turkey and Armenia; Nakhchivan (Azerbaijan) and the Islamic Republic of Iran; Armenia and Iran; Azerbaijan and Iran; and finally flows into the River Kura at Sabirabad in Azerbaijan;
- ❁ River Rioni: 327 km long. It springs in the Racha region in Georgia and flows into the Black Sea near Poti.

The main lake in the Southern Caucasus is Lake Sevan, in Armenia, with 1 250 km² surface area, located at an altitude of about 1 900 m above sea level. It receives water from several rivers flowing from the Lesser Caucasus range; its main emissary is the River Hrazdan that flows through Yerevan and into the River Araz.

The second largest water basin is the artificial lake formed by a dam built in the 1950s on the River Kür in Azerbaijan near Mingacevir. It has a surface area of 605 km².

A great number of small lakes dot the region, mainly in Azerbaijan.

The Caspian Sea is the largest lake on Earth, by both area and volume, with a surface area of 371 000 km² and a volume of 78 200 km³. It is a landlocked endorheic body of water and lies between Asia and Europe. It has a maximum depth of about 1 025 m and is called a sea because when the Romans discovered it they tasted the water and found it to be salty. It has a salinity of approximately 1.2 percent, about a third of the salinity of seawater.







Within a few hundred kilometres, many different climatic patterns can be found, contributing to the rich biodiversity of the territory

CLIMATE

The Caucasus region lies in the middle of the temperate zone of the northern hemisphere, but the Greater Caucasus range acts as an important climate separator, since it prevents the movement of cold air masses from north to south and conversely that of warm air masses from south to north. As a consequence, the Northern Caucasus has a continental climate with cold winters and warm summers, while the Southern Caucasus has a generally milder climate, although with significant variations depending on factors such as altitude, influence of water basins and latitude.





From west to east, the following climate zones can be identified in the Southern Caucasus.

- ❁ The coastal region along the Black Sea, in Georgia, has a subtropical climate, with a winter mean temperature around 7 °C and a summer one around 21 °C. Humid air drafts from the sea imply significant rainfall, ranging between 1 000 and 2 000 mm per year, with peaks of over 2 500 mm per year.
- ❁ Moving eastwards, the influence of the sea decreases and the altitude increases, and the climate becomes cooler and drier. In Tbilisi, the capital city of Georgia, at a height of 490 m above sea level, the winter mean temperature is 2.5 °C and the summer one is 23 °C; rainfall reaches 500 mm per year.
- ❁ In the central part of the Southern Caucasus, dominated by the Lesser Caucasus range and the Armenian plateau, the climate is continental, with cold dry winters and hot dry summers. In Yerevan, the capital city of Armenia, at a height of 900 m above sea level, the winter mean temperature is -1.5 °C and the summer one is 24.5 °C; rainfall reaches 280 mm per year.
- ❁ In the mountains, at heights above 2 000 m, the climate is typically alpine, with cold winters and cool summers.
- ❁ In the western part of the Caucasus, as the altitude falls below 650 m in eastern Georgia and in northern and central Azerbaijan, the climate is again subtropical, but less temperate and drier, because of the more limited thermal influences of the Caspian Sea as compared with those of the Black Sea. The winter mean temperature is 3 °C and the summer one is 24 °C; rainfall ranges between 300 and 800 mm per year.
- ❁ The lowlands along the Caspian Sea, in Azerbaijan, have a dry steppe climate, with warm winters, hot summers and low rainfall. In Baku, the capital city of Azerbaijan on the Caspian shore, the winter mean temperature is 4.5 °C and the summer one is 25 °C; rainfall reaches 210 mm per year.
- ❁ The southeastern region of Azerbaijan (Lankaran-Astara), at the foothills of the Talish Mountains along the border with the Islamic Republic of Iran, has a subtropical climate; rainfall is about 1 200 mm per year.

More detailed information on the climate of the Southern Caucasus can be found in Chapter 4.



Near Xudat in Azerbaijan, farmers have adapted to the great diversity of morphology, climate and soils by developing a mosaic of crops and livestock systems, by alternating annual and perennial crops, and by avoiding cultivation of fragile environments in order to protect wild biodiversity, soil and water resources

LANDSCAPES

As mentioned previously, the territory of the Southern Caucasus is diverse, in terms of morphology, climate and soils. As a consequence, there is a great variety of landscapes. Rural people have developed skills and technologies to manage and use this diversity of landscapes and species. Even in areas where terrain and climates are harsh, people have developed effective agricultural systems, making the most of their resources. Throughout history, the countries of the Caucasus have been both major producers and exporters of agricultural products.

In order to adapt to their environment for agricultural production, generations of farmers and agronomists have selected plant species suited to local conditions. The region offers an array of agricultural products, including rice, cereals, tobacco, fruit – Mediterranean and subtropical varieties – and tea, maize, cotton and beetroot.

Meat and poultry production is also widely practised, as is silkworm farming and the processing of agricultural products. The landscape has also been altered in order to make farming more productive.

In Georgia, the plateaus have been terraced to grow vines and fruit trees while, in Armenia, irrigation projects exploiting water from Lake Sevan have been developed in order to increase agricultural production on the plains of Yerevan and Gyumri. The same has happened in Azerbaijan, where building of the Mingacevir dam has enabled large tracts of drylands in the centre of the country to be cultivated. However, agriculture intensification and overexploitation of water resources have also caused problems with soil degradation and loss of biodiversity. Only in recent years has an effort been made by local institutions to overcome these problems.





Thousand of years of farming have shaped the landscapes in order to increase agricultural production and maintain biodiversity of cultivated and wild species. <<Left: remains of a mediaeval tower in the Samtskhe-Javakheti region, Georgia

A CENTRE OF GENETIC EVOLUTION AND DIFFERENTIATION

The rich biodiversity of the Southern Caucasus originates from a combination of several factors. The process of mountain formation has played an important role in the differentiation of the vegetation into species. The mountain ranges acted as barriers against the spread of species and genera, enabling the creation of closed ecological systems of grasses and legumes where mutant forms could thrive and become established. There were also isolated human communities exerting their own selection pressures for larger seed size; resistance to shattering; and adaptation to drought, humidity, winter and climate extremes.

Low relative humidity and high sunshine hours during the growing season have created a favourable environment for crop growth, with relatively low incidence of diseases and pests. Crop growing periods range from 100 to 220 days

and on average there are between 1 900 and 2 900 hours of sunshine per year. These conditions enabled an early start in the development of agriculture, testified by the fact that the Caucasus is still today one of the world's richest sources of genetic diversity for cultivated species. N. Vavilov claims that primitive fruit growing originated in these mountain regions and that, even today, western Asia has the strongest potential anywhere in the world for fruit production, since this is the home of vines, pears, myrobalan or wild plums, cherries, pomegranates, walnuts, quinces, almonds and figs. In this region, all the evolutionary phases of fruit growing can be traced, including the development of hybrids such as those between plum and apricot trees, and almond and peach trees, as well as certain pome fruit genotypes suitable as potential rootstock, both for the *Malus* and the *Pyrus* genus.



FLORA

The Caucasus region is characterized by its rich and unique flora with high concentrations of economically important and edible plants, particularly wild crop relatives such as rye, barley and single-grain wild wheat (*Triticum boeoticum*) and Ararat wheat (*T. araraticum*). The level of endemisms is extremely high, and almost 25 percent of all species are endemics.

A range of intermediate horticulture plants is also cultivated in gardens. Domesticated varieties of fruits and berries have been developed from their wild relatives, including apples, pears, walnuts, hazelnuts, medlars, apricots, cherries and pomegranates. Fodder plants also occur, mainly from two families: Fabaceae (400 species, including *Medicago*, *Trifolium*, *Onobrychis*, *Lathyrus* and *Vicia*) and Poaceae (including species and varieties of *Triticum*, *Zea*, *Agropyron*, *Arrhenaterum*, *Dactylis*, *Festuca*, *Lolium*, *Phleum* and *Bromus*). Of 454 species of grasses (Poaceae) in Azerbaijan, 25 are cultivated.

Pulses, native cultivars of runner beans (*Phaseolus*), lentils (*Lens*), garden peas (*Pisum*) and broad beans (*Vicia*) are also found in this region. Forests are home to particular species unique to the Southern Caucasus, including the Araz oak, eastern beech, Caucasian pine and a coniferous tree called *tis*.

The Southern Caucasian eastern plain grove forest with lianas, now relict, and the mixed Kolkheti forest in western Georgia, where chestnut and eastern beech, Kolkheti, Imereti and Georgian oak, Caucasian hornbeam and ash are grown, unique to the Caucasus. *Zelkova* (*Zelkova carpinifolia*), oak and beech forests are spread over the mountains of the region. Eastern fir and Caucasian fir are found in the dark coniferous forests.

Fruit trees are important in terms of quality of the environment, quality of food and quality of life of the people who depend upon them.



Many local fruits and legumes, such as plums (*left*) and sainfoin (*above*) are adapted to resource-efficient family systems



FAUNA

Southern Caucasian fauna includes species with different categories of endemism – from strictly endemic species to species that are quite common all over the world. The basic endemics are the west Caucasian tur (*Capra caucasica*), east Caucasian tur (*Capra cylindricornis*), noble deer (*Cervus elaphus*), Prometheomys mouse (*Prometheomys schaposchnicovi*), Caucasian black grouse (*Lyrurus mlokosiewiczzi*) and Caucasian snowcock (*Tetraogallus caucasicus*).

Furthermore, mammals can be found in the plains, such as wild boars, wolves, foxes, badgers, red foxes and hares as well as reptiles (swamp tortoise, Caspian tortoise, Mediterranean tortoise, stripy lizard, testaceous grass snake, gaunt grass snake and adders); various frog species; birds (pheasants, partridges, turaj, eagles, different duck and goose species, crying and puffing cuckoos, coots, *soltan* birds, herons, cormorants and curly-feathered pelicans); and numerous insect species. Apart from animals in the medium and high mountainous belts, there are eastern Caucasian mountain goats, Caucasian deer, Caucasian *kopper*, European roe deer, Caucasian brown bears and bird

species such as the golden eagle, Caucasian falcon, Caucasian *tetra* and Caucasian snowcock. Wild ancestors of agricultural animals are represented by rock goats and *bezoar* goats, wild boars and Asian moufflon. *Jeyran* gazelles (*Gazella subgutturosa*) are among the rarest and fastest species in the Caucasus; they are only found in the Shirvan Nature Reserve, Bendovan and Korchay regions of Azerbaijan. Endangered species include chamois, lynx and leopard. Some representative martens, wild ducks, grey geese, herons, pheasants, partridges, quails and forest hens are frequently to be found in the gardens, vineyards and yards of householders.

The rich fauna and flora of the southern Caucasus are protected in many special areas – there are three reserves and two national parks in Armenia; 11 reserves and eight national parks in Azerbaijan and 16 nature reserves and two national parks in Georgia. These protected areas need investments, continuous support and awareness creation programmes and need to become an integral part of and a resource for the rural population that depends upon them.



The Caucasus is characterized by a complex, sometimes mosaic, spatial structure of biological communities, representing different biogeographic zones. The optimal way to protect Caucasian biodiversity is to pay particular attention to this factor, since its most important feature is the constant interaction of local, west Asian and eastern European communities



The impressive diversity of species and varieties of the Southern Caucasus contributes to regulating the climate, providing and producing food and medicine, recycling of wastes and improving ecosystem health [Source: AZƏRBAYCAN SSR DÖVLƏT TƏBİƏTİ MÜHAFİZƏ KOMİTƏSİ VƏ AZƏRBAYCAN SSR ELMLƏR AKADEMİYASI. 1989. AZƏRBAYCAN SSR-in QIRMIZI KİTABI – NADİR VƏ NƏSLİ KƏSİLMƏKDƏ OLAN HEYVAN VƏ BİTKİ NÖVLƏRİ. İŞİQ]





Rapid degradation of natural habitats, intensification and expansion of cultivation and overgrazing, and replacement of local varieties with highly productive ones are the main factors affecting the diversity of many domesticated species and their wild relatives

HUMAN IMPACT AND ENVIRONMENTAL RISKS

The Caucasus region has been inhabited and exploited by human communities for tens of thousands of years. It has been transformed by human activities and today only a few pristine areas and intact ecosystems remain in remote high-altitude areas and inaccessible gorges. While small-scale family farming had a limited negative impact on biodiversity, most plains and foothills have suffered from human impact, resulting in severe habitat loss.

The diversity of many species and their wild relatives has decreased because of rapid degradation of natural habitats, intensification and expansion of cultivation and overgrazing, and replacement of local varieties with highly productive ones.

As a result, the local knowledge associated with the use and management of biodiversity is also decreasing.

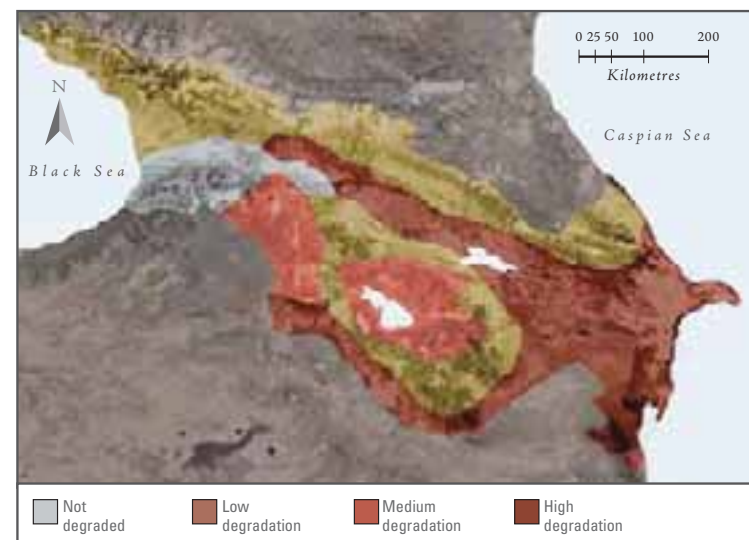


SOIL EROSION AND DEGRADATION

Soil erosion and degradation are serious problems. In addition to natural processes, significant contributions arise from tillage practices (deep ploughing), cultivating steep slopes, overgrazing and logging. Overgrazing by sheep and cattle has eroded the natural vegetation in more than 30 percent of subalpine and alpine summer ranges and about 50 percent in the winter ranges of the steppe and semi-desert areas. Overgrazing has resulted in reduced species diversity and habitat degradation.

The map, extracted from the “World map of the status of human-induced soil degradation”, represents the overall severity by which the physiographic unit is affected by soil degradation. This item takes the degree¹ and extent² into account. The original classification is 1 (low) to 4 (very high). Note that none of the three countries has class 4 (very high soil degradation severity).

MAP OF SOIL DEGRADATION SEVERITY



Source: Oldeman, Hakkeling and Sombroek, 1991

¹ Degree: a measure of how strongly the soil is affected by degradation, estimated in relation to changes in agricultural suitability, to declined productivity and to biotic functions of the soil. Four levels of degree are distinguished: light, moderate, strong and extreme.

² Extent: the percentage of the area of the map unit that is actually affected by soil degradation. Five classes from infrequent to dominant are considered: 0–5%, 5–10%, 10–25%, 25–50% and 50–100%.



SOIL AND WATER POLLUTION

by Mark Lawrence Davis

During the 1980s, the Southern Caucasus produced very large numbers of agricultural products such as citrus fruits, tea, grapes and cotton, and pesticides were widely used for disease control and crop production. But the management of pesticides was weak, with evidence of oversupply, overuse and poor management resulting in the accumulation of extremely large obsolete pesticide stockpiles, and many varied and widespread adverse impacts on human health and the environment.

The problems caused by pesticide mismanagement persist in the Southern Caucasus where agriculture is the mainstay of the economy and represents about a third of national GDP, and pesticides constitute the majority of chemicals in use. Obsolete pesticides were stored for many years in main and small storage facilities or buried, with consequences for the quality of soils, groundwater and air, which were poorly monitored.

Imprecise data on the composition of the hazardous chemicals that were stored exist, but are insufficiently collected, compiled and aggregated on a regular basis, because of lack of adequate technical, institutional and financial capacity to develop the policy and regulatory conditions necessary to clean up the contaminated wastes/sites and to destroy the stocks of obsolete pesticides or manage those in use properly.

Improved understanding of the health and environmental hazards associated with pesticides has led to the development of sophisticated regulatory and control systems designed to control pesticide trade, management and use. Examples include the Rotterdam and Stockholm Conventions, the International Code of Conduct on the Distribution and Use of Pesticides and the Organisation for Economic Co-operation and Development (OECD) Pesticides Working Group.



In agricultural production areas, mismanagement of waste such as obsolete pesticides has severe effects on soil and water pollution and consequently on human and animal health

FAO established a programme for the prevention and disposal of obsolete pesticides in 1994 and has worked to raise awareness, provide guidance and implement projects to remove obsolete pesticides and build up countries' pesticide management capacity. Efforts have also been made in recent years to improve control over pesticides. Many countries have ratified international agreements, developed regulations, moved away from centralized purchasing systems, imposed controls for illegal dumping of hazardous wastes, imposed tighter border controls, and developed integrated pest management (IPM) programmes to reduce reliance on pesticides. However, given the pressures of increasing agricultural exports and a more stringent market, the relevant authorities in the Southern Caucasus are currently willing to act on both obsolete pesticides and pesticide management issues. A FAO project is currently supporting capacity development for sound management of

obsolete pesticide stockpiles and strengthened management of agricultural pesticides in the three Southern Caucasus countries. In addition, efforts are in place to develop projects and secure financing to quantify and eliminate obsolete pesticide stocks and remediate sites that have been severely contaminated through the burial or dumping of pesticides over many years. Actions have already been taken to sample and analyse contaminants in Armenia, put in place pesticide stock management software in Georgia and formulate proposals for obsolete pesticide inventory, risk assessment and risk reduction actions in Azerbaijan.

The impact of this project will be to contribute to preserving the environment and the health of the population from adverse pesticide effects, promoting sustainable agriculture and facilitating access to healthier food.





Overgrazing by sheep and cattle has contributed to the erosion of the natural vegetation in more than 30 percent of subalpine and alpine summer ranges and in about 50 percent of the winter ranges in the steppe and semi-desert areas



OVERFISHING AND POACHING

Overfishing has serious implications for the food security and economic development of the region, since it reduces welfare and has a dramatic impact on the entire marine and freshwater system. The lack of proper marine and inland fisheries management means that fish stocks of the most popular and valuable species, notably sturgeon (Acipenseridae – including *Huso huso*, *Acipenser nudiventris*, *A. persicus* and *A. stellatus*) and salmon (Salmonidae – *Salmo trutta caspius*) in the Caspian Sea, have diminished and continue to do so. Similarly, in the Black Sea, overfishing of the commercial stocks of anchovy (*Engraulis encrasicolus*) by fishing vessels under foreign flags is seriously threatening the survival of the stocks in Georgian waters.

Apart from overfishing, the most serious threat for aquatic biodiversity and fish biomass in the Black and Caspian Seas is the invertebrate predator-ctenophore (*Mnemiopsis leidyi*). Ctenophores attack the eggs and larvae of many fish species in the Black Sea and, since the end of the 1990s, also in the Caspian Sea. Oil pollution and other anthropogenic influences have further added to the decline in biodiversity and fish biomass in the coastal areas of the Black and Caspian Seas.

Poaching of wild animals has increased significantly since the 1990s. The animals at the highest risk in Georgia are leopards (*Panthera pardus*), brown bears (*Ursus arctos*), wolves (*Canis lupus*), bezoar goats (*Capra aegagrus*) and turs (*Capra caucasica*), chamois (*Rupicapra rupicapra*) and lynx (*Lynx lynx*).

Because of extensive hunting in the Southern Caucasus, the populations of Caucasian deer (*Cervus elaphus*) are decreasing. Hunting, extensive sheep farming and habitat occupation may have caused the drastic decline of hyena (*Hyaena hyaena*). Persian gazelle (*Gazella subgutturosa*) almost disappeared in the early 1960s; some reasons were excessive hunting and the degradation of habitats through human impact. This gazelle has recently been reintroduced in national reserves of Azerbaijan.



In the recent past, unbalanced exploitation of natural resources has caused the loss of wild and domesticated species. Today, there is increasing awareness that biodiversity is fundamental for food security and economic development

LOSS OF PLANT BIODIVERSITY

The Caucasus is a region of unique diversity, but today this characteristic is jeopardized by inappropriate agricultural practices, loss of natural habitats and heavy industrialization processes. Genetic erosion caused by the introduction of new varieties resulted from the development of modern breeding, but it is necessary to note that a great many imported varieties, which were not suited to local nature-climatic conditions, became unfit for cultivation and diseases spread.

Around the 1960s, governmental strategy in general was to decrease wheat production in the Southern Caucasus. The main emphasis was on maize, subtropical fruit (mandarins, lemons, oranges), wine and tea production, often resulting in local erosion of biodiversity.

The number of rare and vanishing plants in Armenia is tangible. It is thought that approximately 30 species of vascular plants have vanished during the last hundred years, and no fewer than 200 species are deemed rare and exposed to the danger of extinction. More than 20 local varieties of wheat were cultivated in Armenia before 1950.

Currently, only two or three varieties have been preserved; the others are no longer adopted because of their low productivity, despite their important characteristics of drought resistance (*Galgalos, Spitacabat, Karmrahah, Zarda*), fungal resistance (*Deghnazarda, Tavtukhi, Grnani*) and cold tolerance (*Karmir slfahat*). Many of the varieties approaching extinction are not preserved in seed collections.

In Azerbaijan, some plants of both small and market importance are in danger of decline, such as *Capsella bursa-pastoris* L., *Echinochloa oryzoides* Fr., *Heracleum trachyloma* L., *Capparis herbaceae* L., *Sorghum vulgare*, *Milium effusum* and *Rumex* species.

During the last three to four years, the number of species and varieties of some crops (apricots, pears, grapes and leaf vegetables) taken to markets by farmers has increased, while others have decreased in number (watermelons, grain cereals and grain legumes). The local crops available for market vary from region to region. In Baku markets, only four varieties of quince can be found, while in Nakhchivan markets there are 12 varieties. Yet 12 grape varieties are sold in Baku and 15 in markets nationwide. At one time, tens of barley varieties were grown by farmers but now only three to four varieties can be found.

There are ten species of vascular plants known to be extinct in Georgia. Approximately 50 species are known to be in danger of rapid extinction. Until the 1960s, 14 species of wheat and 144 varieties were registered in the region. This was 62 percent of species of wheat registered in the world. At present, this number, especially of varieties, has decreased dramatically.

Millet (*Panicum miliaceum*) and foxtail (*Setaria italica* P. Beauv. – *ghomi* in Georgian) have been grown in Georgia for countless years. Millet was used as a supplementary feed (for animals and poultry) and for making alcoholic drinks. Foxtail grew only in west Georgia and was used for human food. The dish made from foxtail was also called *ghomi*. This dish is still very popular in west Georgia as an everyday meal but is now made with maize, which has almost completely supplanted millet and foxtail. A foxtail-sown area can currently be found in the Samegrelo region of west Georgia.

Rice has also been grown in southern Caucasian countries from ancient times. The seventeenth century Italian missionary A. Lamberti wrote about the Samegrelo region:

“In the main part of Odisbi (the same as Samegrelo), where water was bogged and there was no possibility of growing ghomi, farmers grew rice, which was harvested so much that it was exported to Turkey by Turkish boats.”

However, from 1932 it was decided to replace rice with cotton in Azerbaijan and with tea in Georgia.

Georgia used to produce excellent flax but today only a small sown area remains in the south. The eighteenth century Georgian scientist and geographer Vakhushti Bagrationi in *Kartli’s life* notes the cultivation of volatile oil-bearing plants (roses, camphor, lavender and basil).

The industry for processing the raw materials of these plants developed intensively in the seaside regions of Georgia until the end of the nineteenth century. From cultivated plantations of roses and basil, Georgians produced annually an average of 72–75 tonnes of volatile oil-bearing plants during the Soviet period. This industry no longer exists. In west Georgia there are only a few farmers cultivating roses on a small scale and making volatile oil from the flowers according to a traditional method.

One of the most economically important Georgian crops is grape (*Vitis vinifera*). It has a wild relative species, *V. sylvestris*, which grows naturally in the riparian forests of both west and east Georgia. However, the area of riparian forests is declining and the wild grapevine is under threat and requires protection. Introduction of a parasite from abroad is another reason for the reduction in the native population.

Diversity of landraces/farmer varieties has been declining for more than 50 to 70 years, since the establishment of large specialized farms. This trend continues and the share of varieties in field crops is negligible. Numerous Georgian wheat landraces remain only in collections. Nevertheless, farmers’ varieties in fruit crops should be sizeable since local varieties of apples, pears, plums and grapes can be found in their gardens.



Genetic erosion of domesticated breeds can be prevented by increasing support to local farmers and pastoralists through programmes of *in-situ* maintenance of breeds

LOSS OF ANIMAL GENETIC RESOURCES

Similar problems have also been encountered with animal biodiversity. In many parts of the Southern Caucasus, local livestock breeds are being crossed or replaced with exotic higher-yielding animals, with more input requirements, in order to increase production. In parallel, many native habitats where local livestock were raised with low input strategies are steadily disappearing, as they relinquish their domain to agriculture, protected nature reserves and industrial activities. This trend is further encouraged by formal policies, short-term profit opportunities, production subsidies, and a decreasing appreciation of the value and multiple functions of local breeds by consumers and international markets.

Livestock keepers have for centuries selected farm animal species and breeds to adapt to the production potential of their environments and to respond to their needs for meat, dairy products, eggs, fibre, fertilizers, manure and draught power. Chapter 7 gives some examples of these local breeds that are still

maintained today, thanks to the work of dedicated farmers and pastoralists, who are aware that local breeds adapt efficiently to their habitats, feeding resources, farming practices and limited availability of inputs. But many of these breeds are disappearing because of changing production systems (e.g. animal draught power and transport are replaced by machinery), processing methods (cheese and yoghurt processing factories require animals with very high productivity) and distribution chains.

Consumers today would benefit from maintaining this animal biodiversity since it offers a wide choice of products for a varied and nutritious diet, produced with reduced negative externalities. Livestock diversity also represents future capacity to use local feeding resources better; the animals have a higher resilience to local diseases, reproduce better in the climatic conditions of the Southern Caucasus, make a more efficient use of reduced farm inputs, and minimize the environmental footprint of agricultural activities.



CONSERVATION OF GENETIC RESOURCES AND FAO

The erosion of agricultural biodiversity, mainly caused by the abuse of the Earth's natural resources, is producing a rapid and deep-seated degradation of the environment and generally impoverished conditions of life in the biosphere, especially for poor rural people who depend on the support of biodiversity in their daily lives. There is a need to reverse this erosion trend because the conservation of genetic resources is essential if we are to ensure that any processes unleashed

into the environment remain as manageable, reversible and climate resilient as possible. The diversity of life on the planet contributes to human well-being, to combat poverty and malnutrition, and to global economic development. An enduring solution to maintain agricultural biodiversity will require a fresh perception of our relationship with the different ecosystems, accepting and recognizing the planet's limitations, and the vulnerability of its natural balance.



FAO is committed to promoting the conservation and sustainable use of biodiversity for food and agriculture as a means of helping people to ensure sustainable livelihoods and climate resilience based on their own resources.

FAO assistance is channelled through various avenues including, for example, programmes and activities such as participatory training for IPM programmes (e.g. through

Farmer Field Schools), and advice on soil and water conservation practices. At the policy level, FAO provides intergovernmental fora where biodiversity-related policies are discussed and relevant agreements negotiated and adopted by member countries.



THE COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

by *Álvaro Toledo Chavarri*

The Commission is a permanent forum where governments discuss matters relevant to genetic resources for food and agriculture, including those important for crop, livestock, forestry and aquaculture production.

The Commission works towards raising the awareness of the erosion of genetic resources and looks to the future for ways to solve problems and contribute to the achievement of the Millennium Development Goals through the management of biodiversity. Its 172 member

countries negotiate and oversee the implementation of global policies for the conservation and sustainable utilization of genetic resources as well as the fair and equitable sharing of benefits deriving from their use, for present and future generations.

The Commission's Multi-Year Programme of Work foresees the preparation of country-driven global assessments for various components of biodiversity for food and agriculture, and covers a whole range of cross-sectoral matters.



The Commission provides a permanent forum for governments to discuss and negotiate matters relevant to biological diversity for food and agriculture. The Commission aims at reaching international consensus on policies for the sustainable use and conservation of genetic resources for food and agriculture and the fair and equitable sharing of benefits derived from their use in support of global food security and sustainable development, for present and future generations

In 2010, FAO launched the Second Report of *The State of the World's Plant Genetic Resources for Food and Agriculture*, and in 2007 published *The State of the World's Animal Genetic Resources for Food and Agriculture*. The programme also foresees global assessments of

the state of the world's forest and aquatic genetic resources. A key long-term goal of the Commission's Multi-Year Programme of Work is the first-ever State of the World's Biodiversity for Food and Agriculture foreseen for 2017. In addition, the Commission negotiates and oversees

implementation of global policies. A major achievement has been the negotiation of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The Global Plan of Action for Animal Genetic Resources, adopted in 2007, is an internationally agreed

framework for the management of biodiversity in the livestock sector. In 2009, FAO published *Guidelines for the Development of National Strategies and Action Plans for Animal Genetic Resources* as part of a series of guideline publications addressing specific technical subjects.





HERITAGE OF GENETIC RESOURCES

The well-being of the Southern Caucasus people is also based on the wealth of wild and domesticated genetic resources that can sustain agriculture and food production despite the harsh climatic conditions. Plant genetic resources for food and agriculture are the raw material that farmers and breeders need to improve the quality and quantity as well as the resilience and adaptation of their crops.

The farmers of the Southern Caucasus have made and will continue to make an important contribution towards the conservation and development of plant genetic resources, and particularly those for which the region is a centre of origin and crop diversity and constitute the basis of food and agriculture production throughout the world.

Farmers' knowledge is essential to identify, collect, farm and disseminate agricultural species and to continue the process of adaptation between humans, the plants they grow and their environment.

While we depend on cultivated plants to satisfy the basic human need for food, crops depend on humanity for their continued existence: much of their genetic diversity can only survive through continued human use and conservation.

The entire society will benefit from recognizing and valorizing the role of farmers in the maintenance of their genetic heritage. By facilitating the continuous exchange of plant genetic resources for the continuous improvement of food crops, consumers will have access to a greater variety of foods and agricultural products, thereby helping to underwrite their food security. At the same time, the scientific community will benefit through an improved and better regulated access to plant genetic resources that are crucial for research and plant breeding. International agricultural research centres will have new research opportunities because the International Treaty on Plant Genetic Resources for Food and Agriculture (the "Treaty") places their collections on a long-term secure legal footing. As a result, both the public and the private sectors will have assured access to a wide range of genetic diversity for improved agricultural development.



THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

by Shakeel Bhatti

The FAO Conference adopted the International Treaty on Plant Genetic Resources for Food and Agriculture in November 2001, and it entered into force in 2004, after 40 governments had ratified it. As at 28 February 2010, it has 123 Contracting Parties. This legally-binding Treaty covers all plant genetic resources relevant for food and agriculture.

The Treaty's objectives are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of benefits derived from their use. It is in harmony with the Convention on Biological Diversity (CBD).

No country is self-sufficient in plant genetic resources, and international cooperation and exchange of genetic resources are therefore of pivotal importance and necessary for food security.

Through the Treaty, countries have agreed to establish a multilateral system to facilitate access to key plant genetic resources for food and agriculture, and to share the benefits derived from that access in a fair and equitable way. The Treaty therefore provides the international policy framework as well as practical mechanisms to achieve these goals, including for the adaptation of food crops in response to the challenges of climate change. The Treaty also recognizes the enormous contribution that farmers and

their communities have made and continue to make to the conservation and development of plant genetic resources.

This is the basis for farmers' rights, which include the protection of traditional knowledge, and the right to participate equitably in benefit-sharing and in national decision-making about plant genetic resources. It gives governments the responsibility for protecting and implementing these rights.



The Treaty aims at recognizing the enormous contribution of farmers to the diversity of crops that feed the world; establishing a global system to provide farmers, plant breeders and scientists with access to plant genetic materials; and ensuring that recipients share benefits they derive from the use of these genetic materials with the countries from which they originated



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FROM INDIFFERENCE TO AWARENESS: AN ENGAGEMENT TO MAINTAIN AGROBIODIVERSITY FOR FOOD SECURITY

THE SOUTHERN CAUCASUS, AT THE CROSSROADS BETWEEN EAST AND WEST, NORTH AND SOUTH, GUARDS AN IMPRESSIVE AMOUNT OF SEEDS AND GENETIC RESOURCES THAT ARE THE FOUNDATIONS OF MODERN AGRICULTURE, WHICH HAS TO RESPOND TO INCREASING ENVIRONMENTAL, CLIMATIC AND FOOD SECURITY CHALLENGES.

Many of these seeds could be cultivated in the future by farmers in different parts of the world who will have to adapt rapidly to drought, flood, cold and pest stresses by adopting more resource-efficient and environmentally friendly farming systems.

If new forms of sustainable agriculture are to be developed, centred on an increased environmental awareness and the need to develop low-energy agriculture for healthy and year-round food security, the global community will have to support maintenance of these genetic resources.

Innovative and fair policies and agreements will have to be defined and important investments in the agriculture sector will need to be committed at the national, regional and global levels.

The time has come to engage.





AT THE CROSSROADS BETWEEN EAST AND WEST

IN THREE HOSPITABLE COUNTRIES

AGRICULTURE AND BREEDING HAVE BEEN DEVELOPED SINCE THE NEOLITHIC
COPING WITH THE RHYTHMS OF THE SEASON

A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS
TO MAKE BREAD, CHEESE AND WINE

PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES
RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Երեք հյուրընկալ երկրներում

Մէջ գոնագործեր օժեքած

Տամի ստլումարտմուցարը լէզլլանա

INTRODUCTION

2

IT WOULD BE IMPOSSIBLE TO SYNTHESIZE THE MILLENNIA OF CULTURE, KNOWLEDGE AND HUMAN ACTIVITIES OF ARMENIA, AZERBAIJAN AND GEORGIA IN A FEW PAGES, AND THEREFORE ONLY SOME CHARACTERISTICS OF EACH COUNTRY ARE HIGHLIGHTED. THE THREE COUNTRIES HAVE NATURAL SCENARIOS (LARGE FORESTS, STEEP MOUNTAINS, GLACIERS, GENTLE VALLEYS AND WIDE STEPPE), EVIDENCE OF ANCIENT CIVILIZATIONS, AND THEY ARE RICH IN ANCIENT AND MODERN ARCHITECTURE, LITERATURE AND CRAFTS.

Each country has its own peculiarities, such as the language and even the alphabet, the religion and the culture: the biodiversity in the Southern Caucasus also originates from the specific ethnocultural differences of the region. This chapter is also about people who have contributed to maintaining local traditions in their countries through their daily work and diligence.

These people are examples of the millions who, in their daily lives, contribute another piece of the puzzle that is the social and cultural structure of the Southern Caucasus. Although they might have spent all their lives acting inside their local communities without great recognition, the power of the commitment of these people, their knowledge and their cultural values are inextricably linked to sustainable agriculture.



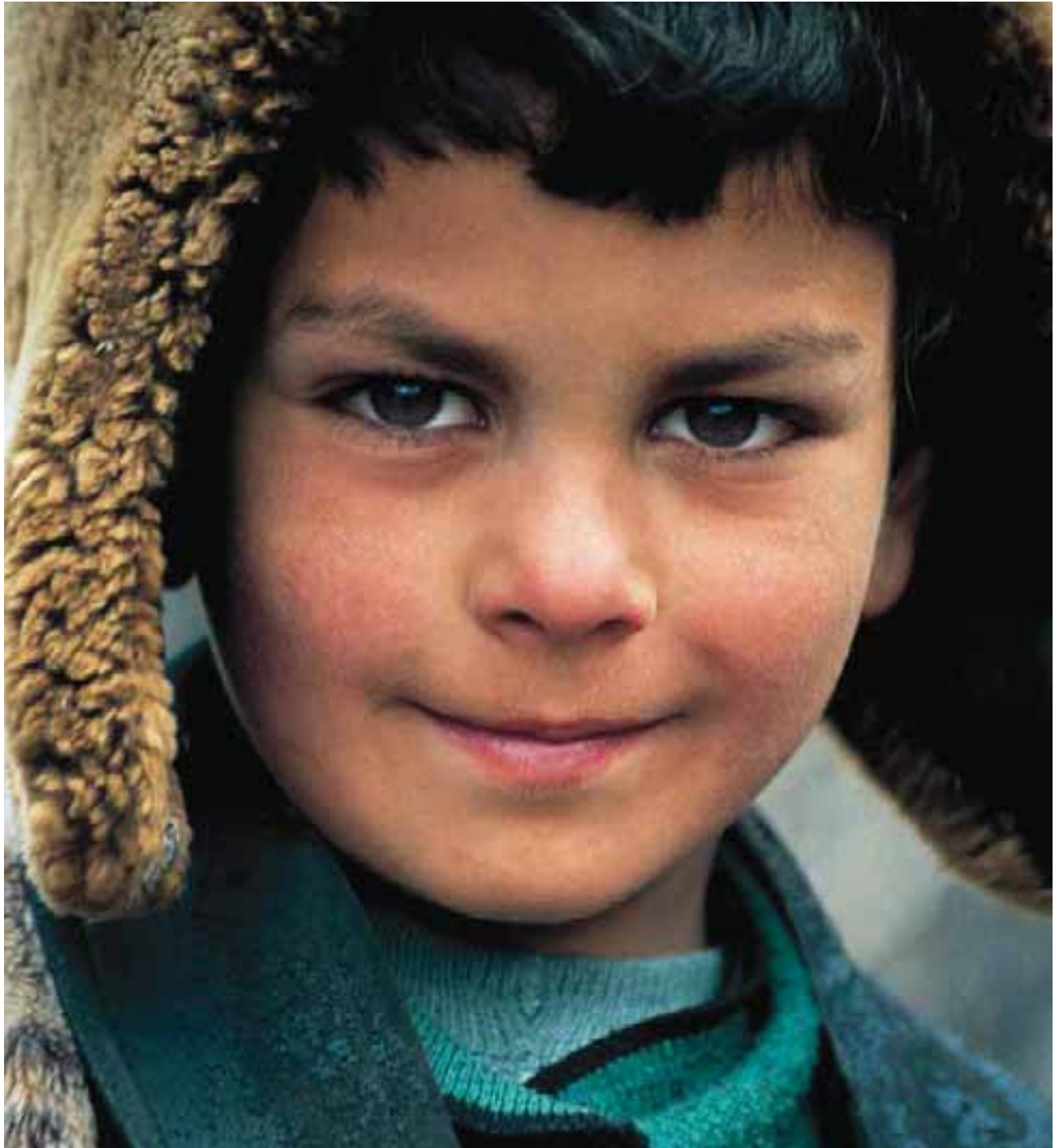


The high level of education of people in the Southern Caucasus plays a fundamental role in the maintenance of the rich heritage of genetic resources

CULTURAL HERITAGE AND HOSPITALITY

The Southern Caucasus is an area of ancient civilization, testified by the many important archaeological sites that can be found in the region, with strong links to Mesopotamia, the Near East and the Mediterranean basin. At the same time, it is crossed by one of the main historic communication routes between Europe and Asia, used by travellers and

merchants for many centuries. These two factors, together with the rich biodiversity of the environment, explain why Armenia, Azerbaijan and Georgia can offer today a powerful combination of cultural heritage, an innate sense of hospitality and a wealth of genetic resources.





Yerevan, the capital city of Armenia, is a lively city located at the edge of the Ararat Valley. It was founded in the eighth century BC. Today's Yerevan is the result of an urban development scheme devised by the architect Alexander Tumanyan in 1924

ARMENIA

GEOGRAPHY

The Republic of Armenia (Hayastan in Armenian) covers a total area of 29 800 km² and lies between 41°18' and 38°5' latitude north and between 43°29' and 46°37' longitude east. It borders Georgia in the north, Azerbaijan in the northeast, east and southwest, the Islamic Republic of Iran in the south and Turkey in the west. Armenia is landlocked and is located at about 145 km from the Black Sea, 175 km from the Caspian Sea, 750 km from the Mediterranean Sea and 960 km from the Persian Gulf. Its capital city is Yerevan. The territory of Armenia is mainly comprised of the Armenian plateau, with an average altitude of 1 500–1 800 m above sea level and by

the Lesser Caucasus range, with peaks ranging from 2 500 to 4 000 m. The plateau is dotted with ancient volcanoes, the tallest of which is the Aragats (4 095 m). The average altitude of the country is 1 800 m.

Over 70 percent of the territory is situated above 1 500 m, and only 10 percent below 1 000 m (the minimum altitude of the country, in the northeast, is 380 m, in the valley of the River Debed). Only 29 percent is flat or has slopes of three degrees or less.



Lake Sevan, located at an altitude of over 1 900 m and, in the background, the Greater Caucasus range

The landform in the centre and north of the country comprises rocky high mountain ranges separating narrow fertile valleys. Towards the south is the broad, flat and fertile Ararat Valley along the left bank of the River Araks.

The eastern region is characterized by the large water basin of Lake Sevan (1 250 km²), located at an altitude of 1 925 m. In the southeast, a few small irregular-shaped valleys are surrounded by high mountain ranges. The main rivers are the Hrazdan, which is the main emissary of Lake Sevan, the Debed that crosses the northern region of the country from west to east and flows into the Mtkvari in Georgia, and the Araz.

ARMENIA – HUMAN DEVELOPMENT INDEXES		
Index	Value	World rank
Human development index	0.798	84
Adult literacy rate (%)	99.5	12
Per capita GDP (USD PPP)	5 693	90

Source: UNDP, 2009

ARMENIA – AGRICULTURAL PROFILE	
Population	3 238 000
Rural/total population ratio	36%
Economically active population	1 192 500
Agricultural labour force	493 500
Agricultural labour force/economically active population ratio	41%

Source: National Statistical Service of the Republic of Armenia, 2009



A mountain slope in Kotayk Marz. Armenian landscapes are characterized by the ever alternating mountains and valleys

ARMENIA – AGRICULTURAL PRODUCTION		
Cereals	tonnes	409 182
Pulses	tonnes	6 171
Fruits and vegetables	tonnes	1 511 229
Roots and tubers	tonnes	648 562
Meat	tonnes	70 900
Milk	tonnes	661 900
Eggs	tonnes	32 220
Cattle and buffaloes	head	629 643
Sheep and goats	head	637 101
Wood fuel	m ³	40 000
Fish	tonnes	4 566
Agricultural imports	million USD	543
Agricultural exports	million USD	167
Fishery imports	million USD	4.3
Fishery exports	million USD	4.7
Forestry imports	million USD	59
Forestry exports	million USD	0.5

Source: FAO, 2010. Data refer to 2007–08

LANDSCAPE AND AGRICULTURE

Landscape types in Armenia are mainly determined by altitude and the characteristics of the reliefs. At altitudes between 600 and 1 000 m, limited precipitation and relatively high temperatures create semi-desert conditions.

The natural vegetation is mainly represented by xerophytes (*Hordeum crinitum*, *Kochia*, *Euphorbia marschalliana* Boiss., etc.), and ephemerals and ephemeroïds (*Bromus tectorum*, *Poa bulbosa*, etc.). In summer, high temperature and low humidity result in significant evaporation of soil moisture which, in turn, leads to salt accumulation; in areas of intense salinization the vegetation is dominated by *Salsola* spp. Natural zones are mainly used for pasture for cattle and small ruminants.

ARMENIA – USE OF LAND				SURFACE							
				1 000 ha	%	1 000 ha	%	1 000 ha	%	1 000 ha	%
Total country area	Land area	Agricultural area	Arable land and permanent crops	460	28	1 615	57	2 820	95	2 974	100
			Permanent meadows and pastures	1 155	72						
		Forest area			274	10					
		Other land			931	33					
	Inland waters					154	5				

Source: FAO, 2010. Data refer to 2007

Where irrigation has been introduced, e.g. in the Ararat Valley, these natural environmental conditions (heat, light and ground salt) have favoured the development of horticulture (onions, cucumbers, radishes, garlic, cabbages, spinach, tomatoes, peppers, eggplants, cauliflowers, turnips, cress, parsley, dill, coriander, basil, mint, okra, marrows, pumpkins and horseradish) and fruit growing (such as grapes, apricots and peaches), with very high yields.

At altitudes between 1 000 and 2 200 m, the continental dry climate creates steppe and steppe-meadow conditions. The main crops in this zone are cereals (wheat, barley and oats). Crops are both irrigated (mainly at lower altitudes) and rainfed. Steep land is used for pastures and fodder production. At altitudes between 2 300 and 2 800 m, subalpine meadows are widespread. As a result of severe climatic conditions, farming of field crops is not possible. Meadows are mown for fodder production; areas on very steep and stony slopes are used as pastures. Above 2 800 m, only alpine meadows are found. Environmental conditions are extreme, with night frosts that can occur even in summer months. Farming in this zone is impossible, and mowing of natural vegetation is not practicable because grasses are very low. Alpine meadows serve as a natural fodder base for livestock breeding in the summer months. Forests cover only 10 percent of the land, and are concentrated mainly in two regions, in the northeast and in the south. The composition of forests is diverse and rich. The most common species are *Quercus*, *Fagus*, *Carpinus*, *Tilia*, *Acer* and *Ulmus*.

They typically cover mountains and steep valleys. The tree limit is normally at 2 300 m, although in some regions trees can be found even at an altitude of 2 600 m. In the past, incorrect forest felling and overexploitation have radically reduced the forest area, especially on plains and mild slopes. Cleared forest land is either abandoned or used as grasslands and pastures. In southern Armenia, where the climate is arid and the relief is highly rugged, cleared forest areas have turned into steppe and mountain grasslands, but not into meadows. Historically, different branches of agriculture were established and subsequently improved and concentrated in different areas of Armenia, corresponding to economic, land and climate conditions.

In the post-Soviet era, various structural changes took place in agriculture. Former large state collective farms were transformed into smallholdings, which suffered from problems such as those connected with investment in intensive technologies and mechanical cultivation. Nevertheless, these difficulties should gradually be overcome through state support and technical assistance.

Armenian flora comprises about 3 600 species of vascular plants, making up about 50 percent of Caucasian flora. The Poaceae L. family, one of the most important for human use, is present with 336 species and 106 genera. Cereal groups include 13 species and about 360 varieties of wheat, nine species of *Aegilops*, eight of wild barley, seven of oats, lentils, wild chickpeas and peas.



In Armenia, many species of wild plants are used for a variety of purposes, such as medicines, condiments, herbal teas and food

WISE USE OF PLANT BIODIVERSITY

Armenians traditionally use plant biodiversity (approximately 2 000 species of wild plants) for a variety of purposes such as medicine, food and dyeing. This tradition still persists although it is reduced to a limited assortment of plants that are used in a fairly intensive way. Recently, the population intensively harvested and sold 28 species of wild edible plants; various industries process 52 species of medicinal plants. These data are confirmed by a survey in a major market in Yerevan, where 15 species of wild edible plants totalling 18.5 tonnes and 14 species of wild fruits and berries totalling 9.5 tonnes were commercialized in 1995. Unfortunately, neither past research programmes nor current research activities have information on sustainable harvesting rates.

The risk is that excessive or destructive harvesting of these species may threaten their long-term survival. To overcome this problem, harvesting regulations could be developed specifically for each species. At the same time, the cultivation of some of the overharvested species could be encouraged on a small scale, in house gardens and smallholdings. Research studies are already available on the development of planting methods for some edible and medicinal plants, such as sickleweed (*Falcaria vulgaris*), horse fennel (*Hippomarathrum microcarpum*), foxtail lily (*Eremurus spectabilis*) and valerian (*Valeriana officinalis*). These studies indicate that there is potential to protect the diversity of useful plants by encouraging local production methods.





The *khachkar* (holy cross carved in stone) is a very common decoration on Armenian churches

LANGUAGE AND CULTURE

Armenian architecture, urban construction and constructive art, mediaeval miniature painting, carpets, poetry, music and painting have an important place in world culture. Of the eight million native Armenians around the world, only three million live in Armenia (the others live in some 60 different countries, notably in the Russian Federation, the United States of America, France, Georgia and the Islamic Republic of Iran).

Armenian belongs to the family of Indo-European languages. It is one of the separate branches of the family and has similarities with the Iranian, Baltic, Slavonic and Greek languages.

It became the language of the Armenian ethnos as a result of its close relationship with some of the Indo-European, Caucasian and Uartian languages. After the fall of the Uartian state (sixth century BC), it spread throughout Armenia. During the Hellenic epoch, it served both as the

vernacular, and as a language for religious ceremonies, oral folk art, theatrical performances and the court. The written form of the language originated in the fifth century AD after the creation of the Armenian alphabet by Mesrop Mashtots. This alphabet, which perfectly suits Armenian language phonology, consists of 36 characters.

The fifth century AD was the golden age of Armenian literature. The written language of the period is called Classical Armenian or *grabar* ("written language"). Besides translations from Greek and Syriac religious scripts, Armenian ancient literature also includes translations of philosophical works and an original literary production, related above all to the history of the country.

In the twelfth century, some changes took place in the Armenian language and the period is therefore regarded as the beginning of Middle Armenian.



An impressive monument in Aragatsotn region, celebrating the Armenian alphabet created by Mesrop Mashtots in the fifth century AD

By the seventeenth century the language evolved into modern Armenian, divided into two primary dialects: western and eastern Armenian. The language currently spoken in Armenia is based on the eastern dialect, even if over 40 Armenian dialects exist.

In pre-Christian times, Armenians built many temples dedicated to the gods, which were very much like Hellenistic temples or pantheons. Most of these pagan temples were destroyed when Christianity became the state religion. The only pagan temple to withstand historical change is the Garni

temple (first century BC). Since then, Armenian architecture is essentially that of its churches, simply because few other types of buildings have survived.

Thousands of Armenian churches, both small and large, were built in the period from the fourth to the seventeenth century. Some churches were intended to stand alone, while others belonged to monasteries. Various styles were developed, for both interiors and exteriors. Armenian folk songs are quite diverse. Ancient and mediaeval songs have been retained in written form by historians and in song books. The sung parts of the national



The Hellenistic temple of Garni, built in the first century BC, is the only pagan temple that survives today in Armenia

epic poem *Sasounci Davit* were first performed orally and then recorded at the end of the nineteenth century. Of country and labour songs, the most remarkable are the *horovels* (ploughing songs) and the threshing songs of Lori and other regions.

Some of the most famous wedding, ritual, social and everyday songs are *Tsirani tsar* (Apricot tree), *Sirts nman e* (My heart looks like ...), *Krunk* (Crane), *Garun a* (Spring) and *Alagyaz sarn ampel a* (Mount Alagyaz is shrouded in clouds). Each Armenian *marz* (province) has its own characteristic folk songs reflecting everyday country life.

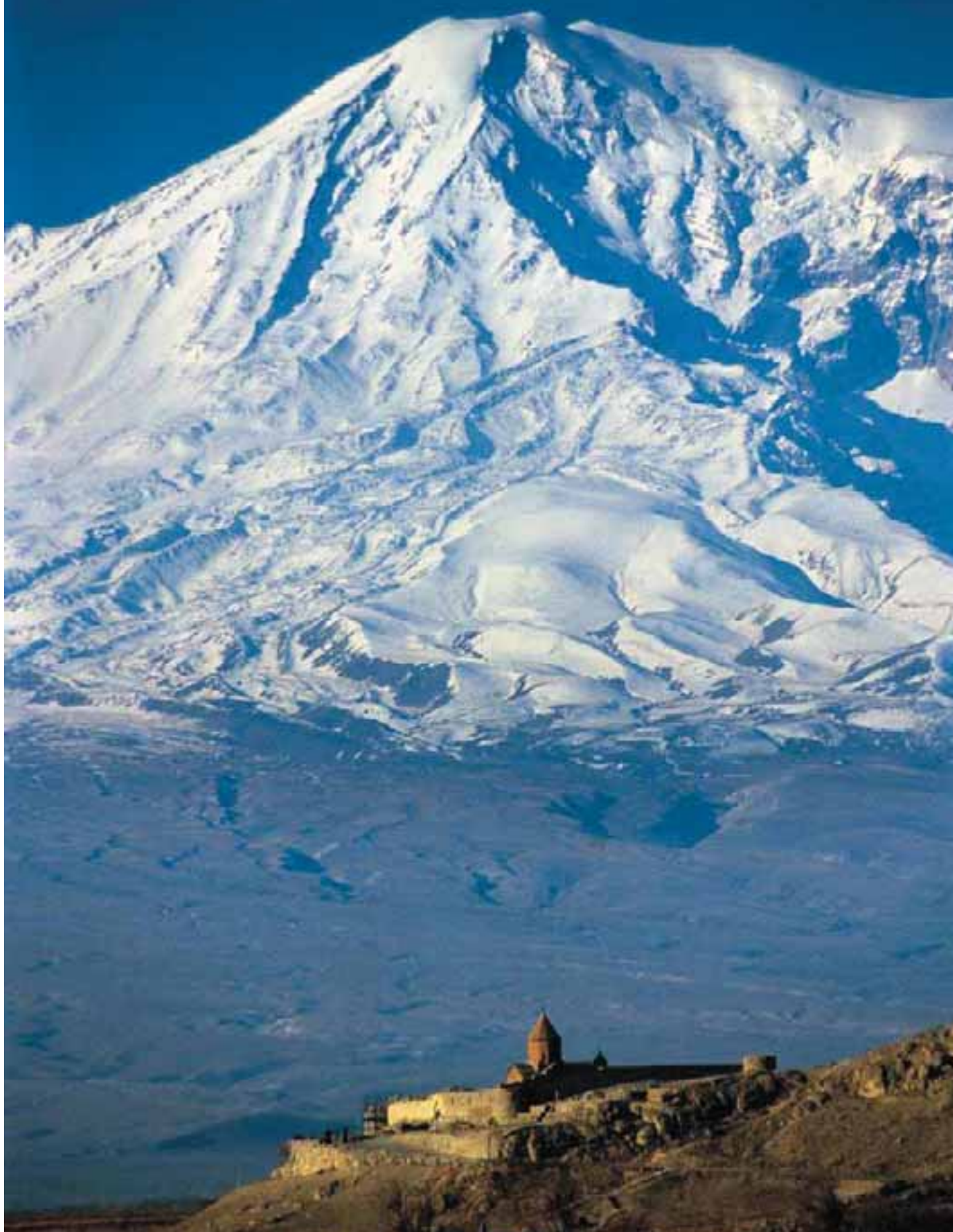
National tunes were recorded by special note marks (*khaz*) and widely used in religious music (*sharakan*). Many scenes of national folk dances and musical instruments are depicted in early miniatures.

At the end of the nineteenth and beginning of the twentieth centuries, Armenian national songs were recorded by the composers N. Tigranyan, K. Kara-Murza, M. Yekmalyan and Komitas. There are also many Armenian musical instruments (such as the *kjamancha*, *tsiranaphogh* – pipe, the *duduk* made from apricot wood, and bagpipes) that are still widely in use today.



Thousands of churches were built in Armenia between the fourth and the seventeenth centuries AD. The Monastery of Geghard, Kotayk Marz. *Below:* music in Armenia has always played an important role, both in religious and in secular ceremonies. >>*Right:* the church of Khor Virap with the impressive silhouette of Mount Ararat in the background







**PROFESSOR
PAPIN GHANDILYAN
AND HIS WIFE**

Papin Ghandilyan, a member of the Academy of Armenian Agricultural Sciences, was born in 1929 to a rural family in the village of Hacavan (now the town Gavar) in the Gegharkunik region. He studied at one of the village schools, which is now named after him.

In 1947, Papin Ghandilyan left for Yerevan and entered the Faculty of Agronomy at the Armenian Agricultural Institute where he graduated with honours in 1952. It was the beginning of the young scientist's commitment to his mission. The object of his first research was the cultivated species of wheat; after that, until the end of his creative life, he devoted himself to researching the genetic resources of wild Gramineae (*Triticum* L., *Aegilops* L., *Hordeum* L., *Secale* L.), in which Armenia is extremely rich.

Professor Ghandilyan's floristic investigations are outstanding.



In Armenia, he discovered the ancestor of cultivated barley: *H. spontaneum* C. Koch., *Amblyopyrum muticum* (Boiss.) and eight subspecies of wild wheat. As a result of his detailed research in Armenia, Professor Ghandilyan discovered some interesting species of *Aegilops* and barley: *A. crassa* Boiss., *A. umbellulata* Zhuk., *H. marinum* Huds. and *H. bulbosum f. segetale*. Professor Ghandilyan described the new tetraploid species of barley, *H. hrasdanicum* Gandil. and also *Agropyron semiaristatum* Gandil. His studies on interspecies are of

great significance. Eight groups (convarietas) of cereals and more than 70 new varieties have been described by him.

The professor's efforts have helped to create a solid gene fund of cereal plants that are used as the foundation for the selection of new highly productive varieties. His work has been continued by his students in the Laboratory of Research on Wild Varieties of Plants founded and led by him for 20 years.

Professor Ghandilyan was a heartfelt fighter in conserving

wild crop relatives in Armenia and worldwide. Through his personal efforts, the Erebuni Nature Reserve was set up in 1981, which is the only world reserve to conserve wild wheat (three out of the four wild wheat species in the world grow here).

After his death, his wife (Estella Nazarova) continued his work and contributed to maintaining his seed collections and his scientific reports. She silently dedicated her life to increase and diffuse his world fame and findings with commitment, scientific competence and love.

THE TEACHER FRUNZIK

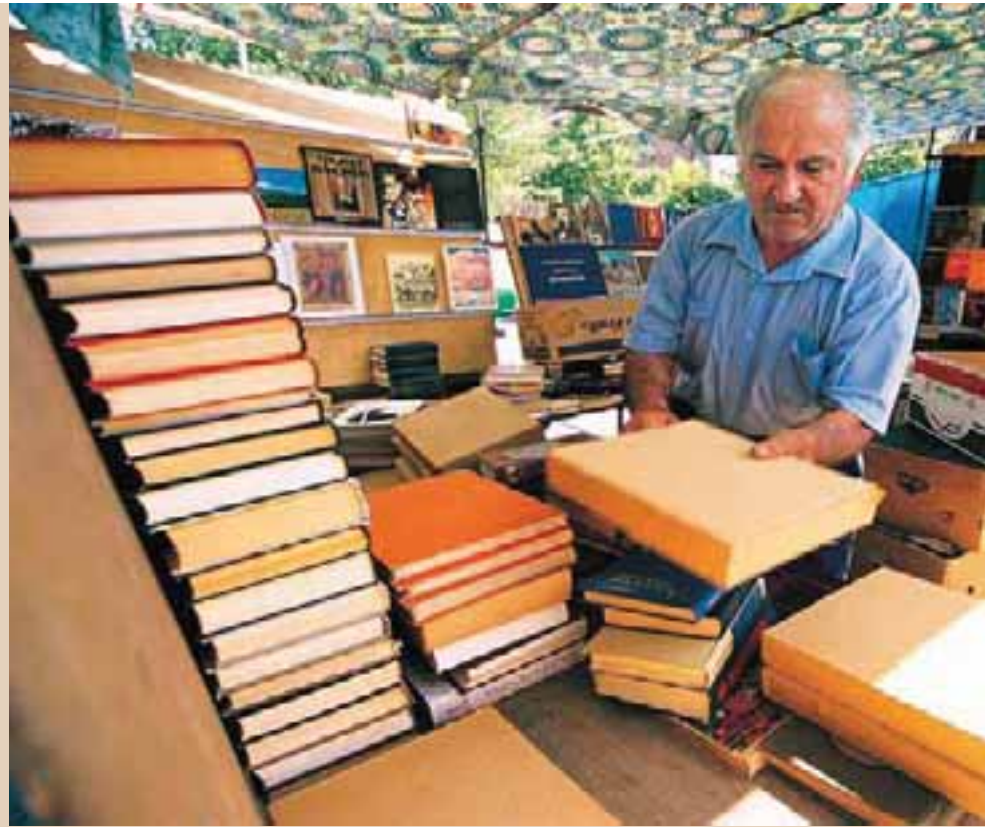
by Syuzanna Hovsepyan

Since his youth Frunzik has loved books. He says that reading gives him heart, soul and ideas.

After school graduation, he began to work and two years later he went to the Pedagogical University to study English. When he was in the third course, he began to work in the Artashat and Gugark regions, then in Yerevan.

One of Frunzik's characteristics is that, apart from books, he is extremely fond of children, a trait inherited from his grandfather. He worked as a pedagogue with enormous pleasure and spared no efforts to transmit his love of books and literature to children. Each day, after finishing work, Frunzik would buy a book and felt himself one of the richest of men. Day by day, his bookshelf expanded until at length he had to stack books on the floor.

With the fall of the former Soviet Union, life became more difficult in Armenia and this affected Frunzik's family as well. His salary was so low that it did not even pay the work; however, Frunzik could not leave school: "Who's going to teach the children?" he asked.



Frunzik's daughter went to university and his son went to serve in the army. At that time, his family needed his work more than ever. "I couldn't do anything else except teaching and I haven't anything else but books. So one day my wife said to me: What are we going to do with these books, sell them."

This idea did not appeal to him at all, but there was no other solution. He began to part one by one from his friends – his books – by giving them to second-hand booksellers. They took the books and sold them but did not give him any money.

So Frunzik had to sell his books on his own after classes but, once he spread the books out and remembered the history of each purchase, he just had to take them back again.

Life became more and more difficult and after 27 years of teaching, and without receiving an adequate salary during the last years, he reluctantly left the school and for ten years has been selling books at "Vernisaj", the most important market in Yerevan, where people gather who love books. He says: "I am happy to show my books to people who love them".

Frunzik has worked hard to make each visitor, especially foreign visitors, understand the power of Armenian culture that, even without government or church, unites the nation.

Frunzik says: "We haven't been translated over time, which is why other nations could not know and appreciate our culture and art. We love our culture and that of other nations. If a man likes his family, he can like other people's families".

He also says to us: "Please stay with us, please come to your home country".





Photo by A. Mamadov

Baku, the capital city of Azerbaijan, is the largest city in the Southern Caucasus and is at the heart of Azerbaijan's rapidly growing economy. Baku, though maintaining its local traditions, is rapidly changing. The new glass and steel skyscrapers emerging in the midst of ancient buildings bear witness to the prosperity and energy of this country

AZERBAIJAN

GEOGRAPHY

The Republic of Azerbaijan covers a total area of 86 600 km² and lies between 41°54' and 38°24' latitude north and between 44°46' and 50°51' longitude east. It borders five countries (the Dagestan Republic of the Russian Federation in the north; Georgia, Armenia and Turkey in the west; and the Islamic Republic of Iran in the south) and has approximately 800 km of coastline along the Caspian Sea in the east. Its capital city is Baku (Baki), located on the southern side of the Apsheron peninsula on the Caspian Sea.

Azerbaijan is bordered by imposing mountain ranges: the Greater Caucasus range in the north, the Lesser Caucasus range in the west and the Talish Mountains in the south. The central part of the country is mainly composed of the broad basin of the River Kür and of its tributary Araz, flowing into the Caspian Sea. The average height is 650 m, although 18 percent of the country is below sea level; the highest peak is Mount Bazarduzu (4 466 m), in the Greater Caucasus range.



The Caspian Sea near the shores of Baku. Below: Lake Goygöl (the “blue lake” in Azeri), a site rich in plant and animal biodiversity
>>Right: the town of Sheki is famous for its Juma mosque, which was built in the tenth century



Courtesy of Z. Agparov

The Caspian shore is mainly flat and uniform, with the only exceptions being the Apsheron peninsula and the bay of Baku, as well as the deeply set bay of Gizilaghaj, to the south of the mouth of the River Kür.

The country is rich in surface water: there are thousands of rivers and over 300 natural lakes (such as Goygöl, Maralgöl, Sarisu and Aghgöl), besides a few artificial ones (the one at Mingacevir on the River Kür is the largest, with a surface area of 605 km²). The water, however, is not evenly distributed, since there are areas with water shortages, such as Garabagh and Shirvan.

AZERBAIJAN – HUMAN DEVELOPMENT INDEXES		
Index	Value	World rank
Human development index	0.787	86
Adult literacy rate (%)	99.5	12
Per capita GDP (USD PPP)	7 851	76

Source: UNDP, 2009

AZERBAIJAN – AGRICULTURAL PROFILE	
Population	8 629 900
Rural/total population ratio	48%
Economically active population	4 318 200
Agricultural labour force	1 557 400
Agricultural labour force/labour force ratio	36%

Source: The State Statistical Committee of the Republic of Azerbaijan, 2009

AZERBAIJAN – AGRICULTURAL PRODUCTION		
Cereals	tonnes	2 419 908
Pulses	tonnes	27 336
Fruits and vegetables	tonnes	2 412 173
Roots and tubers	tonnes	1 077 110
Meat	tonnes	175 724
Milk	tonnes	1 381 623
Eggs	tonnes	60 956
Cattle and buffaloes	head	2 511 775
Sheep and goats	head	8 109 713
Wood fuel	m ³	3 200
Fish	tonnes	3 056
Agricultural imports	million USD	915
Agricultural exports	million USD	536
Fishery imports	million USD	5.8
Fishery exports	million USD	5.9
Forestry imports	million USD	103
Forestry exports	million USD	1

Source: FAO, 2010. Data refer to 2007–08

Lake Goygöl (literally, the “blue lake”, in Azeri) is particularly fascinating. It covers an area of 0.79 km², is 96 m deep and is situated at a height of 1 556 m, in a state reserve founded in 1925. Over 400 kinds of plants grow here, and many kinds of mammals, birds and fish are to be found. Two water layers coexist: the upper layer, oxygen and lower layer, hydrogen sulphide. Insufficient





oxygen is typical for a lake with such depth. There is no oxygen below 30 m. Saturation by hydrogen sulphide increases with depth. For many centuries, the levels of oxygen and hydrogen sulphide in the lake have been relatively stable. These processes on a larger scale are characteristic of the Black Sea. In this respect, Lake Goygöl is its natural model. These water basins have been explored, but they still have many secrets. Consequently, studying and preserving such territories as monuments of natural architecture represent important tasks.

LANDSCAPE AND AGRICULTURE

Landscapes in Azerbaijan are diversified, ranging from high mountains to hills, plains and lowlands, with different climatic patterns from desert to subtropical. In the Greater and Lesser Caucasus ranges and in the Talish Mountains, at altitudes varying from 1 600 to 3 500 m, mainly alpine and subalpine meadows are found. Vegetation is dominated by perennial grasses (such as *Festuca* spp., *Bromus* spp. and *Poa* spp.), forming

AZERBAIJAN – USE OF LAND				SURFACE							
				1 000 ha	%	1 000 ha	%	1 000 ha	%	1 000 ha	%
Total country area	Land area	Agricultural area	Arable land and permanent crops	2 079	44	4 757	58	8 263	95	8 660	100
			Permanent meadows and pastures	2 678	56						
		Forest area				936	11				
		Other land				2 570	31				
	Inland waters						397	5			

Source: FAO, 2010. Data refer to 2007



The highlands at the foot of Mount Shahdagh in Azerbaijan have a subtropical climate with adequate rainfall that favours agriculture

rather thick turf. These areas are an important resource for summer pastures. Each year, more than three million sheep, goats and young cattle are taken to summer pastures where they graze from May through September.

The lower mountains and foothills in northern and central Azerbaijan have a subtropical climate with adequate rainfall (500–800 mm), which supports many types of natural vegetation. Agriculture is widespread, partly irrigated and partly rainfed, and produces cereals, legumes, fruits, fodder and other crops such as cotton. The production of cotton, which was significant until the 1980s, is now much reduced. Improper irrigation management has caused degradation of soils: almost half a million ha of land have been affected by salinization.

The plains and lowlands are located in the central and western parts and cover 40 percent of the surface of the country. The climate is mostly dry and subtropical. Natural vegetation includes *fringo* (*Artemisia fragrans*) and *fringo*-thistle formations (*Artemisia fragrans*-*Salsola nodulosa*); this vegetation is an

important and inexpensive fodder resource for nomadic cattle and sheep in the cold season. Agriculture is widely practised, but depends mostly on irrigation. Products include cereals, potatoes, tobacco, vegetables and fruits.

The area around Lankaran in southern Azerbaijan, at the foot of the Talish Mountains, has a wet subtropical climate, which enables cultivation of many crops, including tea and lemons.

Azerbaijan has the most pastureland within the Southern Caucasus region, totalling 3.8 million ha (1.5 million ha of winter pastures, 0.6 million ha of summer pastures and 1.7 million ha around villages). Despite such large areas of natural pastures, in 2002 only 43 percent of winter pastures and 29 percent of summer pastures were used by sheep, with high grazing densities. Intensive use of fragile grasslands has led to erosion, changes in the structure of pastoral communities and an increase in invasive species, with a consequent decrease in pasture productivity. Today, 70 percent of pastures are threatened by erosion, and 16–20 percent have suffered from salinization.



The creation and proper management of natural reserves are fundamental for the preservation of endangered species, such as the Persian gazelle (*Gazella subgutturosa*) protected in the Şirvan Milli Park

IN SITU AND EX SITU COLLECTIONS OF GENETIC RESOURCES

Azerbaijan's environment is represented by 4 300 species of flora, more than 600 species of vertebrates and more than 14 000 insects, and it has a considerable level of endemism.

Of the total number of flora and fauna species, more than 37 species of flora and 180 species of fauna, including 14 species of mammals, 36 species of birds, 13 species of amphibians and reptiles, five species of fish and 40 species of insects, are endangered.

There are ten species of barley, five species of rye and 400 species of leguminous crops. Over 13 900 plant accessions are available in 34 *ex situ* collections in 12 institutes in Azerbaijan.

Mainly as a result of the establishment of state reserves, the Persian gazelle (*Gazella subgutturosa*), leopard, moufflon, *Francolinus francolinus*, *Tetraogallus* and falcons have been preserved, as well as the yew, box tree, iron tree, Lankaran persimmon and many other species of plants. In order to prevent endangered species from disappearance, both *in situ* and *ex situ* methods must be applied. Large natural reserves and protected areas must be managed to maintain species in their natural habitats.

Seed collection and the creation of seed banks must be encouraged. However, all these activities are expensive and require commitment both nationally and internationally.



Photo by E. Cattaneo



Photo by E. Cattaneo

Azerbaijan is rich in culture, history and traditions, as testified by its many monuments, beautiful fountains and gardens

LANGUAGE AND CULTURE

The official language of Azerbaijan is Azerbaijani or Azeri, which belongs to the Altaic family. Azerbaijani is spoken not only in Azerbaijan but also in the northwest Islamic Republic of Iran, northern Iraq, eastern Turkey, eastern Georgia and in the Russian Federation. In Iran, the Azeri people are some 28–30 million. Spoken Azerbaijani has several dialects.

In the ancient Azeri states of Manna and Atropatena, mainly cuneiform, Greek and Parfiya calligraphy systems were adopted. In the Albanian period, there was a local Albanian alphabet. When the country became an Arab state, Azerbaijani was written in Arabic letters but, in 1926, there was a gradual introduction of the Roman alphabet. In 1940, the alphabet changed again through the influence of Russian, and Azerbaijani began to be written in Cyrillic letters.

Finally, in 1991, when Azerbaijan became an independent republic, the Roman alphabet was officially chosen, but some new letters were added to represent particular Azerbaijani language sounds.

Azerbaijan is a country with an ancient history, culture and traditions. The Azikh cave, one of the earliest human dwellings, is to be found here. Azeri literature also had early beginnings. One of the greatest works of the literature, *The book of Dede Korkut*, which recounts epic tales of the Oghuz Turks, was written around the seventh to ninth century. It is a brilliant testimony to the language, way of life and traditions of Azerbaijan. Creating great classics in the Middle Ages were poets and philosophers such as Nizami Ganjavi, Nasimi, Fuzuli, Bahmanyar, Nasraddin Tusi and Shah Ismail Khatai.



In the sixteenth century, Azeri literature flourished. Epic tales such as *Ashig Garib*, *Asli* and *Karam*, *Shah Ismail* and *Koroglu* were famous throughout Azerbaijan and eastern countries. In the nineteenth century, both comic and tragic plays held an important place in Azeri literature. Comedies in particular were written by Mirza Fatali Akhundzade, who drew on those of Molière. In the eighteenth to nineteenth centuries, the able poets and writers Vagif, Seyid Azim Shirvani and Bakikhanov were well known in the east. The golden era of natural literature was in the early twentieth century, a national renaissance period.

Azeri architecture went through many different stages over the centuries but the lasting legacies belong to mediaeval times, especially the Maiden Tower in the Old Town and the Shirvanshah palace in Baku. Well-known architectural monuments and gems include ancient Albanian buildings, the Momina Khatun tomb in Nakhchivan, the Palace of Khan in Sheki and other early remains, mainly in mountainous areas.

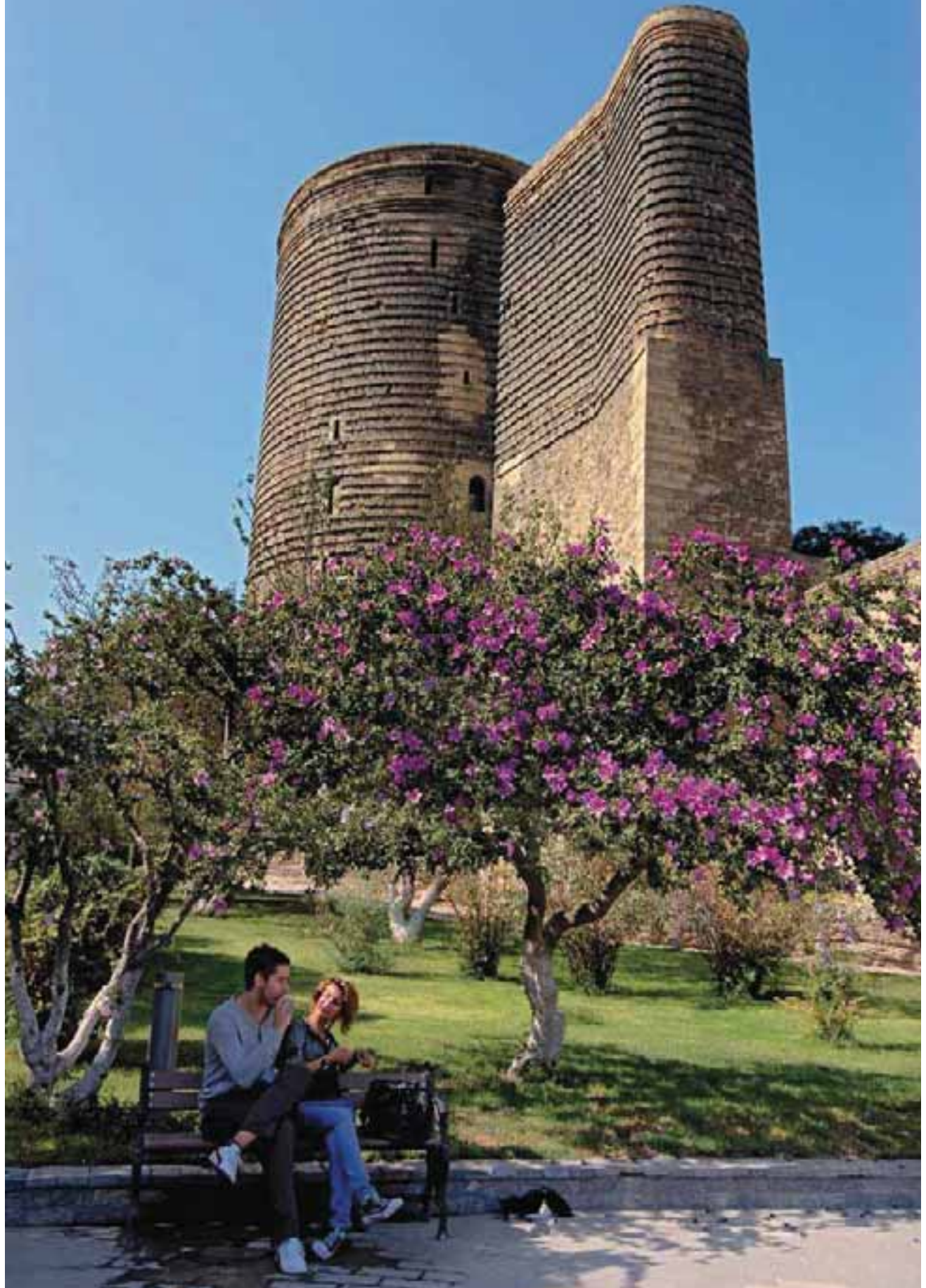
The capitals that ornately decorate the subway stations are the most recent architectural marvels.

Azerbaijan is famous for its carpets, but also for its embroidered textiles. Artisans use colourful threads (sometimes of gold or silver) and beads to create geometric patterns on a thin woollen fabric called *tirme*. The country's many brightly plumed birds, its animals and plants have also featured in designs. Popular Azerbaijani textiles include rugs, veils, shawls and towels. Today, the music of Uzeyir Hajibayov, Gara Garayev and Fikrat Amirov, and paintings by Sattar Bahlulzade, Tahir Salahov and Togrul Narimanbekov are known throughout the world. The country's musical traditions are preserved by *ashugs*, or minstrels, who often strum the *saz* (a traditional stringed instrument) while singing of the deeds of former heroes. The most popular form of music in Azerbaijan is *mugham*, which is a vocal improvisation, together with wind and stringed instruments (*tar*, *kamancha*), and is often compared to jazz.



The old town in Baku is extremely well preserved and is a UNESCO World Heritage Site. Azerbaijan is famous for its carpets, embroidered textiles and crafts. <<Left: traditional copper making at Lahic village







Both in folklore and literature, natural elements are often used to evoke beauty and passion. Rose petals are likened to girls' lips <<Left: the Maiden Tower is one of the most remarkable monuments in Azerbaijan. Its origin and function are surrounded by legends and mystery

BIODIVERSITY IN FOLKLORE AND LITERATURE

There are many sayings, proverbs, *bayaties* (Azeri folk poems), *oxshamas* (poems showing devotion to people or animals), games, stories and legends concerning plants and animals in particular.

Many folk poems date back some thousand years, and were exclusively dedicated to animal breeding (*sayachi sozler*) and agriculture (*halavar*).

An Azerbaijan folk story, *Debate on plants*, deals entirely with plant characteristics and their usage, including the use of plants in folk medicine. The noted Azeri poet Fizuli (1494-1556) deals with an analogous topic in one of his famous poems entitled *Conversation of fruits*.

Both in folk creative work and sayings, and in the literary

works of poets and writers, beautiful girls' cheeks are likened to apples, lips to rose petals, mouths to almonds, noses to hazelnuts, tongues to fruit drops and a slice of melon, breasts to pomegranates, quince and flower gardens or melon plantations, figures to a cypress tree, while glances and attitude or even the girl herself are likened to a gazelle or deer. Both in the past and in the present,

a number of plants and animal species have been honoured or even considered sacred (for instance, the nettle tree and rue).

There is a belief that even cutting the stems or branches of some plants brings misfortune. According to folk tradition, the wolf and eagle are symbols of heroism and courage, but the horse and dog are those of friendship and fidelity.

**PROFESSOR
JALAL ALIYEV**

Jalal Alirza Aliyev was born on 30 June 1928 in Nakhchivan. He received his Ph.D. in 1955. From 1951 until now, Professor Aliyev has been leading research projects at the Department of Plant Physiology, Azerbaijan Research Institute of Agriculture.

Since 1971, he is also Head of the Department of Molecular-Genetic Bases of Production Processes in the Institute of Botany of the Azerbaijan National Academy of Sciences (ANAS), founded by him.

Professor Aliyev's more than 50 years of dynamic research have been devoted to the study of the theory of photosynthetic activity as fundamental for the productivity of crop plants, particularly wheat.

The overall activity of this research covers physiological, biophysical, biochemical and molecular-genetic bases of plant productivity, and the study of production processes at all levels of the structural-functional organization of plant organisms, from molecular to the whole plant and sowing.

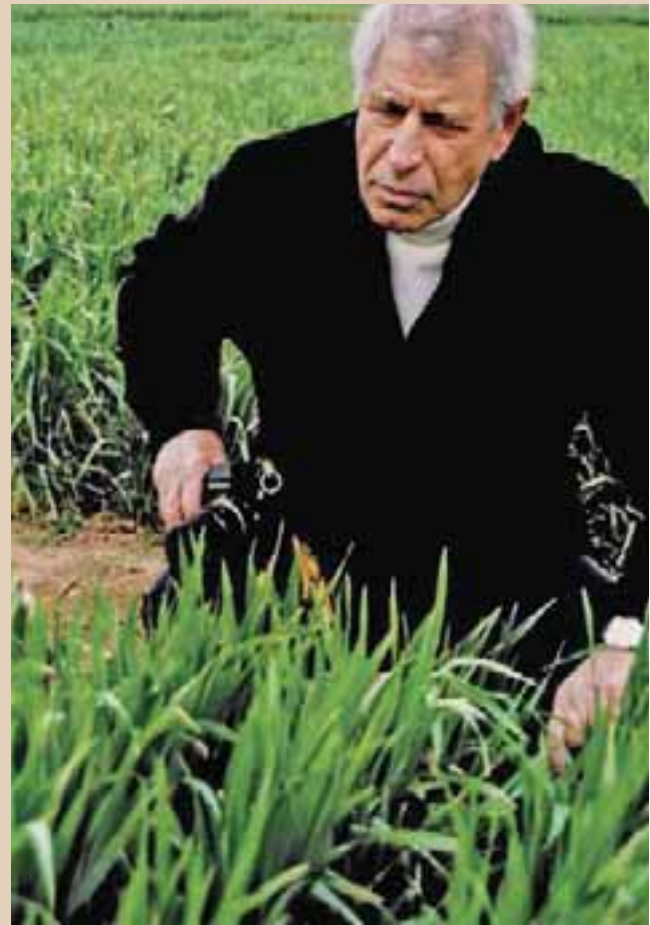
In connection with the development of investigations in the field of physico-chemical

biology, particularly biophysics and biochemistry, Professor Aliyev was the initiator and founder of new directions of research in molecular and cellular biology, molecular genetics and biotechnology, mathematical biology and bioinformatics.

For his outstanding contribution to science in Azerbaijan, Professor Aliyev was honoured with the Order of Independence in 1998 and with the Order of Glory of the Republic of Georgia in 2003.

One of the fundamental directions of the professor's wide scientific activities is to study and organize the preservation and effective utilization of biodiversity in Azerbaijan. He has gathered together an extensive wheat collection, which includes more than 1 000 accessions with high donor characteristics. Many new highly productive varieties have been created through this collection.

Professor Aliyev is the founder of more than 20 varieties of wheat. These varieties constitute more than 50 percent of the areas of wheat sown in the country.



Courtesy of Z. Akparov
Courtesy of Jalal Aliyev

The professor has donated his valuable collection to the national gene bank. All the main research activities on biodiversity and agriculture at the Genetic Resources Institute, as well as at other similar institutes in the country, are carried

out under his leadership. He is Head of the National Programme on Plant Genetic Resources, in the framework of which all important crops for Azerbaijan (cereals, legumes, forages, vegetables, fruits, etc.) are studied and maintained.

Photo: <http://jazzdunyasi.az.az>

THE MUSICIAN VAGIF MUSTAFAZADEH

by Marzio Marzot

Classical Azerbaijani music is a precious element of Azeri culture. The most popular Azerbaijani traditional music, called *mugham*, belongs to the wider musical tradition of

the Near East. The Azerbaijani *mugham* follows the *maqam* structure but has developed its own particular features transmitted orally from teachers to their students. *Mugham* has derived its melodies, rhythms and performance techniques from the singing bards of the Caucasian mountains. The bard or *ashik* (from the Arab word *ashiq* "lover") travelled singing historical songs and epic legends called *dastan*, love lyrics, to celebrate the farmers' way of life. The musician accompanied himself with the *saz*, a type of lute. *Mugham* is usually performed by a singer who is accompanied by musicians playing traditional instruments.

The more common instruments used to play *mugham* are the *tar* (a long-necked lute), *kemanche* (a stringed instrument played with a bow) and *daff* or *gaval*, a frame drum.

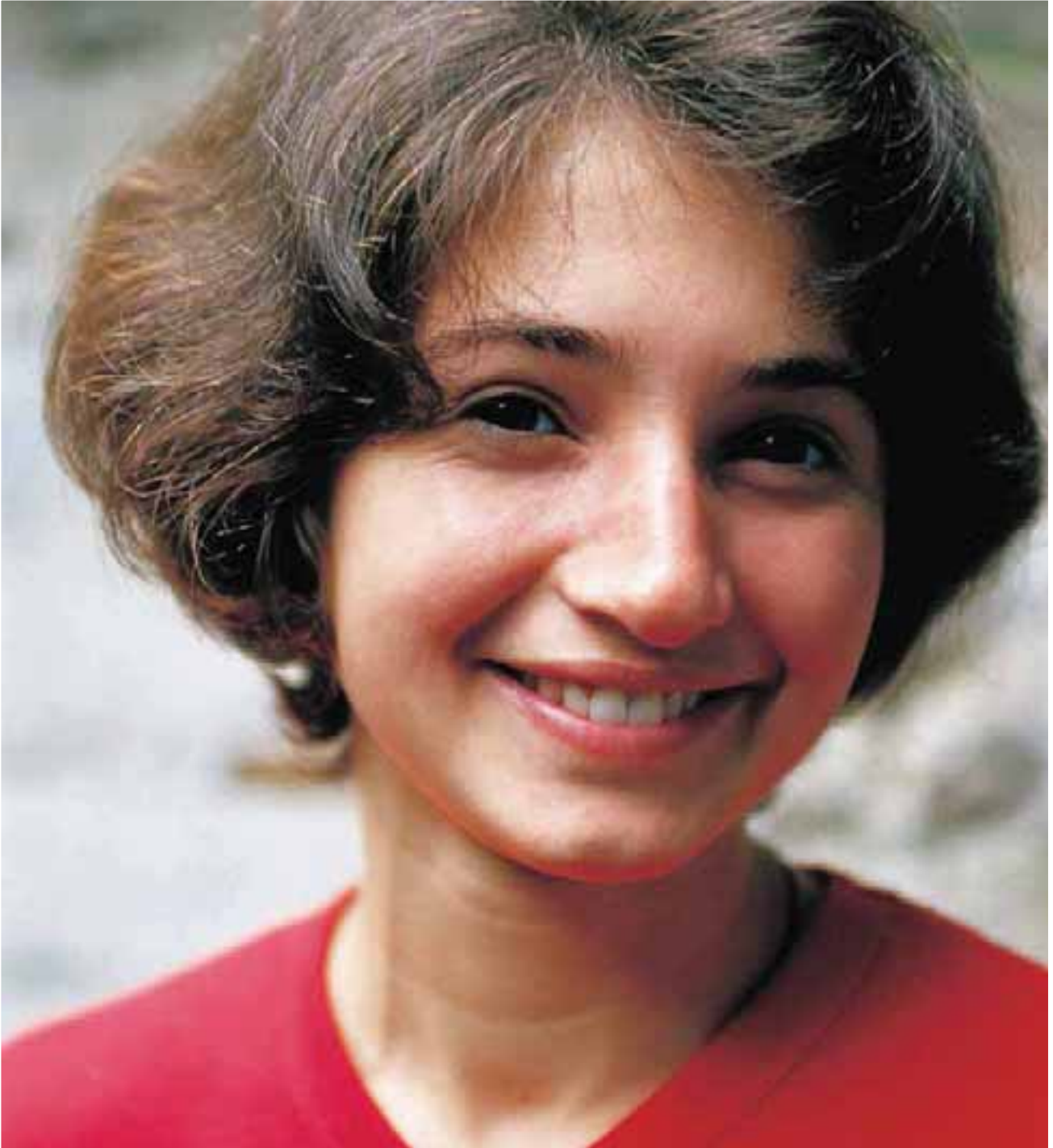
At the end of the 1950s, a brilliant pianist-composer, Vagif Mustafazadeh, known for his smile behind an enormous "gypsy" moustache, was the first to suggest the union of jazz and traditional *mugham* music.

To a certain extent, this union would seem natural since *mugham*, normally played during folk events, is based on improvisation, just like jazz. Improvisation makes every *mugham* performance and

performer unique, and the particular and characteristic tone scale fits nicely in the free phrases so typical of jazz. Vagif followed his idea through with great enthusiasm, facilitated also by his family who supported his initiative with affection.

Vagif's wife, who was born in Georgia, is also a musician and their two daughters have followed in their parents' footsteps.

Vagif's beautiful daughter Aziza Mustafazadeh is a talented pianist, not to mention an acrobatic singer, and is today among the internationally best-known Azeri musicians.





Tbilisi, the capital city of Georgia, lies on the banks of the River Mtkvari with elegant tree-lined avenues. It is rich in history and monuments and has an active cultural and economic life. Narikala fortress and the ancient thermal baths situated in the old city (Maidan) are important tourist attractions

GEORGIA

GEOGRAPHY

The Republic of Georgia (Sakartvelo in Georgian) covers a total area of 69 700 km² and lies between 43°34' and 41°02' latitude north and between 40° and 46°43' longitude east. It borders the Russian Federation to the north, Turkey and Armenia to the south, Azerbaijan to the east, and has approximately 310 km of coastline along the Black Sea in the west. Its capital city, Tbilisi, is located in central Georgia, on the River Mtkvari. Georgia is a mountainous country: 54 percent of the territory is covered by mountains, while hills cover 33 percent and plains and valleys make up the remaining 13 percent.

About 30 percent of the country is situated above 1 700 m. Along the whole of the northern border of the country lies the Greater Caucasus range, the highest peaks of which exceed 5 000 m (Mount Shkhara, 5 201 m), while the Lesser Caucasus range lies in the south, along the border with Armenia.

The western part of the country is occupied by hills and plains, constituting the basin of the Rioni and Inguri Rivers. The eastern part, along the border with Azerbaijan, is constituted by the upper basin of the River Mtkvari.



GEORGIA – HUMAN DEVELOPMENT INDEXES

Index	Value	World rank
Human development index	0.778	89
Adult literacy rate (%)	100	1
Per capita GDP (USD PPP)	4 662	100

Source: UNDP, 2009

GEORGIA – AGRICULTURAL PROFILE

Population	4 382 100
Rural/total population ratio	47%
Economically active population	1 917 800
Agricultural labour force	1 024 100
Agricultural labour force/labour force ratio	53%

Source: Department of Statistics, Georgia, 2008

GEORGIA – AGRICULTURAL PRODUCTION

Cereals	tonnes	408 024
Pulses	tonnes	10 180
Fruits and vegetables	tonnes	673 300
Roots and tubers	tonnes	139 200
Meat	tonnes	44 900
Milk	tonnes	644 200
Eggs	tonnes	24 623
Cattle and buffaloes	head	1 048 500
Sheep and goats	head	706 500
Fish	tonnes	18 377
Agricultural imports	million USD	812
Agricultural exports	million USD	299
Fishery imports	million USD	34.8
Fishery exports	million USD	2.6
Forestry imports	million USD	60
Forestry exports	million USD	22

Source: FAO, 2010. Data refer to 2007–08

The impressive statue of Kartlis Deda (Mother Georgia) was erected in 1958 to celebrate the 1 500th anniversary of the foundation of Tbilisi



LANDSCAPE AND AGRICULTURE

There are many types of landscapes and ecosystems in Georgia. The plains and hills along the Black Sea have a wet subtropical climate with 1 000–2 000 mm per year of rainfall. Natural vegetation includes moor forests and Kolkheti evergreen forests, where the *zalkova* relict tree can also be found. The area is perfect for agriculture and produces a wide range of vegetables, tea, citrus and other fruits, Suhumi tobacco, cotton, maize and sesame. Grapes for extensive wine production are also significant. As the altitude and distance from the Black Sea increase, the climate becomes drier and cooler. At altitudes up to 850 m, the natural vegetation is based mainly on thorny bushes, moor forest and oaks. Agriculture is widely practised and produces vegetables, fruits (such as figs, peaches, apricots and pomegranates) and wheat.

In central and western Georgia, at altitudes of 450–1 500 m, the climate is more continental. Natural vegetation is composed of beech, fir and oak forests.

Agriculture is based on grapes and horticulture. Livestock breeding is also common. In the mountains of the Greater and Lesser Caucasus ranges, at altitudes of 1 500–2 500 m, the climate is subalpine, and natural vegetation comprises beech and fir forests, and meadows. Agriculture is limited to some cereal cultivation. Livestock breeding is still practised. At higher altitudes, up to 3 500 m, alpine meadows can be found and are used for livestock grazing.

Georgia is justly famous for its natural and medicinal water springs. There are approximately 2 300 springs at 730 sites across the country, which together are estimated to yield approximately 130 million litres of mineral water per day. About 4 200 vascular plants have been registered in Georgia. Among them are 317 species of Leguminosae, 332 species of Gramineae and 238 of Rosaceae. More than 2 000 species have direct economic importance for food, timber, edible fruits, nuts, forage and fodder, medicine, colourants, industry and essential oil production.



Almost half of the population of Georgia lives in rural areas and maintains a rich biodiversity of crops and livestock

GEORGIA – USE OF LAND				SURFACE							
				1 000 ha	%	1 000 ha	%	1 000 ha	%	1 000 ha	%
Total country area	Land area	Agricultural area	Arable land and permanent crops	577	23	2 517	36	6 949	99.7	6 970	100
			Permanent meadows and pastures	1 940	77						
		Forest area		2 760	40						
		Other land		1 672	24						
	Inland water		21	0.3							

Source: FAO, 2010. Data refer to 2007



AGRICULTURE INFORMATION FOR FARMERS

Agrarian sector recommendations are made by the Ministry of Agriculture and Food; the Centre of Scientific and Technical Information (Techinform); the Academy of Agricultural Sciences of Georgia; the Georgian State Agrarian University; the industry-wide Georgian Biological Farming Association, Elkana; the Farmers' Union of Georgia; and the House of Georgian Farmers. According to the Georgian agricultural development project, AgVantage, a modern information system has been developed for the agro-industrial market. The system includes magazines, weekly information bulletins in Georgian and Russian and a Web portal. The Farmers' Union produces a monthly newsletter called *My Fatherland*,

highlighting foreign and local achievements and giving advice to farmers. The Union also funds publication of up to 20 books and booklets. The Association for Protection of Landowners' Rights publishes a magazine called *Land Owner*, which discusses legal issues.

The Georgian National Association for Animal Production (GNAAP) is developing an AgroWeb portal in English and Georgian to collect and provide information for farmers on agriculture in Central and Eastern European countries as well as those of the Russian Federation, and a portal on farm animals and gene banks in Georgia and globally.



The mediaeval Sapara Monastery belongs to the greatest period of Georgian architecture, before the Mongolian invasions. The building has been influenced by Roman, Hellenistic and Syrian cultures

LANGUAGE AND CULTURE

The official language of Georgia is Georgian. It is a member of the Kartvelian family, which also includes Mingrelian, Laz and Svan (colloquial language), all spoken in the area between the Black and Caspian Seas. Georgian is written in an original and ancient alphabet, which currently consists of 33 letters.

The first incontrovertible evidence of Georgian writing is an inscription in a church in Bethlehem, dated 430 AD.

Georgia boasts an extremely rich secular and religious literary tradition. Three main periods can be distinguished. The Old Georgian period, which extends from the fifth to about the twelfth century, was rich mainly in religious works.

The Mediaeval Georgian period, which began during the twelfth century and continued to the eighteenth century, can be considered the golden age of Georgian literature. Notable epic works were produced, such as Rustaveli's *Vep'khistaosani* (The knight in the tiger's skin), which became a Georgian national epic poem.

After the Mongol invasion in the 1240s, Georgian literature entered a period of decline but, from the eighteenth century, attempts were made to salvage historical matter that had survived the Mongol conquest and this period constituted a renaissance in Georgian culture. The Modern Georgian period began in the nineteenth century, with the opening of Georgian literature to the influence of Russian and European poetry.



Religion has always played an important role in Georgia, as evidenced by architecture, literature and other figurative arts

Georgian architecture is also significant. Two major forms of ecclesiastical building were developed at the beginning of the Christian age: the basilica and the central domed structure. The basilica came to Georgia primarily through the influence of the Roman and Hellenistic worlds. Its reformulation in Georgia was a blend of Syrian influences as well as of secular buildings, such as markets, country halls and audience chambers.

The second form of building that appeared in Georgia in the early feudal period and evolved into many complex variations was the central domed structure. The substructure acted as a base upon which the drum and, ultimately, the cupola rested.

The transition from the room shape to the circular drum was achieved through the use of squinches, small arches that grow wider as they project in concentric arches across the interior corners of a square or polygonal room. Ninotsminda Cathedral (sixth century) is the earliest large centralized ecclesiastical building that has survived.

The greatest period of Georgian architecture was from the tenth to the thirteenth centuries. Exterior ornamentation reached a supreme level of artistic confidence. Fanciful use of a wide variety of motifs – animal, vegetal and geometric – worked in conjunction with architectonic devices to render a harmonious and powerful organic totality.



Stone carving in the archaeological site of Dmanisi. The site is rich in architectural remains from the Bronze, Early Iron, classical and mediaeval ages. In the 1990s, the remains of hominids, dating back 1.8 million years, were also discovered at the same site. They are the oldest remains ever found outside Africa. >>Right: a party at which three girls are singing traditional *mtiuluru* songs, accompanied by the small guitar called *changuri*

The golden age of Georgian culture came to an abrupt end with the invasion by the Mongols in the thirteenth century. Despite many attempts by Georgia to throw off foreign dominance, the Iranian influence was the strongest new element in Georgian architecture from the end of the fifteenth through the seventeenth century. Brick was preferred to stone for building, and brick patterns are distinctly Islamic, although the Georgians adapted the technique to serve their own Christian iconography. The Gremi citadel and the Ninotsminda bell tower are superb examples of Georgian interpretation of Persian tastes.

With Georgia's incorporation into the Russian Empire in the nineteenth century, Georgian architecture was influenced by Russian neoclassicism: the three-storey bell tower across from Sioni Cathedral, erected in 1812, is the earliest example.

Among the other arts, high levels were achieved by Georgia in sculpture (especially in relief works of facades and decoration of altar screens), in jewellery and in painting.

Georgia has ancient and deep-rooted musical traditions and culture. Sumerian cuneiform inscriptions mention the original





The Cathedral of Alaverdi, erected at the beginning of the eleventh century AD in the Kakheti region (eastern Georgia). Every year this site hosts the “Alaverdoba festival”, to celebrate with music and other artistic features the end of a successful harvesting season

musical rituals of tribes residing in the territory of present-day Georgia. Archaeological excavations have uncovered musical instruments, including pipes and stringed instruments. The importance of music in the lives of the peoples of Colchis and Caucasian Iberia was stressed by the ancient Greek historians Herodotus and Xenophon. Folk music, specifically traditional polyphonic choir performances, has a special place in the cultural values of the Georgian people. Polyphony has been preserved from early times to the present day. Every region of Georgia has its own specific traditional musical dialect and manner of performance, yet all share the same intonation and harmonic characteristics.

Once, upon hearing a recording of the Gurian marching song, *Khasanbegura*, Igor Stravinsky said:

“One of the most impressive recent musical experiences I owe to the tapes of polyphonic singing recorded in mountain villages near Tiflis. The discovery of an active performing tradition of music ranging from tenth century conductus and organum to High Renaissance was a major find, I think, and contributes to performance knowledge being even more valuable than acquisitions of more music. Yodelling, called krimanchuli in Georgian, is the most virile vocal performance I have ever heard.”



Courtesy of Levan Mosiashvili

THE PAINTER LEVAN MOSIASHVILI

by Alison Hodder

Levan Mosiashvili was born in 1971 in Tbilisi, Georgia. He graduated from the Agrarian University in 1993 and, in 1994, from the secondary faculty of art. He is a self-taught artist, working in animalistic and abstract styles, and portraiture. His work is painted in oil on canvas.

A distinctive characteristic of much of Levan's work is the representation of typically Georgian agrarian scenes and figures; thus he has contributed significantly to the recording and preservation of this key aspect of his country's rich cultural heritage.

He has been a member of the Georgian Artists' Union since 1999, and honorary member of the Southern France Young

Artists' Association since 2003. From 1995 to 1997, he worked for the French charity organization "Équilibre" as charity-cultural projects coordinator; in 1996, with the support of the French Embassy, he organized the project "Art for children".

Since 1998, Mosiashvili has had several one-man exhibitions in France, the Russian Federation, Turkey and the Syrian Arab

Republic, as well as in Georgia. His paintings are in private collections, art galleries and museums in numerous countries.

He has received various awards in France and also at international exhibitions and competitions abroad. He currently lives and works in France but returns periodically to Tbilisi to renew the inspiration for his art.



**PROFESSOR
KAMO KARTVELISHVILI**

by *Levan Tortladze*

In Georgia, rural people have bred livestock for centuries. Livestock-related literature has been written and translated, and specific schools and institutes established for people to study zootechnical, veterinary and animal care issues.

The Georgian Scientific Research Institute of Livestock/ Zootechnical and Veterinary Educational Research

Institute was established at the beginning of the twentieth century and scientific material was gradually added. Zootechnicians raised several highly productive breeds, which spread throughout the Caucasus and Russia. The Institute has produced more than 7 300 zoo-engineers and 5 900 veterinarians. Professor Kamo Kartvelishvili, a corresponding member

of the Science Academy of Agriculture, worked at the Institute from 1956 until his death in 2000. He served as teacher, dean, pro-rector and rector. From 1983, he was the Chairman of the Department of Milk and Beef Production Technology.

Professor Kartvelishvili was an outstanding scientist in the field of animal breeding.

The main direction of his scientific investigations was to increase beef production. In Georgia, he carried out an investigation into the industrial crossing of dairy breeds raised in the country, bearing the world's best beef genetic resources. He also created herds of beef cattle adapted to high-intensity farming conditions. During the civil war (1992–93), the university faced



Professor Tortladze and Tamara, daughter of Professor Kartvelishvili, at the Georgian Zootechnical-Veterinary University. Many of the scientific educational tools have been preserved thanks to the university staff who protected them from vandalism during the civil war

both theft and vandalism. In this period, the rector decided to create a night duty with the help of professors and lecturers. In spite of the danger, four to five unarmed professors protected the building every night and saved the university from further theft and destruction.

Professor Kartvelishvili was among these guardians and during many cold and risky

months protected the important scientific material of the university without thought for his own safety. His dedication to science is continued today by the committed work of his daughter and son, testifying to the important role assigned to education in Georgia.

The university and his children are proud of the example given by Professor Kartvelishvili

and his memory is celebrated through the diffusion of his scientific findings and his dedication to both his family and students.

Nevertheless, the region still hosts wild and domesticated species that can ensure the future of agriculture for the world, and preserves the knowledge and the science base necessary to make a

better use of local genetic resources for sustainable agricultural production. But there is a need to act quickly before these species are lost. The international scientific and political community should engage in preserving *in situ* and *ex situ* this reservoir of genetic material for food security in reserves, gene banks and farmers' gardens in Armenia, Azerbaijan and Georgia.

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EDUCATION TO MAINTAIN LOCAL GENETIC RESOURCES

THE PEOPLE OF THE SOUTHERN CAUCASUS DESERVE RECOGNITION AND RESPECT FOR THEIR CULTURE AND WORK, WHICH HAVE CONTRIBUTED OVER MILLENNIA TO SHAPING AGRICULTURAL SYSTEMS CONCILIATING THE USE AND PROTECTION OF BIODIVERSITY AND GENETIC RESOURCES. THE HIGH LEVEL OF EDUCATION NEEDS TO CONTINUE AND THE MODERN CONCEPT OF ECOSYSTEM MANAGEMENT NEEDS TO BE TRANSFERRED TO YOUNG PEOPLE.

The interdependence between people, plants, animals and their habitats is challenged by the loss of soil health and fertility, inadequate agronomic practices and inefficient use of energy resources, as well as the risks posed by climate change, social and economic changes and food insecurity. Innovative regulations need to be developed as well as mechanisms and connections promoting a better equilibrium for food production based on landscape memory, a locally adapted science focused on dynamic complexity, data and information better connected with specific farmers' knowledge and needs, and capacity building programmes to manage biological processes for crop production.

This transition will require education, knowledge and a careful focus on land and genetic resources, new global and local commitments, new energies and technologies, and will build on the very high level of education that is the foundation of culture in the Southern Caucasus.

There is a need to support the education and training of young people so that they can maintain with pride, imagination, care and humility all the different aspects of their culture, and treasure the biodiversity of genetic resources in Armenia, Azerbaijan and Georgia through efficient agricultural management practices and responsible ecological lifestyles.





AT THE CROSSROADS BETWEEN EAST AND WEST
IN THREE HOSPITABLE COUNTRIES

AGRICULTURE AND BREEDING HAVE BEEN DEVELOPED SINCE THE NEOLITHIC

COPING WITH THE RHYTHMS OF THE SEASON

A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS

TO MAKE BREAD, CHEESE AND WINE

PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES

RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Հողագործությունը և անասնապահությունը զարգացել են նոր
քարեդարյան ժամանակներից ի վեր

Թեկնչիլիկ və seleksiya neolit dövründən inkişaf etdirilmişdir

նեոլիտիտիս ხანა – მიწათმოქმედებისა და
მესაქონლეობის დასაწყისი

3

INTRODUCTION

DURING THE NEOLITHIC, 10 000 TO 5 000 YEARS AGO, HUMAN BEINGS STARTED TO CULTIVATE AND DOMESTICATE PLANTS AND ANIMALS. THE DEVELOPMENT OF AGRICULTURE CHANGED THEIR LIFESTYLES; UP TO THEN THEY HAD BEEN MAINLY HUNTER-GATHERERS. THE AVAILABILITY OF FOOD IN THE SAME AREA FOR LONG PERIODS OF TIME MEANT THAT IT WAS POSSIBLE TO SETTLE DOWN, BUILD PERMANENT DWELLINGS, MANUFACTURE POTS AND TOOLS, EXCHANGE GOODS AND ORGANIZE MORE COMPLEX SOCIAL STRUCTURES.

The early process of agricultural development was not uniform either in place or time. Almost all the plant species cultivated in the world today originate from just four or five areas in Asia, Africa and Central/South America; agriculture began in these places and then spread throughout the rest of the world. The Southern Caucasus, together with the Fertile Crescent,¹ is one of the areas from which many plant species originated.

In particular, it is considered the centre of origin of one of the most widely cultivated crops, soft wheat, and of several fruit species. Legume species were cultivated in rotation with cereals, and diversification of crops and cropping systems provided more complementary food for humans, contributed

to maintaining soil fertility and made the best possible use of the many different microclimates and biodiversity species available in the Southern Caucasus.

A diversified diet, based on cereals, fruits and dry cooked legumes, together with vegetables and roots, occasionally supplemented with meat, improved both the fertility and health of the population which, in turn, determined the increase in numbers and the longevity of individuals. The archaeological evidence of late Bronze Age tools, probably used for digging, as well as the remains of grapes, peaches and other fruits found in Armenia, Azerbaijan and Georgia, strongly suggest that a process of agricultural evolution was already well under way.

¹ The Fertile Crescent is a crescent-shaped region in the Near East, comprising the basins of the Tigris and Euphrates Rivers (Mesopotamia), of the River Jordan, and the lower basin of the Nile in Egypt.



The Stones of Carahunge in Armenia (sixth millennium BC), also known as “the Stones of Zorats”

EARLY AGRICULTURE IN THE SOUTHERN CAUCASUS

In the first part of the last interglacial period, about 10 000 years ago, the climatic conditions of the Fertile Crescent and the Southern Caucasus were particularly favourable for growing many species of wild plants (such as grasses, legumes and trees with edible fruits) with a potential human use. Submountainous areas were partially covered by trees and shrubs and partially by steppe vegetation.

Within relatively short distances, these areas presented varied microclimatic conditions, depending on altitude, slope,

orientation, solar exposure and availability of water. Species included wild cereals (barley in the more arid zones, wheat in intermediate zones and rye in the more humid and cooler zones); legumes such as lentils, vetches, peas, *Lathyrus*, chickpeas and fava beans; and fruit trees and shrubs producing almonds, pistachios, figs and oak acorns, etc. Many of these could be preserved throughout the winter. These environments were well suited to human dwellings, since they guaranteed availability of combustibles for domestic use and that of many edible annual and perennial plant species.



In Armenia, archaeological remains of the Hittite and the Urartu tribes, dating between 4 000 and 3 000 years ago, reveal that agriculture was already well developed. The laws of the Hittites specifically refer to fruit orchards and vineyards and establish punishment for stealing fruit.

Theft from a private apple orchard shall be punished with a fine of between six and ten silver coins. Theft from an apple orchard belonging to the community will be punished with a fine of three silver coins.

These rules suggest that even in those early times there were both private and public fruit orchards, and that laws had been set in place to protect them. In excavations of sites settled by the Urartu tribes in present-day Armenia and Azerbaijan, archaeologists have found the remains of carbonized fruit, as well as apple, grape and pomegranate seeds and plum, peach and apricot stones. Cuneiform writings from that period often refer to fruit orchards.

In Southern Caucasian architecture, grapes and pomegranates are favourite decorative motifs. There is evidence to suggest that the region supplied ancient Greece and Rome with apricots, as well as dwarf varieties of apples or plums, such as the Regina variety. Fruit trees were planted between the rows of vines. Cultivation of wheat and barley dates back five to six thousand years BC, and animals such as cattle, pigs, sheep and goats were domesticated during the Neolithic. In prehistoric settlements (Teghut, Shengavit, Nakhchivan, Kultapa, Aghstev, etc.), remains of cereals, animal and agricultural tools have been identified. Fossils from Bronze Age settlements testify that agriculture was the major occupation of indigenous tribes residing in the Armenian highlands.



In later times, the varieties and breeds of animals and crops were improved (fine- and coarse-wool sheep, draught and saddle horses and a wide range of wheat, barley and grapes). In the upper valley of the River Aratsani, in the catchment area of Lake Vana and in Tsopq and the Ararat Valley, viticulture and fruit farming were advanced. Greeks retreating through Armenia found large quantities of stored wine and beer, as well as raisins and other dried fruits in the villages. Archaeological digs in Azerbaijan from the Aratta, Lulubi and Kutuy periods give incontrovertible evidence of domestication of most agricultural crops from 5000 to 4000 BC. Finds from Kultapa (Nakhchivan) and Mingacevir excavations dating back to the third century BC show that cereals were also cultivated in these areas.

The Southern Caucasus is rich in archaeological findings that testify early development of civilization. Above: excavations at the site of Dmanisi, dating back to prehistoric times (about one million years ago). <<Left: a skeleton found in a burial site in Mingacevir, now preserved in the History Museum of the Azerbaijan Academy of Sciences



Environmental conditions in the Southern Caucasus have favoured the differentiation of many species and the development of agriculture. Grapes were among the first fruits to be domesticated

The Shulaveri-Shomu culture in east Georgia (Kwemo Kartli region), which occupies the middle course of the Mtkvari Valley, is among the best known Neolithic cultures of the Southern Caucasus. The sites are generally located on the most fertile land along rivers, not far from the foothills. The Shulaveri-Shomu culture is characterized by circular mud-brick houses, domestic animals and cereals. Remains of *Triticum polba*, *T. macha*, bread wheat, barley and millet were discovered at Shulaveri.

The material culture includes handmade pottery with incised and relief decoration, an obsidian industry based on the production of regular blades with a high proportion of burins and scrapers, and large numbers of bone and antler implements. The sites of Shulaveri, Imiris and Khramis didi gora (Kwemo Kartli region) were excavated by a team from the National Museum of Georgia.



Petroglyphs in Gobustan confirm the early development of crop cultivation and animal husbandry in the Southern Caucasus

GOBUSTAN CAVES

Gobustan is an archaeological site in Azerbaijan near the Caspian Sea, about 60 km southwest of Baku. It comprises rock caves that were used as shelters as far back as 10 000 years ago.

At the end of the 1930s – when the area was used as a stone quarry – petroglyphs were found in the caves. They had been carved from about 3000 BC to the first centuries AD. Evidence of fire-worship can also be found in pictures carved in stone. The petroglyphs

depict people, animals, plants (especially wheat and barley), agricultural tools, musical instruments and boats and testify that crop production and animal husbandry were common practices dating back to the Neolithic. Pictures of boats carrying the sun allow scientists

to presume that the inhabitants of these places knew how to navigate ships by the sun and the stars and had direct contact with the Sumerians (the former population of Mesopotamia), who belonged to the most ancient cultures on the continent.

THE ORIGIN OF WHEAT CULTIVATION IN THE CAUCASUS

Wheat has been cultivated in the Southern Caucasus for 6 000 years, as evidenced by ethnographic, archaeological and botanical studies. Traces of burnt wheat straw found among bricks, together with the remains of wheat stubble, show that wheat was grown locally rather than being imported from elsewhere. In fact, the region is considered a primary centre of origin of the most widespread wheat species, *Triticum aestivum* (bread wheat).

The history of the domestication of wheat is complex, involving selection of species by farmers, natural evolution and hybridization. The result is a wide range of cultivated and wild varieties, with different specific characteristics, often sharing the same habitats. Many authors also believe that the evolution process is still under way, as natural cross-fertilization still takes place between wild and cultivated *Triticum* species.

THE OBJECTIVES OF WHEAT DOMESTICATION

People have selected wheat to increase its production, facilitate harvesting and storing, and augment pest resistance. The comparison between domestic and wild wheat illustrates the long process of selection in obtaining wheat with more suitable characteristics for cultivation and human consumption:

- ✿ Production of plants with “non-shattering” seeds that do not break off the plant before harvest and are therefore easy to harvest. (In nature, wild grasses disperse their seeds by releasing them once ripe and not synchronizing is a security system to face unpredictable climate variability and other stresses such as grazing by animals and wind storms.)
- ✿ Production of large, plump seeds. (In nature, seeds are smaller so that plants can produce them with less use of energy and nutrients.)

- ✿ Production of more seeds per plant by increasing the number of fertile flowers. (In nature, it is more secure to produce a larger number of plants each with a limited number of seeds.) Traditional crops used by farmers in difficult environments also have a limited number of seeds per plant because the entire plant is used (e.g. leaves are fed to animals, stems are used for housing, roots are used for soil erosion control.)
- ✿ Production of “naked” varieties, where the husk around the seed comes off easily during threshing. (In nature, wild varieties of wheat are hulled to improve the protection of the seed against aggression by animals, wind and heavy rains.)
- ✿ Production of seeds that germinate together. (In nature, wild forms have adapted to delay germination until climatic conditions are suitable and to vary the timing of germination so that seeds do not grow and die altogether during a season of erratic and poor rainfall.)
- ✿ Response to irrigation and resistance to wilt, rust and other pests. (In nature, this resistance is reached through the use of a combination of varieties and species rather than through a higher resistance of plants grown in monocultures.)
- ✿ Good response to fertilizers. (In nature, this response is reached through a combination of species and varieties. Biological processes are enhanced and the combination of species and varieties maximizes the use of soil nutrients).

For these reasons, domesticated varieties are better suited to agricultural production, but they may lose their capacity to survive if the conditions for which they have been selected disappear. For example, “non-shattering” varieties would no longer be able to colonize new areas, and plants that germinate simultaneously would not be able to survive if a sudden drought follows germination. Local farmers are aware of the importance of managing a large number of varieties, and of maintaining old varieties that contain genetic material resulting from thousands of years of human selection. These heirlooms may provide the genes needed to create varieties that will thrive in a changing climate.

ANTIQUITY OF GRAPEVINE CULTIVATION IN THE SOUTHERN CAUCASUS

by Lorenzo Costantini and David Maghradze

Recent archaeobotanical material dating back to the seventh-sixth millennium BC confirms that the Caucasus was an independent heart of a food-production economy. This refers in particular to wheat, barley, rye and grapevine, the remains of which have been found in various Neolithic settlements. Armenia, Azerbaijan and Georgia are three important areas for both the study of varietal (ecotype) diversity of wild grapevine and for knowledge of the process of domestication.

The presence of grape seeds in archaeological sites is sporadic and occasional, since they are not foodstuffs of economic importance that would justify their being accumulated, unlike cereal or legume seeds. The importance of archaeological seeds in the study of cultivated grapevine origin and evolution as well as for ancient wine-making has often been affirmed by botanists, agronomists, archaeobotanists and archaeologists. According to morphological and ampelographic analysis, the seeds from neolithic Shulaveris Gora and Dangruei Gora (Georgia) are considered to

be those of the cultivated vine – *Vitis vinifera* L. spp. *sativa* DC. In Georgia, seeds and other grapevine remains have been found in more than 40 sites, from the early Neolithic onwards. Archaeological seeds have also been found at Shomu Tepe (Azerbaijan). According to Kavtaradze, the mainly sixth millennium chronology of the early farming culture of Shulaveri-Shomu Tepe in the central part of the Southern Caucasus is based on calibrated radiocarbon evidence. These calibrated data partially solve the discrepancy between the Near Eastern archaeological parallels of this culture, dated to the seventh-sixth millennium, and the uncalibrated radiocarbon dates of the Shulaveri-Shomu Tepe culture, which were largely placed in the fifth millennium.

In the framework of the collaborative project “Conservation and sustainable use of grapevine genetic resources in the Caucasus and Northern Black Sea Region”, coordinated by Bioversity International (formerly IPGRI) and supported by the Government of Luxembourg, a special section has been dedicated to the archaeology of grapevines. This research has been undertaken by the Bioarchaeological Research Centre of the Italian Institute for Africa and the East

(IsIAO) in collaboration with several Georgian institutions. It is expected that this collaboration will increase our knowledge of the evolutionary process of one of the most important cultivated plants that has accompanied the development of central Asian societies, and build up a computerized database for grapevine biodiversity.

The collection of information will provide documentation on the use of grapevines through the various stages of cultural, social and economic development of the region. Moreover, the studies will provide additional information connected with ethnological and anthropological topics related to traditional agricultural systems and to models of sustainable agriculture.



Photo by D. Maghradze

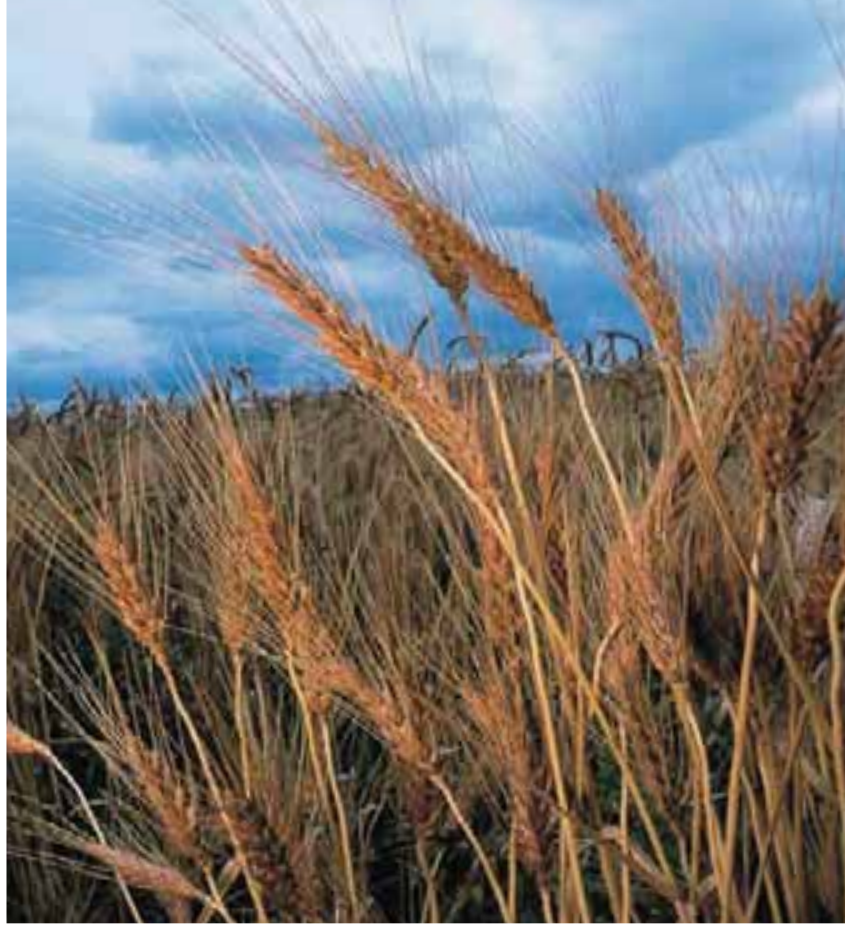


Photo by D. Maghradze

Top: ancient *kvevri* (clay vessel for making wine) from Vani, Georgia. Centre: *pithos* from Tsikiagora, Georgia. Below: carbonized seeds of cultivated grapevines from Tsikiagora



Photos by D. Maghradze



THE ANCESTORS OF WHEAT

The Caucasus is a centre of origin of wheat species, some of which form the base of wheat production throughout the world. For example, *Triticum spelta*, a form of semi-wild wheat with a resistant midrib and hulled grains, is considered one of the earliest ancestors of bread wheat. Remains of *T. spelta* have emerged from excavations led by the Georgian archaeologist, Iv. Javakhishvili, in the Imiris-Gora region (east Georgia), together with bread wheat, *T. cariticum*, wheat with single and double grains, barley, oats, lentils and millet, all catalogued as early as the fourth or fifth century BC. Eight different varieties of wheat, including those considered as the evolutionary link between the ancient species and those cultivated today

(*T. polba*, *T. macha*, *T. aestivum* and *durum* wheat), were found by the botanical archaeologist Chubinishvili at Aruklo, in western Georgia, in a site dating back to the sixth century BC.

In Kultapa, Azerbaijan, not far from Nakhchivan, carbonized wheat dating from the Neolithic has been found. In Chalagantepe (Agdash) and Misharchay (Jhalilabad), wheat remains from seven to eight thousand years ago were discovered. The high mountains and alpine highlands are the main regions of species formation and intraspecific differentiation. A favourite dish cooked in Azerbaijan from bread-baked wheat (*T. aestivum*) is *aghandz*. It is made from roasted wheat grains,



The history of the domestication of wheat is complex, involving selection of species by farmers, natural evolution and hybridization. Such processes are still under way. From left to right: *Triticum monococcum* and three subspecies of *T. aestivum*: red doli, macha and spelt

often mixed with seeds of other plants (for instance, hemp, flax or some leguminous seeds) and it is believed that *aghandz* is the most ancient wheat product in human meals.

In Armenia, in archaeological sites dating back some 8 000 to 5 000 years (Shengavit and others), mainly barley-wheat mixtures have been discovered. Pure wheat crops appeared later, about 3 000 years ago (Karmir-Blur, Argishtikhinivili and others). Carbonized wheat spikelets and grains of *T. aestivum*, *T. compactum*, *T. spelta*, *T. sphaerococcum* and *T. dicoccum* were found in archaeological excavations.

At the Erebuni Nature Reserve in Armenia, *T. urartu* was discovered, together with other wild wheat species such as *T. boeoticum*, *T. araraticum* and *Amblyopyrum muticum*, a species taxonomically intermediate between *Agropyron* and *Aegilops*.

The latter species caused great interest among scientists, because some consider it to be the donor of the first (A) genome, which is widespread in tetraploid and hexaploid wheat. Six varieties have been identified to date; new scientific data will shed light upon their characteristics. For this reason there is an urgent need to protect these varieties.



Many local wheat varieties, such as *Triticum georgicum*, are disappearing because of their limited market value, but they should be maintained because of their importance for selection, especially in view of changes in environmental conditions.

>>Right: Irakli Rekhviashvili, Head of the Selection Achievement Testing Station in Asureti, Georgia, inspects a wheat field

Aegilops, a wild relative of wheat

Aegilops is a cereal similar to wheat, and grows in the Southern Caucasus, sharing the same habitats as other wild wheat species and varieties.

Recent interest in this species arose from the cytological proof of its role in the origin of tetraploid and hexaploid wheat varieties, i.e. of some of the most widespread crops in the world. Further research on *Aegilops* could have various benefits – by bringing improvements to the wheat itself, because it is a rich reservoir of genes for drought resistance and poor-soil tolerance; it could encourage and promote the sustainable development and protection of the ecosystem in which it grows. Its habitat is the same as that of other wild wheat species and varieties, which would also benefit from this situation.

The genus *Aegilops* comprises 11 diploid and 12 polyploid species, including tetraploids and hexaploids, nine of which grow in the Southern Caucasus.

The genus *Triticum*

The Southern Caucasus is famous worldwide for its diversity of endemic species and subspecies of wild and cultivated wheat. At present, over a dozen species and several hundreds of subspecies have been identified in the region. All the three countries maintain rich collections within public institutions. Many local wheat varieties are no longer used, mainly because they do not sufficiently increase production with increasing inputs, and they are not easily sold in international markets. Consequently, many valuable subspecies and forms, which are of great importance for selection, are disappearing. All cultivated wheat species of the genus *Triticum* have a number of chromosomes, a multiple of seven, and they have been classified as diploid (with $2n=14$ chromosomes), tetraploid ($2n=28$) and hexaploid ($2n=42$). Further studies have confirmed that the basic genome of the Triticeae tribe is organized into seven chromosomes, and that a specific chromosome or part of it in a basic genome is genetically related to a specific chromosome or part of it in all other genomes of the Triticeae. This is because gene synteny has been conserved throughout genome evolution and speciation of the genera in the Triticeae tribe and Poaceae family. The table on page 102 lists the species and main subspecies of the *Triticum* genus.





The Erebuni Reserve near Yerevan, established in 1981, is a unique place in which many wild wheat species and wheat ancestors are grown and preserved. >>Right: Syuzanna Hovsepyan collects *Aegilops* specimens, a wild relative of wheat grown at the Erebuni Reserve, for the State Agrarian University of Armenia and a close-up of mature *Aegilops*

CLASSIFICATION OF <i>TRITICUM</i> SPECIES AND MAIN SUBSPECIES					
Ploidy level	Species	Main subspecies	Common name	Notes	
Diploid	<i>T. monococcum</i> L.	–	einkorn or small spelt wheat	cultivated	
		<i>aegilopoides</i> (Link) Thell.	–	wild	
	<i>T. urartu</i> Tumanian ex Ghandilyan	–	–	wild	
Tetraploid	<i>T. turgidum</i> L.	–	pollard wheat	cultivated	
		<i>durum</i> (Desf.) Husn.	durum wheat	cultivated	
		<i>carthlicum</i> (Nevski) A. & D. Löve	Persian wheat	cultivated	
		<i>dicoccum</i> (Schrank) Thell.	emmer wheat	cultivated	
		<i>palaeocolchicum</i> (Menabde) A. & D. Löve	–	cultivated	
		<i>polonicum</i> (L.) Thell.	Polish wheat	cultivated	
		<i>turanicum</i> (Jakubz.) A. & D. Löve	Khorassan wheat	cultivated	
	<i>diccooides</i> (Körn. ex Asch. & Graebn.) Thell.	wild emmer	wild		
	<i>T. timopheevi</i> (Zhuk.) Zhuk.	–	–	–	cultivated
		<i>armenicum</i> (Jakubz.) van Slageren	–	–	wild
Hexaploid	<i>T. aestivum</i> L.	–	common or bread wheat	cultivated	
		<i>compactum</i> (Host) Mackey	club wheat	cultivated	
		<i>macha</i> (Dekapr. & Menabde) Mackey	–	cultivated	
		<i>spelta</i> (L.) Thell.	large spelt or dinkel wheat	cultivated	
		<i>sphaerococcum</i> (Percival) Mackey	Indian dwarf bread	cultivated	
	<i>T. zhukovskyi</i> Menabde & Ericz.	–	–	–	cultivated



Examples of selected *durum* wheat varieties

The main characteristics of three varieties of *durum* wheat that have been recently selected in Azerbaijan are described below.

Terter. This variety has been obtained through intraspecific hybridization of the *Giorgio 447* variety of Italian origin with the *Mehsuldar* (productive) variety. The height of the plant is 90–95 cm; vegetation period is 180–218 days; tillering ability is good; its diversity is *provinciale*. The length and thickness of the ear are average. The potential productivity of the plant is 6.5–7 tonnes/ha; grain size is large; 1 000 kernel weight is 53–58 g. The macaroni quality of the grain is satisfactory; gluten quality belongs to the second group. It can be slightly infected with rust and mildew diseases; susceptibility to stem rust is average. It is resistant to smut diseases, but its resistance to frost is weak.

Garagilchig-2. This variety has been obtained by crossing the *Garagilchig* variety with the *Norin-10* variety through multiple individual selection. With semi-winter characteristics, the plant is short (78 cm), resistant to lodging, early ripening and has good tillering ability. Its diversity is *apulicum*. The ears are cylindrical

and large, and density is average. The potential productivity is 7–8 tonnes/ha; in high agrotechnical on-farm conditions 6–7 tonnes/ha yield has been obtained. The light-yellow grain is longish, oval and large; 1 000 kernel weight is 45–50 g. Grain albumin is 15–16 percent; gluten is 28–32 percent, total macaroni quality is extremely high (4.9 points). Although the variety has weak resistance to frost, it is drought tolerant. It is resistant to rust diseases, mildew and stinking/barley smut, but can be slightly infected by loose smut.

Bereketly-95. This variety has been obtained through intraspecific hybridization of the wheat varieties *Qirmizi* and *Garagilchig-2*. It is a quality, semi-winter, intensive plant, short (95–98 cm), high-yielding and tolerant of extreme climatic factors. Its vegetation period is 210–219 days; tillering ability is good. Its diversity is *hordeiforme*. The ears are red and prismatic. The potential productivity of the variety is 7–8 tonnes/ha; the grain is extremely large; 1 000 kernel weight is 56–60 g. Grain albumin is 13.5–14.5 percent; average value/magnitude of gluten is 26–28 percent. The plant is resistant to rust mildew and smut diseases as well as to drought and frost.



FRUIT DOMESTICATION

Thousands of years ago, fruit growers in the Southern Caucasus learned how to transfer fruit trees (which grew wild on the mountains) to the fields and gardens below, close to the settlements where people lived. These fruit growers also mastered the art of grafting. Evidence suggests that the technique was practised in the region as early as 6 000 years ago.

In Azerbaijan, the local population settled in the vicinity of forests and used wild crops as rootstock in hybridization with local fruit varieties; fruit orchards were established along the edges of forests. This is still a tendency of the local population in the Quba-Khachmaz and Sheki-Zagatala regions. The local *Gizil Ahmedî* and *Jir Haji* apple varieties have been developed through improvement of wild apple varieties.

In Armenia, fruit farmers developed late-flowering almond trees to overcome late frost damages.

In Azerbaijan, in order to withstand the strong winds blowing in the southeastern lowlands, varieties of olive trees with a very strong connection of drupes were selected.



Fruit orchards were originally established along the edges of forests, using wild crops as rootstocks in hybridization with local fruit varieties. Apple orchard in Quba, Azerbaijan (left); pear grafted on to spontaneous pome hybrid (centre); olive tree variety selected for its resistance to strong winds (right)



The Southern Caucasus is a centre of origin of important wild almonds such as *A. fenzliana*. Though wild almonds are often bitter and their domestication is complex and poorly known, the domesticated sweet types have been found in archaeological remains from the Bronze Age suggesting that the almond was already cultivated together with cereals and grapes

During Roman times, Armenian growers developed a plum – today’s Reine-Claude (greengage) variety – which was considered preferable to the common wild plums found on the hillsides.

In the Southern Caucasus, fruit growing has always been greatly influenced by climate and geology. Even when these two factors conspired against fruit cultivation, local farmers adapted production to the physical circumstances. In Georgia, an apple variety known as Kekhura was identified and cultivated to take the place of the small wild apples growing in the woods.

Since much of the terrain in the country is mountainous, fruit growers built terraces to grow their vines and fruit trees, and selected varieties that would flourish in mountainous regions. Until the eighteenth century, fruit varieties grown in the Southern Caucasus were isolated from genetic influences from other parts of the world.

In the nineteenth century, in Europe, new cultivation and production techniques had developed and, with advanced research into genetic improvement, European fruit varieties started to replace the local ones.



In universities, students learn about both indigenous germplasm and high-yielding introduced varieties that hold the potential to sustain agricultural production in the future

Some varieties failed to adapt, but others thrived and were widely grown. Thanks to the favourable climate, some varieties did even better in their new habitat, producing higher yields. Among these was the Champagne rennet apple, imported into Georgia from France. As the region's transportation network improved, more fruits were exported from the Southern Caucasus.

Records show that, in 1914, the Armenian railway carried 1 600 tonnes of apricot purée and other conserves, such as fruit syrups, from Yerevan to destinations including Baku, Tbilisi, Saint Petersburg, Moscow and Warsaw. In 1921, a new era in fruit cultivation in the Southern Caucasus began. Large-scale agricultural farms developed, with the principal aim of increasing production. As a result, cultivation of a wide



Professor Aida Stepanyan of the State Agrarian University of Armenia explains local fruit varieties. After a long period in which many varieties were abandoned in favour of a few high-yielding ones, today there is increasing awareness that diversification contributes to resilience to climatic and economic fluctuations and enables small farmers to reach the markets with their products

variety of fruits, which had always been the practice under private ownership in small orchards, was largely abandoned in favour of a relatively narrow selection of high-yielding varieties. Intensifying agricultural production did produce gains in all sectors, including those of livestock, cereals and fruits. Advances were made in studying the particular agronomic, genetic and biochemical aspects of fruit cultivation.

This led to both an increase in the indigenous germplasm available and to the introduction of new varieties. However, this progress came at a high price in terms of loss of local rural traditions and knowledge, since there was no place for these in the new collective agrarian society. Some examples follow of fruits that have been cultivated in the three Southern Caucasus countries since prehistoric age.



The walnut is well adapted to the climatic conditions of the Southern Caucasus and represents a precious source of food and energy

Walnut (*Juglans* spp.)

Armenian	<i>Ynkuiz, Kakal, Popok</i>
Azeri	<i>Goz, Javis</i>
Georgian	<i>Kakali, Nigozi</i>

The walnut exists in the wild in the Southern Caucasus and is perfectly adapted to growing in its different ecosystems. Walnuts represent a highly nutritious and versatile food that has been used and selected for millennia in the region; they are often used in paintings for their beautiful shape, and are a precious source of energy in the diets of the Caucasian people, particularly in winter. They are also used in many traditional dishes. Walnuts are one of the genetic resources of the region that must be maintained and cultivated because they are adapted to local conditions. Furthermore, walnuts are an important income resource for smallholders who cultivate them in their gardens to

sell on local and national markets. Walnuts are consumed fresh or processed as a quality food throughout the year. *Juglans regia* is native to the mountain ranges of Central Asia, extending from Xinjiang province of western China and parts of Kazakhstan, through Afghanistan, Turkmenistan and the Islamic Republic of Iran. In these countries, there is a great genetic variability, particularly ancestral forms with lateral fruitfulness.

The introduction of the walnut into the Southern Caucasus goes back to the period preceding the birth of Christ. Because of favourable conditions in the region, the walnut tree became an endemic species. Until the nineteenth century, the landscape was thickly covered with walnut forests, but unfortunately these have been gradually depleted to provide timber. In the twentieth century, the mass felling of these trees came to a halt and, instead, plantations were established.



Mr Baghdassaryan builds models made of beautiful walnut wood (left); Hikmet Novrusov cuts a slice of *sheki halvasi*, a delicious cake (right)

In Armenia, *Juglans nigra* L., *J. mandshurica* Maxim. and *J. regia* L. are all present, but for nut production purposes, popular tradition has selected around 100 seedling lines of *J. regia*, which are widespread in several regions.

In Azerbaijan, there are mixed groves of walnut with Caucasian persimmon (*Diospyros lotus* L.) in the Talish Mountains; with oriental plane (*Platanus orientalis*) in the Lesser Caucasus (Zangilan district, Basitchay reserve); with *yalangoz* (false walnut) (*Pterocarya pterocarpa*) and Caucasian persimmon in the Greater Caucasus (Sheki-Zagatala region); and with chestnut (*Castanea sativa*), birch and relict species. A.I. Guliyev found 396 forms of walnut, 136 of which maintain important farming indicators. The walnut varieties *Kagizi*, *Katan koynek*, *Araz*, *Disar*, *Darvish papag* and *Nazikgabig* developed over time through folk selection methods known in Europe, the United

States of America and other countries. The varieties *Evrica* and *Blekmer*, well known in California, have been developed from the *Kagizi* variety which, in the eighteenth century, was taken to the United States from Azerbaijan.

In Georgia, the walnut is mainly represented by seedling lines belonging to *J. regia* L., which vary greatly from one another. Indeed, many genetic forms are catalogued according to the shape of the nut: *globosa*, *ovalis*, *ovata*, *obovata* and *rostrata*. The size of the fruit also varies greatly, ranging from 25–45 mm in height to 22–41 mm in width. Other forms are catalogued according to the fat levels of the nut, which may vary from a minimum of 55 percent up to more than 75 percent.

The walnut kernel is consumed fresh and is used in the preparation of traditional sweets such as *shakarburra* and *pakhlava*.



Magamued Yekabashov with his production of walnut oil

In the Sheki-Zagatala region of Azerbaijan and in Georgia, people make preserves from immature walnuts, which they also sell at markets. Wood from the walnut tree, which polishes up beautifully, is highly prized in furniture-making, as well as for making gunstocks.

In the Southern Caucasus, the available genetic material is excellent, such as the many accessions that can be found in the collection established at the Zagatala Station of the Research Institute of Horticulture and Subtropical Crops in Azerbaijan. This legacy has never been exploited to its full potential; some seedlings have apical and lateral fruit production, and are resistant

to diseases. Furthermore, in Georgia, a study and collection of various types of walnut have been carried out by the Institute of Horticulture, Viticulture and Oenology in Tbilisi.

With regard to commercial standards set by world markets, varieties for selection should have fruits no smaller than 28 mm, with kernels of a light amber colour. These are rich in fats but have a flavour that is not too sharp. As for fruit-bearing characteristics, preference should be given to genotypes with lateral fruiting, with a good resistance to disease; in the forests of the three countries it is possible to find several genotypes with these features.



The hazelnut has a rich and diversified genetic heritage. Many varieties are studied at the Genetic Resources Institute in Baku and many wild forms are widespread throughout the Southern Caucasus

Hazelnut (*Corylus* spp.)

Armenian	<i>Tkbil, Pnduk</i>
Azeri	<i>Fyndig</i>
Georgian	<i>Tkbili</i>

This deciduous shrub is widespread throughout the Southern Caucasus, in both its cultivated and wild forms. The genus *Corylus* has a varied genetic patrimony, offering wide scope for cultivation. *Corylus* is one of the most ancient sources of nuts known to human beings. Indeed, it is widely held to have been the first species of shrub to emerge after the last Ice Age, helped by its considerable capacity to establish itself in different environmental conditions – so much so that it is often used to anchor soils in areas prone to erosion. Varieties found in the Southern Caucasus include several types that produce few suckers and could therefore be used to produce single-trunk trees, a feature that would be highly attractive for production purposes.

The absence of suckers could lower maintenance costs and make mechanical harvesting easier.

In Georgia, the endemic varieties *Corylus colchica* Abb. and *C. imeretica* Kemular Nat. enabled P.M. Zhukovsky to consider the Southern Caucasus one of the centres of origin of the genus. Hazelnuts have the advantages of being easy to transport and keep for long periods. The hazelnut has one of the highest fat contents of any fruits, they can be either eaten fresh or toasted and, in some cases, as in the preparation of cosmetics, they can be used while still unripe. They have a high nutritional value and are extensively used in cakes and biscuits, and for the preparation of poultry and vegetable dishes. There are also genotypes with unusual traits, such as red fruits or, like the cultivar *Badam*, a nut in the shape of an almond. Both features make them suitable for niche markets.



The almond is one of the world's oldest nut crops and is an essential component of a healthy diet. It has a high content of healthy fats, vitamins E and B2, magnesium and potassium

Almond (*Amygdalus* spp.)

Armenian	<i>Nush, Badam</i>
Azeri	<i>Badam</i>
Georgian	<i>Nushi</i>

The almond is a drupaceous tree and is generally the first to blossom: a genetic characteristic that has aesthetic advantages, but that is a serious drawback from an agronomic point of view since it restricts cultivation to those varieties that flower late and are therefore not at risk from spring frosts. In order to tackle this problem, a number of late-flowering genotypes have been selected locally, although the quality of the almonds cannot compete with that of Californian almonds, which are the benchmark for international marketing. Three almond species are found in Azerbaijan, the common almond (*Amygdalus communis* L.), the mountain almond (*A. fenzliana* Fritch. Lipsky) and the Nair almond (*A. nairica* Fed. et Takht.), which are widespread naturally. The village of Badamli, Nakhchivan, bears evidence of long cultivation of almonds. By using this gene pool, the local population has selected almond accessions with valuable agronomic indicators through folk selection methods and has cultivated these almonds in their households.

The application of traditional selection methods has resulted in the emergence of high-quality almond varieties such as *Saray*, *Apsheron*, *Shahbuz* and *Novrasta*.

The almond has two clear advantages over many other types of fruit – it keeps for long periods and is easily transportable. In the Southern Caucasus, growers have also developed numerous ways of exploiting its suitability for processing, especially in confectionery. Two almond species, *A. fenzliana* Fritch. and *A. georgica* Desf., could have value as dwarfing rootstocks for other drupaceous species.

Fig (*Ficus* spp.)

Armenian	<i>Tuz</i>
Azeri	<i>Enjir</i>
Georgian	<i>Leghvi</i>

The genus *Ficus* includes some 1 000 species, most of which are evergreen. In subtropical climates, a few deciduous species exist, among which the edible *F. carica* L., found throughout the Caucasus as the following types:



Fresh figs contain up to 25 percent sugar, mainly fructose and glucose, which is easily assimilated by humans

- ❁ *Ficus carica silvestris*, or wild fig tree, that can be used as a pollinizer;
- ❁ *F. carica hortensis*, which does not require pollination, since it has partenocarpic fruits;
- ❁ *F. carica smirniaca*, which requires pollination in order to bear fruit;
- ❁ *F. carica intermedia*, whose flowers produce fruit without pollination if they are formed on branches from the previous year. Those formed on branches of the current year need pollination if they are to bear fruit.

The process of producing fruit is extremely complex and involves a small insect, called *Blastophaga psenes* L., measuring 2.5 mm, which lives in the fruit of the wild fig tree. The male insect, which is wingless, fertilizes the female – which is larger, black in colour and has wings – before dying. As the fertilized female insects swarm, and leave the fruit – the first of the two fruitings that occur each year in the wild fig tree – they become covered with pollen.

The females then transfer the pollen to the flowers of the female fig, where they lay their eggs. Here, brushing against the style of the gynaecium, they pollinate the tree.

The flowers that give rise to the first production of figs bloom in May and the fruit ripens in July (the early harvest crop called “Breba”). The flowers that produce the second crop of figs form in July, with the fruit ripening in September. The flowers producing the next set of fruit form in September, with the fruit ripening in May of the following year.

Fresh figs contain up to 25 percent sugar, while the figure may be as high as 75 percent in the case of dried figs. Around 90 percent of the sugars are made up of fructose and glucose, two glucides that are easily assimilated by the human organism. The fruit is rich in P, Fe, Mg and Cu, thiamine (vitamin B1), riboflavin (vitamin B2) and carotene (vitamin A). The fig is a hardy tree that thrives even in conditions of dry heat, although it does not easily tolerate excessively wet conditions and cannot survive at temperatures lower than -17°C . The form of the tree changes according to the conditions – it may grow as a shrub, with several trunks, or as a tree, with a single trunk and several branches. It is an easy species to propagate, either by suckers, by cutting or by grafting. Propagating by seed is also simple, but in this case the genetic characteristics of the mother plant are not passed on.



Pear (*Pyrus* spp.)

Armenian	<i>Tandzeni, Tandz, Panta</i>
Azeri	<i>Armud</i>
Georgian	<i>Mskhali, Panta Mskhali</i> (wild)

Vavilov indicated three centres of diversification of the cultivated pear, divided by geographic area: China, Central Asia (including northern India, Afghanistan, Tajikistan, Uzbekistan and West Kiamscian) and the Southern Caucasus. The most common species of *Pyrus* that can be found here are:

- ✿ *P. communis* L.: the tree grows up to 20 m. Wide pyramid-shape, with or without thorns. Long-living. Small, oval leaves. Flesh is sharp and acid.
- ✿ *P. caucasica* Fed.: the tree grows up to 25 m; long-living. Round to oval leaves and roundish fruit. Flesh is sharp and acid. Prefers sunny zones.
- ✿ *P. salicifolia* Pall.: the tree grows to between 8 and 10 m, is resistant to cold, droughts, saline or rocky soils. Lanceolate, hairy, silvery leaves. Flesh has fibrous glomerules. Used as rootstock.
- ✿ *P. siriaca* Boiss.: large tree (10 m), pyramid-shaped. Fruit is classic pear shape.



Pear wood is highly prized and is used to make tools, instruments and furniture. This has caused the genetic erosion of giant centenary pear trees, making it increasingly difficult to find them.

<<Left: a 150-year-old pear tree



Pears were already widely cultivated by ancient civilizations and today many cultivated and wild pear varieties can still be found in the Southern Caucasus

In Armenia, pear trees are less cold resistant than other species, such as apples, and are cultivated mainly in the Ararat Valley. Soil type plays a decisive role since many parts of the country have calcareous-clay soils, making the pear vulnerable to chlorosis. Varieties of pear found in Armenia have the same origin as those grown in Azerbaijan and Georgia. They are divided into three groups.

❁ The first group consists of long-established pear varieties that ripen in summer. They are propagated by suckers and produce a small fruit, similar to that of the wild pear tree, with a very sweet, aromatic flesh that is well suited to drying. This type of pear is called *Panta* or *Amarva tandz*, meaning “summer pear”, or *Katuk tandz*, meaning “pear that falls”. The latter name comes from the Kafan region where trees grow

so tall – up to 20 m – that the fruit cannot be reached and harvesting has to wait until the pears drop to the ground. Another local name is *Megra tandz*, meaning “honey-tasting”, a clear reference to the fruit’s very sweet flavour.

❁ The second group covers varieties of pear that ripen in autumn or winter. They have coarse, juicy flesh with a slightly acid taste and a large number of sclereids. The trees are vigorous and have good resistance to disease and aphids, but they are vulnerable to attacks by *Septoria piricola*. This group includes several Armenian varieties, such as *Dzmer nuk*, *Kaghani tandz* and *Isha tandz*, as well as varieties from Azerbaijan, such as *Nar Armudi*, and from Georgia, such as *Khechchuri*. It is believed that the group, which is typical of the Southern Caucasus area, is derived from the Chinese pear and is a hybrid of *P. salicifolia* Pall. x *P. communis* L.

✿ The third group comprises varieties of pear that are recognizable from certain characteristics, including the thickness of the leaves and the shape and flavour of the fruit. They are generally small trees, with thin leaves and fruit that ripens in summer or early autumn. The flesh is soft, aromatic and juicy, with a sweet-sour taste. Among cultivars belonging to this group are *Malacha*, *Adriani*, *Sini*, *Emsba*, *Eghvard tandz*, *Gulab* and *Nanaziri*.

Only two of the 18 species growing in Azerbaijan are cultivated: *P. communis* L. and *P. serotina* Rehd in the Sheki-Zagatala and Quba-Khachmaz regions; 14 wild forms and over 170 local varieties have been found that have not yet been described in the literature. *P. salicifolia* Pall can grow in very arid and stony terrains where no other tree can flourish.

Over centuries, the local population has selected different pear forms from forests for their distinguishable characteristics and cultivated them in their households, which resulted in the emergence of hundreds of local pear varieties. According to the academician Ahmad Rajabli, once there were more than 400 folk selection varieties of pear in Azerbaijan, half of which are under threat of disappearance. But, in spite of this, one can still find undocumented forms in forests and households.

Pears have been cultivated in Georgia for centuries. Even today, ancient pear trees can be found, belonging to the old and popular *Panta mskhali* local variety. Pears were widely used by a variety of ancient civilizations. The ancient Greeks had advanced knowledge of the fruit and of growing techniques. They knew about seed propagation and rootstocks and used various methods to fight parasites. They also understood the importance of cross-pollination for improving production and adopted techniques to bring forward the tree's fruiting period.

One such practice involved driving a stake into the trunk, in order to weaken the tree and force it to bear fruit more quickly.

Among the varieties found in the Southern Caucasus, some are resistant to scabies, one of the most dangerous parasites, and to the dreaded fire blight (*Erwinia amylovora*), and they could be used in programmes of genetic improvement of European pear varieties. Some pear genotypes – among them the variety *Buldurcimbudu* (meaning “quail thigh” in Azeri) – have dwarfing characteristics. Thus far, the challenge of dwarfing pear trees has only been tackled by using quince trees as a rootstock, in order to reduce the pear's vigour. Finally, several pear varieties are valuable for their large fruit and good flavour, such as the *Kban armudu* pear variety observed in the farmholding of Zulfugar.

Quince (*Cydonia oblonga* Mill.)

Armenian	<i>Serkevil</i>
Azeri	<i>Heyva</i>
Georgian	<i>Komsbi, Bia</i>

The quince is a small deciduous tree, many varieties of which can be found in the Southern Caucasus. It is highly resistant to low temperatures and is propagated either by suckers or by grafting. Some varieties bear fruits that can be eaten fresh and others have fruits that can keep for long periods. Other varieties are suitable for processing, while some are valuable for their resistance to diseases. This genetic material, after testing to ensure grafting compatibility, could be useful as rootstock for pear trees.

The quince, in fact, as pear rootstock reduces the plant size and improves the fruit taste. If such tests prove positive, the nursery sector could derive significant benefits. Some quince varieties grow on soils with an active limestone level of over 5 percent, without symptoms of chlorosis, a characteristic rarely found in the current selection of quince rootstocks available in European nurseries. These Caucasian quinces, if positively tested for pear grafting compatibility, could contribute to the development of pear orchards also on limestone soils.



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1: *Amygdalus communis*, 2: *Juglans regia*, 3: *Cucurbita pepo*, 4: *Hippophae rhamnoides*, 5: *Punica granatum*, 6: *Malus orientalis*, 7: *Prunus divaricata*, 8: *Castanea sativa*, 9: *Rubus idaeus* [Source: ТРОССГЕЙМ, А.А. 1952. РАСТИТЕЛЬНЫЕ БОГАТСТВА КАВКАЗА. МОСКОВСКОЕ ОБЩЕСТВО ИСПЫТАТЕЛЕЙ ПРИРОДЫ. МОСКВА.]



THE ORIGIN OF LEGUME-GROWING PRACTICES

Pulses have been discovered in many archaeological sites where cereal remains were found. The association of legumes with the chaff of domesticated cereals assumes the synchronous development of cultivation between legumes and cereals. Legume plants (family Fabaceae) are particularly adapted to withstand seasonal climatic fluctuations and demonstrate a high degree of adaptability. They have hypogeal germination that protects seedlings from frost, wind, insects and grazing damage. Thanks to their tolerance, grain legumes survived major climatic changes at the end of the Pliocene and were available for collection by humans.

Legumes are generally high in protein and carbohydrate content. Some of them are easily assimilated while others are less palatable and need to be cooked before becoming edible. Their importance in the diets of people in the Southern Caucasus is witnessed by the large variety of legume-based dishes in the traditional cuisine and by the many cultivated forms that can be found in gardens.

In addition to their importance for balanced human diets, grain and forage legumes fix atmospheric nitrogen (N) through soil bacteria (*rhizobia*) contained in nodules on their roots. The N is used by the plant to grow and is also transferred to subsequent crops, increasing their yields. Legumes contribute to improving physical and chemical soil properties and are therefore essential elements of sustainable agriculture production systems. A progressive shift from N fertilizers to N-fixing legumes would seem to be highly desirable in the context of the increasing prices of fossil fuels and mineral fertilizers, and to reduce emissions from the agriculture sector.



It has been estimated that, globally, current biological nitrogen fixation (BNF) by crop legumes is 20 to 22 million tonnes of N each year and there is potential to increase this amount if relevant biological processes are promoted within legume-based production systems, either as green manure, planted in intercropping systems or as part of a scheme of crop rotation. This contribution has tremendous potential to sustain agriculture production systems in the future, contributing to more economically viable and environmentally friendly agriculture.

Pulses have been cultivated in the Southern Caucasus since time immemorial. Remains of mixed cereals and pulses have been found in many archaeological sites, confirming their synchronous development in the dawn of agriculture. Beans being sundried (above) <<Left: Gulperi Abdullazade with a dish of beans from her family garden in Yeniyol village



Legumes have the ability to fix atmospheric nitrogen, making the land fertile for the next crop and reducing the need for fertilizers. Vazhe and Vano Loladze of the Elkana NGO in their chickpea field, and a close-up of a chickpea plant. >>Right: immature green peas

Chickpea (*Cicer arietinum* L.)

Armenian	<i>Siser</i>
Azeri	<i>Nokbud</i>
Georgian	<i>Mukbudo</i>

Different geographic groups of cultivated chickpea species (*Cicer arietinum* L.) are found in the countries of the Southern Caucasus. A total of 51 subspecies of cultivated chickpeas are registered. In addition, there are dozens of ecotypes, which are characterized by the shape and colouring of the seeds. The shapes of chickpeas vary. In dry climate conditions, the seeds are usually angular with thick skins. In humid conditions, they are bean-like with thin skins.

The seed skin may be white, yellow, pink, brick-red, grey, brown, red-purple or multicoloured. There is a relationship between the flower colouring, shape and seeds. Local chickpea varieties are extremely diverse; most are endemic in the Southern Caucasus

and represent great value in terms of selection. Unfortunately, local varieties are rarely cultivated at present. Chickpeas have been used in cooking over the generations, for instance in *lablabi* (a well-known dessert) and in *dovga*, *dolma*, *bozbash* and *piti*.

Vetch (*Vicia* spp.)

Armenian	<i>Gjulul</i>
Azeri	<i>Larga, Cholnokbudu, Inek nokbudu</i>
Georgian	<i>Tsertsvela</i>

Vetch is a perennial, rarely annual, or biennial herbaceous plant. Most species are weeds and grow in fields under winter and spring crops. Some varieties, e.g. *Vicia sativa* (common vetch) and *V. villosa* (hairy vetch), may be cultivated as forage herbs in low mountain and foothill zones. Roots are spindly, and stalks are branchy, stagnant or unfolded and villous. Vetch blooms from June to July. The seeds are round. Vetch is a valuable forage crop, rich in proteins.



Green pea (*Pisum sativum* L.)

Armenian	<i>Volor</i>
Azeri	<i>Goy nokhud</i>
Georgian	<i>Mtsvane, Barda</i>

The Southern Caucasus is a centre of origin of the green pea. It grows mainly in subalpine zones. The *Pisum sativum* L. variety is cultivated. It has two subspecies: *sativum*, ordinary green pea, and *arvense*, field green pea. Many interesting old green pea varieties and populations exist in Armenia. For instance, in Salvard village, Sisian region, there are many local varieties with different morphological and biological characteristics. Wild species of these peas are of great interest and sometimes they are named as a separate variety, e.g. *P. arvense* L. (*P. sativum* conv. *speciosum* [Dierb.] Alef.) – green peas, field green peas, *gyulul*. Single green pea plants may be found in sown areas under local varieties of wheat and barley. They are currently cultivated less often, and thus may die out so it is important to protect them. They are characterized by the shape of their seeds and colour of the flowers, similar to the *Zangezour* local varieties of cultivated green peas.

Lentil (*Lens* spp.)

Armenian	<i>Vosp</i>
Azeri	<i>Marjimak, Marji</i>
Georgian	<i>Ospi, Ugrekbeli</i>

Lentils are cultivated almost exclusively in Azerbaijan (according to FAOSTAT, in 2008 Armenia produced 11 tonnes and Azerbaijan 1 900 tonnes), where they are one of the main traditional crops. The main species are *Lens culinaris* (food lentil, cultivated), *L. ervoides*, *L. orientalis* and *L. ervilia* (a French lentil). Numerous populations and local forms are specific to the southern Mugan region. A lentil with small seeds belonging to the *L. culinaris* species is widespread in the country. Some selection varieties are also available (such as *Azer* and *Arzu*). In the Southern Caucasus, lentils are mainly used in the Azeri cuisine. Local people in Azerbaijan make various dishes including soup, desserts, *dolma* and *plov* from lentils. The wild species is widespread in the low and medium mountain belts of the Caucasus range, Nakhchivan and the Talish regions in forests and shrubby lands on stony slopes and on rocks.



The rich diversity of legume species and varieties of the Southern Caucasus contributes to increasing soil fertility, regulating the variability of the climate and maintaining ecosystem functions



TABLE A



TABLE B



TABLE C



TABLE A: 1. *Pisum elatius* M.B. (Лерик в Тальше): 1a. – боб. – 2. *Cicer ervoides* (Sieb.) Fenzl (Каре). – 3. *Cicer anatolicum* Alef. (Ольты): – 4. *Vavilovia formosa* (Stev.) Fed. (хребет между Маднис-хеви и Эльбрусом): 4a –цветущая ветка. **TABLE B:** 1. *Hedysarum caucasicum* M.B. (Солух-даг в Дагестане): 1a – бобы.- 2. *Hedysarum formosum* Fisch. Et Mey. (Шорбулаг близ Еревана): 2a – бобы. **TABLE C:** 1. *Astragalus candolleanus* Boiss. (Ахура в Нахичеванской АССР). – 2. *Astragalus declinatus* Willd. (Пирдаудан): 2a – бобы. 3. *Astragalus cicer* L. (окр. Ставрополя). – 4. *Astragalus aureus* Willd. (Арагац). **TABLE D:** 1. *Ononis arvensis* L. (Гуниб.). – 2. *Cytisus caucasicus* Grossh. (Гагра Х Адлер): 2a – бобы- 3. *Teline monspessulana* (L.) Koch (Сочи). **TABLE E:** 1. *Gleditsia caspica* Dsf. (Ленкорань): 1a–боб. – 2. *Albizia julibrissin* Durazz. (Ленкорань): 2a – боб. **TABLE F:** 1. *Ornithopus compressus* L. (Келасури). – 2. *Glycyrrhiza glabra* L. (Тбилиси). – 3. *Glycyrrhiza echinata* L. (Майкоп). – 4. *Scorpiurus minima* A. Los. (Картмаши Х Х Карамарян). [Source: Grossheim, A.A. 1952. ФЛОРА КАВКАЗА, (Flora of the Caucasus). Vol. V-Rosaceae- Leguminosae. Moscow-Leningrad]

TABLE D



TABLE E



TABLE F





ARCHAEOLOGY OF LIVESTOCK KEEPING

Whether the spread of agropastoralism was a result of an increased number of hunter-gatherer groups or by farmers' colonization is uncertain. However, the integration of grain and livestock production in a system of mixed farming – in which cereals and pulses were grown in flatter, better-watered lowland soils and sheep and goats grazed and browsed on rougher upland terrain (whether locally or by means of seasonal transhumance) – proved to be effective, both ecologically and nutritionally, in sustaining the growing number of sedentary villages.

The bones of domestic cattle dating back to the fifth millennium BC were found during an archaeological dig in Georgia. Cattle domesticated from wild aurochs have served the Georgian people for more than 7 000 years.

Archaeological materials and ethnographic data provide evidence of sheep breeding and its role in the development of the Southern Caucasus. The oldest Kolkheti-Greek epos – the legend of the Argonauts and the Golden Fleece – might refer to the old tradition of using sheep skins to collect golden flecks in rivers.

Cattle breeding provided meat, milk, skins and draught power. According to archaeological data, butter was prepared in clay wares during the Neolithic. In the fourth century BC, Hippocrates described the Scythian practice of butter preparation in wooden wares. Butter was called *buttirons*. This name spread throughout Western Europe. A butter beater made not of wood, but of burnt clay, a better-quality material, was used in the early centuries and can occasionally still be found in some mountainous areas.



Sheep grazing in the Vorotan Valley, Syunik Marz, Armenia. The integration of grain and livestock production proved to be effective in sustaining the growing number of sedentary villages in the early stages of agricultural development. <<Left: Ilhama Abdulhamidova, in Kish, makes butter with a traditional churn. It is a long and tiring job: the churn must be pushed back and forth for about an hour in order to separate the butter from the buttermilk

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DIVERSIFICATION FOR ADAPTATION

SINCE THE NEOLITHIC, AGRICULTURE HAS BEEN BASED ON DIVERSIFICATION IN ORDER TO MAKE THE MOST EFFICIENT USE OF THE TEMPERATURE VARIATIONS, DIFFERENT TYPES OF SOIL, VARIOUS WATER SOURCES, AND VARIOUS SPECIES OF CROPS AND ANIMALS THAT EXIST IN NATURE AND IN ORDER TO PROVIDE BALANCED MIXED NUTRIENT ELEMENTS TO HUMANITY, INCLUDING ENERGY SOURCES, PROTEINS, VITAMINS, MINERAL SALTS AND FIBRES.

Diversification of agriculture and food production through landscape management enhances the resistance to pests and diseases, the maintenance of soil fertility and implies a reduced use of energy, among other features. Today, scientific evidence demonstrates that diversification contributes to increasing resilience to climatic and economic fluctuations that affect agricultural production and the billions of poor and rural populations depending upon it.

Yet diversification of crops and livestock is also important to avoid excessive food waste and to enable small farmers and their production capacity to reach the markets.

A larger, collective effort should go into promoting agricultural production and consumption habits based on diversification. Consumers are already requesting food more adapted to their health and lifestyles. They are increasingly paying attention to food that is produced according to seasonality, territoriality and quality requirements.

Farmers will need to readapt their crops and livestock to their territories, and provide a diversified, integrated and advantageous offer for the consumer. Local and national policy-makers will have to accompany this change and science and breeding activities will need to enlarge their programmes and provide new seed bases relying on the many seed and genetic resources that can sustain diversification of agriculture.

The Southern Caucasus with its genetic resources should be at the centre of this agricultural diversification process.





AT THE CROSSROADS BETWEEN EAST AND WEST
IN THREE HOSPITABLE COUNTRIES
AGRICULTURE AND BREEDING WERE DEVELOPED SINCE THE NEOLITHIC

COPING WITH THE RHYTHMS OF THE SEASONS

A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS
TO MAKE BREAD, CHEESE AND WINE
PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES
RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Հաղթահարելով տարվա եղանակների վայրիվերումները

Բժսիլերի առօրյա սպասարկում

Տեղական օրվերների կառավարում

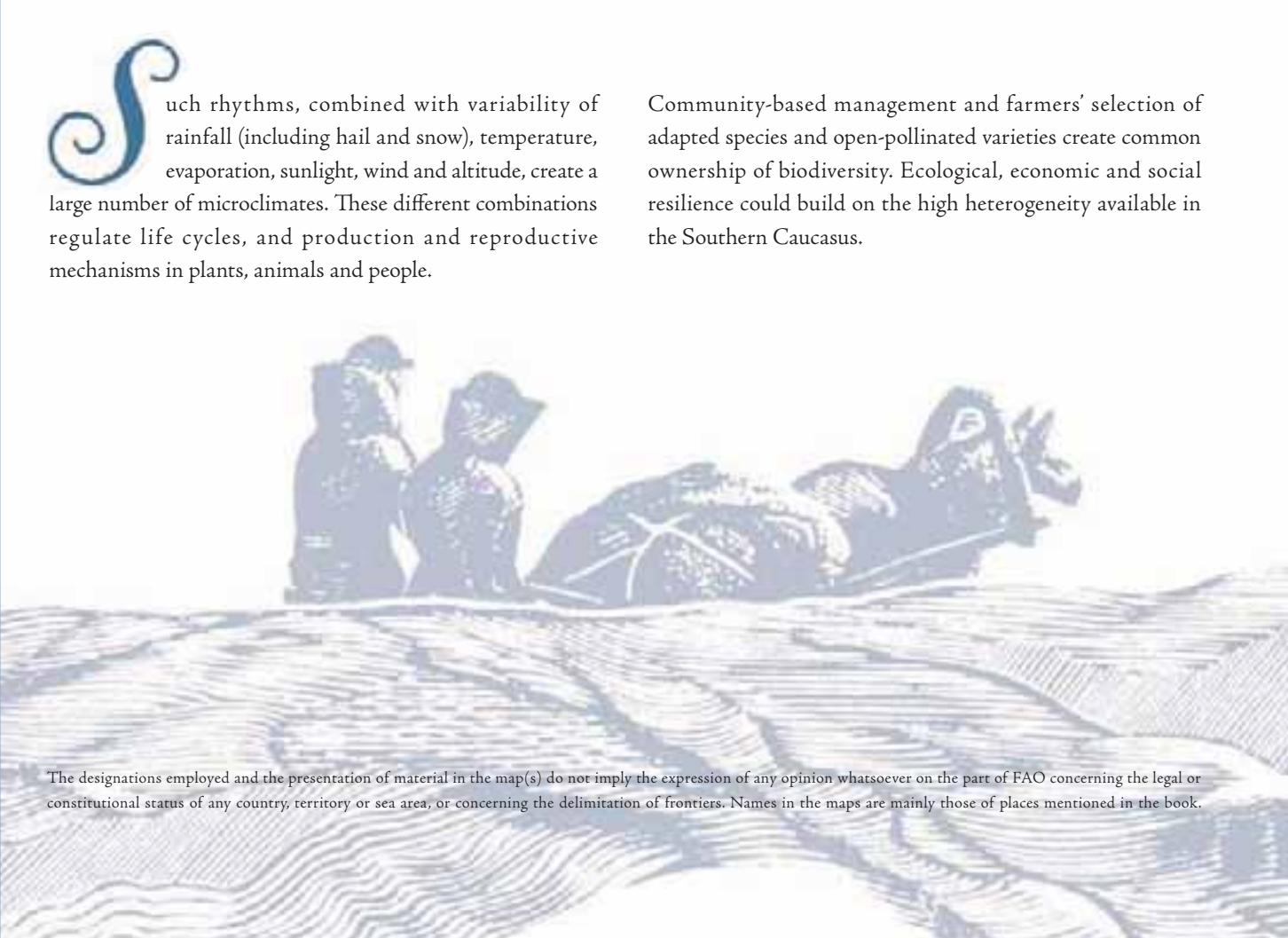
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INTRODUCTION

THE SOUTHERN CAUCASUS IS CHARACTERIZED BY DIFFERENT CLIMATIC PATTERNS, DEPENDING ON ALTITUDE, INFLUENCE OF MOUNTAIN RANGES AND WATER BASINS, BUT ALL THE REGIONS SHARE ONE IMPORTANT FEATURE: SEASONALITY. IN FACT, THE TERRITORY SPREADS OVER A LIMITED RANGE OF LATITUDES, BETWEEN 38° AND 43°N, WHICH MEANS THAT FROM SUHUMI IN NORTHWESTERN GEORGIA TO LANKARAN IN SOUTHEASTERN AZERBAIJAN, THERE ARE MANY CHANGES IN LANDSCAPES, CLIMATE, FAUNA AND FLORA. YET DAY BY DAY THE SUN RISES AND SETS AT PRACTICALLY THE SAME TIME, AND ALL THE LIVING ORGANISMS HAVE HAD TO ADAPT TO THE SAME RHYTHMS OF THE SEASONS: SPRING, SUMMER, AUTUMN AND WINTER.

Such rhythms, combined with variability of rainfall (including hail and snow), temperature, evaporation, sunlight, wind and altitude, create a large number of microclimates. These different combinations regulate life cycles, and production and reproductive mechanisms in plants, animals and people.

Community-based management and farmers' selection of adapted species and open-pollinated varieties create common ownership of biodiversity. Ecological, economic and social resilience could build on the high heterogeneity available in the Southern Caucasus.

A blue-tinted photograph showing a mountainous landscape. In the foreground, there are terraced fields. In the middle ground, a pack animal, possibly a mule or horse, is carrying a large load. Two people are standing near the animal, one appears to be leading it. The background shows more mountains under a clear sky.

The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers. Names in the maps are mainly those of places mentioned in the book.



The Southern Caucasus lies in the temperate zone. Its climate is characterized by the rhythm of the four seasons: spring, summer, autumn and winter. *Overleaf: winter and summer views of the same apple orchard (left) and family garden (right)*

SEASONAL FLUCTUATIONS AND FOOD PRODUCTION

Farmers have chosen crops and agronomic management practices in order to produce sufficient and good-quality food and ensure food security on a yearly basis. The purpose of food stability is to ensure adequate food at all times for their households and cope with climate risks. Early- and late-producing fruit trees have been grown in order to extend the period of availability of fresh fruits and adapt to climate variability and unpredictable weather conditions such as late frosts, storms and prolonged droughts. Cereals, fruits and vegetables suitable for preservation have been cultivated in order to have good-quality food

particularly throughout the long winters. Plants and animals have been chosen with specific characteristics of resistance to pest and disease attacks, as well as for their capacity to mature on poor soils, and their adaptability to make the best use of solar radiation in the climate of the Southern Caucasus.

New challenges that may be faced by agriculture through the negative effects of climate change could build on the experience gained by farmers and the genetic resources they have maintained.







ADAPTATION OF PLANTS TO SEASONAL CYCLES

ACCLIMATIZATION

Annual crops such as wheat and rye have had to develop adaptive mechanisms in order to survive low winter temperatures, defined as acclimatization. At the end of the warm season, plants are mere seedlings and their crowns are located about 5 cm below the soil surface. The acclimatization process is regulated by the temperature at that level. When temperatures fall below 10 °C, the crowns gradually harden and growth stops. The plants can then survive the cold season.

At the beginning of spring, when the temperature in the soil rises again, the crowns gradually soften and growth restarts. The degree of low temperature tolerance depends on the genetic potential of the plant. If the temperature becomes very low and the soil freezes, the crowns will be damaged and most of the plants will die. The acclimatization process is gradual because the temperature in the soil is more stable than at the soil surface; this helps the plants to survive sudden changes in temperature that may occur, especially at the beginning and at the end of the cold season.

SOLAR RADIATION AND EVAPOTRANSPIRATION

by Michele Bernardi

The development of green plants, which form the basis of the world's agricultural systems, is regulated by light duration and intensity through chlorophyll synthesis, the process that transforms solar radiation into biochemical products.

In temperate areas, the duration of useful solar radiation reaches 16–18 hours during the summer, as compared with the duration of only 10–12 hours over the year in tropical areas.



Plant species in the Southern Caucasus are well adapted to seasonal cycles. Acclimatization is the process through which annual crops can survive the cold season





The experience gained by farmers, the genetic resources that they have maintained, the efficient use of energy and nutrients and waste management are essential to adapt agricultural production systems to climatic variations

Furthermore, at higher altitudes the solar radiation intensity is higher; in contrast, in tropical monsoon areas, cloudy weather decreases light intensity. These differences explain why some summer basic food crops such as maize, rice and sorghum can reach production rates of up to 10 tonnes of grains/ha in 100 days in temperate areas, while 150 or more days are needed to reach the same yield in tropical areas.

The Southern Caucasus, with its combination of seasonal cycles and relatively high altitudes, experiences a high level of sunshine hours and consequently has great production potential for summer crops.

Evapotranspiration measures the amount of water that vaporizes from soil, waterbodies and plant cover. Evaporation and transpiration occur simultaneously and there is no easy way of distinguishing between the two processes. Apart from the water availability in the topsoil, the evaporation from a cropped soil is mainly determined by the fraction of the solar radiation reaching the soil surface. This fraction decreases over the growing period as the crop develops and the crop canopy shades more and more of the ground area. When the crop is small, water is predominantly lost by soil evaporation, but once the crop is well developed and completely covers the soil, transpiration becomes the main process.



Selection and cultivation programmes have to work on a larger number of species and varieties to ensure resilience of agriculture to climatic variations

Weather parameters, crop characteristics, management and environmental aspects are factors affecting evaporation and transpiration. The principal weather parameters affecting evapotranspiration are radiation, air temperature, humidity and wind speed. Density and type of vegetative cover, soil moisture and root depth also affect evapotranspiration. As a consequence, evapotranspiration rates follow seasonal cycles, but may vary significantly from site to site even within the same region. Farmers in the Southern Caucasus harbour a traditional knowledge of the variations of solar radiation and evapotranspiration that influence their crop production and they select their crops accordingly.

CLIMATIC VARIATIONS

According to the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, the “warming of the climate is unequivocal”, and therefore adaptation of agriculture is unavoidable. The Caucasus is especially vulnerable to droughts because it is highly dependent on snow melt and on rainfall variability and, at the same time, its economies are highly dependent on agriculture and there are few and poorly localized hydrometeorology observation stations. Summer droughts and increased temperatures will put additional stress on irrigated and perennial crops such as grapes. Intense rains and snow melt may increase the risk of slope erosion and soil degradation.



An efficient use of natural resources: a sulphuric hot water spring near Khudat, Khachmaz province, Azerbaijan (left) is used to heat a greenhouse in which vegetables such as cucumbers are produced (right)

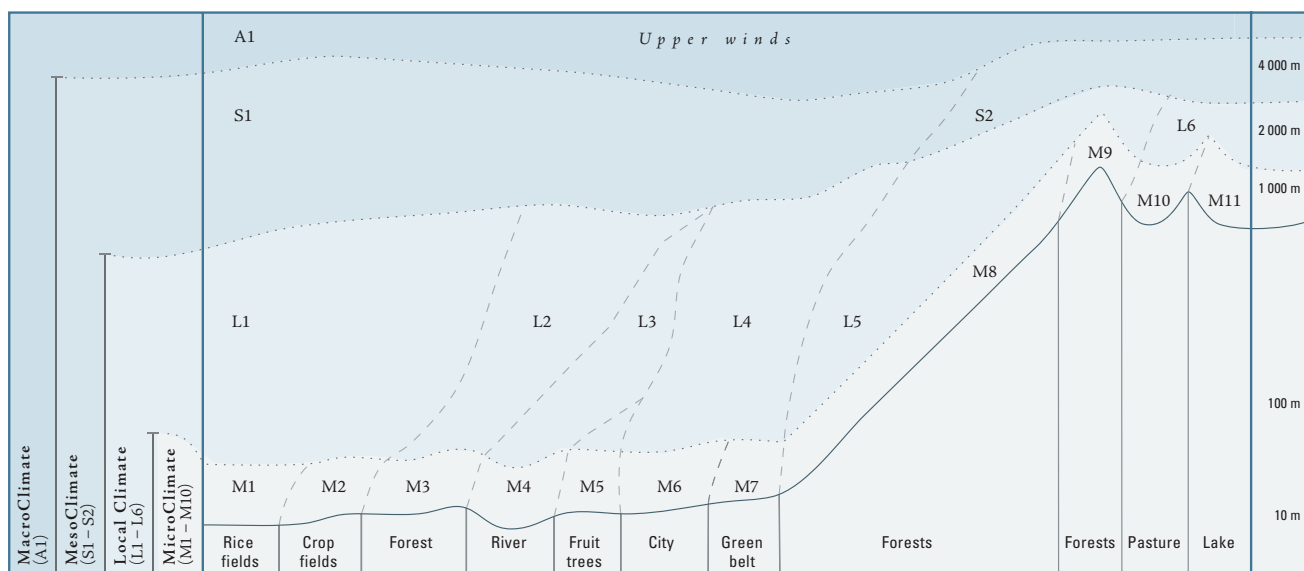
There is a need to acquire a better understanding of the mechanisms that can increase resilience of agriculture and capture synergies between food security, adaptation and mitigation in order to add value to the work of those farmers who adopt them in their farms and family gardens. Some factors, such as unfavourable temperatures, droughts and soaring global food prices are beyond the control of farmers, while others can be influenced by them. For example, many farmers influence biological nitrogen fixation through legume cropping, and a progressive shift from nitrogen (N) fertilizers to N-fixing legumes could be more widely adopted, given sufficient technical and market support and information.

Well-motivated farmers also have the potential to adopt more ecological management practices for their machinery (such as tractors, hay dryers, water pumps) to help contain costs, minimize energy consumption, lower carbon dioxide emissions and increase the adoption of technologies and biological

processes using renewable energies. Efficient technologies and machinery need to be developed that respond to the needs of small farmers and are adapted to operate in their ecological and social context. Rehabilitating degraded grassland and adopting improved grazing land management practices have also much to offer to food security, rural development and mitigation. The World Summit on Food Security Declaration, FAO, Rome, 18 November 2009, states:

“It is necessary to enable all farmers to adapt to, and mitigate the impact of, climate change through appropriate technologies and practices that improve the resilience of farming systems, thus enhancing their food security.”

To achieve such goals, the global community should engage in developing models that are able to predict performance from different farming systems, including carbon dioxide accounts; provide information about adaptation and mitigation capacity



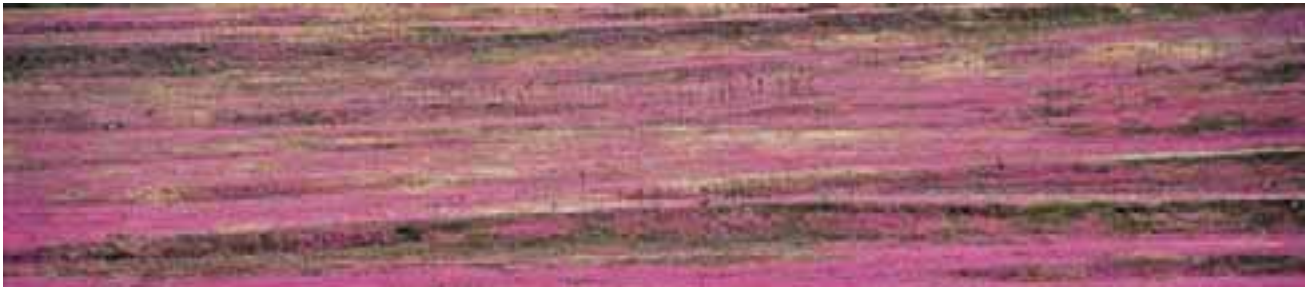
Models are needed to predict performance and provide information about adaptation capacity at local farm level. The figure depicts the relationship of climatic phenomena on the macro, meso, local and micro scale

Source: Bernardi, 2008, adapted from Yoshino, 1978

at local and national level; acquire a better understanding of synergies between adaptation, food security and mitigation and consider them as priority options for the required financing and possible elements in designing country agricultural implementation processes; and enhance investments in rural areas to allow countries to increase their capacity for producing sufficient and good-quality food for their citizens, while minimizing the impacts of climate change.

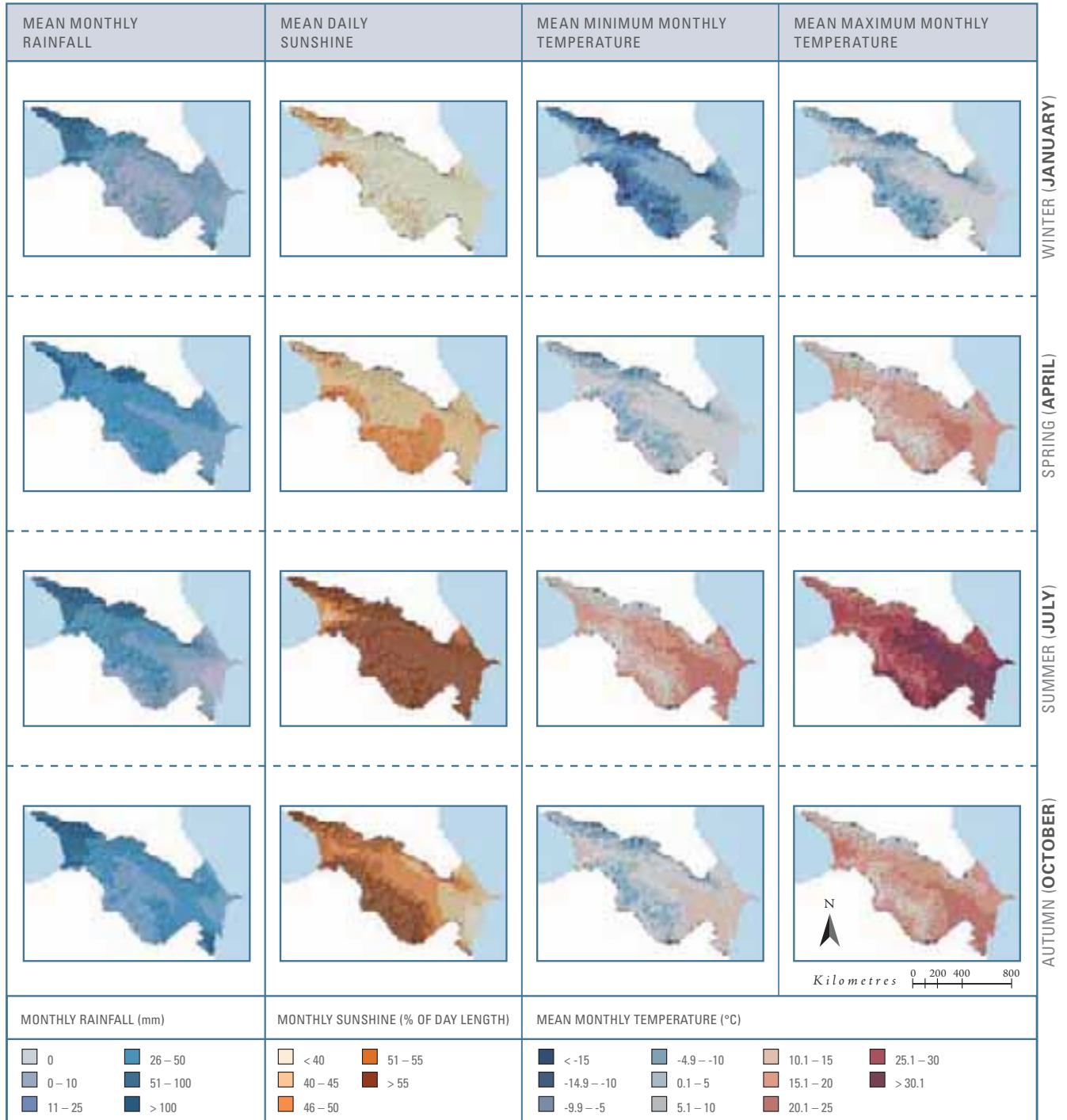
Crop seed selection is an important component of agriculture adaptation. Many underutilized and wild cereals, fruits and forages mentioned in this book are likely to assume greater importance as some of the current staples might become displaced. Selection and cultivation programmes have only worked on a very limited number of species and varieties up to now (e.g. out of the almost 10 000 existing grassland species, to date no more than 45 have undergone some form of selection and cultivation; and only four crops account for more than

50 percent of human calorie intake). It is therefore important to change this trend and characterize and evaluate a wider range of germplasm for avoidance, resistance or tolerance to major stresses associated with climate change, such as drought, heat, waterlogging and soil salinity. Research will also be needed to gain a better understanding of the physiological mechanisms, biochemical pathways and genetic systems involved in such features in order to enhance the natural capacity of plants to adapt to climatic variations. There will be a need to acquire information on the role of non-genetic inheritance in adaptation. These will be acquired through learning processes of phenotypic plasticity and epigenetic inheritance and ecological studies to complement our knowledge obtained under laboratory conditions. For this to happen it is necessary to adopt new research and development programmes and additional financial resources to screen and maintain germplasm for key agronomic systems now, as results are expected to be available in the next ten years.



The Caucasus thanks to the high level of sunshine hours has a great production potential of summer crops. Meanwhile, the region is particularly vulnerable to drought owing to the fact that it is dependent on snow melt and on rainfall variability and, at the same time, its economy is dependent on agriculture. Summer droughts and increased temperatures put additional stress on irrigated and perennial crops, and intense rains and snow melt may increase the risk of slope erosion and soil degradation. >>*Right:* four seasonal climatic maps showing the geographic distribution of monthly climatic variables: mean rainfall, mean daily sunshine and mean temperature

CLIMATIC MAPS



Resolution 10 arc minutes (16 km at the equator). Source data: CRU 2.0, HWSD derived SRTM DEM



ADAPTATION BY PEOPLE: FOOD PRESERVATION

The ability to process and preserve agricultural products locally is a fundamental component of food security because it provides good-quality food for rural people in non-productive seasons at a low cost and with limited energy consumption.

Many different techniques are used to preserve various types of products. Some examples are described in the following sections.

GURUT

Gurut is a milk product widely used in the western parts of Azerbaijan. In order to prepare *gurut*, yoghurt or *ayran* (a liquid separated when making fresh butter using traditional techniques) is filtered through a cloth until it becomes thick; it is then salted, shaped into a ball and dried. *Gurut* may be preserved for a long period of time and is consumed as a liquid, adding hot water and garlic.

DRIED MEAT

For a long time, people in the Southern Caucasus have consumed dried meat prepared from mutton or beef, especially during the long winters. After skinning the animal, the meat is salted. Then, it is cut into pieces (in order to facilitate the process of drying), rubbed and salted. The meat is often covered with gauze and then hung to dry.

Elene Gabidauri shows a container of salted sheep meat in Batsara-Babaneuri, Akhmeta district. >>Right: fruit preserves on sale at Teze bazaar in Baku. Many methods of preserving food have been developed in order to withstand the long winters, and with additional investment into improving traditional techniques and technologies, sanitation issues can also be addressed





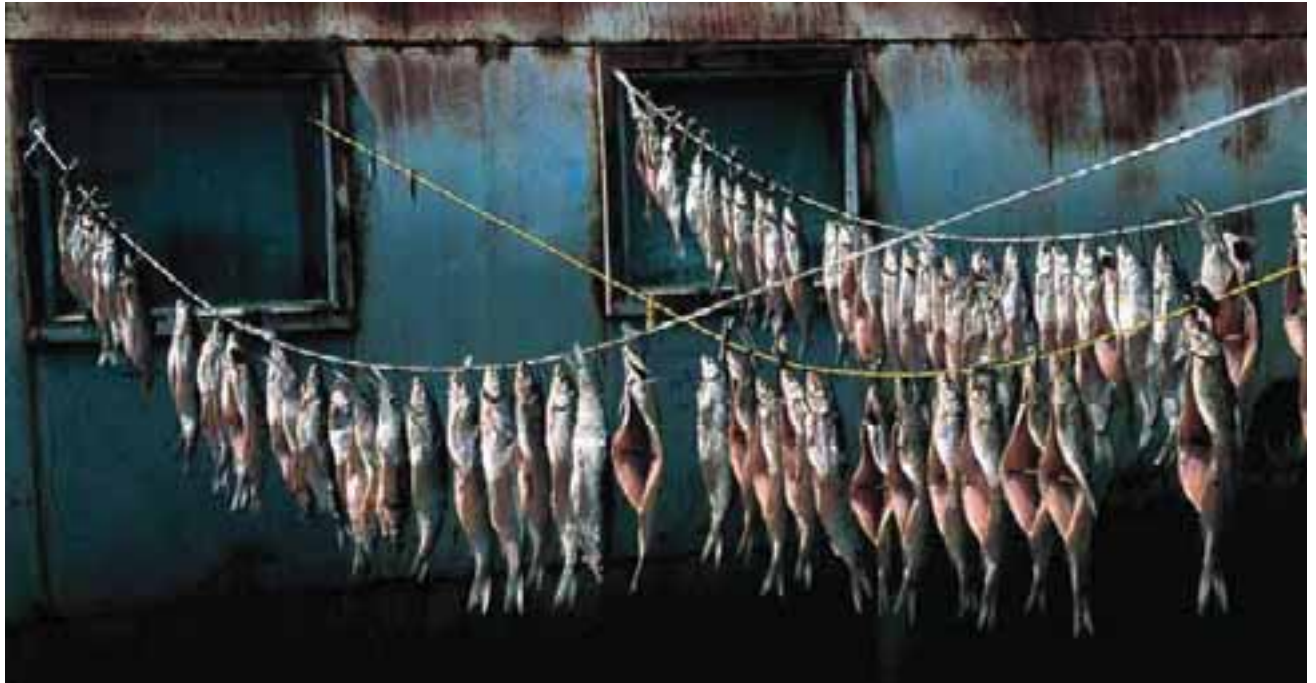
Preserved fish can frequently be found in markets and represents a good and affordable source of proteins

PRESERVED FISH

Freshwater fish caught in the inland waters of the Southern Caucasus is generally only cleaned and then sold directly along roadsides or at local markets.

The dynamic fish processing industry, which once could be found along the Georgian Black Sea coast (Kutaisi, Batumi and Suhumi) and, to a lesser extent, also in Azerbaijan, has largely ceased operations.

Nowadays, to preserve marine and brackish water fish, only two traditional methods are commonly used: after cleaning, the fish may be salted and hung, or it is smoked. While there are modern and hygienic sturgeon (caviar) processing facilities in Baku, which process the legal catch of this species, a significant part of sturgeon caviar is sold on the black market; smoked sturgeon meat is considered a delicacy by many Caucasians.



Traditional sun-drying technique of sigfish caught in Lake Sevan



**PROFESSOR
NARIMAN ZAMANOV**

by Marzio Marzot

At Banka village, on the left bank of the River Kür, a few kilometres away from the sea, there is a small cooperative for the preservation of fish by smoking. The site is currently closed and looks abandoned. All activities have ceased because fishing vessels prefer to deliver their fish to large-scale factories. It seems that all the small local firms

such as this one will also disappear, because there is no state support.

Professor Nariman Zamanov is a prominent member of this cooperative. He is a scientist, an expert in sturgeon breeding and caviar production. He proudly shows us the certificate that states his affiliation to the Russian Inventors' Association, as well as other documents and newspaper cuttings that talk about his discoveries and the awards he has received

regarding sturgeon and caviar. At the end, the professor kindly agrees to illustrate all the phases of the fish-smoking process: a very old tradition that – he affirms – dates back to prehistoric times. The fish he uses for the demonstration consist of some slices of beluga and a few carp.

First, the fish are washed in running water. Then the entrails are removed, the fish are salted and left to rest for five to eight days. The salt dries the flesh,

favouring preservation and adding flavour. The larger fish are then cut into slices and either hung in special cupboards or laid on horizontal trellises. As a rule, two days of smoking are sufficient. The substances absorbed by the flesh inhibit bacteria reproduction almost totally. Different types of wood give slightly different aromas. Smoking has antiseptic, antioxidant and antimicrobial properties, and gives the flesh a particular flavour that is highly appreciated by consumers.









A remarkable number of wild and cultivated forage plants are to be found in the Southern Caucasus. *Trifolium pratense* L., *Phleum pratense* L., *Trifolium repens* L., *Alopecurus pratensis* L. [Source: Newton, J. 2001. *Organic grassland*. Southampton, UK, Chalcombe Publications]

HAY

Hay is the oldest and most important preserved fodder, and can be made with simple equipment, manually or with mechanization. Farmers make hay to carry livestock through long winters. Crop residues, straw and stovers of the main field crops represent half of the biomass produced; in addition, hay is produced from mowing natural grasslands and is also widely cultivated (alfalfa, clover and vetch) in crop rotations and permanent pastures. Haymaking involves reducing the moisture content of cut forage from an initial 70–90 percent to 15–20 percent, which is highly dependent on the weather and demanding skills and judgement by the farmer.

The quality of hay varies greatly depending on the composition of the grasslands (generally legumes have a higher crude protein content than grasses and forbs), the timing of harvesting (early production of hay generally results in better-quality hay but less quantity) and soil types (influencing micronutrient content and species composition).

Hay production in the Caucasus is the basis of meat, milk and wool production and provides a good income. It is also important to maintain a healthy environment, good soils and abundant biodiversity in natural ecosystems. In Azerbaijan, it was found that in pastures subject to moderate and severe erosion, the quality of plant cover has become worse. Especially legumes (alfalfa, sainfoin, clover, lupin and sweet clover) disappear. Only those plants that are resistant to trampling and drought remain in the plant cover. Usually weeds (*Senecio* spp. and thistles) replace useful grasses in such pastures. It is important to improve regulations and grazing management practices to protect and restore the productivity of natural pastures.

Since drying reduces digestibility and animal intake of hay, new conservation methods such as ensiling have been introduced in recent years. But this is laborious without heavy machines and silage is not suitable for transport and marketing.



In recent years, the growth in the price of hay has made its production increasingly interesting as a source of income but its market value is still poorly known and analysed



In the mountainous region of Svaneti in Georgia, where machines cannot be used, farmers still use scythes to mow the grass. On the steepest slopes, farmers are tied to each other to prevent falling; they all climb together and swing their scythes simultaneously – a really remarkable scene.

In recent years, the rapid growth in animal stocks together with the decrease in productivity of natural pastures have caused an increase in the price of hay, making its production more and more interesting as a source of income.

The price of one tonne of hay is about USD270 in Armenia, USD120 in Azerbaijan and USD260-300 in Georgia.



Tklapi is an ingenious way of preserving fruit and is widespread not only in the Southern Caucasus but also in surrounding areas such as the northern Islamic Republic of Iran. Below: the family of Alkan Garayev show their production of preserves in a “Terra Madre” Presidium

JAM, SYRUP AND *TKLAPI*

Besides being eaten fresh, many fruits are preserved for winter. Like most farming cultures, families in the Southern Caucasus are masters in the art of making sure that nothing is wasted and that every available source of food and sustenance is either used immediately or preserved for later consumption. There are numerous local recipes for preparing jam from plums, apricots and wild berries. Some varieties are also cultivated for their processing suitability. Apples are fermented to make cider, alcohol or vinegar. One significant example of this approach is a preparation passed down through generations as a way of consuming excess fruit grown by the household or collected in the wild: *tklapi* a layer of boiled and sundried mulberries (or plum or other fruit), as thin as a sheet of paper.







In Mr Iadzet's household, Manana and Shushana prepare *churchella*, a type of *tklapi* made from mulberries

A GEORGIAN RECIPE FOR *TKLAPI*

The following recipe for *tklapi* originates from Georgia and is based on mulberries, but can be adapted to almost any kind of fruit; it is also diffused in Armenia and Azerbaijan. The mulberry fruit is first chopped finely to a pulp. It is then sieved and boiled until it is reduced to one-tenth of its original volume.

In a separate pan, a thick paste of wheat flour and water is prepared and added to the fruit concentrate at a ratio of 0.5 kg flour to three litres of fruit. After mixing well, the dense concentrate is spread over a clean linen cloth laid on the table. It is then left to dry in the sun for about a day.

When the mixture is ready, the opposite side of the cloth is lightly dampened, and the dried concentrate is lifted off and rolled up, and can be stored at room temperature for a long time. *Tklapi* can also be made without flour.





ADAPTATION BY PEOPLE: CULTIVATION OF CEREALS, FRUITS AND FORAGES

In order to obtain fresh quality food throughout the year, farmers maintain a mixture of different species and varieties. The main purpose is not to maximize total market production, but to ensure a continuum of production for consumption in the household.

COLD-RESISTANT CEREALS

The following two examples of cereals, rye and barley, have been cultivated for millennia for their resistance to cold winters and rusticity, respectively.

Some Caucasian varieties and wild species have not yet been fully studied and are of great selective value.

Rye (*Secale cereale* L.)

Armenian	<i>Ashora</i>
Azeri	<i>Chovdar</i>
Georgian	<i>Chvavi</i>

An important cereal that has adapted to the low temperatures of the mountainous regions in the Southern Caucasus is rye (*Secale cereale* L.). The scientist P. Zhukovsky has frequently mentioned the importance of the Southern Caucasian rich gene bank of rye (up to 23 subspecies) for selection purposes. *S. cereale* L. (2n=14) is the only cultivated variety. It has an annual cycle, occasionally biannual, and the grain is easily detached. Zhukovsky believes that this species originates from *S. segetale* Roshev. (2n=42), a species that is found in wheat fields in the mountains and hills, and is widespread in the region of Leric. There are also two varieties of *S. segetale*: the perennial *Pereunans decoprelebur*, which can be found in the three countries in weed-infested areas and on roadsides and *Rubebluiri* Roshev, found in wheat fields.



There are many wild species of rye in the mountains of the Southern Caucasus that would deserve research and protection because of their great potential to increase resilience to cold and long winters

An endemic species of rye is *S. vavilovii* Grossh. ($2n=14$), also called Caucasian rye. This species grows in sandy soils of volcanic origin in the hills at 600–900 m above sea level. *S. montanum* Guss. s.l. is on the list of those plants that have not yet been fully studied and are not used in the national economy. Many of its valuable subspecies were used in the past to obtain hybrids of perennial wheat. It is important to protect this variety, especially in its largest natural habitats, e.g. in Tsaghkadzor, Geghard, Jermouk and Nakhchivan.

Barley (*Hordeum* spp.)

Armenian	<i>Gari</i>
Azeri	<i>Arpa</i>
Georgian	<i>Keri</i>

Barley (*Hordeum vulgare* L.) is one of the most important cereals in the Southern Caucasus. It has been cultivated for thousands of years because of its rusticity and resistance to extreme seasonal

variations. Although populations of old local variety of barley are still preserved in different parts of the Southern Caucasus, barley-sown areas have diminished. In Armenia, seven wild species of barley can be found. The Armenian varieties and their intraspecific diversity have not been fully studied to date. They are normally used as forage crops, although they also have great selective value. Some interesting ones are the following.

H. violaceum Boiss. et Huet – purple barley. The crop usually grows in moist meadows. It is a valuable forage crop.

H. bulbosum L. – bulbous barley. This crop grows widely at altitudes of 700–2 200 m above sea level. Local people use the bulbs in the preparation of food. Different species also grow in some areas and have a height of over 2 m.

H. spontaneum C. Koch. – two-row wild barley. This crop is significant in terms of phylogenetic studies and was only recently discovered in Armenia.



A fruit orchard in spring in Baxili village. Unpredictable weather conditions such as early or late frost can severely affect fruit production. The selection of varieties in the Southern Caucasus should therefore be directed towards increasing resilience to climatic fluctuations
*Below: fruits on a persimmon tree (*Diospyros kaki*)*



Photo by A. Gasanov

FRUITS THROUGHOUT THE YEAR

The following three examples of perennial fruit trees, apple, cherry and cornelian cherry, help guarantee food for families throughout the year. Some Caucasian apple varieties can be stored for several months during the winter, while some cherry varieties have late-ripening characteristics and remain on the tree long after ripening.

Cherry (*Prunus* spp.)

Armenian	<i>Baleni</i> (sweet cherry), <i>Keraseni</i> (sour cherry)
Azeri	<i>Gilas</i> (sweet cherry), <i>Albali</i> , <i>Gilenar</i> (sour cherry)
Georgian	<i>Bali</i> (sweet cherry), <i>Alubali</i> (sour cherry)

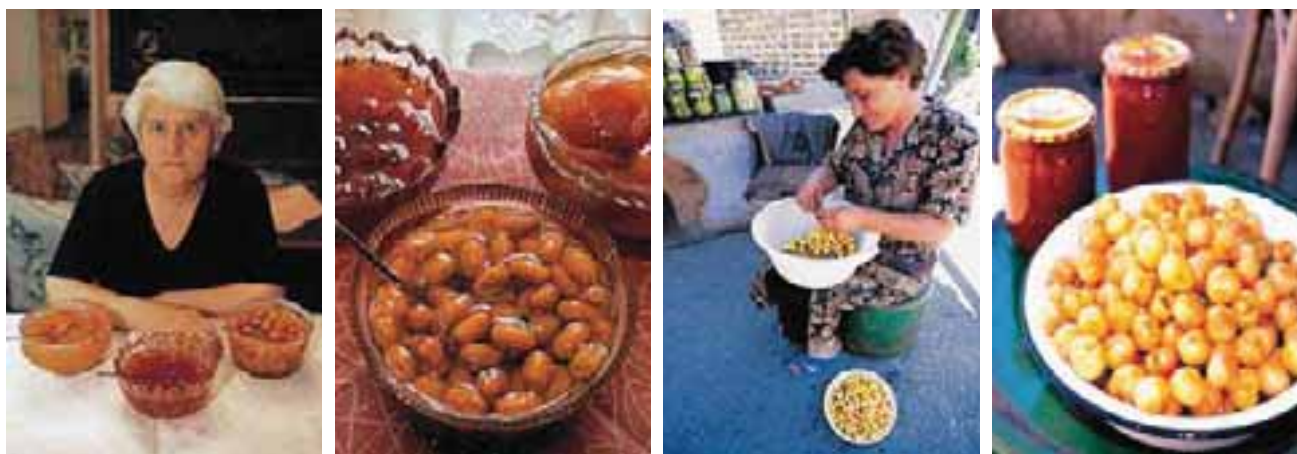
The cherry is a member of the *Prunus* genus and consists of two edible species – the *avium*, sweet cherry and the *cerasus*, sour cherry. The two species have also been classified as *Cerasus avium* Moench., in the case of the sweet cherry, and *C. vulgaris* Mill., in the case of the sour cherry. Both names are clearly derived from Kerasus, the city on the Black Sea from which this fruit was introduced to ancient Rome as early as 2 000 years ago. These distinctive trees are a feature of the Southern Caucasus landscape and culture. The species are used extensively in the region. One important feature of the cherry is that many varieties do not ripen simultaneously and therefore offer a continuum of fresh fruits over several months.

The sweet cherry is eaten both fresh and dried and is also used to make syrups and preserves or fermented to make liqueurs. The varieties found in Armenia, Azerbaijan and Georgia differ very little from each other. One common feature is that the cherries of the Southern Caucasus can be propagated by suckers, as well as by grafting. In Armenia, cherry trees tend to grow at random rather than in plantations. They are often planted at the edges of farms and smallholdings. The trees are extremely vigorous, growing to a height of 12 m, and they bear fruit from an early age, usually in the third year. The fruit generally weighs between 2.5 and 6 g, making it smaller than that of selected varieties grown intensively in plantations. Local varieties are also sensitive to late frosts and have a relatively low yield.

The varieties of cherry have been selected so that they ripen at different times during the season, thus ensuring fresh fruits over a longer period. Here, Gurgen Hovhannisyan harvests white cherries in his garden







The cherry is widespread throughout the Southern Caucasus. Besides being eaten fresh, the fruits are used to make syrups and conserves or fermented to make liqueurs. Women are incomparable in making preserves from fruits; family recipes are an important component in the cultural and social identity of families in the Southern Caucasus. <<Left: Voghchabert Village, Armenia, Lucine sells fresh cherries along the road – a very popular habit among small farmers

The fruit starts ripening towards the end of May, with the season lasting until the beginning of July. This type of cherry has a variegated colour and is eaten either fresh or dried.

The sour cherry is less common than the sweet cherry. In harsh winters in the Ararat Valley, where temperatures can plunge below -30°C , the tree can survive, although the harvest may be compromised. The sour cherry is richer in vitamins than the sweet cherry. Hybrids have been obtained by crossing the sour cherry with non-suckering sweet cherry varieties, which are propagated by grafting, either on to the sweet cherry or on to the *Mahaleb* cherry. These produce excellent fruit. In harsher climates, and especially in the Eastern Caucasus, where soils are arid, stony and calcareous, both types of cherries have been crossed with the *Mahaleb* cherry. Generally, their names derive from the places where they are grown. In the late nineteenth century, many selected varieties were imported from Russia and Europe. Nevertheless, local varieties continued to be prized for their particularly sweet and aromatic flavour.

A niche market for certain early-maturing cherry varieties, such as the Georgian *Kakha bali*, could be developed. The local improved variety does not have large fruit but could be used to improve other varieties genetically, in order to transmit the late-ripening characteristic to the offspring. In some varieties, the fruit remains on the tree long after ripening. This quality has been lost in many improved varieties, but the characteristic could prove useful in smallholdings and gardens, where growers may appreciate this natural way of drying or preserving fruit that is still fresh on the tree. Traditional preservation techniques, as well as germplasm collection, should be reinstated.

The cherry tree provides many gifts. The *Mahaleb* cherry (*P. mahaleb* Mill.) is used for decorative purposes, because of the particular shape of its flowers. Its wood is hard and aromatic; once refined and polished, it is used for furniture and for small objects, such as pipes or walking sticks. Infusions made from this wood have traditionally been used as a diuretic, while the leaves and fruit are distilled to produce an aromatic liquid used in the preparation of cosmetics.



A small farmer selling his own production of cornelian cherry in Teze bazaar in Baku

Cornelian cherry (*Cornus mas* L.)

Armenian	<i>Hon, Zokhal</i>
Azeri	<i>Zogal</i>
Georgian	<i>Shindi</i>

The cornelian cherry (*Cornus mas* L.) genus belongs to the Cornaceae family and grows in the wild in the Greater and Lesser Caucasus mountains in the Samur-Davachi and Alazan-Ayrichay valleys in Azerbaijan, from the plains up to medium mountain belts, in a composition of forests and shrubs, to 1 500 m above sea level.

Growing together with cherry-plum trees, sloe, hawthorn, dog roses, apples, pears, quinces, medlars, hazelnuts, elms, Christ's thorn trees and other plants, it forms impassable thickets. These thickets house multicoloured high-yielding forms with large fruits and small kernels.

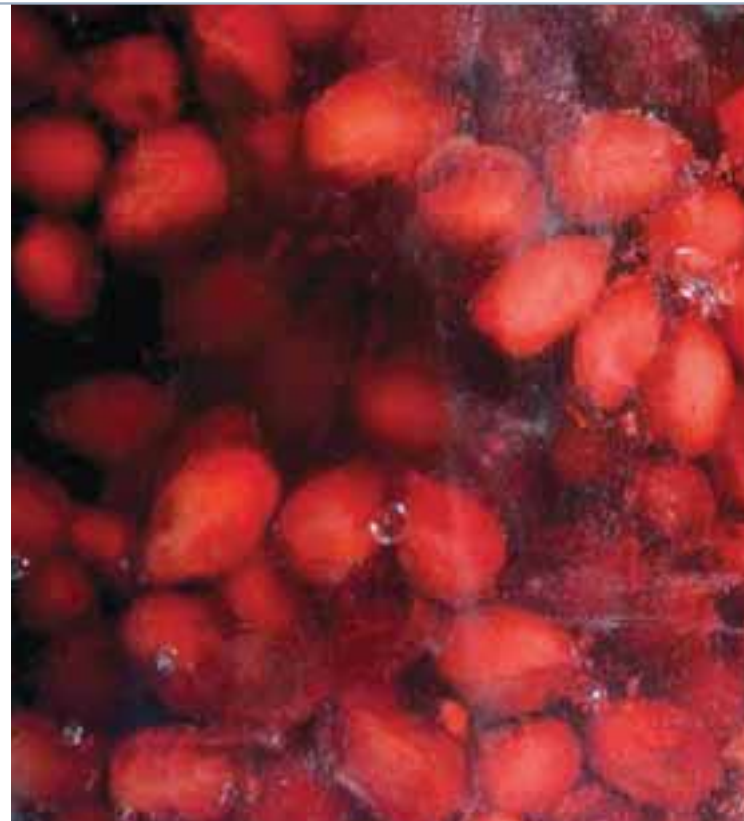
The fruits are oblong, round, oval, pear-shaped or cylindrical with a light-yellow, yellow, red, dark-red or black-red colour. By cultivating this valuable wild form, local people have developed a number of folk selection varieties such as *Gara zogal*, *Sari Kabraba zogal*, *Irimyvali zogal* and *Armudu zogal* as well as more than 40 other forms.



The fruits of the cornelian cherry have a slightly sour taste and are used to prepare jam, liqueurs and brine

The forests of Georgia are rich in wild varieties of cornelian cherries, such as *Cornus typica* Sanadze, var. *pyriformis* Sanadze with red fruit and var. *flava vest* with yellow fruit, ripening from the end of August to the middle of October. There is a folk tale about the pale colour of yellow cornelian cherry fruits:

Once upon a time, the cherry said to the cornelian cherry: “You have only one colour to be proud of, but see how multicoloured and tasty I am”. The cornelian cherry grieved about this, and its fruits became paler and paler. But it started to multiply in order to tease the cherry trees.





A more standard quality of fruit production can be reached by spreading rare local varieties, such as the Georgian Sinap apple, with its characteristic elongated shape

Apple (*Malus* spp.)

Armenian	<i>Kbndzoreni</i>
Azeri	<i>Alma</i>
Georgian	<i>Vashli, Majalo</i> (wild)

The apple belongs to the genus *Malus* Mill., which covers a number of species. The name comes from the Greek *melon*, a generic word used to describe not just the apple, but any kind of soft-skinned fruit.

The apple is grown throughout the Caucasus. Studies on the origin of the species have identified four centres of genetic differentiation – central Asia, western Asia, China and North

America. In the Caucasus, two species have been identified – the *Malus orientalis* Uglitz, a polymorphous species, whose main characteristic is its vigorous growth and which is generally used as a rootstock; and the *Malus pumila* Mill., which includes the “paradise” and “doucin” botanical varieties used in the selection of the famed dwarfing rootstock East Malling series.

Popular selection in Georgia has identified genotypes whose characteristics include adaptability to the Georgian climate, productivity, pleasing appearance and the ability to keep well and to tolerate transportation. Indeed, such is their quality that many of the genotypes selected – among them *Kekhura*, Georgian Sinap and *Semir-Alma* – are still grown today.



Irina Kokhreidze in her garden in Dzevera village, Georgia, with a basket of “winter” apples: these fruits may be stored in the home pantry for several months and consumed during the winter

One feature shared by all Georgian cultivars is the flesh, which is soft, coarse and aromatic. Apples have a medium sugar content of between nine and ten percent, and acidity levels of less than one percent. Most Georgian varieties of apple resist the cold, although the climate varies widely throughout the country, with temperatures plunging to $-30\text{ }^{\circ}\text{C}$ in some places, a factor that can damage buds and hence subsequent yields. For the cultivation of apple trees on poor soils, vigorous rootstocks must be used, especially in wind-exposed areas where weaker rootstocks can only be adopted with the help of supporting poles. In humid areas, the apple tree is prone to a number of diseases, including *Venturia inaequalis*, *Podosphaera leucotrica* and rust; some local varieties are more vulnerable than others.

Common features of the apples of the Southern Caucasus are thick skins, which makes them good for handling and hence for transportation. One indirect indicator of this latter quality is the fact that many varieties heal readily after their skin has been damaged, with no ill effects for their long-term conservation.

Many local varieties, such as the Georgian *Kekhura*, can be kept for a year and even longer at room temperature in cool cellars. Negative characteristics of some local apples include the rough, grainy quality of their flesh and the low level of acidity and tannin, two organoleptic parameters that lower their commercial value.



Popular selection has favoured varieties that tolerate handling, transportation and storage

In forest areas of Sheki-Zagatala, Quba-Khachmaz and Nakhchivan, a great richness of wild forms is found and old varieties obtained by popular selection are preserved and cultivated in gardens.

This genetic richness has favoured the constitution of winter improved varieties (*Azerbaijansky*, *Nasimi*, *Samed Vurgun* and *Shargi*), which are resistant to pests and can be preserved from four to eight months under natural conditions. In the past, selection favoured types suited to certain conditions – including different soil types, varying altitudes and different degrees of humidity – as well as types that were resistant to diseases. Today, this genetic patrimony has been dispersed throughout the territory.

In some cases, it may have been preserved in germplasm collections, while in others it may have been perpetuated, unknown to the rest of the world, in some small private garden.

Selected varieties brought in from Europe have been widely grown and have replaced the traditional varieties. However, due to post-Soviet conditions, which make it difficult and expensive to procure the pesticides on which the successful cultivation of such imported varieties depends, many old local varieties are being readopted, not just because they are more hardy, but also because of their flavour. Indeed, some traditional products and dishes can only retain their proper flavour if local varieties of apple are used. With this in mind, the sustainable development of apple growing in the Caucasus may be furthered if attention



is focused on cultivating certain old varieties with a clear market potential, alongside the established European cultivars. These could include *Kekhura*, *Ivory*, *Emishackndzor*, *Karmrkeni* and *Shakarkeny*. To ensure local production of a more standard quality, certain agronomic practices will, however, need to be introduced, such as thinning out fruits to ensure the apples are of a more uniform size.

Resistance to the cold is a characteristic of almost all varieties found in Georgia, while in Armenia it is particularly marked in the *Vardaguin shertavor*, *Ameh*, *Arevshat*, *Goar* and *Leninakanskaja posniaja* apples. Some varieties can be eaten straight after picking – and therefore have no need for post-harvest ripening – both in summer and in autumn.

Some old varieties are of low vigour, a useful characteristic when it comes to establishing high-density plantations. These include *Turashauli*, *Gomavashli* and *Aksca Kialbadjafar*. One particular group of varieties, known as the *Khomanduli*, are unusual in that they regularly transmit certain agronomic characteristics to their progeny from seed, which is why, in the past, they were widely grown in the rural areas of Georgia.

From a pomological standpoint, these varieties do not represent the future of apple growing in the Caucasus, but they could have a use as cloned uniform rootstock obtained from seeds. Another common feature of a number of varieties in the Caucasus is the ability of the fruit to self-heal lesions, a factor that is useful for handling and transportation.



The Southern Caucasus is the cradle of several legume species of important economic and biological value that are cultivated throughout Australasia and Europe. Therefore, the creation and protection of seed collections of these species should be an international issue

FORAGES ADAPTED TO CLIMATIC FLUCTUATIONS

Natural grasslands adapt to the variations of climate and the availability of soils, water and sun, by varying species composition and length of growing period. Farmers have observed these adaptation mechanisms and selected some of the most plastic species in order to grow forages for their animals. Their selection criteria were to obtain good-quality and highly nutritious forages, able to resist cold winters and dry hot summers, and able to maintain and increase soil fertility and to reproduce safely, making the best use of local pollinators. Alfalfa has all these characteristics and was therefore one of the first forage species domesticated by farmers in the Southern Caucasus.

Alfalfa (*Medicago spp.*)

Armenian	<i>Arvuit</i>
Azeri	<i>Yonja</i>
Georgian	<i>Ionja</i>

Alfalfa (lucerne) is a highly nutritious and versatile forage crop that exists in the wild in the Southern Caucasus and has adapted to its seasonal variations. It has been used and selected for millennia in the region. Alfalfa was the first species to be cultivated as a forage crop. It probably fed the horses that pulled chariots in the second millennium BC. Today, alfalfa is grown throughout the world.

It is cultivated over more than 30 million ha, in the United States of America, Argentina, Canada, China and many other countries. It is an important source of income for smallholder farmers in the Southern Caucasus, who sell it on local markets.

The Caucasus is considered to be the centre of origin of the winter-hardy, disease-tolerant *Medicago falcata* species, while *M. sativa*, which has adapted to warm, dry conditions, originated in Central Asia. The hybridization between the two, which produced *M. media*, probably occurred in Eastern Europe. Alfalfa is a drought-resistant and winter-hardy plant that can withstand soil temperatures as low as -20°C . The hardening process is associated with the induction of dormancy, brought about by shortening days, as well as declining temperatures. Light (radiant energy) controls the rate of photosynthesis and influences branching, flowering, cold hardiness, stem elongation and other processes under photomorphogenic control. Alfalfa stem elongation ceases earlier in autumn in winter-dormant, cold-climate types. Winter-dormant types are generally more responsive to shortening photoperiods in autumn than less winter-dormant ones – a perfect mechanism for adapting to the severe winters of the Caucasus. Alfalfa also grows well in the dry summers of the region. In the early stages of drought, there is a reduction in light interception which, in turn, exacerbates reduction in shoot growth. Therefore, alfalfa is more tolerant to drought than most other temperate forage legumes – another perfect mechanism of adaptation.

Alfalfa is pollinated by bees (honey bees, short-tongued cutter bees and *Megachile rotundata*, alkali bees and bumblebees), which are prevalent throughout the Caucasus – this synchronicity is a further perfect mechanism of adaptation to the Southern Caucasus environment since the region is the centre of origin of the Caucasian bee.

Several wild *Medicago* species occur in western Asia: *M. cancellata*, which is used as a gene source for adaptation of *M. sativa* to poor soils, *M. dzhawakhetica*, found in Georgia and *M. glutinosa*, found in the Caucasus and also used as a gene source for crop improvement. A. Grossheim mentions 19 species of alfalfa with rich intraspecific diversity. Not all of them are of economic value today and are not yet fully studied, but they still constitute a huge source of genetic material holding potential for future agricultural production systems.

M. falcata L. – falcate or yellow alfalfa – is a perennial crop ($2n=16$), which is distinguished by its resistance to drought and cold. It is also salt-tolerant. It grows and develops very slowly, without blooming the first year. It grows mainly in the wild.

The *M. pauciflora* Led. variety is typical only of the dry steppe zone of Azerbaijan, whereas *M. glutinosa* M.B. (including its three subspecies) is typical of mountain meadows (1 200–1 500 m above sea level) in Georgia.



Alfalfa is considered to be the first forage species to have been cultivated in the world. The Southern Caucasus is the centre of origin of the variety *Medicago falcata*, perfectly adapted to the region's long winters and summer droughts

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FARMERS CAN PRODUCE SEED ADAPTED TO CHANGES

FOR THOUSANDS OF YEARS, THE CAUCASUS PROVIDED SEED ADAPTED TO THE RHYTHMS OF THE SEASONS AND MAY PROVIDE IN THE FUTURE VITAL GENETIC MATERIAL TO THE ENTIRE WORLD TO MEET THE CHALLENGES OF THE EFFECTS OF GLOBAL WARMING AND A LESS PREDICTABLE CLIMATE.

In a region characterized by seasonal changes, low rainfall and extremes of temperature, a wide variety of genetic material, including cereals, fruits and legumes, exists and its genetic adaptation may well hold the key to crops of the future. Scientists are studying these adaptation characteristics and those farmers growing a mixture of crops to adapt to the rhythm of the seasons, to offset risks and to stabilize yields, know how to maintain a high level of heterogeneity in their seed stocks and perform what scientists call “population breeding”, a technique of maintaining a cluster of genotypes to ensure that the population has as many different genes as possible. In this way, it has the plasticity to respond and produce in varying conditions (droughts, pest attacks, wind and floods).

Predicted climatic changes will likely result in a demand for large quantities of seed adapted to changing conditions and farming practices that will need to make a more efficient use of solar energy, soil biological processes and water resources.

Thanks to their agricultural knowledge, the farmers of the Southern Caucasus who have managed and maintained this treasure of local genetic resources adapted to risks could be ready to become active producers of seeds adapted to future site-specific needs and risks. But they will need political and economic support to enhance the production and exchange of seeds at the local level and improve their capacity to distribute their seeds at markets.





AT THE CROSSROADS BETWEEN EAST AND WEST
IN THREE HOSPITABLE COUNTRIES
AGRICULTURE AND BREEDING HAVE BEEN DEVELOPED SINCE THE NEOLITHIC
COPING WITH THE RHYTHMS OF THE SEASON

A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS

TO MAKE BREAD, CHEESE AND WINE
PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES
RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Այգիներում պահպանվում է գենետիկ պաշարների ողջ
հարստությունը

Genetik ehtiyatlar xəzinəsi bağlarda saxlanılır

ბაღებში შემორჩენილი გენეტიკური საგანძური

5

INTRODUCTION

IN THE SOUTHERN CAUCASUS THERE IS A HIGH PERCENTAGE OF RURAL POPULATION (36 PERCENT IN ARMENIA, 48 PERCENT IN AZERBAIJAN AND 47 PERCENT IN GEORGIA). FAMILY GARDENS ARE AN IMPORTANT SOURCE OF FOOD PRODUCTION AND, ALTHOUGH THEY ARE NOT EVIDENT IN NATIONAL AND INTERNATIONAL STATISTICS, THEY PLAY A VITAL ROLE IN FOOD SECURITY AND RURAL LIVELIHOODS.

Food production in gardens depends on solar energy, biomass use and, to a very limited extent, fossil energy. The purchase of inputs such as fertilizers and pesticides is low because of the limited availability of ready cash. All family members are involved in garden production and have strategies to maintain soil fertility, and a large variety of crops and animals to satisfy their food needs and for manure production. They use legumes and crop rotations, annual and perennial species, and adapted animal breeds in an intelligent mix that often results in limited energy consumption and high efficiency.





The family of Tengo Akopashvili in Adigeni district, with beans in their garden. The family garden represents the basis of agricultural production in the Southern Caucasus: a symbol of a lifestyle, deep knowledge of a territory and its resources, a continuous search for balance between exploitation and maintenance of soils and water, and an agricultural system adaptable to varying climatic and economic conditions

AGRICULTURAL PRODUCTION AT THE FAMILY LEVEL

A large part of production in gardens is consumed directly by family members and sold at local markets; it is difficult to estimate the actual amount of food produced in gardens and its contribution to the gross national product (GNP).

Family gardens are pillars of the social structure in the Caucasus countries because they also produce services for their communities (farmers maintain common goods through beekeeping, cleaning of irrigation channels and rural roads, and weeding of communal pastures and forests). Moreover, they provide work (part- or full-time) for the many people who live in rural areas but are not directly accountable as part of the agricultural labour force.

The need to increase and standardize agricultural production in the region has often led to neglecting plants selected by the family for specific needs (such as plums suited for jam production or apricots to be dried) and replacing them with higher-yielding varieties, or those with larger fruits. One of the main objectives of family farming is to obtain sufficient income to pay for good education for children. Yet many of these gardens no longer offer an attractive lifestyle for young people who do not see many economic prospects in looking after their gardens and making a living from them. If food produced in the gardens is not well appreciated by consumers and supported by local policies, a significant portion of biodiversity and the ecosystem equilibrium that has been maintained for millennia will be disrupted.



HORTICULTURE AND FRUIT TREES IN THE GARDEN

Today, some of the genetic heritage of the Southern Caucasus has been dispersed throughout the territory, and some has been lost. Other genetic information has been preserved only in germplasm collections by the dedicated work of scientists, but plants must also be kept alive *in situ*, and many valuable food seeds have been perpetuated, unknown to the rest of the world, in private gardens.

Haricots and beans are grown in gardens, as well as various coloured forms and indigenous varieties of lentils. Local eggplants, cabbages and potatoes together with garlic, celery, dill, basil, tarragon, mint and spinach are grown for the preparation of sauces and spices and to be sold at local markets. Many fruits are also grown to complement family diets and as a source of income. Gardens are a wise mixture of perennial and annual species, legumes, tubers and cereals that contribute to

a healthy and varied diet as well as to maintaining good soil fertility, while distributing family labour throughout the year.

A few vegetables, fruits and legumes maintained in the gardens of the Southern Caucasus are described in the following pages.

Spinach (*Spinacia* spp.)

Armenian	<i>Spanakb, Shomel</i>
Azeri	<i>Ispanakb, Shomu</i>
Georgian	<i>Ispanakhi</i>

The natural habitat of spinach in the Southern Caucasus is primarily in dry climate zones, i.e. in warm sandy and clay soils and on southern slopes, which warm up early in spring. All conditions allow the early plants to start



Small farmers maintain a variety of genetic resources in their gardens for their food security and livelihood – a heritage that should be better known at national and international levels

and end their growth before the end of summer. Besides the cultivated variety of spinach (*Spinacia oleracea* L.), there are many other wild types that grow in Armenia, Azerbaijan and Georgia, such as *S. tetrandra* Stev. (tetra-stamen), a wild variety of spinach, which could have great selective value. The crop was described for the first time in 1809 by Kh. Steven, a Russian botanist, while studying Caucasian flora. Observations revealed that in Armenia (especially in those regions where wild spinach grows), even elderly people use spinach as an early spring herb, picking it in the fields.

Bean (*Phaseolus* L.)

In the Southern Caucasus, beans have been cultivated in gardens for centuries and have been an important and inexpensive source of protein for the rural population. Beans

are a valuable part of a healthy diet because they are low in fat, do not contain cholesterol, have a significant amount of fibre and a high protein content. In addition to their high nutritional value, beans return nitrogen to the soil for the benefit of nearby plants, and legume cover crops are ploughed into the soil as valuable green fertilizer to maintain the soil fertility of the garden. In Armenia, populations belonging to two species (*P. vulgaris* L. – ordinary bean and *P. coccineus* L. [*P. multiflorus* Willd.]) are widely spread almost everywhere and are still in cultivation.

There are many endemic populations known and described with very different biological and economic characteristics. There are semi-climbing and climbing beans of different length, with or without strings, and with different resistance to parasites.



The Elkana NGO provides farmers with seeds and information on crops adapted to local conditions, such as *Lathyrus sativus*, with the aim of increasing the self-reliance of the population

LEGUME RECOVERY, CONSERVATION AND SUSTAINABLE USE OF GEORGIA'S AGRICULTURAL BIODIVERSITY

Through a Global Environment Facility (GEF) project, "Recovery, Conservation and Sustainable Use of Georgia's Agricultural biodiversity", implemented by the United Nations Development Programme (UNDP) and executed by the Georgian Biological Farming Association Elkana, Georgian farmers are reclaiming neglected legume varieties and landraces to diversify their agricultural

production systems. The project has established a seed multiplication system to encourage farmers to use and sow local landraces and in 2009 many households were cultivating them.

Farmers are reporting diversification of the family diet and higher nutrition levels.

In addition, they are obtaining higher prices at local markets and increasing the fertility of their home gardens thanks to the N-fixing legume bacteria that lives in legume root systems.





ON-FARM MANAGEMENT OF PLANT GENETIC RESOURCES

Thanks to their valuable traits, ancient crop varieties adapted to local conditions are widely cultivated today by farmers and amateur gardeners in ten natural economic regions of Azerbaijan, meeting both their need for food and the conservation of these crops. There are farmer groups that have established the collection of some crops and are busy with multiplication and dissemination of their seedlings and seeds. A farmer in the Astara region cultivates and maintains more than 25 rice varieties on his farm. Another in the Khanlar region has collected more than 88 grape varieties. In the Shamkir region, in a similar household, a farmer has a fruit collection representing local and valuable cultivars of peaches, raspberries and other berries. Farmers in Chayly village in the Gobustan district cultivate and preserve more than 50 different melon varieties in their homesteads. In the Quba region, which has always been famous for its pome fruits, fruit orchards have been established by grafting wild fruit species with indigenous cultivars.

A farmer in Alpan village in the same region maintains 90 varieties and 175 forms of fruits and berries in his garden. In the Talish region, food legumes (chickpeas and lentils) are widely grown, since they are considered important in the diets of the local population.

Dishes using these legumes are characterized by their flavour, nutrient quality, calories and variety. Farmers in the Lankaran, Khachmaz and Shamkir regions are engaged in the collection, cultivation and utilization of decorative bushes and trees. In several regions, particularly in southern Talish and northern Quba-Khachmaz, farmers cultivate and maintain many kinds of plants that they use for different purposes (for making sheets, blankets, clothes, plates and packaging). The Genetic Resources Institute is collaborating with these farmers, providing them with scientific and technical advice.



More than 800 genotypes of melon (including both wild and cultivated varieties) have been identified in the Southern Caucasus. One particular variety is the Shamam melon, which is inedible, but is appreciated for its scent and colour

Shamam melon and other Cucurbitaceae

The Shamam melon (*Cucumis melo* var. *microcarpus*) is inedible, but is used for decorative purposes because of the striking nature of its skin, which has alternating yellow, black and green stripes. Perfume houses also use it for its strong scent. The fruit is small, weighing no more than 200–500 g, and contains around 300 seeds. This melon is a member of the Cucurbitaceae family and widely represented in the Southern Caucasus. At least 800 genotypes of Cucurbitaceae melons have been catalogued from both indigenous and cultivated varieties. Among them are watermelon (*Citrullus edulis* Pang., *C. vulgaris* Schrad.), gourd (*Cucurbita pepo* L.), cushaw (*Cucurbita moschata* Duch., of which there are dozens of local varieties), the hard-rinded gourd (*Cucurbita maxima* Duch., of which there are more than 100 local varieties) and the cucumber (*Cucumis sativus* L.). Not all of these have survived the genetic erosion that has taken place over the years, but a considerable number still exists today. As for the musk melon (*Cucumis melo* L.), 67 varieties have been catalogued, of which 25 have died out and some are extremely rare (*Sineyvaz*, *Haji Salim*, etc.). Some varieties of folk selection once considered as lost have been found and

regenerated through the efforts of the Genetic Resources Institute of Azerbaijan. The *Dostujan*, *Narinji* and *Hasanbayi* varieties keep for an entire winter. The fruit of the *Bilerjhin* variety lasts even longer, keeping from one year to the next.

In Shahtakhti village, Nakhchivan, the small fruits of the musk melon are covered with earth to protect them from insects. One side-effect of this practice is that the fruit has high sugar levels. This technique, known as *tutma*, is used to produce melons for export, among them *Alamdardar*, *Hamkar*, *Agbad*, *Narinji* and *Hasanbayi*.

In Armenia, species of Cucurbitaceae are found in their wild state, and there are more than 45 varieties of cultivated melon. The wild species are highly resistant to attacks by insects, a feature which makes them valuable in genetic improvement programmes. Attempts to produce hybrids from local cultivars of edible melon (*C. melo* var. *dutmase* x *C. melo* var. *agrestis*) have produced an F_1 – a first-generation hybrid, which has a bitter-tasting fruit. Subsequent crossing between this and the edible cultivar has produced fruit with a good flavour, together with the precious ability to resist attacks by insects.



Melons filling rows and rows in local markets generally come from family orchards. The income from this production is often used to pay for good education for children





THE FARMER MIHRABYAN AND HIS FAMILY

At Salvard village – in the Sisian district of Syunik Marz, Armenia – which is a mountainous border village 10 km from Azerbaijan at 2 000 m above sea level, the hospitable Mihrabyan family invited us to visit their farm. The family is composed of mother, father and three sons. With hard work, this family has managed to make a living in the harsh mountain areas but, more important, the parents have managed to give a full education to their children.

One son is at present studying for his Ph.D. in Moscow and the other two sons work and live in Sisian.

In their garden, they grow apples, plums, spinach and carrots, and harvest walnuts, berries and wild vegetables from the nearby forest. The family looks after three cows that produce milk throughout the year, and bees that produce honey, which provides most of the yearly family income.

The family does not use external labour; the mother transforms over half of the garden production into preserves that will give the family sufficient and quality food during long winter periods.

The family preserves with care the winter apples that grow in the garden and that are an important genetic resource adapted to grow under the local extreme conditions.

During our visit, we were impressed by the family's ecological knowledge and understanding of the biological processes of their farm.

We learned about the importance attributed to education, the awareness of belonging to a community, hospitality and the consciousness of contributing with their daily good farming to the future of their children.





Pomegranate (*Punica granatum* L.)

Armenian	<i>Nur</i>
Azeri	<i>Nar</i>
Georgian	<i>Brotseuli</i>

The pomegranate is one of the fruit trees that exist in the wild in the Southern Caucasus and has adapted perfectly to growing in its different ecosystems. It is a highly nutritious and versatile food that has been used and selected for millennia in the region. It is considered the symbol of fertility and is often used in songs, poetry and painting for its beauty and delicate shape. The pomegranate is among the many genetic resources that deserve to be maintained and cultivated because it is so well adapted to local conditions and is an important income resource

for smallholders who cultivate it in their gardens, often as a welcome symbol at the entrance to their houses. Pomegranates are highly appreciated at local markets and may be consumed fresh or processed.

The pomegranate originated from an area that includes the Islamic Republic of Iran and the Caucasus, and it was from here that the fruit was later exported to the Mediterranean region, at the time of the Phoenicians. The fruit was cultivated in the gardens of tribespeople from the Kingdom of Urartu, between 880 and 610 BC. The remains of the temple of Garni, in Armenia, built in the second century BC, clearly show images of pomegranate fruits and branches, which were carved on



The Southern Caucasus is a centre of origin of the pomegranate. It is cultivated in lowlands and hills, both in large orchards and in family gardens, as in the Goychay region. The fruit contains hundreds of seeds that are juicy and delicious but can only be separated by hand: a characteristic that has always limited its diffusion

blocks of stone and adorned the exterior of the building. The pomegranate is widely cultivated in Armenia, Azerbaijan and Georgia, in lowlands, hills and at lower mountain altitudes. Wild varieties can also be found, especially in Azerbaijan, along the river valleys, in dry and loose terrain, and on mountain slopes. The pomegranate can be eaten fresh, distilled to make liqueurs or used as a concentrated juice known as *nar-sharab* (*sharab* means wine in Azeri), which is used as a condiment. In Azerbaijan, the wild varieties are used to produce citric acid. The tree is also used as an ornamental plant.

In Azerbaijan, many places are named after the pomegranate, such as Narinj village in Gakh district, Narlidara in Samukh

and Nardaran on the Apsheron peninsula. A lot of men also have the word “nar” incorporated in their names, for example, Naringül, Nargile, Narxanim and Naride. Pomegranates are often found in the patterns of old carpets, on rock carvings and in miniatures. The famous poet of the East, Nizami Ganjavi, described the pomegranate in his poems as an especially valuable crop.

In the hot areas of the Southern Caucasus in summer, the pomegranate is a potential victim of insects that lay their eggs inside the fruit. The pomegranate skin is hard and insects therefore enter through the weakest point of the fruit, i.e. the membrane of the flower chalice which they can easily penetrate.



Pomegranates on sale at the Teze bazaar in Baku. A clay plug is put on pomegranate chalices when the fruit is small and still on the tree in order to prevent insect attacks in summer

In Azerbaijan, this problem is resolved by a traditional and ingenious technique. Pomegranate fruits that are intended for conservation (in order to be consumed fresh during the winter) have their chalices plugged with clay while they are small and still on the tree. This prevents parasite attacks. The operation is undertaken in July and the clay plug is left on the fruit all through the winter-spring season as a guarantee to the consumer.

The pomegranate tree is both productive and adaptable, with fruits that keep well. Yet as fruit growing has become more intensive, the pomegranate has not been able to compete with other major species, such as apples, pears and peaches.

This is partly explained by the nature of the fruit itself, which contains hundreds of seeds that are full of flavour but very difficult to separate from the chambers in which they are housed. The only way of removing the seeds is by hand and this, naturally, is reflected in the cost. The pomegranate is certainly a difficult fruit to serve ready to eat, particularly in restaurants, and this militates against its use, even though the actual taste of the fruit is delicious. Better prospects exist in the industrial sector, where mechanization, while it can do little to solve the problem of removing the seeds, could at least help produce good-quality juices that do not suffer from the aftertaste of tannin extracted from the skin.



The pomegranate is a symbol of fertility and is often used in paintings and decorations because of its beauty and delicate shape

Since wine was formerly made from pomegranates, and since today varieties exist that would be highly suitable because of their high juice and sugar content, it may be worth reinstating this tradition in a bid to create a valuable niche market.

One particularly suitable variety for wine-making is *Azerbaijan Juloscia* pink. The thorns covering the branches of most cultivated varieties offer another explanation for the limited commercial success of this fruit. But some varieties have very few thorns, and these deserve to be better known. They include *Rosovi*, *Kirmizi kabuk* and *Balamursal*. In a few cases, most notably that of *Slatkii rannii*, the tree has no thorns whatsoever.

Given that the fruit's good handling and keeping qualities are shared by a number of varieties grown in the Caucasus, it seems a shame that such sought-after characteristics should not have a larger audience. It is quite likely that these genotypes could find a niche in much wider markets.

Germplasm collections should be created to select the varieties that are characterized by few thorns and a juicy fruit that is suitable for transformation.

Farmers' associations could be encouraged to produce these varieties with organic techniques.



Photo by E. Cattaneo

THE URBAN GARDENS OF MUSAYEV FAMILY

In many cities and villages of the Southern Caucasus, small family gardens continue to provide an important safety net, as well as significant supplemental food of high quality, which is available independently from the family's income. In the city of Sheki, hidden behind tall walls and an iron gate, we entered a beautiful mixed garden, with a striking diversity of food plants, layered to mimic a natural forest.

In a small area near their house we discovered the impressive garden of the Musayev family, comprising Ilyas, the father, who is an engineer, Sebire, the mother, a physics professor, the son Murad, a young doctor,

and the daughter Sevinc, who is studying biology. A wide diversity of plants are grown including parsley, tomato, cucumber, pepper, potato, pomegranate, mulberry, pear, apple and plum, as well as beautiful roses and chickens.

They manage their soils wisely by alternating an herbaceous layer near the ground, a tree layer at upper level, and an intermediate layer in between of climbing horticulture crops. Their garden is an integrated unit in which the solar energy is channelled through the different layers of plants to animals and humans, cycling and recycling all organic matter, protecting the soils from exhaustion and erosion, and managing every drop of

water carefully. Their gardens are thus managed according to the principles of organic agriculture.

Despite their daily work in the office or at school, the family is glad to spend a lot of time and energy in the garden and is proud of the quantity, quality and availability of their own food. They are also enlarging their house in case the son might wish to stay with his new family, and the garden will certainly produce good food for all of them and their friends.

Sebire has a sister, Rúbaba, who is teaching literature, and together with her three children, Vúqar, Vúsale and Shahla, she also maintains an urban garden. The father,

Nazim Ismayilov, who is Chief Agricultural Adviser for the region of Sheki and the surrounding areas, guided us through his garden and invited us for a wonderful dinner made from his own chickens, tomatoes, cucumbers, mulberries and plums.

Whoever visits the Southern Caucasus will soon learn that behind many walls and many gates there are rich gardens of biodiversity contributing to healthy and nutritious diets for the benefit of their owners, for local and national markets, and for the environment. And whoever will make friends in the Southern Caucasus will also soon learn to appreciate the hospitality and the food produced in these gardens.



Photo by E. Cattaneo



Photo by E. Cattaneo



Photo by E. Cattaneo

Ilays Musayev grows bananas, potatoes, pomegranate, cucumbers, persil and many other fruits and vegetables, managing with experience solar energy and soil organic matter



Photo by E. Cattaneo



Nani Merabishvili with a branch of nectarines from her garden. There is a large amount of genetic material that could be used in cross-breeding programmes in order to obtain varieties with specific pulp, skin and disease-resistance characteristics. >>Right: a farmer shows a *Narindgi* peach

Peach (*Prunus persica* L. Batsch.)

Armenian	<i>Deghdz, Deghdzeni</i>
Azeri	<i>Shaftali</i>
Georgian	<i>Atami</i>

Peaches are found throughout the Southern Caucasus, even in their wild form. The species is generally held to have originated in northern China, but in the Caucasus it has adapted to local conditions and is still widely grown in family gardens. Rural people have prepared various peach-based products such as *alana* and *mianpur* for many years. *Alana* is made as follows: the peach is cleaned, the stone removed and, in its place, crushed walnut with sugar is inserted. The fruits are then dried and the result is the delicious *alana*.

In Armenia, the peach is most commonly found in dry warm zones and in the north of the country. It grows well at elevations of up to 800–900 m. For centuries, it has been propagated from seed, such as the group of *Narindgi*, *Tchoughuri*, *Tchgovi* and *Zafrani* peaches. Peach growing in Armenia is based on a large number of varieties whose fruit ripens mainly in August and September. Several of them have a white or red streaked skin and are suitable for niche markets and breeding programmes. Some peaches have crossed spontaneously with almonds and produced an edible kernel.

Some Azeri peach varieties are also characterized by resistance to leafcurl (*Taphrina deformans*) and could be used both for marketing and in genetic improvement programmes. *Salami*, developed in Ordubad, is one of the most valuable and ancient peach varieties. The fruit quality can be preserved intact for up to 20 days after harvesting. *Narindgi* is an old variety with round, large fruits. *Kabraba (sari hulu)* is another excellent old variety with a thick and furry skin. It is grown in Ordubad and Garabagh and is one of the best for consumption.



Peaches in Georgia ripen in September, bear small fruits (that are either round or long), and have a flavoursome flesh. Traditionally, the fruit was dried or used for jams. However, the most interesting feature of *Kartuli atami* peaches is their high cold tolerance, as a result of selection, mostly by fruit growers living in cold areas. In Georgia, the Institute of Horticulture, Viticulture and Oenology has carried out studies on local varieties and on those introduced from other areas, including Europe, the United States of America, Crimea and the rest of the Caucasus. It has created a genetic database to preserve these valuable selections for the future. However, not every local variety has been included in the collection. Some varieties have been lost, while others have been dispersed in remote villages, grown as single trees in household gardens or in small plots that were divided up as a result of reform. Nevertheless, the genetic heritage of peach varieties local to Georgia has a wealth of characteristics that should be preserved. For example, the *Vazhuri* and *Berebis* varieties both produce fruit that handles well. *Khirsuli*, *Bestavashvili*, *Gudauta canning* and *Kakhuri tetri* all bear fruit suited for transformation purposes. *Gavazuri* has a strong resistance to drought, while early *Gori*, as its name suggests, ripens early.

Vazhuri peaches keep fresh for long periods, while *Eristavis vardisperi* and *Nobati* fruit have superb tastes and aromas. The *Vazhuri* variety is also valuable for the unusual white colour of its flesh, a genetic quality that has been requested in Europe in recent years. *Pioner* and *Kezevadze* are both resistant to leaf curling, while *Kezevadze* is also valuable for its adaptability to humid conditions. *Pioner*, *Salami pozdnij*, *Malik* and other varieties, on the other hand, are useful for their resistance to clasterosporiosis.

The groups of peaches obtained by seedling selection (*Zafrani*, *Narindgi*, *Tchoughuri* and *Kartuli atami*) could be used to produce uniform progenies suitable as clonal rootstock. Certain varieties such as green *Tchgovi* could be used to obtain fruit with green flesh. Some dwarf varieties (*Vagaas Khabzrakoriz* and *Cioccikanskii Krasnii*) could be suitable for high-density orchards because of their low vigour. Selections of peach crossed with almond may also have nursery potential for use as peach rootstock on calcareous soils. There is a large amount of genetic material that could be used in cross-breeding programmes and for specific characteristics of the pulp and skin, and disease resistance.



A late fruiting apricot tree in Syunik Marz. This feature could be a key factor to increase the export of this fruit into Europe

Apricot (*Prunus armeniaca* L.)

Armenian	<i>Tsiran</i>
Azeri	<i>Erik, Gaysi</i>
Georgian	<i>Gargari, Cherami</i>

The apricot is one of the symbols of the Southern Caucasus because it is very common and farmers make use of all parts of the plant: the fruit is used fresh, dried, as syrup, or in jam.

The wood of the tree is used to make furniture. The seeds are used for oil and as the basis of a liqueur called *Ratafià*. They may also be burned to produce charcoal for drawing.

The apricot almost certainly reached the Caucasus via Iran and has been growing in the Southern Caucasus for thousands of years. In Armenia and Azerbaijan, apricots grow everywhere.

The origin of the botanical classification of this species, *Prunus armeniaca*, witnesses how deeply entwined is the history of apricot with that of Armenia, where the season runs from the first ten days of June to early August, but most varieties mature in July. At altitudes over 1 600 m, ripening is delayed by a month, a factor that enables some varieties to continue producing until the end of August.



The *Shalakh Erevani* variety of apricot is cultivated at different altitudes, thus enabling the prolongation of the harvesting season

The valuable local types of apricot are *Shalakh*, *Arjanabad* and *Sateni*. Apricot varieties developed through folk selection in Azerbaijan include *Abutalibi*, *Khosrovshahi*, *Gaysi*, *Ag Novreste*, *Girmizi Novreste* and others.

In Georgia, the apricot is mainly grown in the eastern parts of the country. In the west, the wetter climate tends to foster disease and early flowering, which makes the plant vulnerable to frost. Since they are not commonly grown in this part of the Southern Caucasus, apricots do not have much genetic diversity and the number of varieties is limited.

Thanks to current breeding and selection practices by farmers, especially in Armenia and Azerbaijan, a rich apricot genetic diversity now exists. This diversity could help improve cultivation in both these regions and in other apricot-producing countries. The apricot is, in fact, a plant prone to problems, many of which could be solved through genetic improvement.

The varieties of apricot grown in the Southern Caucasus are resistant to drought and certain pests and diseases, which could be exploited.



A delicious dish prepared with apricots, lamb, chestnuts, raisins and rice (left). Homemade jam sold at local and international markets (right)

The most adaptable apricots are those grown from seed. These have a good resistance to early frost and disease, though they do have the disadvantage of bearing small fruit.

Caucasian fruit growers could become the first to establish the production of apricots with sweet kernels and low levels of amygdalin. These apricots would be easy to transport and would have good potential in the confectionery and cake industry.

A promising avenue for research and marketing is the production of varieties with flesh that is not classic yellow. Producing fruits with certain unusual characteristics such as different colours is a growing niche market.

Genetic improvements could create varieties with particular qualities. For example, the combination *Amban* x *Kanaceni* produces drought resistance, and the combination *Deghanusci* x *Amban*, *Abutalibi* (or *Sateni*) x *Kanaceni* produces late flowering.

Natural hybrids between *P. armeniaca* x *P. cerasifera* classified as *Armeniaca dasycarpa* Ehrh. and named *Ziran-salor*, *Shlor-ziran* black and *Shlor-ziran* yellow by Miciurin could be exploited to select rootstocks having high graft compatibility with apricots and plums.

Medlar (*Mespilus* spp.)

Armenian	<i>Zkereni</i>
Azeri	<i>Ezgil</i>
Georgian	<i>Mushmala, Zghmartli</i>

The medlar is a deciduous shrub or small tree that grows wild in the Southern Caucasus. The forms of the common medlar (*Mespilus germanica*) that have been identified are *f. gigantea* Kirchn., *f. macrocarpa* Kock and *f. abortive* Kirchn. (characterized by the absence of stones). Its fruits can be eaten fresh or used to prepare ciders or liqueurs.

In Armenia, medlars can be found in the hills, mainly bordering forests.

Many varieties of medlar are found in Azerbaijan, mainly in the regions of Talish and Zagatala. There are two species with agronomic value: *M. xerophyllous* L., which thrives in dry areas, and *M. mesophyllous* L., which grows in more humid areas.

In Georgia, the medlar is frequently found in gardens. Because of its lack of commercial value, the fruit is not usually cultivated in plantations but is grown on a small scale by rural families. It grows as a shrub. It is thorny in its wild state, although less so if it is grafted on to quince or hawthorn.

The few cultivated varieties have been selected from wild forms and are divided into two groups: the round-shaped *Meretula* and the pear-shaped *Pyriform*.

The species is useful as an interspecific rootstock, given that it is propagated by grafting on to hawthorn (genus *Crataegus*) and is, in turn, also a rootstock for the loquat (*Eriobotrya japonica*).





Many species and varieties of plums are maintained in gardens, differing in colour, size, ripening period and biochemical characteristics

THE PLUM GROUP

The generic term “plum” groups together several species of *Prunus* that grow spontaneously in many parts of the Caucasus region. Of these, local communities have traditionally made extensive use of *P. domestica* L., *P. spinosa* L., *P. insititia* L. and *P. cerasifera* Ehrh.

Plum (*Prunus domestica* L.)

Armenian	Salor
Azeri	Gavali, Albukbara
Georgian	Qliavi

The plum thrives in a variety of different conditions – in semi-desert zones as well as in mountainous areas up to altitudes of 1 800 m above sea level. In Armenia, before the 1930s local cultivars (propagated easily by suckers) were extremely popular.



Photo by F. Cattaneo

Goycia is a wild plum used in Caucasian cuisine predominantly for the preparation of sauces



These were subsequently neglected as intensive fruit farming took over, based mainly on imported varieties. Most plums ripen in August and September but the *Deghnashlor* selection has the unusual trait of being able to stay fresh until January.

In Azerbaijan, numerous plum varieties have been developed through folk selection and scientific methods. They are distinguished by colour, size, ripening period and biochemical characteristics. In Georgia, plums grow in the warm, wet areas of the Black Sea coast. The most common varieties are *Chanchuri*, *Damaski*, *Shavkliava*, *Tetrkliava* and *Tskalkliava*. Many of them have high resistance to both insect and fungal parasites.

Varieties have been selected for their ratio of sugars to acids and for their high fruit yield. Plum-based products, such as concentrated jam, could be exported for the European market, vacuum packing them to ensure sterile conditions. Other local varieties deserve to be more widely grown because of their resistance to parasites. Some varieties of plum have characteristics that could help produce clonal rootstocks.

Elmira is on her way to plant her plum seeds on the outskirts of the village. She has two very sweet plum trees in her garden and knows the value of her genetic material and the importance of recycling all agricultural products. So she finds time to render a service to her community and her environment by planting her seeds along the roadside so that other people will be able to eat her plums in a few years' time. The garden is an open system: besides producing for self-consumption, farmers provide services to the environment by maintaining the common land

Myrobalan (*Prunus cerasifera* Ehrh.)

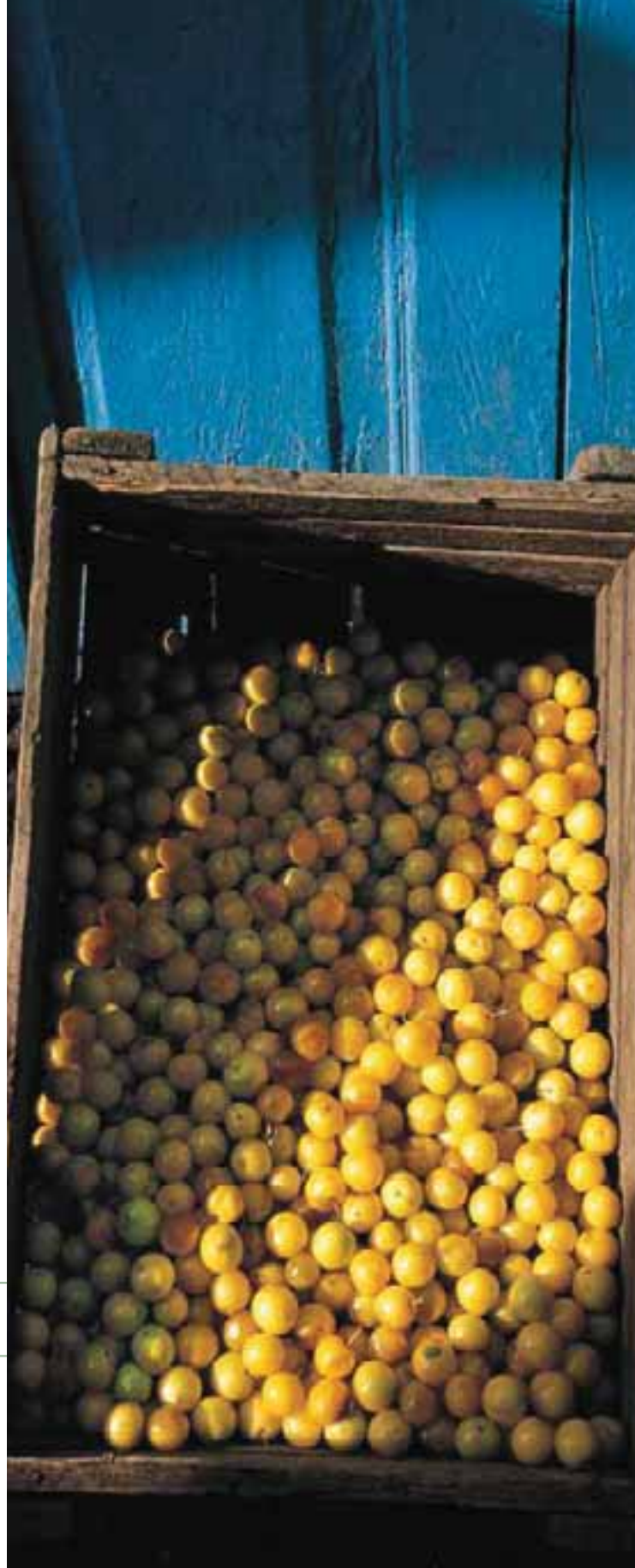
Armenian	<i>Shlor, Alucha</i>
Azeri	<i>Alcha</i>
Georgian	<i>Tkemali, Alucha</i>

Myrobalan is a versatile plant, and its fruits are commonly consumed in the Caucasus. It has valuable agronomic traits, such as its resistance to the cold and an ability to thrive on poor soils. It has played an important role in the intensification of agriculture, serving as an interspecific rootstock for apricot and peach trees, enabling these to be cultivated on heavy soils. Myrobalan also grows in the Ararat Valley and, in some areas, at altitudes as high as 2 000 m. In the northern part of Armenia, the *Prunus divaricata* variety predominates, while the *P. cerasifera* var. *nachichevanica* Koval., which has particularly large leaves, grows in the south. Varieties such as *Ashnan Shlor* keep fresh on the tree for as long as two months.

In Azerbaijan, some local varieties of myrobalan are found in Nakhchivan. Local people call them *goyja*. The fruits are very soft and juicy and are eaten when they are green, because they crack upon ripening.

In Georgia, myrobalan is found in both the western and eastern parts of the country, mainly at altitudes of between 200 and 1 200 m. It is used to prepare jams, fruit in syrup and juices to accompany dishes such as roast meat. One exception is *Alycia* (classified as *P. vachushtii*), which can be eaten fresh and is used to prepare a popular sauce of the same name, served as a side dish with meat courses.

The myrobalan is a versatile and rustic plant, capable of growing on poor soils





The rich diversity of fruit species and varieties combined with small farmers' traditional production and processing methods contributes to their livelihood, health and income [Source: ՀԱՅԱՍՏԱՆԻ ՊՏՈՒՂԱԵՐԸ «ՀԱՅԱՍՏԱՆ» ՀՐԱՏԱՐԱԿՉՈՒԹՅՈՒՆ, ԵՐԵՎԱՆ, Հատոր I, 1958, ՎԵՐՄԻՇՅԱՆ, Ա. Մ., ԳԻԼԱՆՅԱՆ, Է. Հ. & ՍԱՆԱՅԱՆ, Մ. Բ. Հատոր V, 1981, ԱԳՈՒԼՅԱՆ, Ս. Լ., ԱՍՏՐԹՅԱՆ, Ա. Ս., ԲԵԿԵՏՈՎՍԿԻ, Ա. Ն., ԲԵԿԵՏՈՎՍԿՅԱՆ, Ա. Ա., ԳԱԲՐԻԵԼՅԱՆ-ԲԵԿԵՏՈՎՍԿՅԱՆ, Է. Հ., ԿԱՐԱՆՅԱՆ, Պ. Գ., ՍԿՐՉՅԱՆ, Գ. Գ., ՍԱՆԱՅԱՆ, Մ. Բ. & ՎԵՐՄԻՇՅԱՆ, Ա. Մ.]







Small farmers such as Ibrahimov Saodulla grow a wide range of crops including vegetables and citrus fruits and raise a small number of animals. These farmers would benefit from technical and economic support to sustain and improve their livelihoods





THE FARMER IBRAHIMOV SAODULLA

by Marzio Marzot

Shuvi village, southern
Azerbaijan, near Astara.

Ibrahimov Saodulla is full of enthusiasm in managing his farm. Part of his land is in the hills behind his home, and the rest in the plain just in front, on the other side of the road. His work is very tiring, particularly because none of his nine children, who live all over the world, has decided to continue their father's activity. But he is happy because, besides his wife and a daughter-in-law, there is his friend Aliyev Hamid who is ready to help him on every occasion.

They are like brothers, after so many years of work side by side, from old times in the *kolkhoz*. Saodulla's small farm is self-sufficient, but the activity he is most proud of is beekeeping. With his faithful friend Hamid, he dedicates himself to honey production.

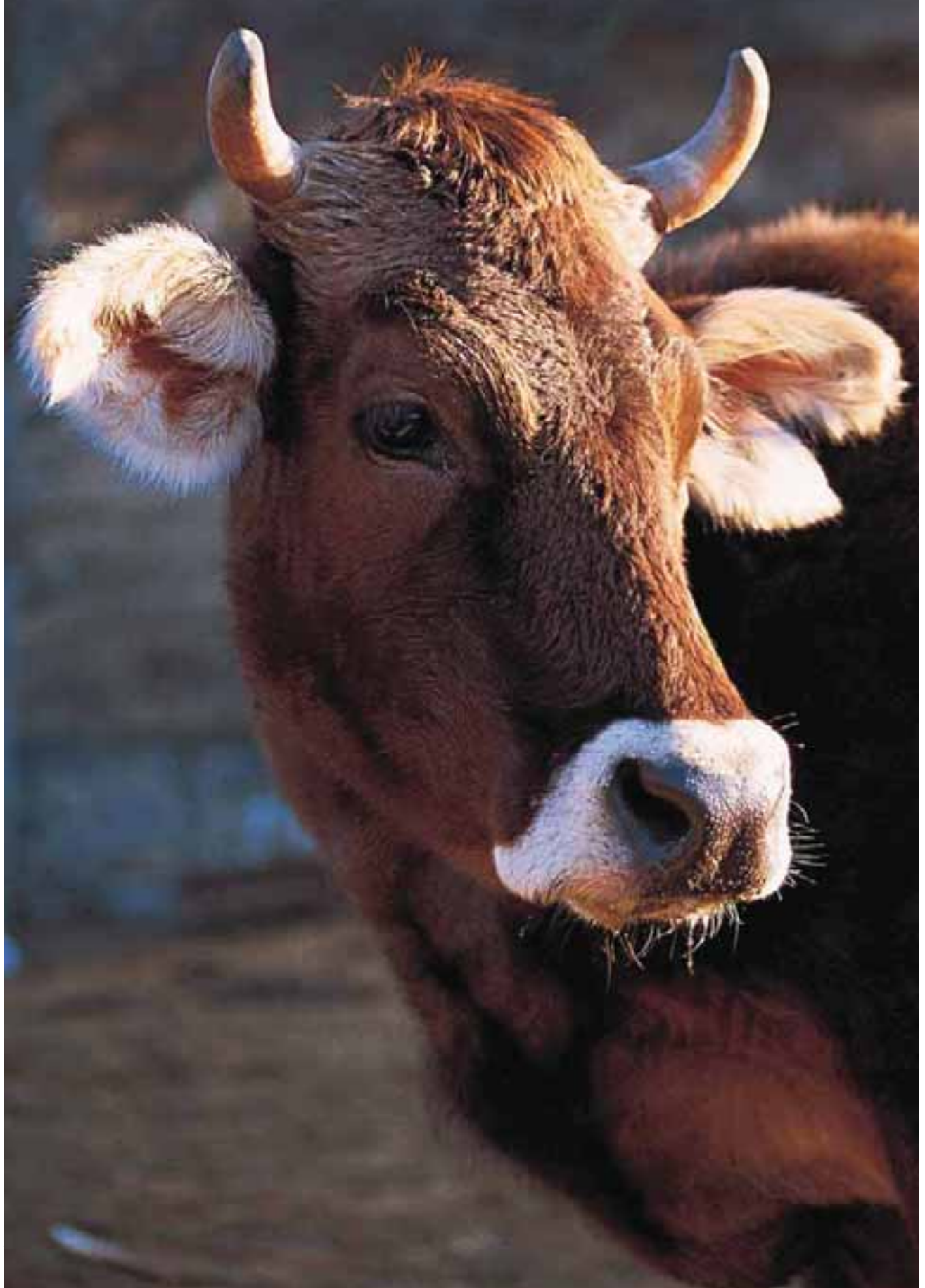
Each one of their ten beehives, scattered among fruit trees, gives them about 8 kg of honey every year. Their honey is delicious and sweet. Almost all the production is sold at the Teze bazaar, the new central market in Baku, more than 300 km away. Sales go well, because about 90 percent of folk medicines are based on honey.

They also sell wax to make candles and honeycomb, while the production of propolis and royal jelly, which is more complex and expensive, is done only on request. For the well-being of their beehives, they replace the queen every other year. The activity stops for three months each year, between December and March.

During this period, Saodulla does not feed their bees with sugar, as other beekeepers do. He would like to have some financial help to improve and increase his production, and he is waiting for the government to introduce a law to facilitate access to loans for honey producers.

On the farm, there are gardens for various types of vegetables, small cultivated fields and many fruit trees.

The production of lemons, oranges and mandarins is excellent, and all the fruits are large, sweet and seedless. Besides fruits and vegetables, the farm has some animals. There is a stable with a three-year-old zebu, of a local breed. A dozen hens, a few cocks and ten turkeys, all of a local breed, scratch freely and are a source of meat and eggs. Near the house is a buried *tandır* oven. Saodulla's mother, Ibrahima Rafiga, makes the traditional bread, *ciorayi tandir*, which is consumed by the family.





Klara Bukia with her hens in the Samegrelo region. Animals in gardens represent not only a source of food when crops fail, but are also a financial resource for the family



ANIMALS IN THE GARDEN

Livestock kept by small farmers in their gardens contribute to food security as well as playing multiple roles, providing manure for sustainable crop production and meat, milk, eggs, feathers and draught power. However, animals also build social capital in rural areas. Crop residues are often used to feed small ruminants, which are in turn sold to finance the basic needs of a family, including costs for education, health and social occasions. Animals are an important financial resource where formal credit is not easily accessible and when there is a poor harvest. When crops fail, animals provide a cushion against food insecurity. Systems are therefore more stable, reliable and adaptable in the face of external climatic and economic changes, and they are also more efficient in terms of sustainable use of local resources and energy management. Typical of the gardens in the Caucasus are geese, chickens, pigs, cattle and turkeys.



Zaza and Maia Zaridze work in their family garden. Hens feed on crop residues and their waste is used to fertilize the soil. Recycling and reusing resources are becoming increasingly important also in modern agricultural production because of their contribution to the sustainability of the system

Chicken

by Professor Roza Nozadze, Georgian Zootechnical-Veterinary University

Armenian	<i>Trchnabucutjun</i>
Azeri	<i>Toyug, juje</i>
Georgian	<i>Frinveli</i>

Chicken breeding is a very old practice in Georgia. In the past, hens and eggs were the main way for Georgian rural folk to pay taxes. This is evidenced by the historical document “Tax List of Kutaisi Province Church”, dated 1578. According to this list, people in the Kutaisi province had to give hens and eggs to the church. At that time, women were the main chicken breeders. By the second half of the nineteenth century, chicken breeding was well developed and played a significant role in the Georgian national economy.

Bartering with chickens became an active occupation and source of income. Rural people began to breed many chickens in their homesteads; they bred only local breeds because they were considered to be the best in terms of hardiness, efficiency in the use of the resources, and taste. At the beginning of the twentieth century, chicken breeding accounted for 3.8 percent of total agricultural production costs in the agricultural economy of the Caucasus and 5.1 percent in Georgia. However, the First World War destroyed the international chicken market which, in turn, hindered chicken breeding. During the Soviet period, many chicken breeds were brought to Georgia in order to improve chicken production: among them Leghorn, Rhode Island red, *Plimutrok*, *Viandot*, Cornish, *Australop*, New Hampshire and Russian white. The chicken intensification process caused a chaotic diffusion of hybrid chickens, which did not adapt well to local conditions.

Megrula

The *Megrula* hen is widespread mostly in the Samegrelo region of Georgia. The hen is well adapted to local conditions and does not need additional heating of buildings even during the cold period. Some farmers build small wooden coops called *karia* in their gardens, to help *Megrula* hens withstand high temperatures in summer and low temperatures in winter. The hen has delicious meat and a coloured eggshell. *Megrula* is a dual-purpose, meat-producing/egg-laying breed.

Conserving Georgia's local chicken gene fund is important for farm and household chicken development. Chicken production in the country is competitive, because the market is full of imported chicken meat and eggs that are cheaper than local products. But local chicken production will always have its own consumers, mainly thanks to Georgia's culinary traditions.

The development of household chicken breeding would be impossible without local chicken breeding by small family farmers. Highly productive hybrids need ideal husbandry conditions, which the present economic crisis does not allow. Therefore, conservation and breeding of Georgian local chicken will significantly support household and farm development.

Local black hen

A.S. Serebrovsky indicates that these hens were brought to the Southern Caucasus some 2 500–3 000 years ago. F.A. Melikov thinks that Azerbaijan hens originated from the Gilan hens of the Islamic Republic of Iran. Other researchers state that local hens were brought to the western zone of Azerbaijan from Iran, they adapted well to the local climate of the territories along the banks of the River Araz and bred in large areas, although their egg productivity was low. Local black hens are now bred in chicken yards in all regions of Azerbaijan. They tolerate the climate, require minimum care and can forage for themselves.



Megrula hen in the Samegrelo region

Local black hens have a high laying ability; five- to six-month old hens lay eggs. The quality of their meat and eggs is high and they are extremely profitable for farmers and chicken yards.

Planned scientific research activities on poultry in Azerbaijan began on an experimental farm at the Azerbaijan Livestock Scientific Research Institute between 1956 and 1958.

At present, research is being carried out on a collection of local hens at the Genetic Resources Institute, Azerbaijan National Academy of Sciences.



Geese are a valuable resource: they are cheap to maintain, being rustic and grazing on pasture, but provide high-quality feathers, meat and eggs

Geese

Armenian	<i>Bad</i>
Azeri	<i>Gaz</i>
Georgian	<i>Bati</i>

In Azerbaijan, geese are reared for meat and egg production. Local breeds of geese are light grey. On average, a local goose produces 15–20 eggs per year. Most of the time the geese graze on local pastures and thus consume very little concentrated feed; they are consequently extremely cheap to maintain. The average live weight of a gander (male goose) is 4–6 kg, and that of a female is 3.5–4 kg. Geese have high fertility.

In the Javakheti region of southern Georgia, the Javakhuri goose has been bred from the wild grey goose. Eye colour is related to its feather colour. White geese have blue eyes and orange beaks, ash-grey geese have brown eyes and greyish spotty beaks and motley geese have dark ash-grey eyes and light orange beaks.

Geese generally start laying eggs at the age of 11–12 months. The average oviposition is 8–12 eggs in the first year, which increases to 12–15 eggs in the second year. The Javakhuri goose is capable of giving high-quality feathers twice a year, in August and October.



PHOTO BY S. HANSEN





Sheep grazing on crop residues contributes to the production of meat, milk and wool and converts organic “wastes” into organic matter

SOIL FERTILITY FOR FOOD PRODUCTION

Maintaining soil fertility is vital for agricultural production, especially in gardens and small farmers’ systems. In the Southern Caucasus, permanent arable farming started many thousands of years ago, and family gardens have been cultivated continuously for centuries. Soil fertility is maintained through a mixture of crops, including annual and perennial species, intensive use of legumes in rotations and mixed crop animal systems. In addition, farmers have also managed and improved soil fertility by recycling all forms of organic “wastes” (that should rather be regarded as “organic treasures”) and have produced compost to increase soil organic matter. Compost is produced through the biological decomposition of organic materials by bacteria and other organisms. It is an important source of nutrients and organic matter.

To ensure sufficient nutrient availability for plant growth, farmers also use chemical fertilizers when available, and if they can afford the costs. The risk of nitrate leaching depends very much on farming practices; however, synthesis of chemical fertilizers requires large amounts of fossil energy (around 27 GJ/tonne NH_3). By contrast, biological nitrogen fixation (BNF) by legumes is based on solar energy and can contribute to reducing the environmental footprint of crop production. Scientists should increase their work on legumes as part of cropping systems especially tailored for small farmers or in situations where fertilizers are scarce. Farmers in the Southern Caucasus keep animals in their gardens not only for milk, meat and eggs, but also to obtain manure, which forms an integral part of their production system.



Recycling organic wastes in the form of manure and compost and cultivating legumes contribute to the maintenance of soil fertility in areas of agricultural production

Ruminant livestock convert a general range of only 15–30 percent of their feed into meat and milk (poultry and swine do better) and manure is a precious “by-product” that may actually exceed the value of what is usually perceived as a “product”.

Farmers have a great respect for the properties of manure in all its forms and plan its management well because they know that their livelihoods are linked to this important resource. Small farmers use manure to improve soil quality, increase crop production and as a fuel source (dried manure/straw).

Manure provides, in varying proportions, the three main plant nutrients (nitrogen, phosphorus and potassium) as well as secondary ones (calcium, sulphur and magnesium).

Sometimes manure has trace elements with a role in plant or animal nutrition: boron, chlorine, manganese, iron, zinc, copper, molybdenum and selenium. Manure stimulates plant root growth, increases nutrient uptake, decreases evaporation from the soil, increases soil water-holding capacity, reduces surface water runoff, facilitates drainage, regulates soil temperature and provides substrates for soil microbes. The composition of cow, pig, chicken and horse manure is quite different. Moreover, the quality varies according to processing (type and length of maturation and drying). Small farmers traditionally know these differences and how to manage them. Today, science is helping farmers to improve the quality of their manure by investigating the possibilities of reducing diseases caused by, for example, *Phytophthora cinnamomi*.



Manure is regarded by farmers as an organic treasure rather than a waste. Farmers know that their livelihood is linked to this important resource. Additional scientific knowledge should be developed to understand better the contribution of manure to livelihoods and climate change

Researchers are also investigating which changes in soil characteristics (including pH, nutrient levels, total and specific biological activities) after compost application help to reduce the effects of incorrect manure management on greenhouse gas emissions and climate change. Organic matter provided by manure is of a high quality because of its cellulosic content and level of available energy and because it supports the growth of suppressive microbes. This activity, however, is complex because disease suppression depends on the dynamic qualities of composts of different maturities, and on different environmental conditions. This is why the direct experience and knowledge of farmers must be combined with scientific analysis in order to improve manure quality. Many production problems encountered by farmers are linked to soil fertility. Therefore, farmer training in soil fertility and compost and manure production and management should be encouraged

and farmers' knowledge of biological processes that sustain farming practices should be enhanced. Organically based fertilizers such as livestock manure should be recommended, where these materials are proven to be free of toxins such as heavy metals, in gardens where animals are an integral part of the food production cycle.

Agronomic operations should avoid overapplying manure and consequently dispersing nutrients into the atmosphere through surface runoff or by leaking into groundwater. Farmers should receive training and information related to: improving the stacking and protection of dry manure on fields; applying manure to the fields; improving transportation of liquid manure to distant fields; increasing coverage of solid manure, enabling it to contribute to reduce greenhouse gas emissions; and reducing pathogen numbers during anaerobic composting.



Small farmers maintain soil fertility through wise management of crop rotations. On-farm recycling reduces production and energy costs and consumption of fertilizers, and improves soil structure and biodiversity. Well-managed gardens use reduced inputs for weed control. Today, recycling should no longer be considered a practice of farmers living in isolation, but a modern agricultural production practice

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RECYCLE AND REUSE

IN A WELL-KEPT GARDEN, FARMERS BALANCE THE PRODUCTION OF CROPS, ANIMALS AND ENERGY. RECYCLING AND REUSING ARE BASIC MANAGEMENT PRINCIPLES FOR BALANCED AND SECURE FOOD PRODUCTION.

RECYCLING FOR A FARMER MEANS PROCESSING USED MATERIALS SUCH AS CROP RESIDUES (STRAW), PLANT RESIDUES (WEEDS, PRUNED MATERIAL, FRUIT STONES), ANIMAL WASTE (COW, POULTRY AND PIG MANURE, GEESE FEATHERS, SKIN AND BONES) INTO NEW PRODUCTS (SUCH AS FERTILIZERS, FUEL AND BIOGAS).

This recycling decreases inputs and reduces production costs, energy costs and consumption of new material (introduced fertilizers), and improves soil structure and biodiversity. Recycling used agricultural materials also reduces air and water pollution, prevents the waste of organic material and lowers greenhouse gas emissions.

Farmers know their gardens and are aware that if nutrients leave the soils they must be replaced if crop production is to remain abundant.

Therefore, recycling today is no longer considered a practice of farmers who live in isolation, have little relation with markets or are reluctant to use new technologies. Recycling is now an integral part of modern agricultural production systems.

Recycling combines benefits for the farmer (income), for the consumers (clean and quality food) and for the environment (sustainable waste management and maintenance of the natural resource base).





AT THE CROSSROADS BETWEEN EAST AND WEST
IN THREE HOSPITABLE COUNTRIES
AGRICULTURE AND BREEDING WERE DEVELOPED SINCE THE NEOLITHIC
COPING WITH THE RHYTHMS OF THE SEASON
A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS

TO MAKE BREAD, CHEESE AND WINE

PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES
RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Հացի, պանրի և գինու պատրաստում

Çörək, pendir və şərab hazırlanması

პური, ყველი და ღვინო

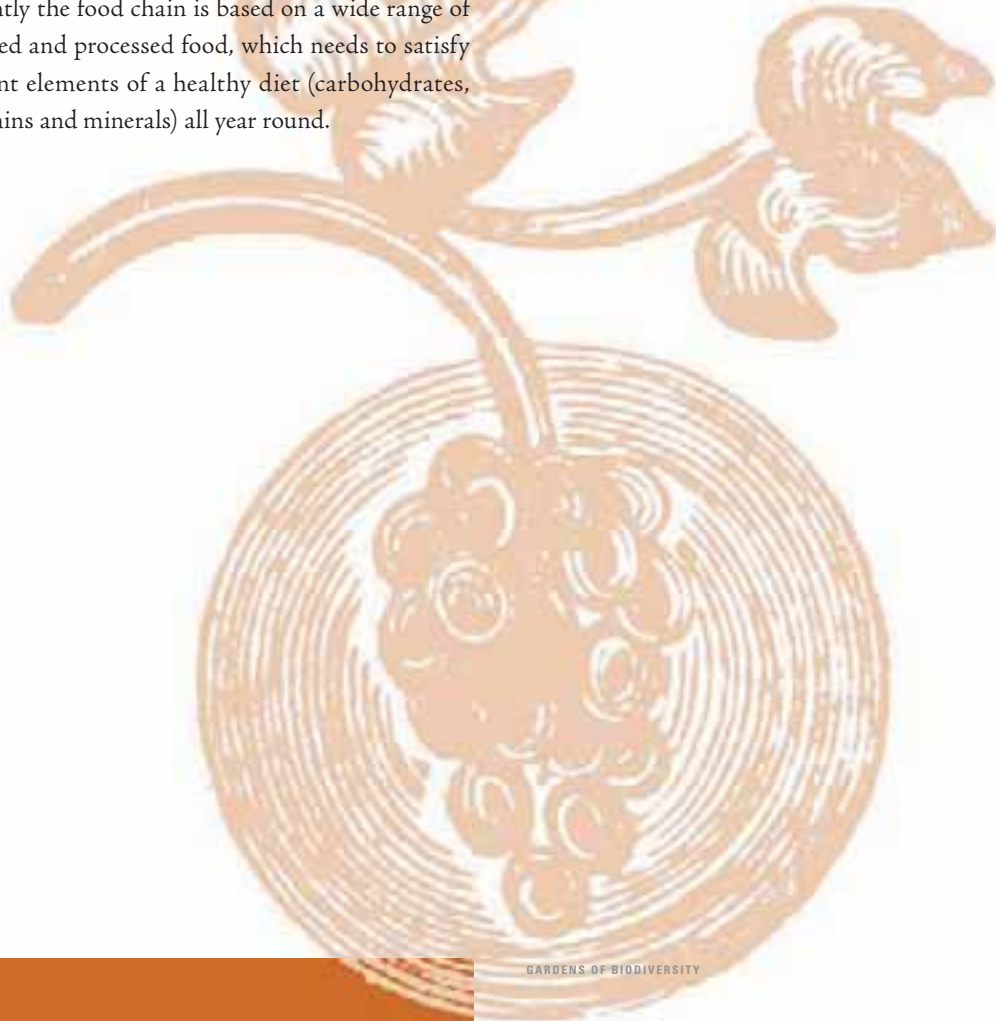
6

INTRODUCTION

FOOD PRODUCTION IS INEXTRICABLY LINKED TO PEOPLE'S CULTURE AND LANDSCAPES. THE SOCIAL AND CULTURAL TRADITIONS OF FOOD PREPARATION HAVE BEEN PASSED DOWN FROM GENERATION TO GENERATION TO THE PRESENT DAY. WHEN THERE IS A CELEBRATION AND A SOCIAL GATHERING, DELICIOUS FOOD IS PREPARED TO SHARE WITH FAMILY AND FRIENDS. BUT THE DAILY BASIC MEAL FOR MILLIONS OF PEOPLE IN THE SOUTHERN CAUCASUS IS COMPOSED OF BREAD, CHEESE AND WINE.

*T*he mountains of the Caucasus oblige many farmers and pastoralists to reside in remote rural areas that are quite isolated from main markets, and consequently the food chain is based on a wide range of locally produced and processed food, which needs to satisfy all the different elements of a healthy diet (carbohydrates, proteins, vitamins and minerals) all year round.

Consequently, the Caucasus displays a range of food products building upon socially and geographically embedded local production.





In rural areas, the food chain is based on a wide range of locally produced and processed food according to seasonality and territoriality. This contributes to healthy diets and reduces transportation costs and food wastage

LINKS BETWEEN TRADITIONAL KNOWLEDGE AND LOCAL CUISINE

The cuisine of the Southern Caucasus uses a wide range of herbs, spices and aromas, vegetables, all types of legumes, and meat in the preparation of exceptional soups, stews and roasts. Many traditional food preparation secrets are passed down through the generations and form a family heritage. A wealth of different bread and cheese types is prepared in each different region and delicious preserves are made from fruits grown in family gardens and from berries collected in the wild.

In Armenia, Azerbaijan and Georgia, people have a preference for lamb but many poultry, game and beef dishes are consumed, particularly on special occasions. Fish from the many lakes and rivers are a prized delicacy. The style of cooking in the Southern Caucasus is at the crossroads between East and West and has some common elements with Middle Eastern dishes, but the singular perfume of its herbs, the many bread and wine types that reflect the climates and soils of this territory, and the



The rich biodiversity of plants and animals is reflected in the variety and delicacy of the many dishes prepared in the Southern Caucasus Vine leaves sold at the market to make *dolma* (left). Traditional preparation of cheese (right)

creativity of people in the Southern Caucasus have generated a unique culinary style not easily found elsewhere in the world. The common elements in the diets of the three countries are bread, cheese, grapes, honey, nuts, eggplants, legumes, yoghurt and lamb. Many variations and differences exist, depending on the season, traditions and recipes, and the influence of neighbouring countries. Even if the three countries prepare the same dishes, each country adds a particular spice, herb or fruit or uses a cooking method (such as the diverse bread ovens described in the following pages) that makes the dish unique. According to Sonia Uvezan, spit-roasted chicken is traditionally accompanied by sliced cucumbers, tomatoes and lemon in

Armenia, pomegranate syrup in Azerbaijan and sour plum sauce in Georgia, resulting in three completely different-tasting dishes. Each country has specific recipes that cannot be found in the other two countries and uses its own wild and local plants to give an exclusive taste to its dishes, while bringing out the best of the territory and its resources and maintaining a lively link with national traditions. This inextricable link between biodiversity and local agriculture, cuisine and the social and cultural traditions of people in the Southern Caucasus shows that it is possible to reach a balance between livelihoods and natural resources.



WOMEN AND FOOD PRODUCTION

Caucasian women have always played a major part in creating a great variety of food products. Apart from making different types of bread (*tandır chorek*, *sac chorek*), milk products and daily and festive dishes, female labour and taste are incomparable in making preserves from fruits, pickled vegetables, marinades and other foodstuffs during certain periods of the year. Women pass down their recipes and their culinary secrets to their daughters, and family culinary traditions are a strong component of the cultural and social identity of families in the Southern Caucasus.

Men only take on the preparation of certain dishes such as *kabab*. In most cases, neighbours and relatives help each other in turn to prepare various foodstuffs for winter such as jam, syrups, preserves, *bakmaz* (boiled-down mulberry and grape juice) and pickles from wild fruits and vegetables. While involved in these activities, women sing and recite *bayaties* (a kind of Azeri folk poem).



Family culinary traditions are passed down through generations to maintain the cultural and social identity of families. At family and religious celebrations, delicious dishes are prepared and shared with friends and relatives





Bread has a special place in daily life in the Southern Caucasus. The whole family participates in bread production, as shown here at the Karabezian home in Garni, Armenia. The critical phase of bread rising is carefully checked

BREAD

Bread connects human life with nature and agriculture. Bread is not only food, but it is a symbol, a medicine, a communication tool that connects different social groups.

Bread is the most consumed food in the world. Even the Armenian expression “to eat, to take a meal” sounds like *bats utel*, i.e. “to eat bread”.

Good-quality bread has a particular place in the life of people in the Southern Caucasus because it is the basis of their daily

food and, when dried, preserves its quality, does not get stale or spoil, can be stored for a long time and retains its softness and freshness after being sprinkled with water.

When we eat bread, we do not immediately think of its main constituent, wheat. However, the origin of a good piece of bread is the wheat seed that is maintained, selected, cultivated, stored and cooked by millions of farmers. The Southern Caucasus is considered to be the place of origin for many wheat species. Botanists, geneticists, biochemists, embryologists



Bread being placed in the traditional buried oven. Bread can be produced in large quantities thanks to special techniques that enable it to be stored for a long time

and cytologists from all over the world have focused on the Southern Caucasus, identifying the region as a natural museum for wheat, because of the wide number and diversity of wild and cultivated species.

Yet nowadays these diversities are slowly disappearing and the entire world should be engaged in preserving such important resources. A rich collection of wild and cultivated wheat, mainly representing local species and populations, is maintained in the gene banks of the Southern Caucasus, with very little financial

support, thanks to the dedicated work and love for science and agriculture of national scientists. For example, at the Genetic Resources Institute of the Azerbaijan National Academy of Sciences, approximately 2 500 accessions are maintained, studied, regenerated, protected and used efficiently.

Wheat is not only maintained in gene collections but is still cultivated by small farmers to produce the type of bread they want to consume, and to adapt it to their farming practices.



Wheat diversity enables many different uses and functions. *Zanduri* produces a particularly soft bread and its long stems provide essential insulation for houses. >>Right: *dika* can grow in damp conditions and could become very important in adapting to climate changes

Zanduri

Over the centuries, people have developed ways of using the genetic potential of wheat at each evolutionary stage. An ancient pair of wooden tongs, found in Georgia and called *shamkvi*, was created to harvest *zanduri* soft wheat, which has particularly fragile ears.

Zanduri is a form of wheat selected by local communities in western Georgia who prized the variety not only as a food source but also to insulate their dwellings. With its long and strong stem, this wheat variety was used to make straw matting that could then be inserted under the roof to provide extra warmth.

Despite the fact that the wheat is found only in Georgia, it could be useful for cropping systems based on zero tillage. These cropping systems need straw residues for covering the soil and avoiding soil erosion between harvesting and the next planting period. Moreover, the flour made from *zanduri* wheat is rich in starch and produces a particularly soft bread that keeps well for long periods; this characteristic is appreciated by consumers since it reduces the energy consumption needed to preserve bread. Currently, only a few farmers grow local varieties of wheat (including *zanduri*), mainly because they lack seed sources and supporting policies that exploit crops adapted to their specific ecosystem.

Dika

Many farms in the Southern Caucasus grow wheat in wet mountain areas. Farmers observed that under these conditions wheat germinated soon after ripening, losing both its nutritional and market value. To counter the problem, they selected a variety called *dika* (*Triticum ibericum*) that matures earlier when temperatures are still low and thrives even in damp conditions, making it suited to wet mountain locations. Even if this wheat variety is harvested while it is still damp, the seeds do not germinate.

Dolis puri

Farmers have managed to turn what would normally be considered negative traits into positive ones. The Georgian wheat, *dolis puri*, is a variety of soft wheat that has two defects: it is sensitive to bending by the wind and, given the right hygrothermal conditions, its grains germinate easily once released from the chaff. However, these wheat grains are not easily released even in hail or strong winds, a factor which was originally considered a disadvantage, since it made threshing (using a heavy mallet or *kevri*) more laborious. In times of war, however, this shortcoming turned into an advantage. Farmers were unable to decide exactly when to harvest and were often forced to wait. In such cases, they often chose to cultivate *dolis puri* for the same reasons for which they shunned it in times of peace.

Ipkli

Ipkli, an autumnal variety of wheat, is grown in western Georgia, mostly in moisture zones. It has a high resistance to fungal attacks and adapts easily to barren soils in wet environments. It has a stable harvest. Its large grains may be red or white; the variety produces a flour that is excellent for bread-making.





Hulugo

This spring variety is grown in the high mountain regions of western Georgia and in the Kakheti region of eastern Georgia, where *dika* wheat is also grown. It has a high resistance to fungal attacks and has dense ears; it is sensitive to temperature variations. *Hulugo* is rich in gluten and is good for bread-making.

Emmer

Emmer has a high resistance to fungal attacks and adapts easily to poor soils, both in dry and wet environments. Its flour produces flavoursome and aromatic bread, which stays fresh for a long time. *Emmer* was formerly used for religious ceremonies, particularly to cook a special dish called *korkoti*. This tradition is still popular, but *korkoti* is now made with any kind of wheat. All farmers make *korkoti* on special feast days. *Emmer* and *korkoti* were mentioned in one of the oldest Georgian sources – *Life and activity of Grigol Khandzteli* by Giorgi Merchule (sixth century AD). Information about *emmer* and *korkoti* also exists in other ancient Georgian literary and historical works.

Nurlu-99

This variety has been developed through individual selection of germplasm introduced from the International Maize and Wheat Improvement Center/International Centre for Agricultural Research in the Dry Areas (CIMMYT/ICARDA). It is highly productive and resistant to diseases, lodging and shattering. The height of the plant is 70–80 cm. The variety is early ripening. Its bushing out is erect. The diversity is *graecum*. Ears are medium-sized and of average density, white and cylindrical. The ear scale is oval; awns are medium size, white and weak-charactered. The potential yield is 8–9 tonnes/ha.

At the Selection Achievement Testing Station in Asureti, many wheat varieties are maintained and selected. This white *ipkli* is particularly prized for its resistance to fungal attacks



Bread links food production, nature, social and religious life. *Above:* the traditional Armenian dance after the first wheat harvest. *Below:* the large oven, now electric, built in the basement of Sioni Cathedral in Tbilisi





Two phases of wheat processing in the village of Musachyan, Armenia: fresh water washing (left), and hand threshing (right)

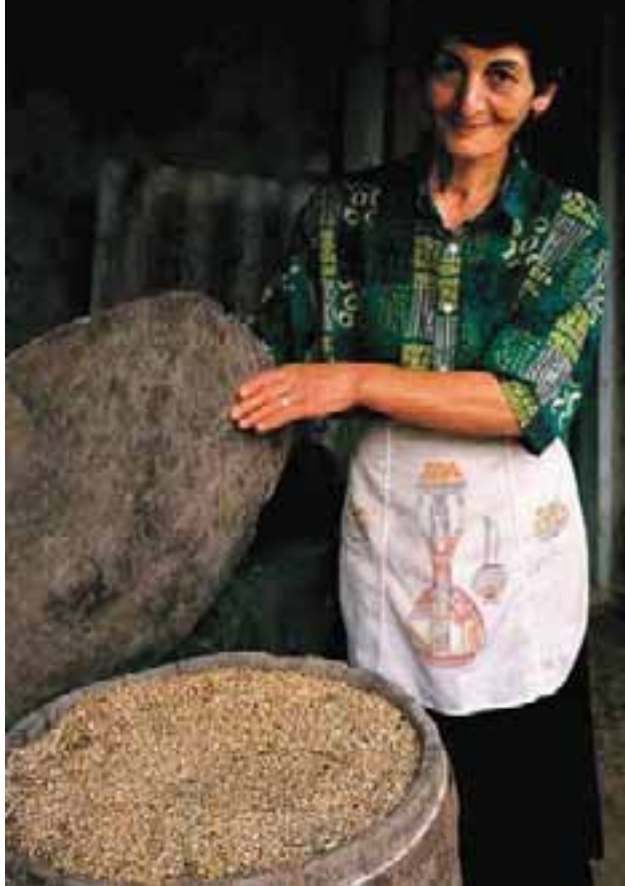
FROM FIELD TO TABLE

In the Caucasus, the end of the harvest and the beginning of threshing are marked by much festivity, and villages celebrate with traditional songs and dances. Harvesting takes place at the end of July. The ripe wheat is bundled into sacks that are stacked in the courtyard of each house. Two weeks later, the threshing starts, and subsequently the grains are washed and then left to dry before being stored in special amphoras known as *ambar*.

The wheat is milled to make whole-wheat flour, without separating out the bran. Throughout the rural areas of the Caucasus it is still quite common to find families using hand-operated mills to process small quantities of wheat when they need it.

In 1991, during the energy crisis in the region, mills throughout the Caucasus were once again used to make flour. Among them were a number of water-powered mills, such as the one in Agner, an Armenian village of 1 000 people.

In Armenia, whole-wheat flour is used to make flat bread called *lavash*, which can be dried and kept for as long as a year. Before eating the bread, it has to be moistened with water, a fact which made it popular in former times with travellers, and which still makes it attractive to shepherds who take their livestock into the mountains during the summer. An old Armenian proverb praises the bread, saying: “If you don’t eat large quantities of it, it means you must be ill”.



Wheat can be stored for many months in wooden barrels, thus ensuring a secure source of food in case of scarcity (left). Village water mills are used by each family to make their own flour (right)

Today, Armenian communities continue making their traditional *lavash*. Two to three people working for 12 hours can make approximately 300 loaves, enough to supply the whole family for days and still have some over to sell at market.

Lavash is also the national Azeri bread. This type of bread-making was developed by tribes of migrant animal breeders who used to lay in stocks of bread for three to four months when migrating. The bread is still consumed in all regions of Azerbaijan. High-quality *lavash* is made of durum wheat, which has long been cultivated in Azerbaijan. *Lavash* is eaten with cheese, butter, dried ricotta, vegetables and sometimes meat, which is wrapped inside it. *Lavash* filled with vegetables

is cooked on a *sac* (an iron disc for making bread) and eaten with fresh butter made inside a hollowed-out large tree trunk, or *nehra*, which is about 1.5 m in length.

In Azerbaijan, the above-ground oven is called a *tandır*. It is constructed from a mixture of materials: grey clay, hay, horse dung and goat wool are placed in a tub and macerated in water in the open air for 40 days until the mixture can be used to create the vault of the oven, which is 50–70 cm high and open at the top. When the vault is raised, using an object with a smooth surface, it is pressed to give it a stronger consistency and to model the shape. The oven floor has a hole for air during the burning of the wood.



A fragrant loaf of bread on the table is the result of a process that starts with wheat seeds maintained, selected and cultivated by farmers. The Southern Caucasus is a natural museum for wheat, thanks to its large number of wild and cultivated species. Preparation of *khachapuri*, a typical Georgian bread filled with cheese (left)

The upper hole is closed with a lid during combustion and the oven is blazed until the wood has a whitish colour. This indicates that the oven has reached the necessary temperature for baking the bread. Before the bread is put in the oven from the top, the walls of the oven are sprayed with a mixture of water and salt in order to prevent the main surfaces of the bread from burning during baking, where the bread is “glued” to the oven walls.

The *tandir* is not only used for cooking bread. It is also used for cooking various delicious dishes, including those with meat. These types of dishes are called *tandir khoraklari*.

In Georgia, the oven for baking *lavash* is called *tonnè*. Since it is constructed above ground, it is easier to manage. One of these ovens can be seen near Tbilisi’s seventeenth century cathedral. Here, bakers churn out *djuris puri* – loaves of bread in the shape of flattened clubs that are thicker than *lavash* loaves. There are also other types of bread-making ovens. One has two openings, the first for the wood and the second for the bread. The extra opening can also be used to blow in more air when the fire shows signs of dying and allows the baker to regulate the temperature more carefully. This type of oven is particularly suited to producing popular Georgian *khachapuri* cheese pastries.







The Southern Caucasus is rich in summer pastures, which enable the production of many different types of quality cheese and other dairy products. In order to safeguard this production and consequently the livelihood of rural people, it is important to promote safe small-scale processing and distribution

DAIRY PRODUCTS

In the Southern Caucasus, milk has been traditionally produced by sheep, goats, cows and buffaloes. Each region still produces typical products that are sold at local markets and much appreciated by the local population. Most cheese is produced during the summer when animals have access to better-quality pastures and feeding resources.

The importance of cheese in the culture of the Southern Caucasus is illustrated by the Azeri traditional way of swearing one's loyalty: "I swear upon my bread and cheese".

A few examples of the traditional dairy products of the Caucasus are given in the following pages.



Photo by E. Cattaneo



It is crucial to link producers and consumers, ensuring that agriculture can meet both the needs of farmers (to maintain their livelihoods, their work and their land) and consumers (to have sufficient, healthy and diversified food at a reasonable price). Dairy products such as yoghurt and dried ricotta are widespread throughout the Southern Caucasus. They can be consumed fresh or preserved for the winter

YOGHURT

Acid yoghurt is very popular and is called *matsun* in Armenia, *gatiq* in Azerbaijan and *matsoni* in Georgia. To produce this yoghurt, milk is boiled and fermented. Approximately 100 cc of old yoghurt is added to 10 litres of milk and then covered to cool the milk slowly. When old sour yoghurt is not available, *makardakhot* (bedstraw – *Galium L.*) may be used instead. The quantity of the ferment, the temperature of the milk and the locality condition the degree of acidity of the product. Yoghurt may be consumed on its own or in other dishes, mixed with garlic, *tolma*, steamed herbs, etc. It is used for making old Armenian *matsnapur* and *matsnabrdosh*. Butter and *tun* are produced by beating up *matsun* in a churner. In order to keep *matsun* for longer (for winter), it is usually strained and stored in clay pots, covered with a piece of leather. Sometimes the cream of *matsun* is also preserved for winter. In Azerbaijan, yoghurt made of sheep milk is considered the best. People also make *suzma qatiq*, a type of yoghurt filtered through cheesecloth.

DRIED RICOTTA

Ricotta cheese is produced by boiling buttermilk. In Armenia (Syunik, Shirak and Tavush regions), once the ricotta surfaces, the whey is churned, thereby obtaining further ricotta clots that are left to dry – these are the so-called *chortan* beads. The beads, rehydrated when needed, will then take on the normal shape. This is a strategic food, formerly a true stock item that was often used in the past, but that could now be a good addition to quick business lunches.

Another type of ricotta is prepared in Azerbaijan. It is called *shor* and is a salted ricotta. The fresh ricotta is put in a sheep's leather bag turned inside out (with the woolly part inside) and a mixture of boiled water and salt is added. The bag is closed and the contents mixed. The bag is then left on the ground in a dry place in the shade, and the ricotta gradually dries until it becomes thick and is ready to eat.



Cheese is produced from cow, sheep, goat and buffalo milk. Pakisa Abdullazade makes a typical cheese called *scian-scian*. Overleaf: Mrs Gigolashvili makes *chechil*, a braided cheese

CHEESE

In the Southern Caucasus, cheese is still made by using specific local types of rennet. For example, in Azerbaijan, near Quba, part of a lamb's stomach (abomasum) is washed, spread with salt, rice and wheat, dried, and then added to milk whey in a terracotta recipient.

In both Armenia and Georgia, *chechil* is a very popular stringy cheese. Cow milk is set aside for approximately three hours in Armenia and for 24 hours in Georgia to encourage the milk to turn sour, adding ferments that will cause the curd cheese to precipitate after 10–15 minutes. Without separating it from the whey, the curd is gradually collected in a single portion on which the “extension” part of the process is carried out (in order to obtain the stringy form of the cheese) and the “twisting” (to obtain the typical braided form). When the braid is ready, the cheese is extracted from the whey and left in the open for 10–15 minutes. It is then salted and pressed

with wood for two to three days before it is conserved in jars (marjoram is sometimes also added). The cheese can be kept for approximately one year in these jars at room temperature.

In Armenia, a green (mouldy) cheese that somewhat resembles Roquefort is prepared. It is made of thread-like (braided) and country cheeses. Pieces of cheese are put in clay pots and then salted. Holes are later made in the pots in order to allow air to enter (for mould formation).

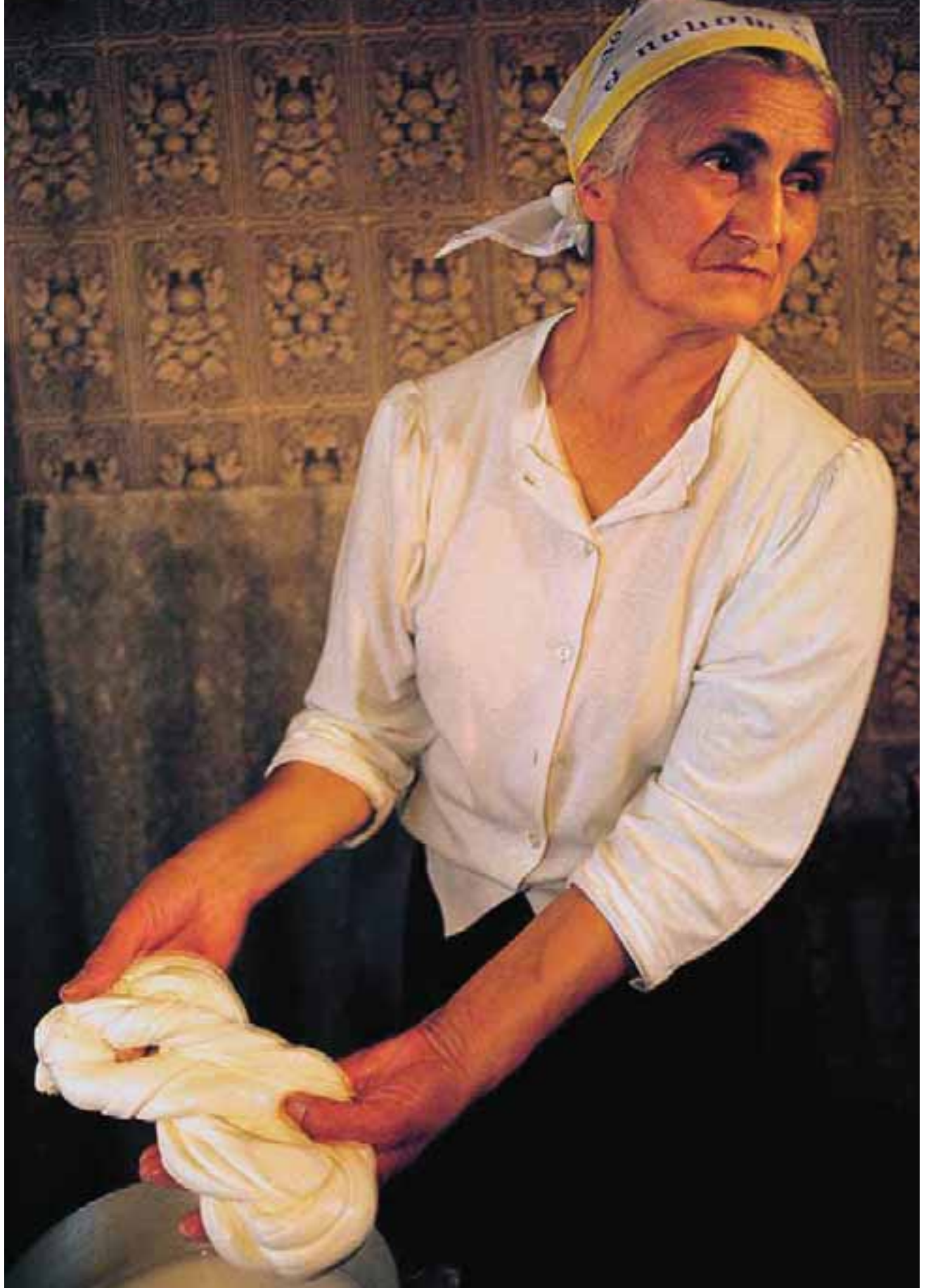
An Armenian cheese that is characterized by having “eyes” (holes) is *ankash panir*, which is obtained from curdling fresh cow milk. In Azerbaijan, a cheese named *scian-scian*, also with “eyes”, is made by mixing colostrum with flour. It is then set to cook on a hotplate, turning it several times until the “eyes” appear.

Some soft cheeses should also be mentioned. In Georgia, the soft cheese *sulguni* is prepared from an ordinary or semi-mature cheese, and is eaten as is, or used in specific dishes (for instance, in the preparation of the pan pizza *khachapuri*). The cheese is thinly sliced (about 1 cm thick), put in a pot filled with hot water and, as soon as it has softened, transferred to a basin where it drips off and is left to harden.

In Azerbaijan, *pendir* is the typical soft fresh cheese. It is made by boiling full milk (not skimmed). After approximately half an hour, curd is added and the curd cheese divided into small pieces. The cheese is then put in cloth bags. In order to preserve the softness of the cheese for the longest time possible, in some areas the cheese is covered with ricotta.

Buried cheese is like *motal* cheese. Chopped and salted aromatic herbs (mint, thyme) are mixed with a mass of fatty white cheese and put into clay pots, covered with a piece of gauze. The pots are turned upside down in order to drain the cheese. Finally, the pots filled with the cheese mass are buried in the soil until the end of autumn.







SUPPORT FOR THE PRODUCTION AND PRESERVATION OF *MOTAL* CHEESE IN THE SOUTHERN CAUCASUS MOUNTAINS

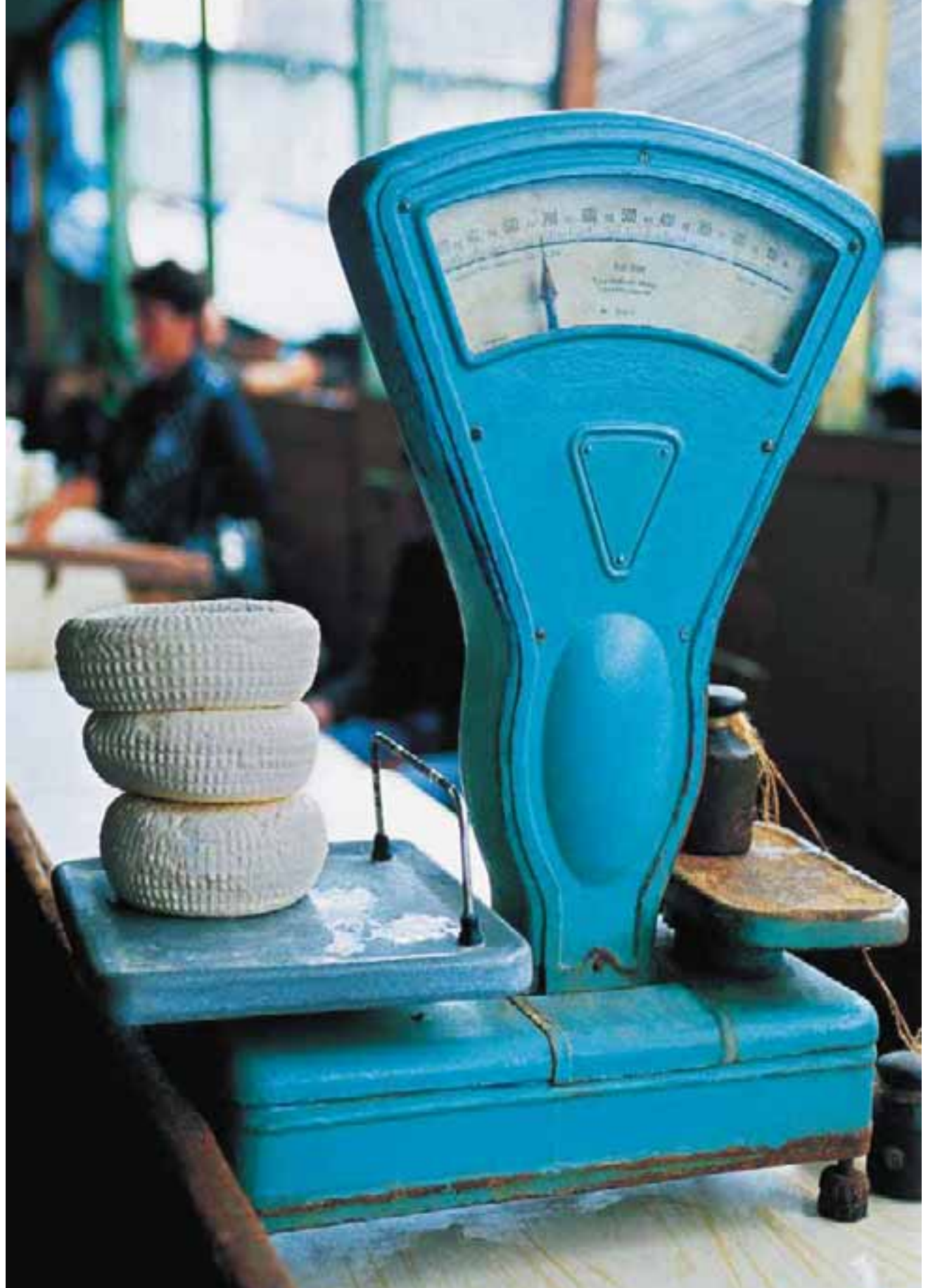
Motal is a type of cheese produced throughout the Southern Caucasus from sheep or goat milk or a mixture

of the two. It is traditionally preserved in terracotta pots or in sheepskin. In the mountainous regions, it is produced by shepherds who rear 40 to 150 goats in a harsh climate, in isolation, and with scarce financial resources. Consequently, they often sell the cheese directly

to consumers or through entrepreneurs just after it has been taken from the brine, instead of preserving it for longer in terracotta, as the traditional technique requires.

In the last few years, some projects have been started in Armenia with the objective

of enabling producers to work together, improve their cheese-making techniques and equipment, and obtain sanitary authorization to sell their products both nationally and internationally, while at the same time preserving traditional production techniques.





WINE

Vitis vinifera or grapevine was one of the first fruits to be domesticated. The Southern Caucasus and northern Islamic Republic of Iran are considered its primary centre. Natural hybrids between the wild and cultivated forms result in newer cultivars.

The importance of wine in Southern Caucasian agriculture in the past is also evidenced by a number of archaeological findings. Of the recovered material, the most attractive are the grape seeds. According to morphological and ampelographic analysis, which was also harmonized with a number of seeds of modern vine varieties, the seeds found at the Shulaveri site in Georgia are considered to be those of the cultivated vine – *Vitis vinifera* L. spp.

The seeds, from the fifth to the sixth millennium BC, are ancient not only for Georgia, but for the whole Eurasian continent. The results of archaeological observations also prove that Georgia is a genetic centre of origin of vines and that in the area seven to eight thousand years ago there were signs of land cultivation, especially of viticulture.

A reference to Armenian viticulture can be found in the Mesopotamian epic poem of Gilgamesh, written around 2000 BC. In the seventh century BC, the Greek historian Herodotus described how the Shiite King Madi raided the territory of present-day Azerbaijan to steal its wine, whose fame had reached the ears of the Babylon people.

The importance of vines in the Caucasus is testified by the ancient traditions of preserving wine in buried jars and by the richness of germplasm of *Vitis* spp. in the region.

At present, there are numerous large- and small-scale wineries producing many types of wines, and Armenian cognac is known worldwide.



Shamam melon, grapes and raisins at a market in Mashtot. The Southern Caucasus is considered a centre of origin of the grapevine. Diversity of landraces/farmer varieties has been declining, however many local varieties can still be found in family gardens.
<<Left: freshly picked grapes from the Shamakhi region

In west Georgia, at the source of the River Rioni, there is a small, beautiful region – Racha. Up to now, Racha has retained its language, folk and living characteristics because of the geographic and ethnographic border.

Field husbandry and viticulture were developed on its fertile fields and riverbanks even in ancient times. In the forests of this region, many wild grapevine species exist. Here, manual labour plays a significant role and the ancient rules of viticulture and land cultivation are still active.

In this region, the population has always cultivated high-quality vines and has its own specific rules for viticulture and wine-making. Even today, the people use the old working tools for vine cultivation such as clippers and axes and the containers for carrying grapes: *salasto*, *gideli*, *khakhali* and *godori*; vessels for measuring wine: barrels or *dora*; leather vessels for wine transportation: *tkhier*; and wooden, horn, clay, glass, pumpkin, gold and silver bowls for drinking wine. Farmers constructed special stone or wood buildings for storing wine, the so-called *marani* – wine cellars.



According to Sulkhan Saba Orbeliani, “*Marani* is a wine house”. These cellars have a ground floor where clay jars (*churi* or *kvevri*), the characteristic pitchers for storing wine, are buried. In lower Racha, on the right bank of the River Rioni, is the microzone for quality vineyards and wine.

The wine *khvanchkara* is made here, one of the first naturally sweet wines in the world. Farmers from Racha are incomparable masters of viticulture and wine-making. Because of lack of land, Racha farmers sowed maize, beans, peas and pumpkins in vineyards.

The German scientist Giuldeshredt (eighteenth century) remarks that “vineyards in Racha are gardens at the same time”.

Peach was favoured for planting because it is small-sized and did not overshadow the vine. On the verges of vineyards, the population grew plums, pears and apples.

The German researcher A. Pettsholdt (nineteenth century) gives the highest plaudits to the activities of Racha farmers in *The essays of Caucasian wine-making*, published in 1875. Farmers empirically classified vine species by zones, according to their maturity period.

It is a pity for this wealth of local knowledge to be lost, along with many folk customs for the protection and cultivation of slopes, and for the preservation of some high-quality local vines that are currently at risk of becoming extinct.



Grapes are widespread in the Southern Caucasus. They are consumed either fresh or preserved. Agricultural production systems should adapt to the changes that take place not only in the environment but also at economic and social levels, in order to maintain their sustainability





THE TOAST

In the Southern Caucasus, the tradition of the toast has survived political and social changes. The toast has its own rules and is conducted by the Tamadà, or “Master of the Toast”. Each glass of wine can be drunk only after a wish has been expressed by one of the guests on a theme selected by the Tamadà. This tradition is so popular that there are many anecdotes about it, such as the one about “the last toast”, which is the toast dedicated to guests’ safe journey home.

A man refused to participate in the last toast because he was afraid of getting drunk and losing his way home. So he said goodbye and left on his donkey. He was almost home when he hit an iron wire stretched across his path and fell to the ground. He immediately thought that what had happened was caused by his refusal to drink the last glass of wine, and decided to go back to the banquet and have a proper last toast. When he left again, he was really drunk. By the time he arrived where the wire had hit him, he had



In Armenia and Georgia, the toast has its deeply rooted rules. The “Master of the Toast” decides on the subject about which each guest has to express a wish before a glass of wine can be drunk

completely forgotten about it, but he was so low on the donkey’s back that this time he passed safely below the wire. Immediately afterwards, he noticed that he had escaped danger and exclaimed: “It is true! One must never refuse the Last Toast!”

The importance of this tradition is shown by the attention in sociocultural literature to “How to behave at the table”. The toast in Georgia is also demonstrated in the *Anthology of*

Georgian Poetry. Below is the first strophe of a poem about a toast, written by the poet Joseph Grishashvili.

Toast

*In your honour, new year
I drink with my father’s silver cup
To your health and welcome fervently these wishes
Sons of hearts as pure as pearls.*



The Southern Caucasus is a treasure trove of biodiversity of wild and cultivated vines. Better policies and efficient agreements should be implemented to maintain and use these valuable resources [Source: МИНИСТЕРСТВО ВКУСОВОЙ ПРОМЫШЛЕННОСТИ СССР. 1946. АМПЕЛОГРАФИЯ СССР, СОСТАВИТЕЛИ ПЕРВОГО ТОМА: I. ЧЛЕН-КОРРЕСПОНДЕНТ АКАДЕМИИ НАУК СССР П. А. БАРАНОВ Я. Ф. КАИ, М. А. ЛАЗАРЕВСКИЙ, ПРОФ. А. М. НЕГРУЛЬ, ПРОФ. И. В. ПАЛИБИН, ПРОФ. Н. Н. ПРОСТОСЕРДОВ. ГОСУДАРСТВЕННОЕ ТЕХНИЧЕСКОЕ И ЭКОНОМИЧЕСКОЕ ИЗДАТЕЛЬСТВО, ПИЩЕПРОМИЗДАТ. МОСКВА.]





Photo by V. Borgianelli

THE VINE GROWERS SOLIKO TSAISHVILI AND RAMAZ NIKOLADZE

by Soliko Tsaishvili,
Ramaz Nikoladze and
Valerio Borgianelli Spina

From time immemorial, vines and wine have been spread across the entire territory of Georgia, influencing everyday life and reflected in religion, art and folklore. For a Georgian, a plain was where vines grew, and where the mountains started was where vines could no longer be cultivated. Although Georgia is a small country, its climate and soil are amazingly diverse and rich, which explains why over 500 different grapes are grown here, each perfectly adapted to its place of origin.

Soliko Tsaishvili says: "I am a Doctor of Philology, and from 1998 to 2003, I was editor and reviser of the journal *Literature and Art*. I am also a translator from German and Russian.

Wine-making has been my hobby for a long time. I made my first wine in 1987 and I worked on the wine production chain with passion and love until I was 42 years old in 2003. Then, I decided to change my life completely, giving up my very interesting career, and dedicating myself entirely to vine-growing and wine production.



Photo by V. Borgianelli



Photo by V. Borgianelli



Photo by V. Borgianelli



Photo by V. Borgianelli



Photo by V. Borgianelli

A fundamental element in this decision was my meeting with the wine producer Giorgi Tushmalishvili, who introduced me to the secrets of growing grapes and their possibilities.

With three friends, I bought a small house with a hectare of vineyards in Kakheti, east Georgia. I still remember that day in May quite vividly. It was the first time I had seen the vine blossom at close quarters. Then, practically under my eyes, this turned into tiny soft seeds. A little later these green, poorly attached, fragile pellets turned into beautiful clusters of the *Rkatsiteli*, *Saperavi*, *Mtsvane* and *Khikhvi* grape types.

In the meantime, it was already mid-September so, just like our forefathers had done for many centuries, we pressed our harvest – heavy, healthy, sweet

grape juice – into *kvevri*, huge earthenware amphoras dug deeply into the ground. And, following the rules laid down by our ancestors, we added some cluster stalks and grape skins to what would become white wine and only the grape skins to what would become red.

Although we hadn't added any yeast, in a little while the juice began to ferment in the pots. But why was it so surprising? We hadn't tried to enrich the soil with any chemicals or modern additives. The fermentation was quite even, neither too strong nor too weak, which must definitely be attributed to the *kvevri* – this wonderful clay invention of the past. Dug deeply into the ground, these oval amphoras create ideal conditions for natural fermentation. For our part, we certainly assisted the process.

Just like our ancestors, we stirred the juice with a special long pole four or five times a day so as not to allow the grape skins to retain unnecessary and unwanted gases at the bottom.

In about three weeks, fermentation was complete, the *kvevri* were filled to the brim and securely sealed, but not airtight since the second stage of fermentation was not far off. In December, the *kvevri* were sealed for good, with a thick layer of soil above them. The next three months passed in tense anticipation. It was only in March that we were able to taste the result of our hard work.

Both wines, the white and the red, proved to be rich, with a distinct aroma and texture and simply delicious. The white had a fiery taint to it, while the red was the colour of a ripe pomegranate. After taking a sip or two for testing, we all decided we wanted to drink more. And we did, which was followed by a lot of singing. We certainly enjoyed it ... When I woke up in the morning, I realized I had turned into a true vine-grower and wine-maker – literally overnight!”

Ramaz Nikoladze works for the European Union Security Service as a bodyguard and tells us: “My ancestors cultivated vineyards in

Nakhshirgele village, Imereti region, and natural wine was at the heart of both my area and my family. They cultivated grape varieties such as *Tsistka*, *Tsolikouri*, *Krakhuna*, *Zvelshavi* and *Aladasturi*. In their backyards, *kvevri* were buried in the earth; they also owned *marani* (wine cellars).

Once I had tasted real, natural, *kvevri*-made wine in the mountain village, I decided I had to use *kvevri* to produce wine myself. I researched modern enological literature and talked to elderly people about the traditional methods of wine-making. I washed the old, abandoned *kvevri* thoroughly and used beeswax for their internal surface. I crushed the grapes by foot, and I poured the juice into the *kvevri* without any yeast; however, I did not follow the advice of my elders but did the fermentation without grape skins. The wine was excellent, but not perfect.

So, the following year, I added some grape skins to the grape juice and, after that, I increased the amount of skins to 6 percent as in the past and left the juice to macerate for four months. As a result, I obtained a bright gold, normal acid and excellent wine.

In 2004, I was invited to ‘Terra Madre’, organized by the international organization





'Slow Food', where farmers gathered from all around the world to share common experiences. I talked to the managerial personnel of the Slow Food Foundation for Biodiversity about the forgotten phenomenon of *kvevri* wine. We decided to set up a project on 'Georgian amphora wine'.

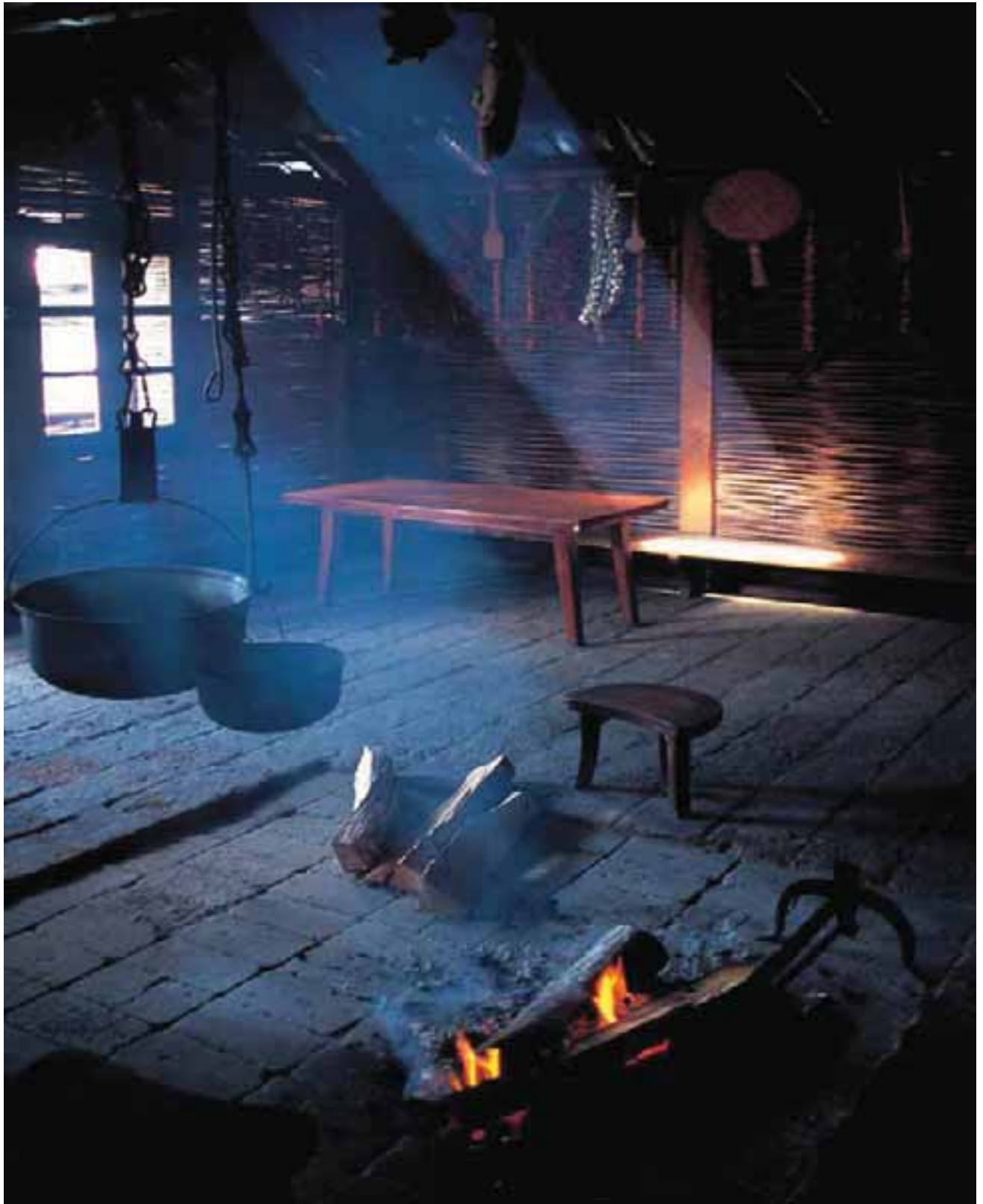
During my work and research, I met people who had experience working with traditional

methods of wine-making; although some were novices they were, like me, full of enthusiasm. Under the project, ten wine-makers were selected from the Kakheti region and six from the Imereti region. We created a management protocol and set up an ethical codex for each participant in the project. We do not use chemical inputs, and we adhere to the Slow Food slogan: Good, clean, and fair."



Photo by V. Borgianelli





6

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LINKING PRODUCERS AND CONSUMERS

TRADITIONAL METHODS OF MAKING REGIONAL FOODS ARE UNDER THREAT FROM SOCIAL, ECONOMIC, REGULATORY AND ENVIRONMENTAL PRESSURES. FOR THE INTEGRITY OF AGRICULTURE, IT IS CRUCIAL TO WORK ALONG THE ENTIRE FOOD CHAIN, FROM PRODUCERS TO CONSUMERS, ENSURING THAT AGRICULTURE CAN MEET BOTH THE NEEDS OF FARMERS (TO MAINTAIN THEIR LIVELIHOODS, THEIR WORK AND THEIR LAND) AND CONSUMERS (TO HAVE SUFFICIENT, HEALTHY AND DIVERSIFIED FOOD AT A REASONABLE PRICE). FOR THIS TO HAPPEN, GENETIC RESOURCES THAT ALLOW SUSTAINABLE PRODUCTION BY FAMILY FARMERS MUST BE MAINTAINED.

New technologies must be developed to reduce the impact of agriculture on the environment while promoting sustainable agricultural production (through, for example, methods that enhance soil fertility, reduce water consumption and pollution and reduce greenhouse gas emissions).

New accounting systems for payments for ecosystem services should be introduced. There is a need to organize and promote safe and small-scale food processing units and provide microcredits to farmers and decentralized investments.

Local policies need to be put in place to create farmers' markets in cities and support online distribution methods facilitating interconnections between producers and consumers. Last, but not least, the entire society should contribute to maintaining local cuisines.

Educational programmes need to be developed on the numerous recipes treasured by each family in the Southern Caucasus for dishes that are creative, make efficient use of the many species and varieties cultivated locally and are extremely healthy and full of flavour.





AT THE CROSSROADS BETWEEN EAST AND WEST
IN THREE HOSPITABLE COUNTRIES
AGRICULTURE AND BREEDING WERE DEVELOPED SINCE THE NEOLITHIC
COPING WITH THE RHYTHMS OF THE SEASON
A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS
TO MAKE BREAD, CHEESE AND WINE

PASTORALISTS AND FARMERS MANAGE THE LANDSCAPES

RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Երկրագործներն ու անասնապահները կառավարում են իրենց
հողակտորները

Otlaq istifadəçiləri və fermerlər landsaftı idarə edirlər

მიწას მწყემსები და ფერმერები განაგებენ

7

INTRODUCTION

PASTORALISM AND AGRICULTURE IN THE SOUTHERN CAUCASUS WERE SUBJECT TO INTENSIFICATION IN THE TWENTIETH CENTURY, FOLLOWED BY A WAVE OF DRASTIC CHANGES AFTER 1989. AS A RESULT, THE TERRITORY IS A COMBINATION OF LARGELY HOMOGENEOUS LANDSCAPES CHARACTERIZED BY INTENSIVE AGRICULTURE, ESPECIALLY IN THE PLAINS, VALLEYS AND FOOTHILLS, AND OF A VARIETY OF TRADITIONALLY MANAGED LANDSCAPES, PRESERVED MAINLY IN PERIPHERAL AND MOUNTAINOUS AREAS.

*A*gro-ecological management entails a paradigm shift where agro-ecosystems are designed and managed in a manner that optimizes nutrient and energy flows below and above ground.

Farmers' and pastoralists' knowledge of ecological processes can replace either excessive dependence on, or the lack of, external inputs.

An understanding of ecological and biodiversity management can unlock new potentials and provide goods and services to both the natural and human environments.

Ecosystem services (e.g. pollination, predation and soil nutrient cycling) are as valuable as agricultural products in providing public goods. Conserving these ecological processes allows managing agro-ecosystems for improved production and resilience.





Ecological behaviour by farmers, such as promoting nutrient cycling and maintaining pollinators, is fundamental to maintain a balance between agricultural production and ecosystem services

THE ROLE OF PEOPLE

Farmers and pastoralists are the custodians of traditional landscapes. Their management practices (such as breeding of local livestock adapted to feed on local poor-quality pastures) could continue to provide food while making a sustainable use of marginal and fragile resources. But changing needs might encourage practices that only bring short-term benefits. The intensification of agriculture mainly based on uncontrolled use of fertilizers, spread of monocultures and heavy machinery

might result in increasing eutrophication, loss of species-rich habitats and loss of landscape heterogeneity. The starting-point for maintaining good landscape management is to reinforce and develop specific agriculture and environment education programmes for all levels of society (including producers, consumers, policy-makers and the private and public sectors) that reconcile food production and the maintenance of natural resources.



Dr Eteri Didmanidze of the Georgian National Museum. International support should be granted to local institutions in order to develop a more interdisciplinary and holistic approach to agricultural science according to agro-ecological principles. Below: butterflies at the Georgian National Museum: *Colias caucasica* Stgr. (left) and *Allancastris caucasica* Led. (right)





Microscopic examination of beetles by Giorgi Chaladze, an entomology student at the Institute of Zoology in Tbilisi

THE ROLE OF SCIENCE

A wealth of information has been developed by scientists to respond to the need to produce sufficient food while maintaining the natural resource base. However, a large part of this information does not leave the research centres to influence farmers' decisions and daily practices. When science builds on local technical knowledge it can contribute to food security while enhancing natural ecosystems and agricultural production. For example, the Research Institute for Buffalo Breeding in Azerbaijan promotes modern technologies for selecting local buffalo breeds, and provides recommendations

for the maintenance of their habitat, directly involving local communities in their daily work and practices to maintain their culture and landscape management practices with which the breed is interdependent.

A collective effort is needed to reorient research and agricultural development towards agro-ecological principles that should lead to another type of science, one that is more holistic and understands dynamic complexity, ecology and landscape management.



Laboratory assistant Nino Miruashvili with the collection of hedgehogs from the Institute of Zoology in Tbilisi

THE ROLE OF DATA

For this book, reliable average and historical data have been used that are considered significant in analysing the condition of a territory: temperature, rainfall, soil characteristics, wild and domesticated species and agronomic practices. Yet this is not enough to understand and appreciate fully the enormous diversity within the territory and among farms. Farmers' knowledge of the basic mechanisms underlying soil fertility, plant growth, biological pest control and animal breeding needs to be analysed and combined with scientific data. Therefore, in order to make the best use of the landscape and its biodiversity, it is necessary to move much closer to farmers. Data have to exit from academic realms and zoom in on the territory and, more important, into the thinking of farmers and rural communities in order to support their decisions.

Efficient and locally adapted information related to the water requirements of plants and to soil fertility needs to be made

urgently available to farmers at site-specific or village level in a practical form, in order to support their daily decisions and farming practices so that they can maintain a sustainable and secure agriculture production. In return, the data and information produced by farmers should be better valued and used by scientists. Farmers can provide help in monitoring landscape conditions. They can help in the development of theories and inform scientists. Their traditional ecological knowledge is essential to develop agricultural practices adapted to new challenges.

The role of policy-makers in adding value to data contained in traditional knowledge and in ensuring that data information is produced for the direct benefit of those people managing the land is essential. Personalized support schemes tailored to specific farms' conditions should be developed to reward agricultural practices combining production with ecosystem services.



Personalized support schemes tailored to specific farms' conditions, including grazing systems, should be developed to reward agricultural practices combining production with ecosystem services



Grasslands cover vast areas of fragile ecosystems that are not suited to agricultural production but provide a significant amount of good feed for nomadic cattle and sheep

MANAGEMENT OF GRASSLANDS

Grasslands cover on average 65 percent of the Southern Caucasus' total agricultural area. They can be found at altitudes of 3 500 m down to sea level and pastoralists have developed strategies to maximize milk, meat, wool, dung and transport from these fragile environments, which are not suited to agricultural intensification.

In Azerbaijan, more than 3 million head of sheep, goats and young cattle are taken every year to summer pastures to graze for 100 to 120 days from May to September. In winter, flocks and herds graze on the lowlands and southern slopes, in desert environments or are kept in stables to protect them from wolves and the cold weather.

Winter pastures, with a total area of 1.7 million ha, are considered an indispensable cheap fodder resource for nomadic cattle and sheep.

In addition to grazing, grasslands are used for hay production and to protect mountain slopes. Currently, many movements between seasonal grasslands are being reduced or eliminated. Herd composition is being restructured along commercial lines; pollution, overgrazing and agriculture intensification are affecting traditional management practices.

Over 80 percent of grasslands in Georgia and more than 86 percent of natural pastures and hayfields in Armenia are degraded. Some 50 percent of total pastures and rangeland in Azerbaijan are subject to erosion processes. Winter pastures and their genetic resources are unprotected.

There are no policies regulating overgrazing and bad management practices such as the cultivation of fragile soils. Regulating norms and agreements specifically for grassland use should be developed, promoting clear rules for summer and



Hundreds of species are preserved in the natural grasslands of the Southern Caucasus and good farming practices help to maintain such biodiversity

winter grazing and supporting mobility as a strategy to make the best use of summer and winter grasslands. Policies should build on pastoral knowledge and community management of grasslands to sustain animal production, to improve quality and quantity of forage production, to maintain its rich biodiversity, and to protect fragile soils. These policies should plan for a period of at least 15 years and seek a balance between animal production and grassland protection.

LOCAL FORAGE LEGUMES OF GLOBAL IMPORTANCE

Farmers and pastoralists do not limit themselves to managing natural grasslands, but they also cultivate forages, and especially legumes, as part of their cropping systems. At present, several legume species that originated in the Caucasus are cultivated in other ecosystems around the world.

The benefits of these species have been examined not only in regions traditionally reliant on forage legumes (e.g. in Australasia) but also in countries (e.g. in Europe) where the use of nitrogen (N) fertilizer is the norm. Forage legumes that originated in the Southern Caucasus are much appreciated for their biological role; their capacity to fix large amounts of N in the soil; their role in crop rotations; their contribution, as cover crops, to soil protection; and their plasticity in adapting to droughts, floods and extreme weather conditions.

The role of forage legumes in animal diets and the high protein content of these plants are important components of sustainable and secure animal production systems. Alfalfa (see Chapter 4), sainfoin and *Lathyrus* have played and will play an essential role in human development and civilizations, in animal diets and in the maintenance of landscapes.

Sainfoin (*Onobrychis sativa* Lam.)

Armenian	<i>Korngan</i>
Azeri	<i>Khasha</i>
Georgian	<i>Espartseti</i>

Sainfoin is a productive legume suited to calcareous dryland soils. It is rich in proteins (16.4 percent) and in minerals. It responds to irrigation on shallow soils. Condensed tannins in its leaves prevent bloating in ruminants and improve their protein metabolism efficiency.

Sainfoin is the most productive fodder in high rainfall mountains, foothills and plains where irrigation is scarce. In foothill zones, sainfoin is sown both in autumn and spring. In rainfed conditions, it gives two hay cuts a year, each yielding 5–6 tonnes/ha dried hay. Sainfoin is a good crop before cereals and potatoes. Both the Southern Caucasus and the Near East are considered the cradles of sainfoin cultivation.

In Armenia, sainfoin cultivation began centuries ago. There are references to sainfoin in *Haybousak* by Ghevond Alishan, as well as in the songs of the Armenian mediaeval philosopher Grigor Narekatsi. For centuries, sainfoin has been cultivated in natural specific conditions, resulting in generation of a local variety of a valuable economic and biological nature. According to A. Matevosyan, there are 21 wild varieties of sainfoin in Armenia. According to Aydin Asgarov, there are 22 or 23 species in Azerbaijan.

Onobrychis transcaucasia Grossh. (Transcaucasian sainfoin) is considered to be one of the oldest forage crops in the world. It grows in the wild everywhere, especially on dry slopes of the middle mountainous zone. There are known to be many different populations, and it is a polymorphous variety. Many wild varieties of sainfoin are also of a certain economic interest

for further breeding given their precocity, winter-resistance, drought-resistance and the fact that the “sainfoin flower mosquito”, which damages cultivated plants, does not harm the sainfoin wild varieties *O. cadmea* Boiss., *O. oxytropoides* Bunge, *O. vaginalis* CAM and *O. biebersteinii* G. Sir. Given the global importance of this species for forage production, the creation and protection of a seed collection of sainfoin in the Southern Caucasus is an international issue.

Lathyrus (*Lathyrus* spp.)

Armenian	<i>Tapolor, Gulur</i>
Azeri	<i>Gululje</i>
Georgian	<i>Tsulispira</i>

Lathyrus grows in the mountains and is one of the best forage species in the Southern Caucasus. It is preferred by ovines and horses rather than by bovines. *Lathyrus* is an indicator of soil fertility. Because of its deep roots, it can grow in both dry and heavy soils. It is a perennial species that produces abundant nectar and good honey.

L. sativus L. (white pea) is a drought- and cold-resistant spring crop good for green forage, silage and its seed flour, which is a preferred feed for pigs and poultry.

One of the best forage species is *L. tuberosus* L. (sweet pea) (called *Catvi-tciank*, *Tap-volor* in Armenia, *Kokuyumru gululje* in Azerbaijan and *Tero* in Georgia), a perennial species found throughout the Southern Caucasus up to 1 000 m. Bees appreciate *L. tuberosus* L. for its rich nectar and pigs eat its root tubercula, which are the size of walnuts, black and characteristic of this species.

The tubercula (called *Glandes terrestres*) contain an essential oil similar to that of roses, which can be extracted by distillation.



The Southern Caucasus is the cradle of several legume species of important economic and biological value that are cultivated in all Australasia and Europe. Therefore, the creation and protection of seed collections of these species should be an international issue



In the Southern Caucasus there are over 400 species of grasses and legumes. This great biodiversity is of global importance but today only a few species are studied and cultivated. Among the species that would deserve more research: from left to right (above): *Bromus inermis*, *Phleum hirsutum*, *Bromus erectus*; from left to right (below): *Trifolium badium*, *Poa alpina*, *Festuca nigrescens*





From left to right (above): *Avenella flexuosa*, *Brizia media*, *Deschampsia cespitosa*, *Sesleria albicans*.
 From left to right (below): *Phleum rhaeticum*, *Cynosurus cristatus*, *Trifolium alpinum*
 [Source: Bozzo, F. et al., 2004. Site-specific grasses and herbs. Rome, FAO.]





MANAGEMENT OF POLLINATORS TO MAINTAIN THE PRODUCTION OF THE ECOSYSTEM

by Barbara Gemmill-Herren

GLOBAL VALUE OF POLLINATION SERVICES

Pollination is a much overlooked and undervalued ecosystem service all over the world, yet one that is critically important to the natural world and to food production for human livelihoods. While foraging for food for themselves and their offspring, pollinators such as bees and moths, and a wide variety of other species, inadvertently provide a service that directly links wild ecosystems with agricultural systems, demonstrating why biodiversity conservation underpins human welfare.

The vast majority of flowering plants will only produce viable seed or fruit if an insect or other animal visits their flowers and moves pollen from the anthers to the stigma of a flower of the same species. Without this service, many interconnected species

and processes functioning within an ecosystem would collapse. Pollination services shape plant communities and determine fruit and seed availability, providing tremendously important food. The diversity of pollinators and pollination systems is striking. Most of the approximately 20 000 species of bees (Hymenoptera: Apidae) are effective pollinators and, together with moths, flies, wasps, beetles, bugs and butterflies, make up the majority of pollinating species.

Notably, arid and mountain ecosystems often have highly diverse pollinator communities as well, with finely tuned adaptations to ensure that pollination is effective even when climatic conditions are erratic.



Beehives in Kotayk Marz in Tsaghkadzor village. Pollinators represent a natural service that can effectively contribute to agricultural production, all the more so in the current conditions of rising input prices and climate change. <<Left: Caucasian bee on blossoming almond

VALUE OF POLLINATION SERVICES

In agro-ecosystems, pollinators are essential for orchard, horticultural and forage production, as well as the production of seed for many root and fibre crops. Eighty-seven of the leading global food crops are dependent on pollination services provided by animals out of a total of 113 food crops, and 35 percent of all food production globally comes from crops dependent on pollinators. For human nutrition, the benefits of pollination include not just abundance of fruits, nuts and seeds, but also their variety and quality. In many countries, quality is vitally important, because well-shaped fruit – the result of good pollination – fetches much higher prices in the market.

Pollination is one ecosystem service that until recently was considered to be poorly documented from an economic standpoint, and had few hard figures to justify its value. But

that has been rectified with a recent careful assessment of the contribution of animal pollination services to the global economy, which places the total economic value of pollination worldwide at EUR153 billion, representing 9.5 percent of the value of the world agricultural production used for human food in 2005. Those crops that depend on pollination services are high value, averaging values of EUR761 per tonne, against EUR151 per tonne for those crops that do not depend on animal pollination.

These figures do not include the contribution of pollinators to crop seed production (which can contribute considerably to seed yields), nor to pasture and forage crops. Nor do these figures include the value of pollinators to maintaining the structure and functioning of wild ecosystems – as yet these are all uncalculated.



THREATS TO POLLINATION SERVICES

Pollination services have been little appreciated until recently, since they are provided by nature at essentially no cost. As evidence, pollination has not been addressed by the agronomy sector, nor treated as a critical agricultural input, together with fertilizers, pest control and water management. Yet as intensive agriculture, with large-scale cropping patterns and inputs of pesticides, has become the norm in developed countries, serious impacts have been seen in the declines of pollinator populations to service crops. Other pollinator groups are also showing serious declines – in particular, butterflies and nectar-loving birds and bats. The ratio of threatened vertebrate pollinators to the total numbers of vertebrates in each genus is extremely high, which indicates that the world's nectar-feeding wildlife may be as vulnerable as carnivores to human-induced extinction pressure. The key threats to pollinators are no different from those to biodiversity in general: habitat fragmentation, intensification of land use, use of agrochemicals toxic to beneficial organisms, climate change and alien invasive species.

ACTIONS TO ENSURE CONTINUED PRODUCTIVITY OF THE SERVICES

As the process of securing effective pollinators to “service” large agricultural fields is proving difficult to engineer, there is renewed interest in helping nature provide pollination services. The international community has identified the importance of pollinators with the establishment of the International Pollinators Initiative in 2000 by the CBD, facilitated and coordinated by FAO. Four areas for action on behalf of the conservation and sustainable use of pollinators have been identified: (i) assessment and better knowledge management; (ii) identification of best adaptive practices in managing ecosystems to promote pollinators; (iii) capacity building so that these practices can be applied; and (iv) greater awareness and policy to support the role of pollinators.

Some recognized pro-pollinator practices include conservation of patches of wild habitat – such as forests or structurally diverse grasslands – in agricultural landscapes. A five-year global project beginning in 2009, funded by the United Nations

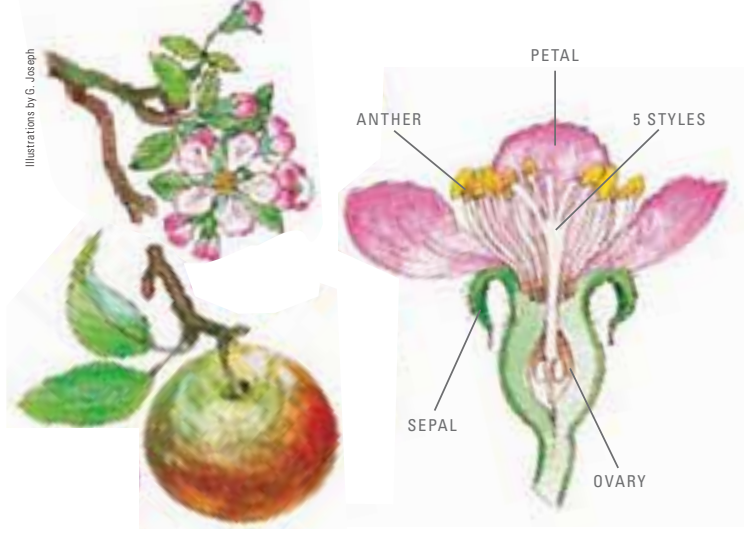


Coleopters on a rose in Suvelan village. In the Southern Caucasus, the value of pollination for pastures and forage crops may rival the value of crop production. The value of pollination worldwide has been estimated at EUR153 billion/year

Environment Programme (UNEP) Global Environment Facility (GEF) and coordinated by FAO, will be able to explore and test, in multiple agro-ecosystems and ecologies, the practices that will prevent the loss of pollination services provided by wild indigenous pollinators. Regional initiatives in other areas – including Europe, North America and Oceania – have similar objectives. Most solutions designed to make modern agriculture more biodiversity-friendly will need to be developed within a supportive policy framework. Merely getting the idea of pollinators into the awareness of policy-makers is a challenge; pollinators are largely insects, which are more often perceived as being unpleasant rather than beneficial.

The process of pollination is subtle, and has often not been understood by farmers, much less by the general public. Public awareness and supportive policies are easier to build around charismatic animals; with pollinator conservation, new ground needs to be broken in conveying to the public that it is the links and interactions between living things that are endangered, not the individual species *per se*. However, most of the policies and practices that will serve to benefit pollinators are not stand-alone measures. Increasing diversity on farms, introducing areas of habitat that foster beneficial insects, linking habitats and reducing the application of toxic agrochemicals also have multiple benefits for other ecosystem services in agriculture.





Pollinators such as bees are important to promote growth and provide local genetic material in order to increase the production of fruits. Flowering branch, fruit and median section of apple flower (left). Queen bee on a typical cage used for its transportation (right)

POLLINATION IN THE CAUCASUS

In the Southern Caucasus, it is impossible to separate meadows and orchards from bees. Many plants need to be pollinated in order to produce fruit, and local genetic material has evolved together with local bees. Small farmers need honey as a source of food and wax to be used during the long winters but they also need bees in order to obtain good fruit production. The many fruit trees in the Rosaceae family with important centres of origin and domestication in this region – for example, cherries, plums, pears and apples – depend heavily on abundant visitation by insect pollinators at the time of flowering in order to achieve good yields. By visiting the flowers, pollinators (mostly bees) move pollen from the anthers on the flowers of one tree to the styles of the flowers on another.

The Caucasian bee

Honey bees (*Apis mellifera* L.) are one of the most well-known, popular and economically beneficial insects. For thousands of years, human beings have plundered honey bee colonies to obtain honey, bee larvae and beeswax. The Southern Caucasus has its own honey bee race, the Caucasian honey bee *A. mellifera caucasica*, which is widespread in the region.

Interest in this species was aroused by the Russian researcher A. Boutlerov, who published an essay about it in 1877, highlighting its pacific attitude.

The Caucasian bee has many characteristics that make it one of the most popular throughout the world: the length of its proboscis and wings; honey and wax production; high queen fertility; resistance to low temperatures and to diseases; lack of aggressiveness; high nectar collection capacity even in rainy and foggy weather; active defence of the hive; low feed consumption during the winter rest; and acceptance of queen coexistence. The production rate of the Caucasian bee is the highest among bee species. It is, however, slow to build up its population in the spring, and is thus particularly effective for crops that flower abundantly in the summer months.

In addition to indigenous races of honey bees, the Caucasus is rich in other species of bees – for example, many species of bumblebees are found here. Bumblebees are particularly well adapted to pollinating trees and crops that flower early in the season, and to tolerating the low temperatures of high mountainous regions.



The Caucasian bee is highly productive, resistant to low temperatures and diseases and is non-aggressive. It is well adapted to the Caucasian climate, as its pollination is particularly effective for crops that flower in summer months

SPECIES POLLINATED BY THE CAUCASIAN BEE AND HONEY PRODUCTION		
Scientific name	Common name	Honey production (kg/ha)
<i>Robinia pseudoacacia</i>	Black locust	1 600
<i>Acacia</i>	Acacia	1 000
<i>Tilia caucasica</i>	Lime tree (linden)	1 000
<i>Castanea sativa</i>	Chestnut	300
<i>Melilotus officinalis</i>	Clover, yellow sweet	170
<i>Medicago</i>	Alfalfa	300
<i>Elaeagnus</i>	Russian olive	80
<i>Symphytum caucasicum</i>	Caucasian comfrey	70
<i>Prunus armeniaca</i>	Wild apricot	5
<i>Prunus persica</i>	Peach	1
<i>Prunus divaricata</i>	Cherry-plum	1–40
<i>Prunus amygdalus</i>	Almond	25
<i>Prunus spinosa</i>	Sloe	20
<i>Laurocerasus officinalis</i>	Cherry laurel	20
<i>Pyrus caucasica, P. communis</i>	Pear	15
<i>Malus domestica</i>	Apple	15



Transhumant beekeeping, in addition to honey production, has an important ecological role in enhancing pollination of wild plants and trees

Transhumant beekeepers

Bee transhumance is a particular feature of Armenia and Georgia. Beekeepers start the bee pollination season in the valleys and then move towards the hillsides and mountains, in order to make the most of precocious flowering in mild areas and late flowering in colder areas.

Pollination is carried out by separating the type of honey by area of pollination, and thereby yielding a product with specific characteristics. Experienced beekeepers have noted that bees are more likely to pollinate wild varieties of pears and apples than other varieties. This, they believe, is because of the faster desiccation of the nectar of the plants that have been selected by breeders.

The acacia tree is one of the bees' favourite trees; it produces large quantities of honey per ha (about 1 000 kg). The honey is yellow, transparent and sweet. The best honey is aromatic and yellow and comes from the lime tree, while another popular variety is chestnut honey. Nectar for bees also comes from herbaceous plants: clover, medick, melilot and rye-grass. The honey harvested from white clover is aromatic and yellowish; that from red clover is darker (almost ochre); and honey from sainfoin is described locally as transparent "as a tear". Specialization is so driven that individual plant species are pollinated by expert nomadic beekeepers who thus secure a very low but highly specialized production (e.g. only 1 kg/ha is produced of rare peach honey or of wild plum honey) that is much appreciated at markets.



Beekeeping is an important source of income. Beekeepers from Yeniol village are depicted, preparing the beehives for the winter

TRADITIONAL BEEKEEPING IN AZERBAIJAN

by Yagub Guliev

Honey bees do not only produce honey, but play a vital role in the balance of nature, especially in the pollination of agricultural and horticultural crops and in home gardens. Pollination is important for the viability of many pastoral enterprises, market gardens, orchards and seed industries. Collecting honey from wild bee colonies is still practised

by aboriginal societies in many parts of the world. At some point, humans began to domesticate wild bees in artificial hives made of hollow logs, wooden boxes and pots.

Beekeeping in woven baskets is still practised in Azerbaijan. Here, the species universally managed by beekeepers are the Caucasian bee and local Gabagtapa bee.

Beekeeping is very popular in rural areas to diversify income sources. Early forms of honey collecting entailed destruction of the entire colony when the honey was harvested until a revolution in beekeeping practices occurred in the nineteenth century through the invention and perfection of the movable comb, thanks to Langstroth. The majority of beekeepers in Azerbaijan

currently use a simple machine for extracting honey from the comb by means of centrifugal force.

Apiarists in Azerbaijan are not particularly mobile in general, with bee populations moving and mingling within a small geographic range from lowlands to mountains. Beekeepers do not migrate to the highlands.



For centuries pastoralists have selected and maintained livestock breeds adapted to the local climate, steep mountain slopes and local grasslands. Domesticated animals and pasture species have coevolved

MANAGEMENT OF LIVESTOCK

Over the centuries, pastoralists have developed local livestock breeds that are exceptional foragers of Caucasian native flora and can survive through a season of scarce food or graze marginal land where improved breeds would not survive. In the Southern Caucasus, domesticated animals and pasture species have coevolved and plant species more appreciated by animals have dominated.

Pastoralists have also contributed to maintaining good landscape conditions through weed control, fire suppression and recycling of nutrients into the soil through hoof action and manure. The strong interdependence between people, animals and their habitat has contributed to shaping today's landscape.

The structure of the herd (number of young animals, milking animals, female and male) is normally regulated according to feeding resources and land tenure rights. Livestock traditionally belong to individual families but graze on private land as well as on communal meadows. Communities still regulate grazing rights.

The extinction of local breeds selected for specific environments in the Southern Caucasus will not only seriously damage farmers and pastoralists who depend upon them, but also seriously damage the gene pool that could provide important genetic material to the entire world. Major efforts are needed to inventory, understand and protect this biodiversity. It is also urgent to mobilize scientists and policy-makers to preserve local breeds in gene banks and to integrate them as important components of modern, diversified and sustainable farming systems.

This book describes a few examples of animal genetic resources found in the Southern Caucasus.

CATTLE

Georgian mountain cattle

Georgian mountain cattle are an old breed selected for milk production. Like most traditional breeds, they also provide meat and draught power.

The breed is maintained on the southern mountain slopes and in the mountainous Ajara region where temperatures are extremely low (falling between -25 and -30 °C); winters are snowy and last from five to seven months; feeding resources are scarce and of very poor quality – only this breed can survive and produce milk.

Georgian mountain cattle are extremely agile and can graze on steep slopes (30–35 percent) where rural farmers have to use a rope tied together around their waists to avoid slipping when mowing and cultivating the land. The cattle breed is very small with an average withers height of 98–100 cm. The main milk production period of this breed is during grazing from May to October.

Generally milk yields are low, but with improved feeding and care can average 2 000 litres/year with 4.2 percent fat. The milk is characterized by small-diameter fat globules, which indicate its dietary characteristics. Its high fat percentage is maintained when total milk production is increased.

The strong constitution, endurance, high milk fat content and meat quality of this breed should be recognized in order to promote the sustainable use of fragile and harsh mountain grasslands but, lamentably, the existence of Georgian mountain cattle is endangered.



Megruli red cattle

Megruli red cattle are a multipurpose breed. They were developed by the Kvaratskhelia brothers in the Samegrelo region in about 1860. They spend the summer in alpine mountain pastures, but in winter they pasture on the Kolkheti bogs without supplementary food. They are permanently in the open air, have a strong constitution and good working characteristics. The breed only exists in Georgia and is endangered.

Caucasian brown/grey cattle

One of the most significant achievements of zootechnical science in the twentieth century could be considered the establishment of Caucasian nut brown cattle, based on the joint work of scientists from Caucasian countries. The breed has been raised by crossing Armenian, Azerbaijani, Georgian and Dagestan local cattle mainly with Swiss breeds.



In the southern parts of Georgia, where the Caucasian brown breed is mainly found, there are extensive grasslands that provide a stable food base. The characteristics of the basic breeds are successfully combined in these cattle: the Swiss brown breed offers large live-weight productivity, while the local breed contributes high milk fat and adaptation to local conditions.

Nowadays, the Caucasian brown breed exceeds 95 percent of total livestock in the country, but its productive indicators do not correspond to breed standards. This is partly because zootechnical registration is poorly maintained and artificial insemination does not exist. Moreover, since there are no breeding farms to produce improved bulls, cows are inseminated by free insemination of young bulls of unknown origin that will eventually cause the deterioration of the Caucasian brown breed. Record-keeping in Armenia and Azerbaijan is better organized and collaboration and joint work are required in order to improve the productivity of this breed.



Pastoralists contribute to maintaining the landscape through weed control, fire suppression and manure management. <<Left: *Megruli red calf and Caucasian brown cow*

Georgian buffalo

Buffaloes are bred in the lowlands and in mountainous regions. They feed well on poor pastures and on marshes, cane and low-quality hay, on which cattle cannot survive and produce. Buffaloes produce on average between 1 300 and 1 500 kg milk/year with 7.8 percent fat but can produce up to 3 000 kg depending on the quality of feeding resources available. The best-quality sour milk and cheese are made from buffalo milk. The meat of the grown buffalo is rough and fibrous and not comparable with cattle meat, whereas the meat of young buffaloes does not differ greatly from that of cattle. The king of Kakheti, Giorgi XII, was called “Eater of young buffaloes”, because he liked their meat so much. It is important to preserve local breeds since:

- ❁ they are resistant to leucosis, piroplasmosis, brucellosis and foot-and-mouth disease;
- ❁ they are adaptable to temperature fluctuations and low oxygen conditions in mountainous areas;
- ❁ they are good users of steep and low-quality pastures;
- ❁ their milk and milk products have specific taste features;
- ❁ they have specific culinary meat traits.

These characteristics of the local gene pool herd have been established by selection carried out over a long period by farmers and pastoralists and are a source for genetic completion.



Livestock graze both on private and communal grasslands and farmers have to regulate grazing periods in order to prevent degradation

Azerbaijan buffalo

by Akif Farajov

Buffaloes roam over the subtropical, boggy, marshy river areas of Azerbaijan. The buffalo is an irreplaceable domestic animal for its productivity in the adverse climatic conditions of the Aran (lowland) region. The animal was not studied on a scientific basis until 1930 and the breed was the result of popular selection.

The main reason for the spread of buffalo breeding was the availability of natural feeding resources (reedy areas, boggy zones, water basins and lakes), and the opportunity to feed non-milked buffaloes on grasslands throughout the year.

Approximately 102 000 family farms are involved in buffalo breeding in Azerbaijan. Ninety-five percent of them keep one to three buffaloes, 3.8 percent keep five to ten and 1.2 percent keep more than ten. In 2005, Azerbaijan provided for the establishment of private pedigree buffalo farmers in the state programme of socio-economic development for the region.

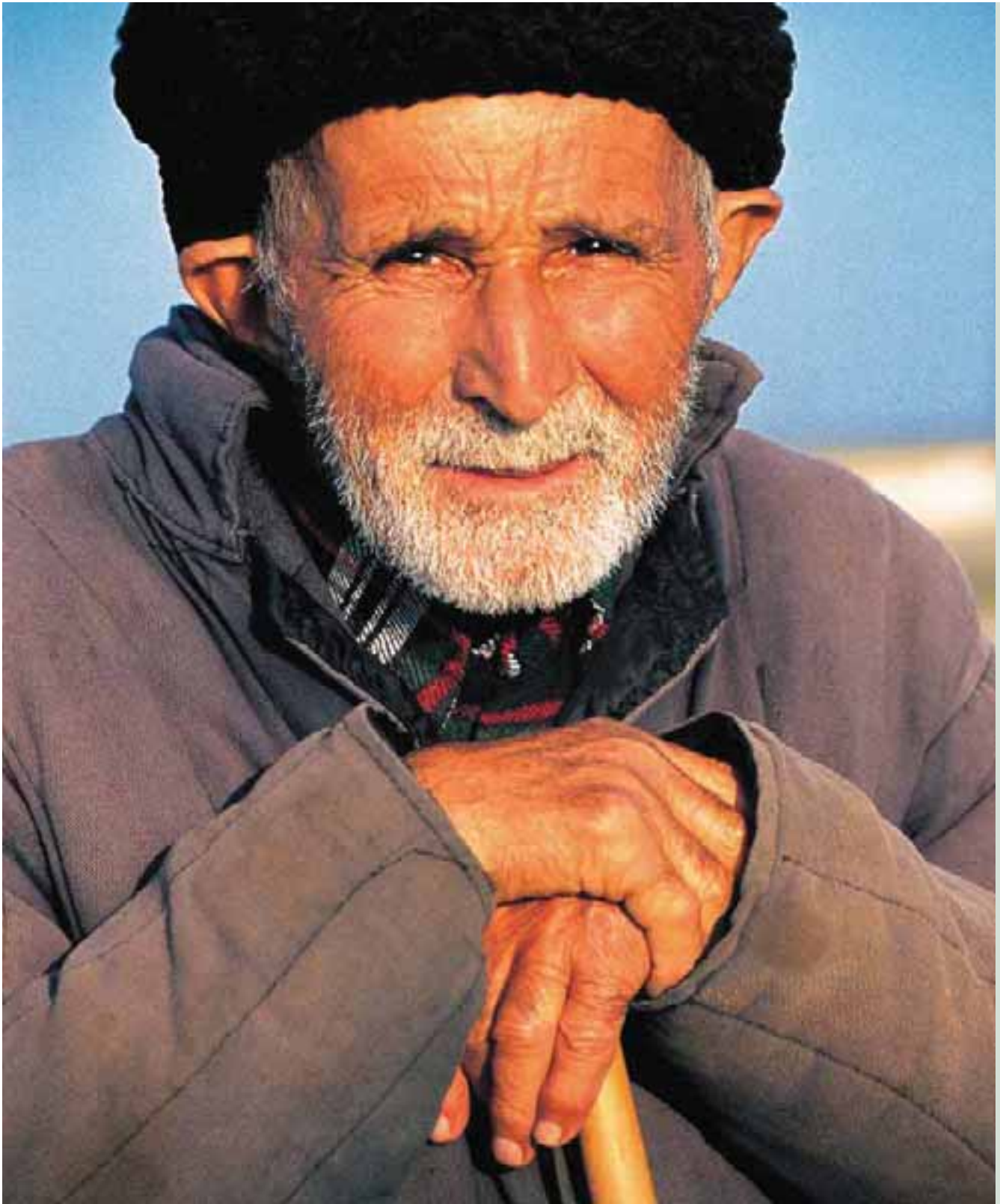
The absence of buffalo milk plants in Azerbaijan creates problems in the marketing of buffalo milk. Plants do not accept buffalo milk or try to buy it for a cheap price. For this reason, farmers prepare their own butter, cheese and *kefir* and sell their products directly at the market.

The reason for the slow development of buffalo products is that the market is poorly organized and potential consumers are not easily reached by producers.

Another reason for the slow development of buffalo products is linked to the need to improve the availability of the feeding base so as to maintain a stable milk production system throughout the year. For this purpose, at least one plant producing feed in Azerbaijan should be developed. In addition, good-quality sire buffaloes or buffalo semen should be made available to small farmers, as well as adequate education and a training programme related to the entire buffalo production chain (genetic resources, quality and quantity of forage and feeding resources, milk and meat production and processing).



Buffaloes are more rustic than cattle, more resistant to diseases and adaptable to temperature fluctuations, but their meat is very fibrous. Buffalo milk is high in quality and cheese and yoghurt would be much appreciated at markets, but the distribution chain is not sufficiently developed





THE BUFFALO FARMER YAVER BINI FARAJOV

by Marzio Marzot

A horseman rides by, rustling the weeds that shine warmly in the evening sun. The sun is setting and we are arriving at the huge *Yaver Bini oghlu* farm. We see and feel the magic around us: it extends as an endless valley with hundreds and hundreds of buffaloes, chewing away, that gaze at us with drowsy and docile eyes. With more than a thousand head, the entire area around the Xazar village (Neftçala) is full of them.

Yaver Bini Farajov, founder of the farm, comes to greet us. His more than eighty years do not show: his back is straight,

his gait steady, his eyes lucid and he rests upon his walking stick as any shepherd would, even at a young age. In keeping with Azerbaijan's hospitable spirit, we are invited to spend the night in Farajov's vast two-storey house built entirely in wood. Around us is a garden rich in fruit trees, small vegetable plots, beehives, chickens, geese, sheep and other animals.

The life story of Yaver Bini Farajov is both complicated and instructive. Farajov's satisfying results are due to study, courage and determination while taking part in a story of hardship

that includes consequences of the Second World War, a forced move from one region to another, working in the *kolkhoz* and the negative repercussions of the fall of the Soviet Union. In spite of – or perhaps thanks to – all this, Farajov today heads an exemplary farm where the core business consists of approximately 200 buffaloes. From their milk, various products are made, such as *pendir* cheese, yoghurt, ricotta (*shor*), cream and butter.

Business is going well and feeds not only Farajov's family but also another dozen families in the nearby Xazar village.





HORSES

Anthropological and archaeological investigations prove that horses were domesticated very early in the area around the Caspian Sea. Excavations in the Jalilabad region of Azerbaijan (Ali-komektepe monument, dating back to the fifth millennium BC), revealed animal bones with 7.5 percent of horse bones.

Horse breeding in Azerbaijan

The establishment of a hippodrome in Baku in 1923 was the first significant event in the development of horse breeding in Azerbaijan. Later, horse breeding farms were established in various regions and paved the way for development. Many years ago, nearly 15 games were played with horses. According to official statistics, at present there are more than 70 000 horses in Azerbaijan. About 400 thoroughbred horses are raised by individual farmers.

The Garabagh (Karabakh) horse is the oldest mountain saddle breed, named after the Garabagh region. Some historians believe that in the past this horse had significant influence on the development of the Arabian breed. The horse is well-proportioned and is golden and red. It significantly influenced the improvement of horse breeds in both the Southern and Northern Caucasus, and also of Don breeds. Garabagh horses have shapely heads, medium-high withers, straight backs and croups, wide breasts, thin limbs and a strong conformation.

The Dilbaz horse breed has analogies with Garabagh horses and was developed at the end of the eighteenth century by crossing local horses with Arab and Turkish breeds. It is used as a saddle and pull horse. It is usually grey or light-grey in colour, but white around the lips and nose. The hooves are usually white. The breed is widespread in the Ganja, Gazakh and Shaki-Zagatala regions. From 1944, state pedigree stables were established where Dilbaz horse breeds were improved by crossing them with Arab and Terek stallions.



Horses were domesticated very early in the Southern Caucasus and used for work, transport and in war. The region is proud of its beautiful animals, many of which are maintained by farmers for work and leisure. *Above: Shalala, a three-year-old Garabagh horse. Below: Sarin, a three-year-old Dilbaz horse*





Because of poor investments, today horse breeding programmes are neglected and the number of beautiful local horses is diminishing



Horse breeding in Georgia

Over the past 20 years, very little has been done to preserve and maintain horse genetic resources in Georgia. Breeding specialists need to receive training and information; the artificial insemination network is very poor.

The *Tushuri* horse has high endurance, courage, caution, good orientation, resistance to temperature changes, and light steps – all fundamental characteristics for living in the mountains. The horse is reared mainly in eastern Georgia. It is used for riding and as a pack animal, especially by nomadic shepherds, who



have problems in navigating roads. It is bred by herd methods on mountain pastures all year round.

The *Megruli* horse has been reared to feed on pastures since antiquity in the lowlands and around the Black Sea. The horse is mainly bay. It is a horse for riding and loading, is slow maturing and grows up to the age of six years. It is hard working and can carry loads of 100–130 kg. It has excellent resistance and works equally well in bogs and in mountains.

Horse breeding in Armenia

Horse breeding was widely developed in ancient Armenia. Domesticated animals had been used by Armenian farmers for agricultural work and transport over a long period. The Armenians mostly bred and improved local animals, which were muscular, light-footed and accustomed to the hilly terrain. Until the beginning of the twentieth century there was a horse breeding industry in Armenia, which was also engaged in breed selection; however, at present, horse breeding is the private occupation of individual farmers, and the head count has sharply decreased.





Sheep are widespread in the Southern Caucasus because they are well adapted to the ecosystem, resist cold and parasites, and tolerate low-quality forage. They provide wool, milk and high-quality meat. Today, there are more than 15 local sheep breeds in Azerbaijan

SHEEP AND GOAT BREEDING

According to archaeological data, the Southern Caucasus was one of the prehistoric centres of sheep breeding, where domestication of sheep goes back to 4000 BC. In the ancient Urartu state, fine-woolled and coarse-haired sheep breeds were known.

In the nineteenth century, sheep were improved and their number increased. Sheep breeds that are bred at present were produced as the result of cross-breeding of Southern Caucasian coarse-haired sheep breeds (*Mazekh, Balbas, Bozakh, Karabakh*) with fine-woolled male sheep. The new breeds are of two types:

semi-fine-woolled meat-wool-milk sheep, and semi-coarse-haired meat-wool-milk sheep. The famous Caucasian carpets highly appreciated for their quality and thickness are woven using this wool. Today, there are more than 15 local sheep breeds in Azerbaijan, and each breed produces a unique type of wool.

In the Southern Caucasus human rituals, both happy and sad, were tied up with sheep. It is clear from local folklore and traditions that it would be impossible for mountainous people to live without sheep.



Sheep and goats are inextricably linked to the life and culture of the Southern Caucasus

Tushuri sheep

The *Tushuri* sheep is a half fat-tail sheep breed. It is raised in nomadic conditions in east Georgia. The breed was obtained in the thirteenth-fourteenth centuries by crossing old Georgian sheep with other rough wool breeds. *Tushuri* sheep endure long journeys from summer to winter pastures (250–500 km) and can feed on poor pastures. Their meat and wool productivity increases considerably with improved feeding. The breed matures early and has high-quality meat and white, flexible, elastic and glittering wool, from which people knit prized quality rugs. A well-flavoured cheese produced from its milk is exported.

Imeruli sheep

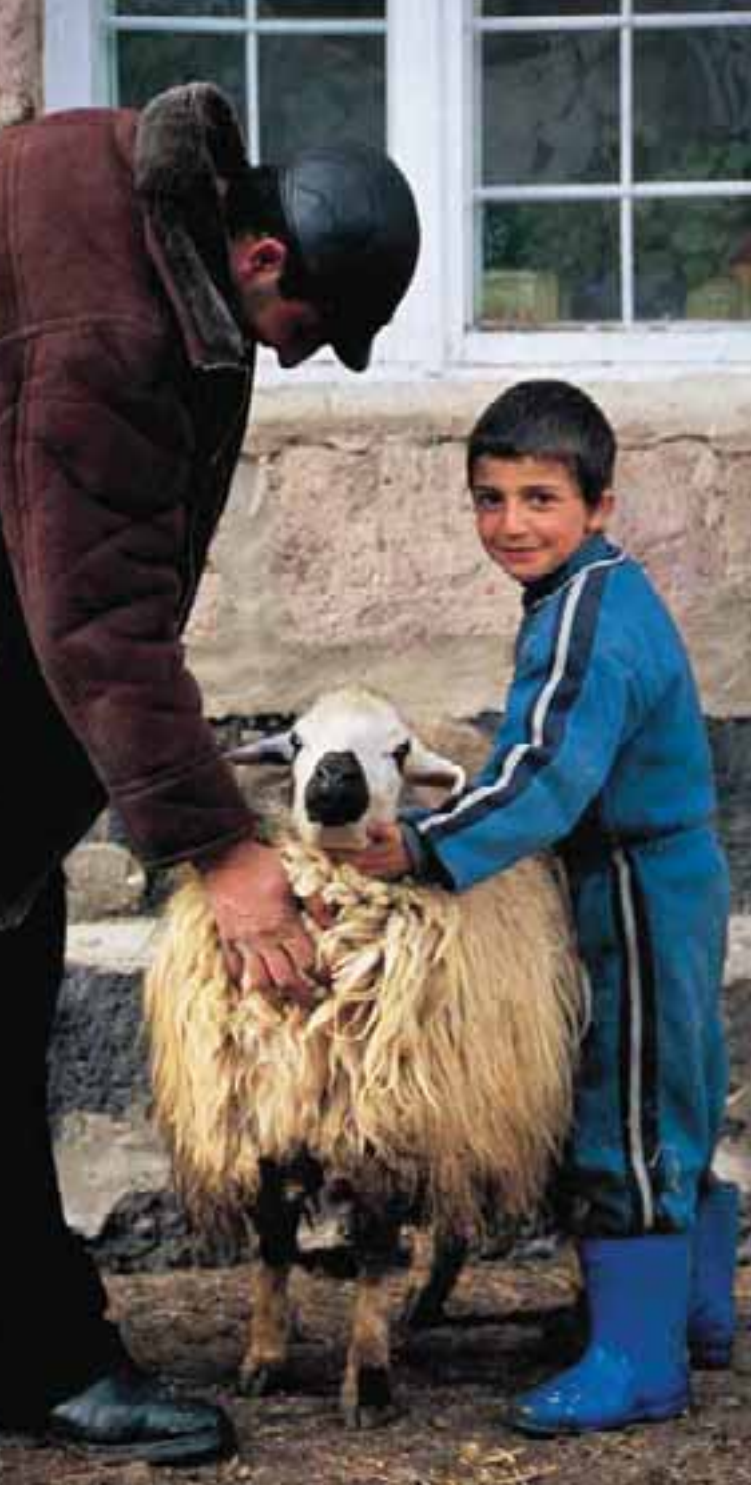
Imeruli sheep descend from old Georgian sheep. The unique breed of *Imeruli* sheep is characterized by an expensive biological-productive feature: it can be inseminated at the age of five to six months and multiplies in any season of the year. It gives wool of extra class and meat with a good taste and no odour.

The natural habitat of *Imeruli* sheep is shrinking because of the lack of village pastures. The breed is now preserved in Imereti, Racha and Svaneti.



A butcher in the Teze bazaar in Baku shows the impressive characteristic tail of a fat-tail sheep. *Below:* Summer pastures in the Mavush and Aragats mountains. In Armenia, Yesidis and Kurds are involved in sheep breeding together with Armenians; the former seasonally migrate to high pastures in summer and return to their settlements in winter





***Balbas* sheep**

Balbas sheep are a result of local selection and their wool is semi-coarse. They are strong, tall with a fat tail, long and divided into two parts. The head, neck and legs are without wool. On average, 1.8–2 kg wool is sheared from one ewe and 2.5–3.5 kg from one ram. The live weight of an ewe reaches 70–80 kg and its milk production is 125–135 kg. Every 100 ewes give birth to 125 lambs a year.

***Bozakh* sheep**

Bozakh sheep have been selected by crossing Garabakh and Tush sheep. They have long ears and a fat tail. The live weight of the ewes is 45–50 kg and they produce 1.8–2.5 kg wool. *Bozakh* sheep have a good milk production and the rate of giving birth to twins is 10–25 percent.

***Megruli* goat**

Two types of *Megruli* goats are bred for milk production in Georgia: mountain goats and lowland goats. Among the mountain goats, does reach a live weight of 40–45 kg and bucks 50–55 kg. The lowland goats are small but produce more milk. Sheep and goats often graze together in mixed herds.





Local animals are well suited to grazing on natural grasslands. To limit the state of degradation of many grasslands, appropriate policies must urgently be developed and pastoralists will need to be increasingly involved in maintenance of locally adapted genetic resources. In addition, animal stocking rates will have to be adjusted to the productive potential of grasslands. <<Left: two images of *Balbas* sheep and a typical *Megruli* goat



AZERBAIJAN CAMEL

Camel breeding is one of the most ancient branches of agriculture in Azerbaijan; one-humped (dromedary) and two-humped breeds of camels are common throughout. The body live weight of a four-year-old camel can reach 900 kg and the milk production 1 600–1 700 kg per lactation. Milk fat is 5–5.5 percent. Camel hair is more expensive than fine sheep's wool and on average 8–10 kg hair is obtained from one camel. Camel breeding has developed in the Apsheron, Beylagan, Barda and Bilasuvar regions of Azerbaijan. The two-humped camel is more active in a mountain and cold climate, while the one-humped camel is more productive in a desert environment.

According to Professor T.A. Bunyadov, the use of camels as a means of transport for people occupied with cattle breeding and living a half-nomadic life, as well as the demand for camels in wars taking place in the Caucasus in the eighth to sixth centuries BC, led to a rapid growth in camel breeding. The German traveller Adam Olerai, who visited Azerbaijan in the seventeenth century, noted that there were small camels as quick as horses.

According to statistics, there were 8 000 camels in Azerbaijan in 1921 but, according to registration by cattle farm workers carried out in 1935, camels were then 10 263 and dropped to 6 500 head in 1941, 500 head in 1968 and 200 head in 1984.

In an old saying, “camel-stature, horse-desire, buffalo-coral, sheep-sacrifice, goat-devil”, the camel enjoys universal esteem and love. Faith in the camel is described with great enthusiasm in the “Karvan” symphony, a masterpiece of Azerbaijan music, composed by Soltan Hajibeyov.

Wearing clothes made of camel hair has a beneficial effect in treating rheumatism. Camel milk is an exemplary medicine for treating coughs, sore throats, tuberculosis and gastrointestinal diseases.

There is a folk story about camel love.

The ruler of the country receives information that there is a poor man who has a very nice female camel with a lovely body. The ruler visits the village and looks at the camel. He thinks about how to get the camel from the poor man. He tells the poor man that he has lost his camel and this camel is his. The poor man swears on his conscience that he had not bought the camel from anyone and he has been rearing it for several years. But the ruler does not agree with him. At last they decide to show the distinctive signs of the camel in front of various people. The camel will belong to the person who can decipher these signs correctly. Both the ruler and the poor man show the distinctive signs of the camel exactly. The poor man demands that the ruler give an additional sign. The ruler is unable to do this but the poor man says that the camel has three wounds in its heart. Everyone is surprised and they agree to cut the camel and look at its heart. If the poor man is right, the ruler has to give him a camel, but if the poor man is not right he will give the ruler a camel. So they cut the camel. When looking at its heart they found three wound sites. The poor man said that the camel received these wounds from three births when she lost her calf at each birth.



Camels can weigh up to 900 kg and can produce up to 1 700 litres of milk per lactation and 10 kg of highly prized hair. This male from the Mughan region is 50 years old, a considerable age for a camel





WOOL PRODUCTION AND CARPETS IN THE SOUTHERN CAUCASUS

One of the best-quality sources for the yarns used in handmade rugs is lamb's wool. Lambs born in March are sheared in summer. Their wool is considered to have a higher value than that of lambs sheared in the spring or autumn. Lamb's wool is exceptionally soft and lustrous. Some of the best antique rugs were woven with this wool.

The most widespread folk art is carpet weaving. This craft made its way into the

everyday life of the people of the Southern Caucasus and became a symbol of the region.

Because of their high aesthetic value, with various patterns and designs, both fleecy carpets and those without pile are used to adorn the walls and floors of marquees, huts, homes, nomads' tents and other buildings.

Carpet weaving took place as early as the Bronze Age, as shown by a clay figure of a horse wearing a flower-patterned woven horse cloth, found in Maku and dating back to the second millennium BC.

Herodotus, Ptolemy, Xenophon and other ancient historians provided information on the development of carpet-weaving traditions in the Southern Caucasus. Weaving carpets with gold silk threads and jewelled decorations became a traditional activity during the sixteenth to seventeenth centuries. These very expensive carpets woven for the feudals were called *zerbaf*.

Anthony Jackinson, who visited Azerbaijan in the sixteenth century, reported that carpets were woven of gold silk threads in the summer residence of Abdulla Khan in Shamakhi.

From the twelfth to the fourteenth century, the Southern Caucasus exported many carpets and carpet products to foreign countries.

These carpets, attracting attention with their delicate patterns, are reflected in the works and miniatures of many European painters. In the fifteenth century, Flemish painter Hans Memling's tableau "Virgin with Child" incorporated a *Shirvan* carpet; in Van Eyck's "Saint Mary" there is a *Zeyva* carpet; in "The Ambassadors" (1533), by German painter Hans Holbein, a *Gazakh* carpet can be seen.



The various phases of the carpet manufacturing process: the wool is washed, teased, spun and finally woven. This work is done mostly by women





According to their technical specifications, Azerbaijan carpets are divided into fleecy carpets and those without pile (*kilim*). The first carpet patterns were *hesir* (matting), *cheten* and *buriya*. According to the style of weaving, the composition, the richness of the design and the colours, there are eight different patterns.

Azerbaijan weaving schools

Azerbaijan carpets are subdivided into seven carpet schools according to geographic composition, design, colour selection and technical specifications. These are *Quba*, *Baki*, *Shirvan*, *Ganja*, *Gazakh*, *Garabagh* and *Tebriz*.

The history of weaving different blouses, jackets, colourful socks, tablecloths, etc. from sheep and goat wool by women in the Southern Caucasus dates back many years and this indigenous knowledge has been transferred from generation to generation up to the present day.

Local people also make felt tents, blankets and mattresses from wool. There used to be a tradition that, when seeing a bride off to the house of her bridegroom, women relatives of the bride and neighbours would gather together and prepare a dowry that included these wool products.



SUSTAINABLE USE OF WATER RESOURCES

The Southern Caucasus is rich in water resources that have been exploited in the agriculture sector over time. In the fourth century AD, the total irrigated area in Armenia was estimated at about 100 000 ha; also Georgia has a long tradition of land improvement through irrigation and drainage. Yet, especially in the last 20 years, the three countries of the Southern Caucasus have experienced many of the typical problems related to poor management of water resources, such as deterioration of infrastructure and pumping equipment because of insufficient maintenance, inefficient water distribution and application, contamination of groundwater sources and salinization of soils.

In recent years, an effort has been made at both national and international levels to improve water management, with an eye also to environmental and health issues. New legislation, e.g. in Armenia, has introduced the concept of integrated river basin management, and the management of transboundary water resources.

As evidenced in the “Final Report on the Evaluation of FAO’s role and work related to water”, concerning water use for agriculture, the most common parameter measured is efficiency, but it must be properly defined. Conventionally, irrigation efficiency is the dimensionless ratio (m^3/m^3) of water available or utilized at one point to water delivered at some upstream point: for example, field irrigation efficiency is the ratio of water consumed by the plant to water delivered to the field. On the other hand, water-use efficiency is a productivity term (USD/m^3 or kg/m^3). The latter term is frequently misunderstood for, or indeed used in place of, the former.

The report highlights that today there is a consensus on moving away from “efficiency” terminology, using fractions (beneficial consumption, non-beneficial consumption, recoverable and



The efficient use of local resources and energies is an essential element for low carbon development and food security

non-recoverable fractions) rather than irrigation efficiency, and productivity instead of water-use efficiency. CROPWAT is the FAO standard reference on this topic, and FAO has now contributed to AquaCrop, a new tool to analyse yield response to water for top production under ideal circumstances. AquaCrop deals with the context of water scarcity as it embodies more complex plant-water relationships based on interactions with the Consultative Group on International Agricultural Research

(CGIAR) crop centres and other specialist groups. The next necessary step will be to verify how AquaCrop can produce “realistic” rather than “ideal” recommendations for design of irrigation that are useful for farmers in specific agroclimatic areas. Maximizing the productivity of water and understanding how technology, water consumption and production interact are critical issues and establishing a culture of water saving and productivity should become a priority for policy-makers.



In order to survive in harsh environments, people must have an individual and collective commitment to use natural resources, including lakes and rivers, without jeopardizing biodiversity and ecosystem balance, avoiding wastes and pollution

According to Juvvá Lemet-Klemetti Näkkäljärvi, farmers and pastoralists have what can be described in a theoretical model as landscape memory. This contains elements of culture, professional and practical competence, and knowledge as well as perception models, cultural observation methods, and detailed classification of natural phenomena, land forms, plant and animal physiology, and behaviour and terminology. Building on this landscape memory to improve the sustainable management of waters while using scientific

and modelling tools and technologies will be necessary to face the new challenges related to water scarcity, water pollution and changing rainfall patterns. Therefore, farmers and pastoralists could be both subjects and informants of research. More training should be provided to scientists to study the traditional knowledge and traditional perceptions of the territory in order to have the foundations to develop innovative management practices for water, land, and wild and cultivated agricultural systems.





EXPLOITATION OF INLAND WATERS IN THE SOUTHERN CAUCASUS: THE CASE OF LAKE SEVAN

Lake Sevan is located in the northeast of the Armenian volcanic highlands, at the junctions of the Southern Caucasus and Near East regions, and its altitude is 1 900 m above sea level.

Lake Sevan is the largest lake in the Caucasus and one of the greatest freshwater high mountain lakes of Eurasia. It has a unique combination of size, high mountain location and comparatively “soft water” (700 mg/litre of mineralization). Its importance in the economy of Armenia can scarcely be exaggerated: it is the main

source of irrigation water and provides electricity, fish, recreation and tourism. Lake Sevan and the wetlands of the basin are significant breeding, resting, foraging and wintering areas for migratory waterfowl. The main economic activities in the basin are agriculture and fisheries. Approximately 20 percent of Armenian livestock are raised here and about 90 percent of fish catch and 80 percent of crayfish catch of Armenia come from the lake.

The biological diversity of plants is very high. Some 1 600 species of vascular plants have been registered in the basin, of which 48 species are in the *Red Data Book of Plants of Armenia*. There are also 276 species

of vertebrates, of which 48 species are in the *Red Data Book of Animals of Armenia*. In the past, reeds were harvested and used for thatching and structural building. Today, reeds are harvested for crafts, bedding material (litter) and fuel. Flexible willow branches are used for fish traps and in basket weaving. Willow wood and that of other smaller-sized trees and bushes is also used for fire production during the very cold winters.

Before human intervention dramatically changed this ecosystem, the lake was 95 m deep with a volume of 58 km³. Since the 1930s, the lake has been increasingly exploited for irrigation, hydropower and domestic water supply.

By 1972, its level had fallen by almost 19 m and its surface area had been reduced to 1 250 km², causing unforeseen changes in the lake’s ecology (loss of fish population), water quality (entrance of sewage) and microclimate (freezing of the lake in winter).

Since 1978, the government has attempted to raise the water level of the lake and reduce water take-off (for example, no water has been used during winter for hydropower since 1978); pumping stations have been built; and interbasin water transferred from the Arpa and Vorotan rivers. A link between the River Debed and Lake Sevan has been planned. Initially these measures were successful and the lake rose



about one metre between 1978 and 1990. However, demands on water increased more rapidly at the beginning of the 1990s, when electricity was again generated during the winter. This resulted in the one metre gained being lost again.

More pumping stations and balancing reservoirs are under construction to raise the level of the lake.

Especially because of the present energy shortages in the country, the construction of balancing reservoirs is both important and urgent, as hydropower production from Lake Sevan is mining its water at an alarming rate without the possibility of winter water being stored for irrigation in the

summer. If stored, some of this water would then allow summer releases from Lake Sevan to be reduced by a certain amount, depending upon electricity requirements in the summer.

In the last few years the level of the lake has actually increased, mainly thanks to the restoration of the Arpa-Sevan connection, and is expected to continue to do so, according to the Lake Sevan Committee.

Currently, the most important threats to the lake are the worsening of the water quality from pollutants, and biodiversity loss from overfishing and anthropogenic interventions.



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THE GUARDIANS OF BIODIVERSITY

THE DIFFERENT LANDSCAPES OF THE SOUTHERN CAUCASUS HAVE DEFINED THE ACTIVITIES OF FARMERS AND PASTORALISTS, AND GIVEN THEM FOOD, FIBRE AND ENERGY. IN RETURN, PEOPLE HAVE LEARNED TO USE THESE NATURAL RESOURCES, INCLUDING LAKES AND RIVERS, ACCORDING TO THEIR POTENTIAL. THEY HAVE SELECTED ANIMALS ADAPTED TO TEMPERATURE FLUCTUATIONS AND LOW OXYGEN LEVELS IN MOUNTAINOUS AREAS. THIS HAS ENABLED THEM TO MAKE A LIVING IN A DIFFICULT ENVIRONMENT WITHOUT JEOPARDIZING ITS BIODIVERSITY AND NATURAL RESOURCES.

Farmers and pastoralists have managed their plants and animals in order to keep risk to a minimum, choosing those that ensure they maintain their livelihoods under local conditions, but where high yields are not the overriding criterion. However, at present, many of these landscapes are no longer available for agriculture and pastoral production; natural resources are degraded; and the need to intensify production may reduce the working opportunities of the traditional landscape managers, confining them to a situation with little hope for a sustainable livelihood in the near future.

Farmers and pastoralists will need to be increasingly involved in management decisions related to their territories. They will need reliable agrometeorological information tailored to their farms and grazing lands, scientific information on agro-ecological farming practices, and new technologies to improve their production efficiency. They will need to become an integral component of social and economic development and maintain a balance between the production of their individual farms and care for the surrounding landscape. Their daily work, their understanding of the landscape in which they operate, and their daily agricultural practices will need to be the building blocks of food security.





AT THE CROSSROADS BETWEEN EAST AND WEST
IN THREE HOSPITABLE COUNTRIES
AGRICULTURE AND BREEDING WERE DEVELOPED SINCE THE NEOLITHIC
COPING WITH THE RHYTHMS OF THE SEASON
A TREASURY OF GENETIC RESOURCES IS MAINTAINED IN GARDENS
TO MAKE BREAD, CHEESE AND WINE

RURAL PEOPLE KNOW AND USE WILD PLANTS AND ANIMALS

COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION:
A PATHWAY INTO THE FUTURE

Գյուղացիները քաղատեղյակ են վայրի բույսերի ու
կենդանիների օգտագործման գաղտնիքներին

Կənd əhalisi yabant bitkiləri və vəhşi heyvanları tanıyır
və onlardan istifadə edir

ველური მცენარეებისა და ცხოველების
გამოყენება სოფლად

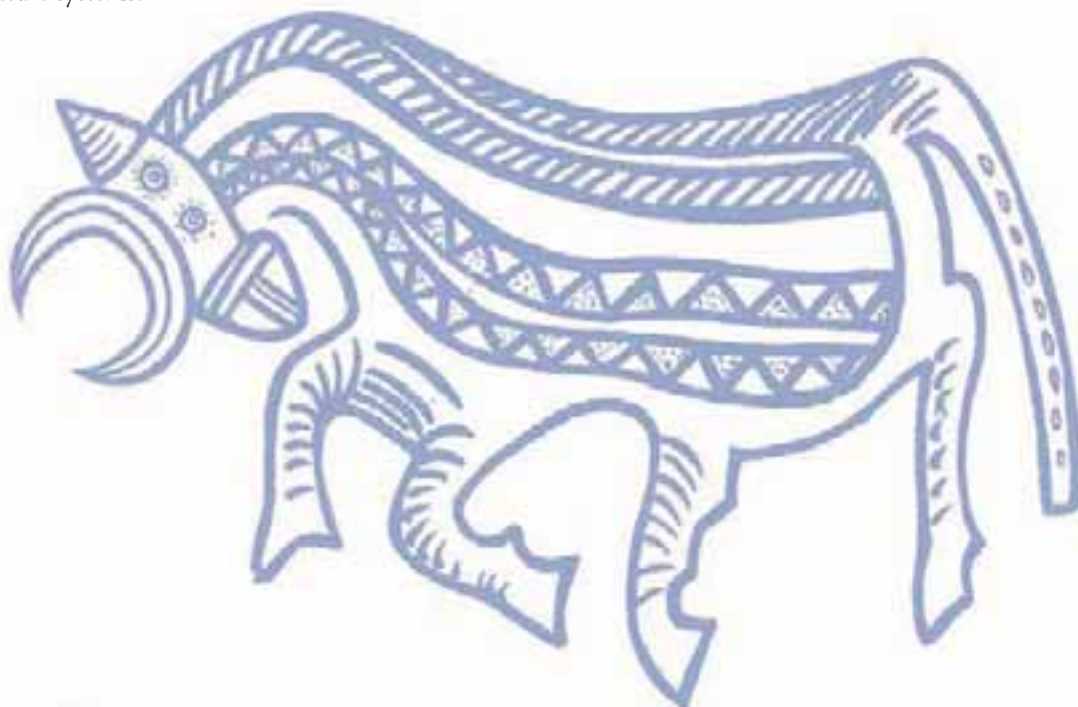
INTRODUCTION

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IN THE SOUTHERN CAUCASUS, PEOPLE STILL GATHER AND MANAGE WILD AND SEMI-WILD PLANTS AND FRUITS; THEY USE HERBS, FISH, WILDLIFE AND GRASSLANDS TO COMPLEMENT THEIR DIETS; AND THEY HAVE A BALANCED INTAKE OF ALL NECESSARY MACRO- AND MICRONUTRIENTS FOR HEALTHY AND QUALITY NUTRITION. EVEN SMALL QUANTITIES OF PLANT COMPOUNDS CAN INFLUENCE THE OVERALL QUALITY OF THE DIET, AND AFFECT METABOLISM AND HEALTH. HOWEVER, PEOPLE DO NOT DEPEND ON WILD AND SEMI-WILD PLANTS TO SURVIVE, AND WILD PLANTS DO NOT FULLY DEPEND ON HUMAN MANAGEMENT.

People collect plants to complement their diets and increase their incomes, for recreational purposes and as sources of food security. Farmers also use plants, as they have done since the Neolithic, to feed their animals. Some people cultivate these plants (such as carrots, berries and herbs for teas and saffron), while others collect them in the wild. Some catch wild animals and fish, while others raise them in ranches and aquaculture systems.

Some protect and care for their forest trees, while others do not respect regulations. Rural people in the Southern Caucasus know how and when to find these resources, their seasonality and plant and animal physiology and behaviour, and they know how to manage and use them. They will be able to continue to do so, if supported by enabling policies, education programmes, technologies and financial mechanisms.





There is a close relationship between rural people and wild and semi-wild plants. People use them as a complement for a healthy and diversified diet, and by responsibly doing so they contribute to the preservation of genetic resources and the environment

THE MANY FUNCTIONS OF GENETIC RESOURCES

There is often a faint border between what farmers collect for food and what they collect for medicinal use. Wild or semi-domesticated plants are often consumed as food but their contribution to people's health is recognized by traditional knowledge and, today, is increasingly confirmed by the science studying the chemical composition of wild plants.

The multiple roles of wild plants (mostly maintained in natural grasslands and forests) in addition to food and medicine production include maintenance of soil structure,

water infiltration capacity, air quality, habitat for wild and domesticated animals and recreation. In short, they serve as a basis for all human activities. The state of the world economy and human welfare and health significantly depend on these resources. Wild plants form a bridge between agriculture, animal production and nature conservation, protection and sustainable management, and deserve greater attention in the context of future agricultural programmes on food security and climate change adaptation, energy saving, degradation control and sustainable use of water resources.

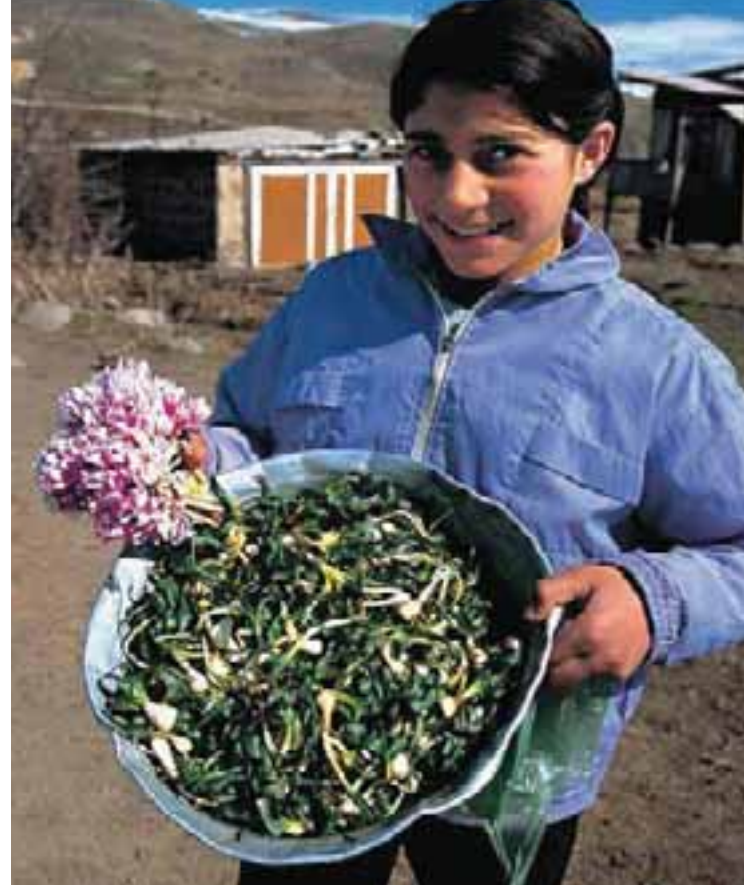


Terterian Haykaz, head of Lusarat village, with wild asparagus. Below: redcurrant berries. >>Right: fresh and preserved wild vegetables sold along roadsides



Micro-organisms also have an important role in the large majority of ecosystems and, although once considered a source of harm, now enable progress to be made in the production of foodstuffs. Modern medical science shows serious interest in genetic resources to find new remedies for the treatment of diseases. At present, 40 percent of sedative drugs used in medicine come from substances derived from wild plants. Genetic resources are used in studies on biotechnology, genetics and for industrial purposes.

Wild ancestors and relatives of genetic resources are used in gene engineering as a source of resistance to biotic and abiotic factors and as a source of quality traits. In genetics, wild species of biodiversity are used to detect the origin of cultivated crop genotypes and in hybridization for valuable traits.



FOOD AND MEDICINAL PLANTS

Hundreds of species of wild vegetable crops are used by rural populations. The shoots and leaves of mallow (*Malva neglecta* Wailler), belonging to the Malvaceae family, are used in making different dishes in the Caucasus. The stalks of the ether-oil plant, cow parsnip (*Heracleum asperum* Bieb.), belonging to the (celery) Apiaceae (formerly Umbelliferae) family, are consumed after being peeled and pickled. Fresh and young shoots and leaves of knotweed (*Polygonum alpestre* C.A. Mey.), belonging to the Polygonaceae family, are used in the preparation of dishes such as *siyig*, *kete*, *plov* and *dovga* or dried and stored to use in off-season periods. These plants are also used in medicine and are increasingly defined as “nutricament” food. The young shoots and leaves of nettle (*Urtica dioica* L.), belonging to the Urticaceae family, are pickled and eaten, and used in the preparation of different dishes. The young shoots and leaves of common balm

(*Melissa officinalis* L.), which has a lemon aroma, are used in perfumery and medicine. A number of wild plants such as fennel (*Foeniculum vulgare* Mill.), bulb onion (*Allium rotundum* L.), asparagus (*Asparagus officinalis* L.), sorrel (*Rumex acetosa* L.), campion (*Silene* L.), rhubarb (*Rheum undulatum* L.), carrots, mountain mint (*Satureja montana* L.), horsemint (*Mentha piperita* L.), beaked parsley (*Anthriscus cerefolium* Hoffm.) and hill coriander (*Bifora radians* L.), are used for food and medicine. Plants available in the Caucasian flora are used in the preparation of oils with diverse composition, extracts and juices.

There are over 250 oil-bearing plants growing in different zones of Armenia. The components of revealed volatile oils are diverse and valuable, especially those with medicinal significance. These important components are carvacrol, eugenol, menthol,



Fruits of wild roses rich in vitamin C. Traditional food production and processing practices can be the starting-point for diversifying sources of income. The non-monetary value for the environment of sustainable agricultural practices could be quantified, and this value reflected in the market value of agricultural products. >>Right: sorrel is consumed fresh or dried to prepare traditional dishes

geraniol, thymol, boras camphor and many others. All of them are important elements in the metabolism of human organisms. They are active biological substances that are widely used in traditional and professional phytotherapy as an expectorant, a diuretic, an anti-inflammatory agent and for the relief of pain. These herbs are mentioned in ancient Armenian manuscripts and the works of Amirdovlat Amasiatsi, Ghevond Alishan, Gabikean and Srvandztyan, and revelation of these plants and analysis of their specific composition are of global significance from the point of view of phytotherapy. All knowledge and use of healing herbs, including manipulative treatments, methodological processes, preparation of poisons, etc. that, in the history of world medicine, are called *Cura Mediana*, are famously related to Medea, a daughter of Aeëtes, the king of Kolkheti. The earliest mention of the medical activities of Aeëtes' family is in the scholia of Homer's *Iliad* (ninth century BC). Diodore Sicilian (first century BC) in *Historic library* describes amazing sleep-inducing potions (including inhalants), prepared with herbs by Medea, as well as

her secrets for treating wounds, childlessness and psychological disorders. "It is said that Medea healed Heracles with her herbs in Thebes, while he was sick with insanity (because his children were dead)." The ancient Colchian-Iberian healing activities continued in the church centres of early feudal Georgia and old Georgian medical treatises and books are safeguarded in the Georgian State Museum. The manuscripts of these books have been kept in the families and handed down from generation to generation as a dowry or inheritance. There is currently growing recognition of the importance of extending the cultivation of medicinal plants, and moves towards certification are necessary to broaden access to European markets. A number of plants from Azerbaijan have attracted foreign business people, and some valuable plants are exported, including cultivated liquorice (*Glycyrrhiza glabra*), linden (*Tilia cordata*), cane (*Phragmites australis*), reed (*Arundo donax*) and nettle (*Urtica dioica*). Some examples of wild plants consumed as food, herbs and spices that have a direct influence on human metabolism are described in the following pages.

Sorrel (*Rumex* spp.)

Armenian	<i>Aveluc</i>
Azeri	<i>Avelik</i>
Georgian	<i>Mzbauna</i>

In late spring, in city markets as well as on mountain roads (near the natural habitats of sorrel), elderly women twine fresh sorrel leaves for sale. Later they dry out the plaited strands. Nineteen varieties of sorrel are known in the countries of the Southern Caucasus, but only the following are popular among local people: *Rumex acetosella* L. (sour sorrel, which grows in meadows and shrub land); *R. acetosa* L. (in mountain meadows); *R. crispus* L. (curly sorrel, which grows mainly in lowlands, in meadows of the middle mountainous zone, in river valleys and damp places); *R. alpinus* L. (alpine dock); and *R. confertus* Willd. (dense sorrel, which grows at altitudes of 1 800–2 500 m, in alpine zones and summer pastures).

Wild carrot (*Daucus carota* L.)

Armenian	<i>Gaza, Gazruc</i>
Azeri	<i>Kök, Yerkoku</i>
Georgian	<i>Pheristsvala</i>

The cultivated carrot probably originated from the crossing of wild varieties. It has succulent roots as a result of popular selection and is biannual, while wild carrots are annual and have thin, stiff roots. Local people use wild carrots particularly as an early spring herb to flavour meat and fish dishes, in marinades and for vodka. In meat and fish dishes, wild carrots retain their appearance and have a pleasant, unique flavour. They are also used in folk medicine as a diuretic, to normalize the functioning of kidneys and urethra, and stimulate menstruation. The plants grow singly or in groups as weeds on roadsides, in vineyards, vegetable gardens, forest glades, ravines and on riverbanks. It has been observed that environmental conditions have a great influence on habitat. In damp and fertile soils, the plants develop lush leafy tops on the surface and larger roots than in other conditions.



Asparagus (*Asparagus* spp.)

Armenian	<i>Tsnebec, Marazho, Tsnepbac</i>
Azeri	<i>Gulanchar, Merejuyud</i>
Georgian	<i>Satatsuri</i>

The asparagus variety *Asparagus officinalis* L., to which cultivated common and pharmaceutical types belong, grows in shrub land, foothills covered by grass, gardens, and on sandy and sludgy riverbanks, i.e. practically everywhere. It has long been used for food, even before cultivation. It is a rhizome plant and propagates through cross-pollination. The roots are used as a diuretic and a cordial, and are also useful to treat kidney complaints. The young stems are prescribed for liver and back pains. Patients eat them during the spring or dried in winter. Local people pick the young stems of asparagus in the fields, use them as food or sell them in large city markets. At the end of summer, mature stems with small fruits are used by florists to make bouquets. Other varieties are typical of drier climate conditions and grow on sandy seashores. *A. caspius* Hohen grows in Azerbaijan and Georgia. *A. littoralis* Stev. grows only in Georgia on the sunny shores of the Black Sea, whereas the variety *A. ledebourii* Misch. may be found on the sandy shores of the Caspian Sea. These varieties adapted to dry climatic conditions have not yet been studied, but they have value for deriving new varieties. Many other mountain varieties have not yet been fully studied, although they have great selective value for obtaining new types.



Photo by Z. Aparov



Saffron (*Crocus sativus* L.)

Armenian	Zafran, Shafran
Azeri	Zeferan
Georgian	Zaphrana

Saffron has been cultivated since time immemorial and is a fundamental element of Caucasian cuisine. Many Azeri national dishes and sweets could not be envisaged without saffron: Azerbaijan pilaf with chicken, dried apricots and chestnuts; *piti*; *kifta-bozbash*; Azerbaijan *paklava*; *tendir chorek*, glazed with an egg yolk, saffron and sesame. Kamenetsky mentions the names of 19 villages in Apsheron where, by 1886, more than 300 ha of saffron were grown. Moreover, he complains that land under saffron on the Apsheron peninsula was much reduced through the impact of the nascent petroleum industry. He stressed that up to 1886 the territory was much more extensive. Saffron in Azerbaijan is unsurpassed as the king of spices – an important food and medicinal crop. It has been to date the subject of a great deal of important scientific research.

Sea buckthorn (*Hippophae rhamnoides* L.)

Armenian	Cicciban
Azeri	Çaytikani
Georgian	Hazvi, Chardela, Jacudla

Sea buckthorn has many uses – for medicine, various fields of production, decorative gardening, soil erosion control, in protective fencing and in green hedges, animal feeding, tanning of skins and energy production. The fruits contain vitamins C, P, E, B1, B2, K and up to 15 microelements. In modern medicine, sea buckthorn oil is used in the treatment of anaemia, cordial ischaemia, hypertonia, eczema and other disorders.

In addition to its medical use, the significance of this plant in soil protection from water erosion and its recultivation is extreme, because sea buckthorn usually grows on the upper layer of the soil, branches strongly and has a multistorey root system as well as root tubers that absorb free nitrogen from the air. This means that it can grow in soils without humus, in infertile areas, even where they have been degraded by mining activities. The use of sea buckthorn as a phytomeliorant (pioneer species) increases the biological productivity of soil and returns it to the agricultural cycle.

The Genetic Resources Institute of Azerbaijan established *in situ* conservation, selected the most promising varieties and distributed the more productive and pest-resistant varieties to farmers. Newly originated varieties, wild and hybrid forms of sea buckthorn are maintained in *ex situ* conditions in research bases of the Institute, where they are observed, their height and growth characteristics investigated, and biological research indexes compared.

A sea buckthorn variety recently created is *shefa*, obtained by selection from natural sea buckthorn grown in the Shinchay basin of the Sheki region. It has no thorns and is late maturing. Sea buckthorn also thrives in Armenia around Lake Sevan.



Dr Qabil Imamaliev of the Genetic Resources Institute of Azerbaijan in Baku with a branch of sea buckthorn. This plant is highly prized for the nutraceutical value of its fruits. It is also a pioneer plant used to rehabilitate degraded soil and to prevent erosion.
Below: wild sea buckthorn along the shores of Lake Sevan





In the Southern Caucasus, a rich diversity of plants is used for multiple purposes, managed by rural people

From top left to right: Juniperus oblonga, Galium cruciata, Foeniculum vulgare, Cichorium intybus, Rumex crispus, Filipendula hexapetala, Atropa caucasica, Thymus rariflorus, Papaver somniferum, Datura stramonium.



From top left to right: *Digitalis nervosa*, *Althaea officinalis*, *Glycyrrhiza glabra*, *Sambucus nigra*, *Aconitum nasutum*, *Capsella bursa-pastoris*, *Vaccinium myrtillus*, *Artemisia absinthium*, *Urtica dioica*, *Humulus lupulus* [Source: ТРОССГЕЙМ, А.А. 1952. РАСТИТЕЛЬНЫЕ БОГАТСТВА КАВКАЗА. МОСКОВСКОЕ ОБЩЕСТВО ИСПЫТАТЕЛЕЙ ПРИРОДЫ. МОСКВА.]



Mushrooms

In the Southern Caucasus, the best known mushrooms are champignons (*Agaricus*) and saffron milk caps (*Lactarius deliciosus*) found in areas rich in coniferous forests; they form communities with pine trees and firs. There are 4 200 species of mushrooms known in Armenia. They are an important functional element in the ecosystem and play a significant role in the processes of decay of organic leftovers and soil origination.

In Azerbaijan, local populations collect and use *Guzugarni* – *Morchella conica*, *M. esculenta* (Gabala and Goychay regions), *Donbalan* – *Terfezia leonis* (Garabagh and Gobustan) and *Kilkeli peyner* – *Coprinus comatus* (Balakan). People who know about mushrooms collect *Boletus*, *Cantharellus*, *Lactarius* and *Russula* genera from forests.

Nearly 1 200 types of macro fungi (Macromycetes) have been identified in Georgia. According to the literature, 300 types are edible, but the local population consumes only 30 types and the rest are considered suspect. In almost all regions of Georgia, winter *Armillaria* is collected in forests, then dried or pickled.

In the last 30 years mushroom cultivation has become an important agrobusiness for smallholders. Today, despite the increasing mushroom production, Georgia cannot meet the demand. Only three cultivated types of mushroom are produced in the region: champignon (*Agaricus bisporus*); oyster mushroom (*Pleurotus ostreatus*); and small amounts of the Japanese mushroom *shiitake*. Cultivating mushrooms needs little outlay. They are mostly farmed on agricultural debris: husks, sunflower skins, vine wood, maize skins, sawdust, etc. Spawn is imported from France, Israel, Ukraine and the Russian Federation.



Infusions and tea production

For over thousands of years the tradition of collecting and blending wild herbs and flowers to produce tea has been an integral part of the daily lives of Southern Caucasus people. Black, green or herbal tea always accompanies formal meetings and business gathering, short breaks and family celebrations.

The cultivation of tea in Georgia decreased from 58 000 ha in 1992 to 6 500 ha in 2008 and a similar drop was observed in Azerbaijan where 8 500 ha were cultivated in 1992 and only 1 004 ha in 2008. However, the tradition of consuming tea has remained unchanged.

Special traditional methods coupled with modern technologies and scientific knowledge must be blended together to produce the best tea.

In the Southern Caucasus, farmers and rural people know the best harvesting time for the various tea species, they manage the different drying processes required to produce tea of the best quality, they know how to select leaves and flowers, how to grade, sort and categorize them, and how to produce different blends.

Maintaining and valorizing these farmers' knowledge by supporting production, processing and trading of local wild and cultivated tea can contribute to raising income, maintaining local biodiversity and promoting preservation of a culture of hospitality.

Two images of the samovar, symbol of good tea quality and hospitality
<<Left: *Russula* mushrooms on sale along the road, a very common sight in forest areas during autumn. Wild and cultivated mushrooms represent a source of income for smallholders





TRADITION OF ARMENIAN HERBAL TEA CULTURE

by Armen Mehrabyan

Herbal teas are an essential part of a varied and healthy diet in Armenian culture. Wherever and whenever there has been a social gathering, herbal teas are brewed to share with family and friends. These herbal teas are characterized by a pleasant taste and aroma, by rich quantities of microbodies, vitamins, oils and other valuable components. These components play a special role in our life and food values, and also have a positive influence on our gastrointestinal tracts and health. Because of these valuable features, technological systems have gradually been developed for herb collecting, drying and other necessary procedures.

The criteria used in choosing herbs for tea preparation are: first, flavour; second, premium quality; and last, the ability of the herbs to enhance the overall enjoyment of a fine meal.

Among 15 rehabilitated herbal teas, the "Mediterranean Mint" herbal blend is a striking example of a recipe revival from ancient Armenian herbal tea culture, where the main components are carefully harvested – wild crafted thyme, wild mint and Armenian wild oregano.

Armenian people love wild thyme but often unsustainable harvesting and exploitation of these resources by local people take place. Enhancing work on natural multiplication and crop improvement should be a priority for joint work among scientists, organic agriculture specialists and companies that are using wild crafted herbal crops to bring them into the spheres of ecobalance and improvement of biodiversity.

Studies on the germination of different species of *Thymus* (*T. serpyllum*, *T. vulgaris*, *T. armeniacus*, *T. kochi*) confirmed their poor germination and growing ability. The maximum percentage and speed of germination were obtained during July at a day/night regime of 22/15 °C (38 percent after seven to eight days) in the mountains (800 m above sea level) near Odzun village in the Lori region of Armenia. From the results of analyses of independent samples and the comparative analyses of test plots the following conclusions were drawn.

- The current methodology of natural multiplication and/or rejuvenation of *Thymus serpyllum* in the field is effective.
- It is important to make thyme seed collections in the year before starting natural multiplication.
- During natural multiplication, higher crop indexes were identified during the fourth year and, starting from that period, the self-rehabilitation and development of plants, without any anthropogenic factors, were registered and a natural balance with the environment achieved.
- Essential oil content does not so much depend on the multiplication or growing elevation, but more on the harvesting time of crops, which is shown in the data of essential oil analyses of *T. serpyllum* from different elevations in the Odzun area.



Thyme bags sold as a tranquillizer. <<Left: Marina Haykaz with a bunch of medicinal herbs: *Artemisia*, *Ipericum*, *Thymus*, *Achillea* and *Anthemis tinctoria*





Rural people know how to use and protect wildlife, but they may also misuse and degrade it. There is a need for a collective shift from indifference to awareness in order to maintain wild resources and benefit from them

WILDLIFE AND HUNTING

Local communities have always exploited wildlife, and this exploitation has taken place on a more or less sustainable level.

Hunting is a popular practice in the Southern Caucasus. With the exception of certain mountainous areas, hunting is a sport and a form of recreation. However, inappropriate game management practices over the last century have led to significant declines in many game species. Populations of species such as red deer (*Cervus elaphus*) and mountain goat (*Capra aegagrus*) have been severely reduced and remain only in protected areas, and the Persian gazelle (*Gazella subgutturosa*) is now extremely rare. Carnivore populations have been significantly affected by a bounty system, although this has recently been abolished.

With the exception of migratory birds, hunting is only permitted in specially designated areas called hunting farms or reserves. These may be owned by a legal entity (e.g. a registered

company or organization, either governmental or non-governmental) or by a private individual. General licences for hunting reserves are awarded by the Ministry of Environment through a competition for each potential site. Currently, in Georgia there are 29 hunting reserves covering a total area of 263 000 ha. The game species are mainly *Capreolus capreolus*, *Rupicapra rupicapra*, *Vulpes vulpes*, *Canis lupus*, *Procyon lotor*, *Sus scrofa*, *Meles meles*, *Martes martes*, *Lepus europaeus*, *Felis silvestris* and different bird species.

Hunting of migratory birds is permitted for *Coturnix coturnix*, *Columba livia*, *Streptopelia turtur*, *Gallinago gallinago*, *Columba palumbus*, *Scolopax rusticola*, *Anser anser* and *Anas platyrhynchos*. In 2005, hunting of these birds was temporarily halted to prevent the spread of the highly pathogenic avian influenza. Quotas for game species are usually set without carrying out sufficient research on game numbers and population dynamics. Poaching is still a major threat to biodiversity.



EMPOWERMENT OF RURAL PEOPLE FOR THE PROTECTION OF WILDLIFE RESOURCES

Non-regulated and illegal hunting can result in the loss of diverse species. Many people are involved in hunting, including government officials, scientists, farmers and pastoralists, urban residents and professional hunters. In addition to wildlife, practically all genetic resources managed as a common resource are today under severe threat in the Southern Caucasus. The same threats to wildlife are faced by the genetic resources of plants (in grasslands), trees (in forest lands) and fish (in rivers, lakes and seas) as their sustainable use is severely challenged by economic pressure, monocultures and the absence of positive incentives. There are poor advisory services and poor legislation and control measures to prevent illegal hunting, logging and fishing.

Since wildlife is managed by rural people for their livelihoods, they know how to use and protect it, but some are also capable of misusing and degrading it. There must be a shift in the general attitude from indifference to awareness, developing mechanisms to socially and economically reward rural people's role as guardians and managers in order to maintain these resources and benefit from the services they provide us with today and, it is hoped, in the future.

Economic investments and education programmes to understand the importance of wild genetic resources need to reach hunters, farmers, students, teachers, non-governmental organizations and national experts.



A balanced combination of agricultural land and protected areas enables wild animals to move in the ecosystem and is an effective and sustainable way of maintaining wildlife

Mayors and government officers must actively participate in the development of better infrastructure to improve rural life.

Farmers and rural people need to have access to technologies and microcredit to develop creative activities in diversification of their work and new forms of production, maintenance and transformation of wild plants, animals and fish, including ecotourism.

In addition, stronger controls and taxation systems should be developed to discourage all activities that destroy genetic resources, comprising plants, animals, forests, fish and common goods.





FISHERIES IN THE SOUTHERN CAUCASUS

by Raymon Van Anrooy

Fishing in Armenia, Azerbaijan and Georgia has long been of importance for both sport and commerce.

The Southern Caucasus has more than 125 fish species, although only about a dozen are endemic. Among the most interesting species are the three lampreys, *Caspiomyzon wagneri*, *Eudontomyzon mariae* and *Lampetra lanceolata*.

Lampreys are jawless, scaleless fish that date back 280 million years, and have the highest number of chromosomes of all vertebrates (164–174).

Another group of fish in the limelight are seven species of sturgeon, including the famous beluga sturgeon (*Huso huso*), the largest freshwater fish and the source of high-value caviar.



In the Southern Caucasus, more than 125 fish species have been identified, about 12 of which are endemic

CURRENT THREATS TO FISH BIOMASS

Populations of all sturgeon species have been reduced through overfishing, primarily for caviar, while other threats include water pollution and damming, which restrict anadromous migrations. At present, many endemic and native representatives of agricultural biodiversity are in danger of extinction and face severe problems of genetic erosion. National policies and comprehensive measures are urgently needed to address the problem.

The negative factors influencing fish biomass and aquatic biodiversity are overfishing; use of prohibited fishing equipment (bottom-trawling, electrofishing gear); illegal catch

of those fish species that are in the Red Book or banned for catch (sturgeons, salmon, trout, sole); water pollution (e.g. oil pollution and the use of pesticides and herbicides); and water management practices (e.g. irrigation) that do not take into account the fish and their biological needs. Overexploitation of fish resources, together with pollution and the occasional introduction by accident of invasive species (e.g. jellyfish, *Mnemiopsis leidyi*) were the main reasons for catch decrease in the Black Sea in the 1990s and in this millennium also in the Caspian Sea. The number of fishing species has decreased from 26 to six.



The Caspian Sea is the largest landlocked waterbody in the world and is bordered by Azerbaijan, the Russian Federation, Kazakhstan, Turkmenistan and the Islamic Republic of Iran

However, in recent years there have been some positive changes relating to the protection of fish stocks, initiated by the Ministry of Environment in Azerbaijan.

Anthropogenic activities and inappropriate management practices have also caused deterioration in the condition of many rivers and lakes. Populations of fish species including *Acipenser sturio* and *Salmo trutta* have been significantly reduced and, in as many as 19 cases, the stocks of economically important fish species are significantly below estimated carrying capacity. Recovery of fish populations in lakes such as Jandari, Tabatskuri, Nadarbazevi, Faravani and Tsalka is unlikely to

occur without active conservation intervention. At present, fishing has been banned on the Mtkvari and Alazani Rivers for a period of four months. Fishing is prohibited in those rivers that are vital for the migration of sturgeon.

There are no modern fishery sector policies or regulatory frameworks in place in support of the sustainable development and management of the sector in the Southern Caucasus. In some cases, there are plans to update fishery laws and regulations but the limited priority given to the sector by the respective governments is constraining the efforts of the sector. Institutional frameworks in support of fishery and aquaculture



development and management are missing (Georgia), or overlap in responsibilities (Azerbaijan). Recurring conflicts among government institutions about their mandates, duties, rights and responsibilities with regard to the management of inland aquatic resources are common in all three Southern Caucasus countries.

Without proper legal, policy and institutional frameworks, the sector is unmanageable and remains in the state of paralysis in which it has been since these countries obtained independence.

THE CRISIS IN THE FISHERY SECTOR

Since 1991, the difficult economic and social situation in the countries, the wars, lack of financial resources, inflexible banking and credit policies as well as the loss of the former Soviet Union consumer market, have all had a negative impact on the fishery sector. Within the sector itself, investment in research and production facilities has been reduced to insignificant levels. While in the Soviet era the sector was a large beneficiary of state subsidies, the loss of these after independence caused a rapid collapse in fishing fleet size and capacity as well as deterioration of aquaculture hatchery systems and fish processing facilities. The absence of fishery management resulted in widespread poaching; moreover, as poverty rates were on the rise, fisheries



offered in some cases a last resort for impoverished parts of the rural population. The rapid breakdown of the old system also resulted in a “migration” of fishery and aquaculture experts, researchers and scientists out of the sector to other sectors where earnings could still be made. The corruption associated with the privatization process that was carried out in the sector in the 1990s added to the absence of proper management of inland waterbodies.

While Georgians were known in the Soviet era as good seafarers, providing admirals and other commanders to the Soviet Navy and freight fleet, the deterioration of political relationships with the Russian Federation has meant that few Georgians are acquainted with modern (fishing) vessel operations and management. Many of the best Georgian fishing vessel crews are now working on fleets of other nations. Similarly, fisheries and aquaculture experts who were working in Georgia and its neighbouring countries in the 1990s have returned to their home countries (particularly the Russian Federation) or have since retired. The ocean-going fishing fleet has largely been sold to other countries. While the Georgian fleet included 48 industrial ocean-going vessels in the period 1980 to 1990, this number was reduced dramatically after independence. Fish landings in Georgia in 1988 were over 200 000 tonnes, which decreased to 58 000 tonnes in 1991 and reached an all-time low in 1999 with 1 400 tonnes. Since then, the capture fisheries production has started to recover, largely dependent on the catch of European anchovy, which makes up about 95 percent of the landings. In 2007, the total catch (in marine and inland waters) was estimated at just over 18 000 tonnes.

The reduction in the fishing fleet caused an outflow of expertise from the sector and resulted also in the closure of supporting industries (e.g. vessel repair services, ice supply services and equipment suppliers) on the input side. Similarly, on the output post-harvest side, the rapid decrease in catches in the 1990s caused private investors to no longer invest in modern processing and marketing facilities for fish and fisheries products. Existing

processing plants closed or ran for just a few weeks per year. Recent initiatives towards the rehabilitation of the processing sector were deterred by the war between the Russian Federation and Georgia in 2008. The present non-existence of educational programmes (at vocational, school and academic level) in capture fisheries and aquaculture in Georgia, together with the weak prospects of the sector in terms of a provider of employment and of opportunities to earn a good income and develop a career, means that the present generation is not attracted by work within the sector.

BLACK SEA BASIN

With the closure a few years ago of the Georgian Marine Ecology and Fisheries Research Institute, located in Batumi, research on fish stocks, species composition and general fisheries resources and their management terminated. At present, there is limited scientific knowledge on the state of marine and inland water resources. Human and financial resources are insufficient to undertake the necessary research that would allow an assessment of fishery resources and support the development and monitoring of fishery management regimes.

There is a clear need for an effective fisheries management regime in the Black Sea basin. Efforts towards this end are being made by various Black Sea littoral countries, FAO, the General Fisheries Commission for the Mediterranean (GFCM) and the Black Sea Economic Commission (BSEC). However, progress is slow. While many are concerned about the resources and consider that fishing quotas should be established based on independent scientific studies of reproductive capacity of fish populations, in practice not much effort is being made. The establishment of national parks (e.g. Kolkheti with its Lake Paliastomi) and coastal marine protected areas near Kulevi has increased environmental awareness among fishers in the area, while at the same time reducing poaching activities. It is apparent, however, that in coastal areas alternative employment and income-generating opportunities for fishers are not widely available.



Agayeva Sulsada shows a catch of Caspian roach (*Rutilus rutilus caspicus*). << Left: national and regional regulations are needed to reduce the risk of genetic erosion



The Caspian Sea is home to seven species of sturgeon, including the famous beluga. The high market value of caviar has made sturgeon a target for illegal fishing and trade and contributed to overexploitation. The illustrations refer to *Acipenser gueldenstaedii* (1), *Acipenser nudiiventris* (2), *Huso huso* (3), *Acipenser baerii baerii* (4) [Source: FAO. 2010. FAO FishFinder. The Species Identification and Data Programme]

CASPIAN SEA BASIN

On the eastern side of the Caucasus, the Caspian Sea basin has comparable fisheries management problems. The importance of migratory species in the fishing catches of Caspian basin littoral countries urges them to work together in the management of the stocks. Before the collapse of the former Soviet Union in 1991, some measures for conservation and management of the Caspian's highly migratory fisheries were in place. For example, declines in sturgeon populations because of the impact of the damming of the Volga were addressed through large-scale hatchery programmes and state monopolies on harvesting. Since 1990, a 40-fold drop in sturgeon populations has been experienced. This is of particular concern given that sturgeon is one of the oldest species still alive, occupying a special place in the biological heritage of the Earth. It is also among the most economically valuable species.

The high-value market for unfertilized roe, i.e. caviar, has made sturgeon a target for organized illegal fishing and trade, and contributed to overexploitation.

Unfortunately, the Commission on Management of Aquatic Bioresources (CAB) of the Caspian Sea, which started to meet in 1992 to discuss and recommend total catch quotas of various commercial aquatic species, in particular sturgeon but also *kilka*, has not yet proved to be an effective fisheries management tool.

While in recent years, CAB, which also includes the Islamic Republic of Iran since 2002, determines not only the annual fishing quotas, but also collects information and advises on fishing regulation measures, the stocks of the main commercial species continue to decrease.

Caspian Sea sprat catches (which generally add up to over 80 percent of the total annual catch) of the Azeri fleet decreased from nearly 39 000 tonnes in 1990 to an estimated 2 400 tonnes in 2007. Sturgeon catches fluctuated over the same period between 108 tonnes (in 1991) and 61 tonnes (in 1998) and were estimated at 67 tonnes in 2007.



COMMERCIAL AND RECREATIONAL FISHERIES AND AQUACULTURE

Both natural and artificial inland freshwater bodies have been traditionally used for commercial fisheries purposes. Total inland capture fisheries production in Georgia was estimated at 388 tonnes in 2003. It is difficult to measure the average annual inland capture fisheries production in tonnes in the Caucasian lakes and reservoirs since poaching is a widespread practice. FAO statistical data, as provided by governments, estimate total inland (freshwater) capture fisheries production in 2007 for Armenia at 3 000 tonnes, Azerbaijan at 426 tonnes and Georgia at around 50 tonnes. The most important species caught include trout, common carp and crucian carp, which together make up some two-thirds of the catch.

The inland aquaculture production of the three Caucasus republics has focused since the mid-twentieth century mainly on the culture of common carp, silver carp and trout.

Generally, large pond culture systems are used, as were established in the Soviet era. Towards the end of the 1980s, the aquaculture production of the three republics added up to over 7 000 tonnes, which gradually decreased to just over 700 tonnes in 1998. The combined aquaculture production has increased slowly in recent years and was estimated at some 1 860 tonnes in 2007. Marine aquaculture production is insignificant in the three republics.

Also after independence, recreational fisheries remained an important hobby for the population of the Caucasus. Although some scientists argue that part of the recreational fishing conducted should be labelled subsistence fishing, fishers themselves prefer the term recreational fishing or angling. At present, the number of active recreational fishers in Azerbaijan is estimated at over 20 000.



Aquaculture can represent an important source of income generation and diversification for rural people, provided financial and technical support is granted

Their estimated annual catch is around 100 tonnes. Generally, the regulations in place allow recreational fishing in all waters, except for reserves, fish hatcheries and aquaculture farms, and in compliance with locally established rules for fishing and water management. The main targets of recreational and sport fishing are pike perch, common carp, eastern bream, roach, *vimba*, Caspian asp, *kutum*, mullet, *shemaya*, barbel, shad, *khramulya*, pike, catfish, shrimp and crayfish. Some large reservoirs in the middle stream of the River Kür are preferred in particular by recreational fishers or anglers: Mingacevir, Yenikend and Varvara, which constitute the cascade of reservoirs.

BETTER PROSPECTS FOR THE FUTURE

In summary, the fisheries sector in the Caucasus republics is slowly recovering from the crisis of the 1990s. The prospects for the sector and its opportunities for development are more and more acknowledged. As a consequence, the seeds have been planted for a sustainable growth of the sector – a growth that will need partnership developments between the public and private sector and stakeholders active in fisheries. Only jointly can the problems and constraints faced by the sector be overcome.



THE FISH BREEDER ASHOT KOCHRYAN

Not far from Harsin village near Haghartsin Monastery, Armenia, we met Ashot Kochryan who breeds *ishkhan*



fish (a kind of yellow trout) in fish basins constructed in the middle of a beautiful wood. He uses freshwater that pours out from a local source and, since the place is cool during the summer, many tourists visiting the monastery stop here to eat a freshly caught trout.

Ashot carries out most of the breeding on his own and buys feed directly from a European

company. Prices are very high, and often he cannot afford to buy feed, especially during winter, when few tourists stop by and eat fish.

Many of his fish die when he is unable to feed them properly, and he is extremely unhappy about this situation.

Ashot is very fond of his fish and looks after the forest, providing

a service to all those who stop by and rest under the trees. He is active and dedicated to his business, and has many plans to produce his own feed to cut down on expenses. He dreams about opening a nice restaurant directly linked to his fish ponds.

But he does not know how to access credit from the bank, and to set up his business he would need some microcredit.





Forests in Armenia cover 10 percent of the land. Wood is a significant source of fuel for heating and cooking and of income generation for rural people

TREES AND FOREST RESOURCES

ARMENIA

Forests and other wooded land make up only one-tenth of the land area of Armenia; the main species are oaks, beech and hornbeam, with ash, elm, lime and maple also common. About 200 species of trees and shrubs are represented. All forests in Armenia are state-owned and many of them are in protected areas. Farmers collect berries, honey and aromatic plants from forests and a logging ban has been in place in Armenia since 1996 to control illegal logging and unauthorized commercial business.

The forestry sector officially contributes a very small part of GDP (approximately 3 percent) but, as in the case of many countries, this does not really reflect the total contribution of the sector in providing environmental services such as climate change mitigation and watershed and soil erosion control. It does not take into consideration its contribution to

enhancing tourism or the daily lives of rural communities that rely on forests for the many activities complementary to their agricultural practices. Production of fuelwood is a traditional and important source of fuel for many rural communities for heating and cooking purposes.

Armenia is a member of the Joint Programme of the United Nations Economic Commission for Europe (UNECE) Timber Committee and the FAO European Forestry Commission. The Government of Armenia has signed and ratified the United Nations Conventions, including that on Biological Diversity (1992), Climate Change (1992), to Combat Desertification (1994) and the Protocol on Water and Health (1999). Commitments under these conventions are being elaborated in policies, plans and laws.



SUSTAINABLE MOUNTAIN DEVELOPMENT IN ARMENIA

by Thomas Hofer

Armenia is fully committed to implementing recommendations from the International Year of Mountains (IYM) 2002, and sustainable mountain development is a national priority.

Armenia established the general framework for a comprehensive approach to the economic, social, environmental and cultural recovery and development of mountain areas to face certain challenges including deterioration of economic potential, and food security problems; shrinking forest areas; soil degradation; limited access to drinking- and irrigation water; and unsustainable agricultural production and cattle breeding practices.

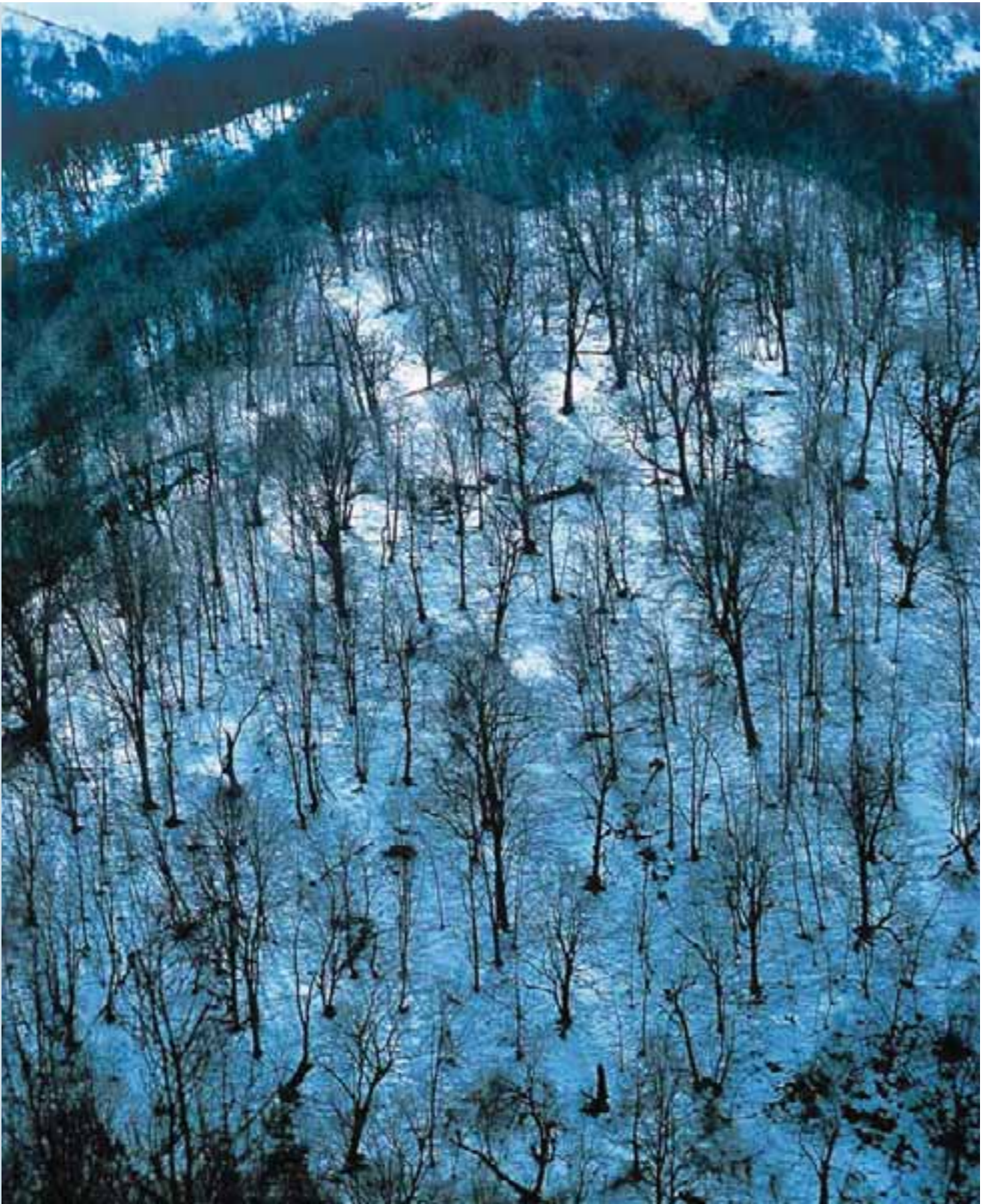
FAO, through its experience with a project in watershed management and sustainable mountain development, assisted the country in initiating pilot activities and establishing a methodology for an interdisciplinary, multistakeholder and collaborative approach to the development and implementation of such a strategy for sustainable mountain development.



In addition to the formulation of the national strategy, an investment programme was formulated to include mountain communities and agricultural development, research, education and training and public assistance to policy-makers. In the Aragats community, a multistakeholder civic action group was established to guide field-level implementation of the project.

The group evolved into a village association with neighbouring communities to improve the livelihoods of mountain people and demonstrated integrated approaches to sustainable mountain development.

A kindergarten, an art school, a public space, a machinery park and afforestation for recreation activities were accomplished. It is hoped that such grassroots institutions will continue to exist and be active in the future.







The forested areas in Azerbaijan have been reduced by more than half in the last 200 years. Ongoing reforestation programmes should be extended, especially to rehabilitate degraded forestland. *Below: Pistachio fruit (Pistacia vera L.). The pistachio tree is often used in reforestation programmes thanks to its capacity of growing in poor soils. A few multicentenary trees of Pistacia mutica, an ancestor of pistachio, can still be found in Southern Caucasus, but are at risk of extinction*

AZERBAIJAN

Around 400 species of trees and bushes are recorded in Azerbaijan (representing nearly 10 percent of the country's flora). Timber provides a source of materials for construction and furniture making. During the past 200 years, forest areas have been halved. In the eighth and ninth centuries, the present area of Azerbaijan was covered with 35 percent of forests. At present, forests in Azerbaijan constitute 934 500 ha or 11 percent of the territory, mainly state-owned, with only 54 000 ha under private or community ownership.

The northeastern slopes of the mountain chain of the Greater Caucasus are part of the vast forest areas in Azerbaijan. In the macro slope of the Greater Caucasus within the territory of the Shamakhi region, forest tracts emerge again and form continuous cover along the slopes up to the border with Georgia. The slopes of the Lesser Caucasus range also have vast forest areas. Forests cover the northern, northeastern and eastern slopes of the main foothills in the shape of single tracts.

Coniferous forests located in a smaller area of the Greater and Lesser Caucasus mainly consist of Garmagvari pine (*Pinus hamata*). On the Eldar Oyughu mountain in an area of 400 ha, Eldar pine (*Pinus eldaricas*) grows in xerofit conditions mainly in

new and humid pistachio forests consisting of *garachobra* (*Taxus baccata*) in combination with broadleaf species or in the form of small forests. Of the coniferous forests, the most widespread are those of juniper, such as Gazakh juniper (*Juniperus sabina*) and elongated juniper (*J. oblonga*). Azerbaijan forests are also famous for their non-wood resources, because there are 150 species of wild fruit plants relating to 35 taxa. These plants produce thousands of tonnes of wild fruits (walnuts, apples, pears, cornel, sour plums, medlars, persimmon, chestnuts, hazelnuts, pistachio and blackberries).





Integrated watershed management contributes to water, land and biodiversity conservation and to improve livelihood of upland inhabitants and people living in downstream areas. Trees and forest can reduce the incidence of erosion, landslides and floods and the impacts of desertification. Altyaghack National Park, Xizi region

Favourable conditions also exist for the development of bee farming and, at present, more than 1 000 bee families are bred in forestry units, contributing to plant pollination and honey production.

ESTIMATED TIMBER RESOURCES IN AZERBAIJAN	
Forest type	Timber resources (m ³)
Pistachio	59 730 000
Oak	27 970 000
Beech	26 220 000
Mountain	110 920 000
Coniferous	114 850 000

GEORGIA

Georgia's forests occupy 40 percent of the country's territory and constitute a crucial element of Georgian natural environment, rural livelihood, cultural tradition and national economy. Forests in Georgia have a habitat of international importance and unique biological and landscape diversity.

Over 80 percent of the state forests are composed of broadleaves (almost 50 percent beech) and 20 percent are conifers. In terms of biodiversity, the forests contain more than 4 100 of the estimated 6 350 species in the entire Caucasus region, including 395 species of woody plants and 153 native tree species. The fauna includes some 330 bird species, 100 mammals and 59 amphibians and reptiles.

According to FAO country profiles, soil degradation and erosion (resulting from the topography, heavy rainfall and overgrazing by livestock) are serious problems in Georgia. Forests have a crucial role in soil and water conservation.

About 200 000 ha of forest areas are reportedly degraded, of which some 70 percent consist of oak and beech forests that have been harvested unsustainably for fuelwood and local construction wood. Some 60 percent of the annual forest harvest is estimated as unrecorded fuelwood.

Forests are a key resource in Georgia and are closely linked to cultural traditions, national income and livelihoods







Illegal logging, scarcity of investments and reforestation programmes, and lack of a landscape vision in agricultural development cause many problems in the sustainable use of forests. <<Left: *Zelkova* relict trees at Batsara-Babaneuri National Reserve

In Georgia, extensive logging was particularly noticeable in the first half of the twentieth century. The energy crisis in the 1990s and fuel shortages caused an increase in woodcutting to obtain firewood for heating.

In addition to official data, it was assumed that local people harvested firewood (but official estimates are not available) primarily in forests of former collective farms. During this period there was a lack of efficient control. After the Rose Revolution, the Ministry of Environmental Protection and Natural Resources (MEPNR) implemented some important reforms, including the establishment of a new Environmental Inspection Service with stronger powers and more resources to detect and prosecute illegal logging. In accordance with the law on “Licences and Permits”, forest usage in Georgia is conducted on the basis of licences, which are sold by auction. The only exception is extraction of fuelwood to serve the needs of the local population. This type of forest use is not subject to licensing.



Georgian forests, in addition to wood and their environmental functions, produce a wide range of non-wood forest products such as fruits, berries, nuts and mushrooms.



**THE FORESTRY TECHNICIAN
GIORGI ICHAI DZE**

by Marzio Marzot

On a cold winter's day in the Akhmeta district (Kakheti, Georgia), we visited Giorgi Ichaidze and his family, his mother Elene Isotsanidze, his daughter Lela Ichaidze and his grandchild.



Mr Ichaidze, a forestry technician in charge of the protection of the Batsara-Babanuri Forest Reserve, accompanied us during our visit to the *zelkova* relict tree forest.

When we visited the forestry section under his responsibility, he explained Georgian legislation related to the conservation of forest genetic resources. He discussed with objective and clear vision the problems caused by illegal logging, by the lack of investments in infrastructures and reforestation programmes, and by the lack of a landscape vision in agricultural development programmes. He explained the importance of this relict tree area from cretaceous formation and said he was proud of his country's wealth of biodiversity.

When I approached a relict tree, I asked him its name. He indicated the species in Georgian and, when I replied that I could not understand Georgian, he said the name again in Russian. When I apologized yet again because I could not speak Russian, he spelled out the scientific (Latin) name to me. Despite the fact that Mr Ichaidze only earns USD50 per month, he speaks Georgian and Russian and knows all the scientific names, as well as the biology and history, of the trees under his care.

In addition to his profound scientific knowledge, he also loves music and literature. As per the tradition of Georgian hospitality, we were invited to his home for a wonderful candlelight dinner (electricity is very expensive in rural areas).

After dinner, his daughter, who studied the piano for over ten years, sang and played beautiful classical Georgian music, and we spent the rest of the evening discussing the agriculture, food and traditions of Georgia.

We learned about the importance that the family attributes to education, including music and artistic education.

We will never forget Mr Ichaidze's hospitality, his pride in doing socially important work, and his dedication to his occupation and the conservation and sustainable use of Georgian forest resources and landscapes, for the future of his children and grandchildren.



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TOWARDS RESOURCE EFFICIENCY

MANY WILD PLANTS, ANIMALS AND ASSOCIATED ECOSYSTEMS THAT PROVIDED GOODS AND SERVICES FOR CENTURIES TO THE HUMAN POPULATION OF THE SOUTHERN CAUCASUS HAVE BEEN OVERUSED OR MISUSED IN THE LAST CENTURY. AT PRESENT, RISING HUMAN, ECONOMIC AND CLIMATIC PRESSURE IS INCREASINGLY REDUCING THEIR RESILIENCE AND PRODUCTIVITY AND, IN MANY CASES, THEIR CAPACITY FOR SURVIVAL.

If, on the one hand, new technologies, research and investment opportunities must be developed to accelerate low carbon development and food security, on the other, microinvestment schemes must be developed to promote a wide range of diversified solutions that can make the most efficient use of local resources and energies.

Agriculture and the use of wild plants and animals are currently inefficient activities that incur waste and high energy inputs. But the traditional food habits and agricultural practices of the people of the Southern Caucasus are based on a good understanding of the physiology and behaviour of plants and animals, low availability of cash, landscape memory and love and respect for the region.

This knowledge, combined with new science and technology, can generate a more efficient form of agricultural production and develop many localized micromanagement agricultural practices that use reduced and different forms of fertilization; enable

farmers to take informed decisions on pest control measures; rely on different sources of energy input; avoid water waste; and make the best use of genetic resources resilient to local conditions.

Changes in the behaviour of consumers will also be important to ensure food security for all human beings. We will have to increase our awareness about the relationship between our food and our health, and the health of the environment that sustains our food production systems, and adapt our consumption habits to increase consumption of food that has been produced and transported more efficiently.

It is urgent for government policies and regulatory regimes to be put in place enabling this overall shift towards efficiency of food production, processing, storing and consumption systems while ensuring minimum disturbance of habitats in order to maintain ecosystems and their wild plants and animals that are the foundations of agricultural production.



COMBINING BIODIVERSITY, HEALTHY ECOSYSTEMS AND SMALLHOLDERS' DEDICATION: A PATHWAY INTO THE FUTURE

Էկոհամակարգային մոտեցումը կարող է հիմնարար դեր խաղալ

Biomüxtəlifliyn, sađlam ekosistemlərin və xırda fermer öhdəliklərinin məcmusu:
gələcəyə aparan yol

Ցիոմրազալֆերոջնեբիս, սալի Եկոսիսթեմեբիսա ևա մցիրե ֆերմերտա
մալիսեմեջիս Երտոբլիոբա: ց՜ա մոմաջլիսկեյն

THE ECOSYSTEM APPROACH, COMPOSED OF 12 PRINCIPLES, IS THE PRIMARY FRAMEWORK FOR ACTION UNDER THE CONVENTION ON BIOLOGICAL DIVERSITY. COP 9 DECISION IX/7 (BONN, MAY 2008) NOTES THAT THE ECOSYSTEM APPROACH IS A NORMATIVE FRAMEWORK FOR BRINGING TOGETHER SOCIAL, ECONOMIC, CULTURAL AND ENVIRONMENTAL VALUES. THUS, THE APPLICATION OF THE ECOSYSTEM APPROACH WILL HELP TO REACH A BALANCE OF THE THREE OBJECTIVES OF THE CONVENTION: **CONSERVATION, SUSTAINABLE USE AND THE FAIR AND EQUITABLE SHARING OF THE BENEFITS ARISING FROM THE UTILIZATION OF GENETIC RESOURCES.**

THIS FINAL PART OF THE BOOK PROVIDES SOME EXAMPLES OF HOW FARMERS APPLY ALL 12 ECOSYSTEM PRINCIPLES TO OBTAIN SUFFICIENT FOOD FROM THEIR LAND, MAINTAIN THEIR NATURAL RESOURCES FOR THEIR CHILDREN AND DEVELOP THEIR SOCIETIES, CULTURAL VALUES AND LIFESTYLES.



PRINCIPLE 1

THE OBJECTIVES OF MANAGEMENT OF LAND, WATER AND LIVING RESOURCES ARE A MATTER OF SOCIETAL CHOICES

Rural people use wild and cultivated genetic resources in the Southern Caucasus for their food security, according to their own economic, cultural and societal needs. For example, in Armenia, family farmers grow apples that have a thick skin, which makes them good for handling and for transportation. They also maintain local varieties that can be kept for a year and even longer at room temperature in cool cellars so they are sure that they have sufficient fresh fruit throughout their long winters (Chapter 4). In Azerbaijan, wild pomegranate varieties are used to produce citric acid (Chapter 5). In Georgia, zanduri wheat is grown because it is particularly adapted for making bread much appreciated in the country (Chapter 6).

RECOMMENDATION

The first engagement of the international community towards rural people should be to understand and respect their objectives, rights and needs in a clear way. The type of assistance that the international community should provide is to promote *in situ* and on-farm conservation and use of the many cereals, fruits, legumes and feed landraces and wild relatives in the Southern Caucasus, by empowering local communities and committed scientists.

PRINCIPLE 2

MANAGEMENT SHOULD BE DECENTRALIZED TO THE LOWEST APPROPRIATE LEVEL

People have selected their plants and animals to adapt to and optimize production in their ecosystems. For example, pastoralists have bred buffaloes to make the best use of marshes and poor grasslands (Chapter 7). Farmers have grown alfalfa in rotation with their cereals to increase soil fertility and to have quality forage for their animals in order to produce milk and meat throughout the year (Chapter 4). Local policy-makers define, in agreement with the population, who should use the summer and winter pastures (Chapter 7) in a specific territory and in what manner. These management practices have been developed by farmers who have a good knowledge of the potentials and limitations of the ecosystem that they are farming, and its productive capacity. Working with farmers and providing appropriate scientific information and support would enable them to make efficient, effective and equitable decisions.

RECOMMENDATION

Since people's innate knowledge is the primary richness of the Southern Caucasus, development and implementation of national agricultural and environmental policies should be decentralized, building on and recognizing farmers' knowledge and practices that have been proven to be effective in regulating food production, maintaining both livelihoods and the natural resource base.



PRINCIPLE 3

ECOSYSTEM MANAGERS SHOULD CONSIDER THE EFFECTS (ACTUAL OR POTENTIAL) OF THEIR ACTIVITIES ON ADJACENT AND OTHER ECOSYSTEMS

Increasing the agricultural irrigated area using water from Lake Sevan caused severe consequences on the environment, on natural vegetation, fish, wildlife and water quality. These management interventions have now been reduced but, if they were to continue, the reduction in the level of the lake could cause unpredictable effects of desertification and climate change in the lake area and on other ecosystems (Chapter 7).

RECOMMENDATION

Intensification of agricultural production, particularly through the use of monocultures and through an increase of water use harvested in adjacent ecosystems, should be carefully evaluated. The quality and fertility of soils subject to irrigation should be assessed, and the effect on loss of productive potential in the ecosystems from which the waters are removed should be carefully analysed and predicted.

PRINCIPLE 4

RECOGNIZING POTENTIAL GAINS FROM MANAGEMENT, THERE IS USUALLY A NEED TO UNDERSTAND AND MANAGE THE ECOSYSTEM IN AN ECONOMIC CONTEXT

Traditional systems should be improved with energy-efficient technologies rather than being replaced by large industrial processes based on high-energy consumption and high external inputs. For example, improving safety and market access of local cheese, fruit, vegetables and herbal teas prepared by traditional methods with recipes conserved in almost every family of the Southern Caucasus, will directly benefit the maintenance of local biodiversity, the sustainable use of local resources, balanced diets and also contribute to increased farmers' income (Chapters 4, 7). Incentives and payments of benefits could be given to those farmers who grow local varieties in an energy-efficient system, such as the many fruit varieties resistant to local pests and diseases mentioned throughout the book, and local legumes that contribute to nitrogen fixation as well as the use of compost and manure in the gardens (Chapters 3, 5).

RECOMMENDATION

Traditional food production and processing practices can be the starting-point for diversifying sources of income. Safety technologies should not be replaced but could build on traditional practices, and incentives could be provided to give value to local products. The non-monetary value for the environment of sustainable agricultural practices could be quantified, and this value reflected in the market value of agricultural products.



PRINCIPLE 5

CONSERVATION OF ECOSYSTEM STRUCTURE AND FUNCTIONING, IN ORDER TO MAINTAIN ECOSYSTEM SERVICES, SHOULD BE A PRIORITY TARGET OF THE ECOSYSTEM APPROACH

Throughout this book there are examples of fruits that have been selected and maintained in the Southern Caucasus thanks to people's knowledge of ecosystem structure and functioning. For example, how the effects of seasons on the ecosystem are managed by farmers (Chapter 4), how farmers collect wild plants for medicinal use and to complete their diets (Chapter 8), and how pastoralists move their herds between summer and winter pastures because they know that winter pastures must rest during the long dry summers, while summer pastures provide good-quality forage only from June to September (Chapter 7).

RECOMMENDATION

Agricultural science must be developed to better understand the dynamics within species and among species and their abiotic environment, and the biological processes underpinning ecosystem functions. A better knowledge of physical and chemical limitations to food production is necessary to conserve the productive capacity of the ecosystem. The practical and daily work of farmers who observe and use these interactions to produce food should be scientifically analysed and supported through appropriate policies, promoting their role as guardians of biodiversity and ecosystem structure and functioning.

PRINCIPLE 6

ECOSYSTEMS MUST BE MANAGED WITHIN THE LIMITS OF THEIR FUNCTIONING

The Southern Caucasus is characterized by dramatic rainfall and temperature changes over a relatively small area, which can limit its natural productivity. However, these are perfect conditions for the genetic evolution of a wide range of plants, and therefore the Southern Caucasus is astonishingly rich in cereals, grain legumes, fodder and fruit plants that can produce and adapt to extreme rainfall and temperature conditions. For example, 26 wild species of pear can still be found today, and popular selection has developed many pear cultivars to fit into the limits of different ecosystems, such as summer- and winter-ripening pear varieties, varieties with different shapes and flavour to suit the different processing needs of the local population, and species adapted to grow in very stony and arid lands, and/or resistant to local pests (Chapters 3, 5). There are cherries resistant to late frosts, geese adapted to feed on local pastures, and wheat such as *dolis puri* resistant to fungal attacks (Chapters 4, 5, 6). Food security and long-term sustainability have been the selection criteria of farmers who have managed the environmental limits of their ecosystems.

RECOMMENDATION

High energy costs, a decrease in soil fertility, new challenges posed by climate change and food price volatility are putting increasing pressure on ecosystems. Agricultural production must develop efficient technologies and localized management practices with particular focus on small farmers' needs, using more of the solar energy that is so abundant in the region. This can only be possible through the use of locally adapted species and varieties that must be maintained *in situ* and *ex situ* for the future of agriculture. Therefore, new vigour, enabling policies, committed researchers and empowered farmers must work together across sectors, across cultures and across countries to protect the precious genetic material that is preserved in the Southern Caucasus.



PRINCIPLE 7

THE ECOSYSTEM APPROACH SHOULD BE UNDERTAKEN AT THE APPROPRIATE SPATIAL AND TEMPORAL SCALES

In their gardens, farmers use and manage gene diversity by planting different fruit and vegetable varieties adapted to the site-specific conditions of their farms. They also manage species diversity by cultivating fruits and vegetables for sufficient food throughout the year, and breeding animals to complete their diets and collect manure (Chapter 5). They manage their ecosystems by supplementing their diets with wild berries and vegetables, fishing, exploiting the forest and by grazing their livestock over large grassland areas (Chapter 7).

RECOMMENDATION

These traditional management choices made by farmers at gene, species and ecosystem level are based upon their knowledge of biological diversity. Much of this knowledge has resisted the many years of policy and research oblivion. In order not to lose the enormous amount of gene and species varieties maintained in gardens and by landscape memory, rapid actions of characterization, documentation, cataloguing, collection and maintenance of genes and species should be organized and human resources, skills and the capacity of plant genetic resources programmes upgraded.

PRINCIPLE 8

RECOGNIZING THE VARYING TEMPORAL SCALES AND LAG EFFECTS THAT CHARACTERIZE ECOSYSTEM PROCESSES, OBJECTIVES FOR ECOSYSTEM MANAGEMENT SHOULD BE SET FOR THE LONG TERM

Traditional livestock production is based on animals selected for their resistance to cold winters and hot dry summers, and for feeding on poor local forage species. The grazing surfaces are collectively used by pastoralists for wool, meat and cheese production, but also for collection of wild vegetables and medicinal plants, fruits and fuelwood (Chapters 7, 8). Pastoralists know that a balance must be maintained between livestock production and preservation of pasture conditions and that obtaining short-term high gains from intensive livestock production causes land degradation, loss of the most nutritious species and loss of soil fertility. The introduction of so-called “improved” animal breeds to increase short-term production, and disruption of traditional management practices have further exacerbated the pressure on grazing resources, many of which are now degraded and unable to sustain the previous levels of animal production.

RECOMMENDATION

The pressure to obtain increasing short-term gains has often replaced pastoral practices that maintained a balance between the herd and the varying temporal scales and lag effects of grazing on pastures. Therefore, farmers and pastoralists currently need specific education and training programmes that revitalize their understanding of the mechanisms underlying soil fertility, plant growth, biological pest control and ecosystem management as well as other ecosystem services such as pollination and nutrient cycling.



PRINCIPLE 9

MANAGEMENT MUST RECOGNIZE THAT CHANGE IS INEVITABLE

*The traditional practices and genetic resources described in this book have been selected because they all have potential to respond to the new challenges of the twenty-first century. Plant selection and management began during the Neolithic (Chapter 3). People from the region learned how to cope with temperature and rainfall changes and consequently adapted their agricultural management practices (Chapter 4). Today, farmers still maintain smooth-skinned peach varieties in their gardens because they can tolerate drought conditions better than villous ones; these varieties could become important in adapting to changing climatic conditions (Chapter 5). In addition, peach tree seedlings are grafted on good-quality soils, while on damp and heavy soils they respond better to grafting on to the myrobalan; and on dry and calcareous soils on to the almond (Chapter 5). Therefore, if peach production has to be moved to different soil types, farmers know how to graft the tree. Since climatic and human needs constantly change, the genetic resources of wheat are maintained to adapt to such needs (Chapter 6). A variety called dika (*Triticum ibericum*) matures at low temperatures and thrives even in damp conditions, and is therefore maintained to grow in wet mountain locations and to be harvested, if necessary, at an earlier stage while still damp.*

RECOMMENDATION

Adaptability, flexibility and resilience are the key words for coping with long-term occurrences such as climate change. But this is not enough. In order to utilize adaptive management to anticipate and cater for such changes and events it is necessary to move much closer to farmers. Scientific information and climatic data must exit from academic realms and zoom in on the territory and, more important, on the needs of farming communities to provide rapid and targeted information and services, enabling farmers to take appropriate management decisions.

PRINCIPLE 10

THE ECOSYSTEM APPROACH SHOULD SEEK THE APPROPRIATE BALANCE BETWEEN, AND INTEGRATION OF, CONSERVATION AND USE OF BIOLOGICAL DIVERSITY

Rural people understand and use wild plants and animals to complement their diets and the borders between harvesting from the wild and agricultural production are slight (Chapter 8). People harvest wild carrots, asparagus, thyme, berries and melons in many mountain environments, and integrate agriculture in their gardens with pastoralism. They use the natural vegetation as food, medicine and a feed resource but, at the same time, they protect fragile soils from overgrazing and preserve local genetic resources. Traditional fishing schemes pose no immediate threat to fish stocks, but the increased pressure to harvest more fish, and the replacement of native fish with “more productive” species, should be balanced by a profound understanding of the ecosystem and all its varied and conflicting uses.

RECOMMENDATION

A further challenge is to empower the people who use and manage common natural resources (e.g. communal pastures, water resources and forests) in their daily practices of sustainable use and conservation of biodiversity and landscape memory. Political, technical and economic measures must be developed at the national level to sustain food production practices, using a continuum concept that goes from strict protection to sustainable production intensification. Implementing international initiatives at the national level is necessary for enhancing production and protection of the many wild species and varieties of the Southern Caucasus that represent a treasure of genetic resources for the entire world. But it is important that rural people, fishers and pastoralists are given a fair and equitable share of the benefits derived from ownership of traditional practices arising from the maintenance and utilization of genetic resources.



PRINCIPLE 11

THE ECOSYSTEM APPROACH SHOULD CONSIDER ALL FORMS OF RELEVANT INFORMATION, INCLUDING SCIENTIFIC AND INDIGENOUS AND LOCAL KNOWLEDGE, INNOVATIONS AND PRACTICES

One of the most significant achievements of zootechnical science in the twentieth century could be considered the establishment of the Caucasian nut brown breed on the basis of joint work by Caucasian scientists. This breed was raised by crossing Armenian, Azerbaijan, Georgian and Dagestan local cattle mainly with a Swiss breed. In 1863, and during the existence of social farms in improved conditions of feed and care, milk yield reached 3 500–4 500 kg. But today these productive indicators do not correspond to breed standards because breeding farms are mostly disrupted, zootechnical registration is poorly maintained, artificial insemination is poorly practised and therefore the Caucasian nut brown breed, without continuous efforts in innovations and practices, is insufficiently adapted to hot, dry and windy summers and cold, snowy and windy winters (Chapter 7).

RECOMMENDATION

Bridges should be built between traditional practices and innovative production systems and green technologies that meet the demands of today's society from an economic, social and ecological perspective. In the Southern Caucasus, the effectiveness of the ecosystem approach for agricultural production will greatly depend on the capacity to use both the existing scientific and traditional information, appropriate technologies and science tailored to smallholders' site-specific conditions to improve their daily practices.

PRINCIPLE 12

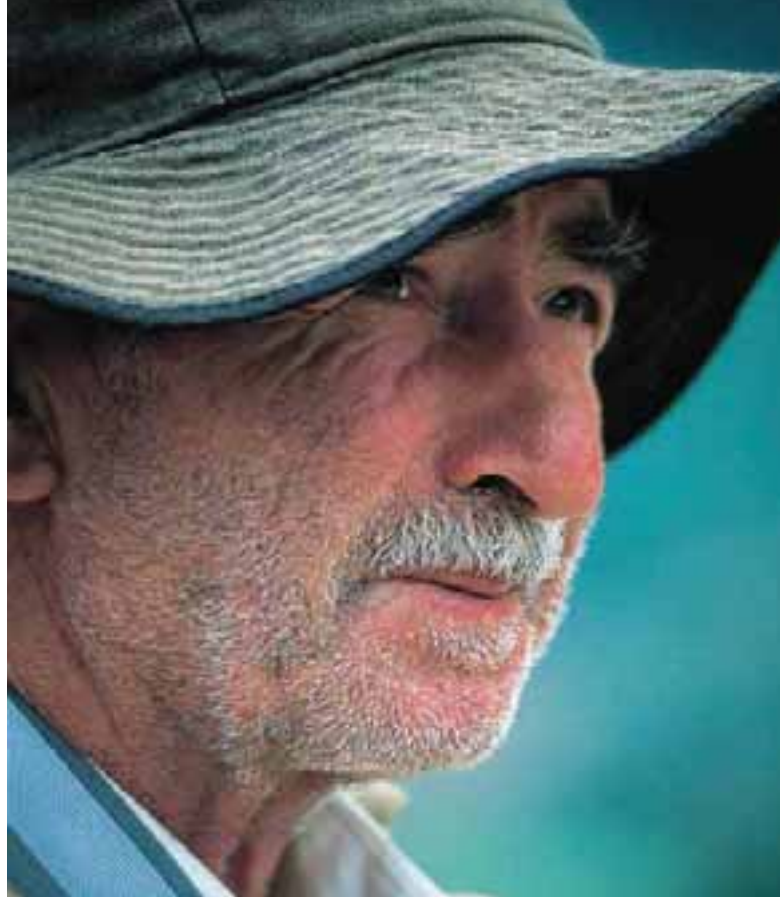
THE ECOSYSTEM APPROACH SHOULD INVOLVE ALL RELEVANT SECTORS OF SOCIETY AND SCIENTIFIC DISCIPLINES

The daily lives of farmers, pastoralists, rural and urban people from all different cultures are closely interrelated and are complementary to their use of the natural resources and food production and consumption (Chapters 1, 2, 8). Many scientific institutions, policy-makers, universities and farmers' and consumers' networks are collaborating to maintain in situ and ex situ the precious genetic resources that will allow them to ensure sustainable food production in the Southern Caucasus.

RECOMMENDATION

New vigour, enabling policies, committed researchers and empowered farmers must work together across sectors, across cultures and across countries to protect the enormous amount of genetic material that is preserved in the Southern Caucasus. For this to happen, it is important for people, in particular decision and policy makers, to internalize issues related to the conservation, sustainable use and the fair sharing of benefits arising from the utilization of genetic resources into their daily work. It is also important to engage with needs of farmers, who are the custodians of genetic resources. Adequate investments in rural infrastructures, efficient technologies, education and development are vital in order to meet the demand for food in the twenty-first century, with a particular focus on environmental sustainability.











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The Southern Caucasus is an important centre of origin and diversity of many species and varieties that are the basis for global food production. This great biodiversity is maintained by farmers, and their gardens are a healthy source of food production, experimental places to develop sustainable technologies and laboratories to maintain seeds and biodiversity.

This book contains 500 photos and documented information on selected species that hold potential to adapt to the production systems of the twenty-first century. It also contains studies and notes on the food habits and associated traditions of the people of the Southern Caucasus, who contribute to maintaining sustainable agricultural systems through their daily work and diligence.

The time has come to awaken and engage in identifying, maintaining and using these genetic resources and agricultural practices. This will enable the present and future generations to improve their food security and livelihood in the Southern Caucasus while ensuring that other countries will also have access to this treasure trove of biodiversity.

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