Yemen, terracing system for the protection and cultivation of the slope. The water intakes deviate the flows from their natural course and direct them along the walls on the terraces. Towers and stone buildings are placed to defend the cultivations. **Photo: P. Laureano.**

UNCCD – The United Nations Convention to Combat Desertification

The international community has long recognized that desertification is a major economic, social and environmental problem of concern to many countries in all regions of the world. The question of how to tackle desertification was a major concern for the United Nations Conference on Environment and Development (UNCED), which was held in Rio de Janeiro in 1992. The Conference supported a new, integrated approach to the problem, emphasizing action to promote sustainable development at the community level.
It also called on the United Nations General Assembly to establish an Intergovernmental Negotiating Committee (INCD) to prepare, by June 1994, a Convention to Combat Desertification, particularly in Africa. The Convention was adopted in Paris on 17 June 1994.

Committee on Science and Technology

The UN Convention to Combat Desertification has established a Committee on Science and Technology (CST). The CST was established under Article 24 of the Convention as a subsidiary body of the COP, and its mandate and terms of reference were defined and adopted during the first session of the Conference of the Parties (COP) in 1997. It is composed of government representatives competent in the fields of expertise relevant to combating desertification and mitigating the effects of drought. The committee identifies priorities for research, and recommends ways of strengthening cooperation among researchers. It is multi-disciplinary and open to the participation of all Parties. It meets in conjunction with the ordinary sessions of the COP. The CST collects, analyses and reviews relevant data. It also promotes cooperation in the field of combating desertification and mitigating the effects of drought through appropriate sub-regional, regional and national institutions, and in particular by its activities in research and development, which contribute to increased knowledge of the processes leading to desertification and drought as well as their impact.

Promotion of Traditional Knowledge: A Compilation of UNCCD Documents and Reports from 1997 - 2003 UNCCD

Oasis of Timimoun (Algerian Sahara), kesria, a water quota sharing system. **Photo: P. Laureano.**

Promotion of Traditional Knowledge

A Compilation of UNCCD Documents and Reports from 1997 - 2003

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Promotion of Traditional Knowledge

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Promotions of Traditional Knowledge

A Compilation of UNCCD Documents and Reports from 1997 - 2003

UNCCD – The United Nations Convention to Combat Desertification
Committee of Science and Technology
2005

Contents

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Executive Summary

This publication aims to contribute to an understanding of traditional knowledge and how its application can minimize land degradation and desertification in arid and semi-arid zones and dry sub-humid zones. It is primarily intended to help those following the UNCCD process to take into account the development of traditional knowledge issues in the context of the work of the Committee on Science and Technology of the UNCCD. The document offers the fundamental information that may be useful to government officials, non-governmental organizations and academic institutions. The publication is organized in three sections and presents the relevant COP decisions, the official CST reports from the Ad hoc panels, followed by consultants' reports.

Section one discusses the first Ad hoc panel on traditional knowledge and covers a range of topics for important and widely applied traditional knowledge on a sub-regional, regional and national scale. It discusses the process of building linkages between environmental conventions and initiatives on the issue. A synthesis on traditional knowledge in dryland ecosystems is highlighted. This includes the system of traditional knowledge in the Mediterranean and its classification with reference to different social groupings. A participatory approach to research and extension in Africa is also discussed.
Section two provides the report of the second Ad hoc panel on traditional knowledge. This includes a report concerning local knowledge and its role in the National Action Programmes (in French). The measurement of the reciprocity between traditional and modern knowledge and its promotion through a set of proposed policy guidelines and criteria is provided.
Section three reviews the recent COP decisions and the proposal by the Government of Italy to establish an international center for traditional knowledge.

Foreword

International scientific cooperation combined with the widespread use of innovative techniques in the field of traditional knowledge is one of the initial steps to obtain success in combating desertification. Based on the work of two Ad hoc panels on traditional knowledge to combat desertification, this compilation of COP documents and experts' papers discusses the benefits in the application of traditional knowledge in different regions affected by desertification and land degradation. Traditional knowledge, technology, know-how and practices have been analyzed and examined from the viewpoints of adaptation, transfer and extension. The transfer of traditional knowledge needs to be flexible and responsive to the diversity of cultures and countries in order to allow profitable benefits from the global sharing of traditional knowledge from the dryland areas.

From its inception, the idea of a National Action Programme to Combat Desertification (NAP) strategy was to build upon traditional technology, know-how and practices with the aim of increasing the ability of both government and stakeholders to control agricultural risk by improving techniques and restoring the degraded lands. It took the view, which subsequently became a guiding principle of the UNCCD, that the people who bear the brunt of desertification, and who best understand the fragile environments in which they live, must be the starting point for efforts to combat land degradation. Traditional societies have nurtured and refined systems of knowledge of their own, relating to such diverse domains as meteorology, geology, ecology, botany, agriculture, physiology, psychology and health. They are also expressions of other ways of living in the world, other relationships between society and nature, and other approaches to the acquisition and construction of knowledge.

As the world population continues to grow, it is important to be aware of the time-tested approaches of traditional knowledge. One of the important issues explored in this publication is the need for a joint effort between farmer-innovators and researchers in order to further improve modern and traditional land and water management practices. Equally important to the application of traditional knowledge is the monitoring and assessment of its effects in combating desertification. Many of the issues surrounding the promotion, protection and use of traditional and local knowledge are being addressed through international collaborative efforts. Yet, it is at the local level that the ultimate benefits of such work should be realized.
It is hoped that this new publication will serve to revitalize the willingness and commitment to pool together the work of the scientific community, local partners and the various specialized agencies in countering the problem of desertification.

Hama Arba Diallo
Executive Secretary
United Nations Convention to Combat Desertification
Bonn, Germany
July 2005

Introduction

In all dryland regions of the world are found local communities who have long histories of interaction with the natural environment. Associated with many of these communities is a cumulative body of knowledge, know-how, practices and symbolic representations. These sophisticated sets of understandings, interpretations and meanings are part of a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview. This local and indigenous knowledge is a key resource for empowering communities to combat desertification.

In view of desertification and land degradation processes, traditional knowledge comprises a wide range of accumulated experience to manage natural resources in farming, grazing, landscape restoration, and other relevant sectors, institutional and organizational arrangements, as well as beliefs and values. Many scientists, community-based organizations and non-governmental organizations working with farmers and herdsmen have compiled a large body of traditional knowledge and local technologies associated with different production systems and agrarian typologies. The quality and quantity of traditional knowledge varies among community members, depending on gender, age, social status, intellectual capability and occupation. Language, religion, biophysical imperatives, and socio-cultural aspects, and environmental traits, are important driving forces in shaping these practices.

Traditional knowledge is often alternated with different names, such as indigenous knowledge, local technology, and native know-how and farmers' practices. Traditional knowledge and local technology are part of social complex systems and represent far more than a simple list of technical solutions. Traditional knowledge can be an elaborate and often a multipurpose system that is part of an integral approach between society, culture and economy. It is grounded on the idea of the world based on the careful management of local resources.

The need for revitalizing traditional knowledge in desertification

Traditional knowledge is often the subject of 'scientific study', but does not usually constitute an input into the scientific process, or into decision-making based upon scientific information. Under a technologically driven, fast-changing environment traditional knowledge may not always catch the attention of decision-makers yet it continues to receive attention, in part because of discussions in such fora as the Convention on Biological Diversity and the UNCCD. Different knowledge systems have been linked to emerging legal and market interests in developing cross-cutting activities on traditional knowledge. This includes identifying customary rules and processes that govern knowledge access and control, in order to develop appropriate normative instruments for protecting traditional knowledge.

From local and environmental points of view, traditional knowledge and its technology plays a primary role in poverty alleviation. Traditional knowledge is not proposed because it is less expensive technology compared to the 'top-down' modern ones, but because it has better results, technologically speaking, when placed within its environmental and social context. Sometimes, it has the most refinedtechnologies, other times, it is very simple but still more appropriate, ecologically compatible and locally manageable.

Revitalization of traditional knowledge should not be considered as strictly implementing more and more sets of simple techniques but should be viewed as an integrative means to be evaluated in the framework of environmental, productive and cultural conditions of societies. Local people, are the custodians of traditional systems. These people are well informed about their own situations, their resources, what works and what does not work. They are also aware of the possible impact of a change in one factor on the other parts of the production system.

Scope and purpose of this document

By its decision 20/COP.1 on traditional knowledge, the Conference of the Parties requested the Committee on Science and Technology (CST) at its second session to review the synopsis of reports on traditional knowledge compiled by the secretariat (ICCD/COP/(2)/CST5), based on the contributions of Parties and observers, and to reach conclusions and recommendations. With this initial COP decision began the work undertaken by the CST that has resulted in this compilation of official documents and reports which stress that the use of traditional and local technologies, knowledge, know-how and practices stand out as complementary to the efforts to combat desertification and mitigate the effects of drought. The CST has underscored the need to develop synergies and to integrate traditional knowledge with modern technologies while addressing: (i) legal implications of intellectual property rights; ways of harnessing the positive attributes of traditional knowledge; socio-economic benefits to be derived from development and use of the traditional knowledge; and the inclusion of traditional knowledge in the National Action Programmes to combat desertification.

The purpose of the document is to contribute to the efforts for traditional knowledge revitalization. It aims at providing the fundamentals of traditional knowledge in order for decision-makers to assess the efficiency of a method of production in which both internal and external aspects need to be considered. The application of a production technique determines the effects from the cradle to the grave of the use of resources and has general consequences for the entire economic, social and environmental system. Many times these interactions are not taken into account with a modern technique based on specific yield criteria. It is therefore appropriate to make inventories such as this, and to compile and share relevant information, exchange experience and establish communication networks to improve information flow so that beneficiaries are ensured of access.

The scope of this document encompasses the traditional values, manufacturing practices and artisan capacities of traditional technologies, which are the basis for the added value of products with enormous economic importance for many developed countries. This work should assist government agencies and stakeholders to create an enabling environment in which traditional knowledge can be maintained and further developed. This document should help in enhancing a careful analysis of the culture-specific division of power relationships which determine the possible roles of innovators and the extent to which innovations are shared amongst the community.

What is possible to learn from traditional and local knowledge within the UNCCD process is not a series of miracle-solutions that could be able to act within the logic of modern production systems. Instead much of the work expressed in this compilation represents the underlying integrative method on which traditional knowledge is based that can be put forward again through means of modern technologies. To be successful, a reciprocity needs to be fostered between traditional and modern knowledge in the different regions affected by desertification and land degradation.

Section 1.

COP Decision and the First Ad Hoc Panel on Traditional Knowledge

1.1 Decision 14/COP.2 - Traditional Knowledge

The Conference of the Parties,
Noting the synopsis of reports on traditional knowledge compiled by the secretariat,

1. **Requests** the secretariat to complete its ongoing work on compiling the most important and widely applied traditional knowledge on a subregional and regional basis and on a national scale where appropriate, and make a synthesis of this work available to the Committee on Science and Technology at its third session;

2. Requests the secretariat:

(a) To explore ways and means of linking the work of the Committee on traditional knowledge with similar work being undertaken under other related conventions and to report to the Committee thereon at its third session; and
(b) To prepare a report on traditional knowledge in dryland ecosystems drawing on the discussions that took place at the second session of the Committee and the synthesis referred to in paragraph 1 above in time for its presentation to the next meeting of the Subsidiary Body for Scientific, Technical and Technological Advice of the Convention on Biological Diversity;

3. **Decides** to appoint an ad hoc panel composed of ten experts with terms of reference as follows:

(a) Drawing upon the synthesis referred to in paragraph 1 above, to identify successful experiences and conclusions relating to:
(i) Threats and other constraints, including socio-economic impacts, confronting such traditional knowledge and practices;
(ii) Strategies for integrating traditional and local knowledge, know-how and practices with modern knowledge based on specific case histories; and
(iii) Mechanisms for promoting and exchanging successful approaches;
(b) To report accordingly to the Conference of the Parties at its third session;

4. **Requests** the United Nations Environment Programme to ensure that issues relating to linking information networks on traditional and local knowledge, know-how and practices to the national action programmes are addressed under the survey and evaluation of networks.

10 December 1998

1.2 Synopsis of Reports on Traditional Knowledge ICCD/COP(2)/CST/5

I. INTRODUCTION

1. In its decision 20/COP.1, adopted at its first session, the Conference of Parties, noting the report of the secretariat of the Convention contained in ICCD/COP(1)/CST/5 on modalities and timing of the work of the Committee on Science and Technology on inventories of research and traditional knowledge, and research priorities:

(a) Encouraged Parties and observers to collate information they had in respect of the use of traditional and local technology, knowledge, know-how and practices and to provide reports not exceeding five pages in length on that topic to the UNCCD secretariat no later than 31 December 1997, and

(b) Requested the Permanent Secretariat to prepare a synopsis of such reports for consideration by the Committee on Science and Technology at its second session.

2. That synopsis appears below.

II. CONTRIBUTIONS FROM PARTIES AND OBSERVERS CONCERNING TRADITIONAL KNOWLEDGE

3. The UNCCD secretariat received reports from 12 Parties and 5 observers. These concern a wide range of traditional and local knowledge, know-how and practices stemming in many instances from experience handed down from generation to generation and responsive to social and cultural change and the local environment.

4. The reports revealed the use of a variety of techniques and can be classified by topic as follows: control of wind or water erosion; water conservation; improvement of soil fertility; plant protection; forestry; social structures; and housing architecture. They are summarized below.

4.1 Control of wind or water erosion

(a) Windbreaks: creation around plots of barriers comprising trees, or in some instances, non-living material;

(b) Erection at right angles to the prevailing wind of obstacles (walls, banks, fences) made of stone, earth or vegetable matter (tree branches or palm fronds). These structures, the height of which is periodically increased, cause sand to accumulate; the sand can then be stabilized by covering it with branches or earth. The operation can be continued by planting species with an extensive root system or by biological fixing of the dunes;

(c) Erection of obstacles at an angle to the wind so as to force it to change direction: this leads to deviation of the sand, which therefore ceases to accumulate;

(d) Placing of large stones on the tops of dunes: this accelerates the wind around the stones, so increasing the lifting force on the sand, which is then carried further away;

(e) Spreading of water on land after ploughing: this stabilizes the fertile components of the soil by increasing soil cohesion;

(f) Building cultivated terraces separated from each other by low stone walls running along the contour lines. The distance between the walls depends on local conditions (rainfall amount, distribution and rate, geology,soil, crop types, etc.). Associated with the terraces are ditches to channel the excess water to gullies serving as natural outlets for it;

(g) In gullies: fixing in place of flat dry stones together with logs and large branches. A simple planting scheme will help to reduce the water velocity;

(h) Use of vegetation to control erosion: the species used are chosen for their rapid growth, high density and well-developed root system.

4.2 Water conservation projects

(a) Construction of ponds, pools and lagoons to collect water during the rainy season for irrigating crops and watering livestock. The structures are made using local materials;

(b) Construction of impoundments on small water courses;

(c) Controlled flooding: a very old technique for conserving water and the soil which is well-suited to desert environments. During the heavy rains, part of the precipitation is absorbed by the ground and some (the proportion varies with the intensity of the precipitation and the characteristics of the soil) runs over the ground surface towards lower-lying areas. This runoff can be directed onto walled plots where its impoundment between the walls promotes infiltration. The land can then be cropped, with good yields. The critical question with this technique is whether the degree of infiltration is adequate for the intended crops;

(d) Cultivation of large areas in order to reduce soil evaporation;

(e) Greenhouse farming with water management;

(f) Construction of watertight clay or tile drains and irrigation channels in order to reduce evaporation;

(g) Construction of "qanats", underground dykes and tunnels for the transfer of subsurface water to the surface by gravity (for agriculture or consumption);

(h) Construction of multi-level "qanats": channels at various depths;

(i) Construction of impoundments for artificial recharge of "qanats";

(j) Use of clay jars for irrigation;

(k) Use of textiles to keep garden soil moist;

(l) Irrigation of hillside terraces by means of channels built by the farmers along the inner edge of each terrace. The water runs along these contour-line channels from the highest to the lowest terrace;

(m) Collection of water on house tops, etc. (installation of tanks)for consumption in the desert or other areas with an inadequate water supply;

(n) Rice-growing based on the use of surface water in the rainy season: berms some 1.5 m high are built to prevent flooding and retain the water.

4.3 Improvement of soil fertility

(a) Use of natural fertilizer: animal or human excrement and decayed plant waste;

(b) In situ manuring: livestock is brought directly onto fields to graze and deposit dung there;

(c) Production and use of compost from plant and household waste. The composting process can be speeded up by the addition of microorganisms;

(d) Production and use of a mixture of animal dung, urine, forest litter and household and agricultural waste, including ash from cooking fires;

(e) Maintenance of soil fertility by green manuring, the manure coming either from natural vegetation or from crops intended for ploughing in;

(f) Use of nitrogen-fixing plants;

(g) Mixing of forest litter directly into the soil;

(h) Mixing of animal carcasses into the soil;

(i) Spreading on the ground, in order to increase soil permeability, of sugar cane ash obtained from sugar refineries;

(j) Spreading of liquid sugar-industry waste. This is suitable for any soil capable of growing sugar cane, but it is also very effective on compacted, saline or eroded soils. It increases both the content of organic matter, especially nitrogen and carbon (a humic substance), thereby improving soil stability, and the bacterial biomass;

(k) Liming to prevent soil erosion and reduce evaporation;

(l) Application of clay (loam) as a mulch to protect the ground surface;

(m) Use of gravel to reduce the risk of soil erosion;

(n) Improvement of the texture of heavy soils by adding sand;

(o) Crop rotation to ensure better management of soil fertility and moisture;

(p) Fallowing in order to maintain soil fertility;

(q) Careful choice of soil-preparation techniques;

(r) Use of multi-bottom ploughs and animal draught power to minimize tillage (for soil preparation and to facilitate crop-growing without inverting soil profiles);

(s) Appropriate soil management: the best example is considered to be the method used by the Jyapu, a Newar community in the Kathmandu valley. Jyapu farmers rarely use livestock, preferring to till the soil with hand tools such as hoes. As manure they use black shale, compost and human nightsoil;

(t) Soil conservation: the traditional "zai" technique employed in Burkina Faso is an intensive technique involving manure management and water-saving. It consists in digging holes in he ground and filling them with manure during the dry season. This attracts termites, which digest the manure; the latter is then more easily taken up by roots and increases soil porosity.

Seeds are sown in the holes. This highly efficient technique enables communities with very limited resources to regenerate even badly degraded soil. When not being used for growing, the holes can provide water storage space.

4.4 Plant protection

(a) Preservation of the natural vegetation: choosing of species to suit micro-climatic conditions; growing of drought and heat-resistant species; growing of salt-resistant species;
(b) Prohibition of grazing: preservation and protection of areas of rangeland, especially in depressions rich in alluvial deposits and forage plants;
(c) Harvesting of spontaneous fodder and burning of land to promote re-growth;
(d) Irrigation of crops in winter to control frost;
(e) Use of birds (e.g., starlings) to control insects (e.g. crickets);
(f) Harvesting outside full-moon periods in order to minimize insect infestation;
(g) Application of ash to plants;
(h) Application of dilute urine to plants and seeds in order to clean them and give them some protection against disease and insects;
(i) Use of common, usually stronger species of plant.

4.5 Forestry

(a) Creation of forests using local species of trees and bushes and planting of fodder trees and bushes;
(b) Creation of nurseries for reforestation and desert pastureland; development of orchards and reforestation in the desert;
(c) Simultaneous planting of sorghum or millet seeds and saplings. The cereals are cut to a height of 50 cm or more so as to protect the saplings, which then benefit from the soil moisture and manure. The high cutting also promotes natural regeneration of all sorts of species, ensuring considerable genetic diversity;
(d) Growing of coffee together with forest species known for providing beneficial shade. Use of the same system to grow cocoa;
(e) Use of clearings for small-plot growing of a variety of vegetables in forests.

4.6 Social structures

(a) There are three types of lifestyle: nomadic, semi-nomadic and sedentary. The distances covered by the population groups who practice them vary widely, entailing differences in management and type of livestock farming and, in the case of semi-nomads and nomads, the presence or otherwise of irrigated agriculture on rivers or lakes. Nomadic herders use their pastureland in a seasonal pattern (transhumance), moving their animals from one zone to another depending on the availability of water and grass. This provides protection against weather risks and prevents the degradation of vegetation;
(b) "Motselo" in Botswana is a form of cooperative and bank involving five to fifteen men and women. Membership of such a group is voluntary and lasts until the end of the loan and borrowing cycle. Each person puts in an agreed sum of money or quantity of seeds or an equivalent amount of work, all of which is then used as well as possible in the light of local knowledge in order to increase the group's monetary wealth. The types of activities supported may include cooking or the brewing and sale of local beer. The cash contributions are used to purchase requisites such as sugar or cooking or brewing equipment, etc. Labour expended in production or marketing is also considered as a capital contribution. All the income is allotted in turn to the members of the "motselo", who then use the money to develop their farms by purchasing equipment or to meet social needs (family celebrations, burial ceremonies, etc.).

The advantages are:

- the structure is simple;
- the funds are turned over rapidly;
- investment is simple and free from conditions, so everyone can afford it;
- the funds and profits go directly to the members;
- very poor people can take part by contributing labour;

(c) Water resources management by local communities or farmers' committees. Their skills and knowledge are passed on from one generation to the next, ensuring that water resources are soundly managed;

(d) Pastureland protection and access control by a community organization that defines rights and roles and enforces sanctions (in connection with pasture management). Knowledge, however, varies from group to group and region to region and depends on local conditions, the responsesto particular problems and the given group's geographical or social isolation. In Nepal, pastureland is managed in accordance with religious beliefs;
(e) Management and control by the local population of access to forest resources;
(f) Development through agriculture of unused floodplains: this can, as in the case of Niger, stabilize the population by increasing food availability. It also introduces a new form of agriculture: the partial replacement of millet, the staple foodstuff, by rice can help to reduce excessive cultivation of millet and prevent desertification;
(g) Use of waste products - from coffee-farming, sugar-refining or sunflower-oil production - as animal feed;
(h) Promotion of Vigna (several varieties) for human and animal consumption: high protein value. The residual matter can be used as green manure;
(i) Storage of cereals and seeds in kitchens, where the carbon monoxide and carbon dioxide prevents their becoming infested with insects.

4.7 Architecture and energies

(a) Protection of structures (houses, equipment sheds, stables, etc.) by siting them outside natural-disaster (flood, storm, etc.) hazard zones;
(b) Building of chimneys in houses to improve ventilation and thereby reduce summer temperatures;
(c) Inclusion in buildings of arches, domes and high ceilings to keep down temperatures;
(d) Insulation of walls with clay or straw to keep out heat or cold;
(e) Construction of basements for their cooling and food-conservation capabilities;
(f) Construction of ice pits in mountainous areas and around towns so as to be able to build up stocks of ice for the summer;
(g) Making of hinged doors and windows and wooden venetian blinds to shield against solar radiation;
(h) Building of dovecotes with a view to using the birds' droppings as a manure supplement;
(i) Building in villages of artificial drainage systems so as to retain some moisture in dry areas;
(j) Use of windmills and water mills; use of solar energy;
(k) Use of briquetted sugar-industry waste as a household energy source (residual crop matter is dried and briquetted);
(l) Use of rice straw as fuel;
(m) Construction using maize or millet stalks, wheat straw, weeds and other waste. This contributes towards keeping villages clean and limiting numbers of rodents and insects.

III. CONCLUSION

5. The reports received by the secretariat differ in origin and content. Some are very detailed, with lengthy explanations; others are very brief and others still address only organizational issues, without commenting on farming techniques. Many reports contain no information or comments either on the overall role of traditional and local technology or on how such technology might be linked to its modern counterpart. Nor is there always information on the participation of nongovernmental and community-based organizations in the gathering of information related to, or the application of traditional and local technology, knowledge, know-how and practices.

6. Bearing in mind the relevant articles of the Convention, the Conference of the Parties might wish to consider recommendations and comments by the Committee on Science and Technology concerning the collation of Parties' and observers' information on traditional and local technology, knowledge, know-how and practices, including guidelines for the UNCCD secretariat on the activity to be undertaken in that connection.

1.3 Synthesis on Important and Widely Applied Traditional Knowledge on a Subregional and Regional Basis and on a National Scale ICCD/COP(3)/CST/2

The formation of artificial sand dunes called afreg in the Sahara Desert. The method exploits the natural principle of dune formation. The dunes originate from the sand transported by the wind that accumulates when it finds an obstacle or a deposit of sand, which stop the grains of sand from bouncing ahead. The figure shows a raw earth cordon which creates the first accumulation of sand on the ground. Then dry palm leaves are progressively laid on the top as the sand dune rises. **Photo: P. Laureano.**

SUMMARY

(i) Different communities have evolved a wide range of traditional technologies through active environmental interactions and empirical experimentation, in their bid to improve living conditions and the quality of life. Technologies recognized in this survey include the following sets of empirical information and packages.

Site amelioration technologies

(ii) Site amelioration practices are perhaps the most basic tools for taming harsh dryland ecosystems. Common practices include:

- Mechanical measures using palisades or grids of straw, or clay-pebble platforms of related local material that are erected between a given property and the sand line,
- Biological measures such as live fences, shelter belts or plantations of woody plants.

Soil and water management

(iii) Techniques of water and soil management are crucial because water deficiency and soil infertility are the major constraints to production in dryland. The common structures are cut-off drains, waterways, terraces and retention ditches, that are built of earth, stones, pebbles or masonry.

(iv) Farmers have developed precise technologies using different structures that are appropriate to given terrains, soils and production systems.

Crop production

(v) Although agricultural production in drylands is limited to pockets of relatively moist areas, dryland farmers have managed to expand their cropping fields through diversification of crop species/varieties and integration of crops with livestock portfolios and other strategies that satisfy their needs for food and income. The major technologies include conservation tillage, nutrient management, incorporation of complex systems such as the agro-pastoral–forestry systems that capitalize on agronomic management through niche diversification, crop complementarity and their mutual support, and opportunities for hedging options.

Water management

(vi) Water resources management practices date back to early times and range from simple catchment and diversion structures to sophisticated underground canals found in North Africa, the Middle East and China, such as Faggaros in North Africa and Karez wells in Pakistan. Groundwater is also tapped through hand-dug wells that extend from riparian areas to depths of over 100 m, on higher ground.

Biomass energy

(vii) Local communities continue to rely on biomass energy from fuelwood and agricultural residues for cooking and heating. Preferences range from wood and charcoal to animal dung, depending on local conditions. Conservation strategies include the development of energy-saving burners.

Animal production

(viii) Animal production dominates land use with pasturage and water management being guided by customary rules. Common technologies include investment in a wide portfolio of animals: cattle, goats, sheep, donkeys, mules and poultry. This is supplemented in some areas with domestication of wild game such as ostriches, and native livestock such as llamas and alpaca in South America. Herd mobility, dispersion, shifting of households, utilization of wildlife and range rehabilitation provide powerful strategies for sustainable pasture use. Notable technologies are specialization in animal health management, water resource use, and fire management.

Forestry

(ix) Woody plants constitute important components of the farming system and play a central role in supporting all aspects of dryland ecosystem functions. Proactive management programmes include tree planting and management of natural vegetation to support food security, as defense lines against sand dunes, protection against dry/cold winds, provision of wood and non-wood products and conservation of biodiversity.

Wildlife resources management

(x) Traditional communities have coexisted with wildlife for millennia. Cultural beliefs in abstinence from wanton killing of wild animals, and regulated hunting or fishing habits are a clear reflection of people who have concern for their environment and biodiversity. Thus the concept of multi-animal management is widely observed and wild animals graze freely in community lands.

Specialist skills

(xi) A number of specialist skills are recognized in areas such as the harvesting of wood and non-wood products, crop knowledge and management including the zoning of agricultural land, and crop species/variety matching with sites using rational environmental indicators. Skills on seed and food storage are particularly impressive. Examples of traditional biotechnology skills in food preservation and fermentation in the production of fermented food such as chicha in South America, and masi by Polynesians of the Solomon Islands are noted.

(xii) Applications of traditional integrated pest management systems and use of indigenous indicators of climatic and weather variations, and site quality are highlighted. The knowledge and application of ethno-medicine for human and livestock diseases management are also acknowledged as areas with potential for future scientific research and development.

Recommendations

(xiii) The great potential of traditional technologies, existing confidence and trust between CBOs and NGOs, and their experiences and understanding of traditional technologies are recognized. The mobilization and promotion of organized participatory approaches to documenting, screening and assessing promising traditional technologies for mainstream sustainable development is recommended. It is stressed that such approaches should be mounted by teams of biological, social scientists, and community partners in networks at different levels, focusing on the documentation, validation and testing of promising practices through modern processes. It is also emphasized that such work should employ standard common methodologies so that results at the national, regional and international levels may be comparable.

(xiv) Parallel activities proposed include training and capacity-building at the community and scientific levels; and research and development on priority scientific, technical, policy and legal issues.

I. INTRODUCTION

1. The arid, semi-arid and dry sub-humid lands of the world, which are affected by drought and desertification, cover about 5.1 million hectares, about one third of the earth's surface (UNEP 1992). This is concentrated in the land surface between latitudes 72o north and 57o south, particularly in Africa and Asia, where large land areas have lost most of their original biotic functions. Unfavourable topographic, edaphic and climatic conditions make drylands ecologically fragile when

subjected to intensive use. Consequently crop production is limited to a few wet areas leaving pastoralism as the main pillar of the economy. The topography and latitude play important roles in the distribution and amounts of rainfall in these areas, causing great variability in the precipitation which comes in the form of rain, snow and water from melting ice.

2. The original natural dryland vegetation varies from scrub, through open grasslands to wooded grasslands that are generally characterized by scattered trees and shrubs interspersed with herbaceous elements, and open spaces between tree canopies which allow a luxuriant growth of graminaceous species and forbs. These plants have evolved diverse drought-resistant traits that enable them to cope with the harsh environment. Droughts and high evapo-transpiration rates are common experiences.

Traditional technologies

3. Traditional and local technical knowledge, know-how and practices, often collectively referred to as traditional technologies represent accumulated cognitive and perceptive experiences of interactions between a group of people, their physical and biological environments, and the production systems. The quality and quantity of traditional knowledge varies among community members, depending on gender, age, social status, intellectual capability and occupation (hunter, spiritual leader, healer, etc.) or trade. Language, religion, bio-physical imperatives, and sociocultural aspects (e.g. tenure and environmental traits) are important driving forces in shaping these pactices.

4. Traditional technologies are dynamic and have built-in mechanisms for innovation and growth of new dimensions according to changing challenges and circumstances. In practice, communities continue to learn from one another, through interactions between neighbours, cross-border marriages, and adaptation of a given culture to new environments following conquest and subsequent domination. Many cultures have also borrowed from modern and scientific developments.

5. But a few strong enclaves of original cultures are still found among nomadic, pastoral and hunter-gatherer communities in corners of nearly all continents, such as the Incaic traditional culture in the Andean world. Remnants of European culture such as the Mennonite culture found in Paraguay, the Welsh in Patagonia and the Italians in Cuyo, have been adopted partially in the new environments, and continue to subsist in the production systems.

6. On the whole, traditional technologies have been ignored by modern development and scientific institutions since the dawn of industrial society. Indeed, a marked erosion of traditional technologies occurred during colonial times and more recently, during the influence of research-driven and concerted global promotion of the green revolution in the 1960s and 1970s. It is only in the past decade that this knowledge has been recognized by the Western scientific community as a valuable source of information. Today, a growing body of literature attests not only to the presence of a vast reservoir of information regarding plant and animal behaviour, nutrition and medicinal potentials of natural products, but also to the existence of effective indigenous strategies for ensuring the sustainable use of natural resources. Consequently many scientists, community-based organizations (CBOs) and non-governmental organizations (NGOs) working with peasants have compiled a large body of traditional technologies associated with different production systems and agrarian typology. But vast quantities of information remain undocumented, while very little validation and appraisal of efficacy and sustainability has been done.

7. Dryland communities have a rich heritage of managing and living in these environments despite heavy erosion of traditional technologies due to different factors. Some of the knowledge lives on, and is evident in extant traditional farming and range management practices throughout the regions. Still more of this knowledge remains locked in the hills, mountains and valleys of the landscapes, awaiting archaeological analysis. Traditional technologies recognized in this survey include sets of empirical information and packages on improving site quality, management of farming systems, animal production, food processing and storage, management of health of man and livestock, water and wildlife resources.

II. SITE AMELIORATION PRACTICES

8. Communities living in open degraded sites and areas affected by sand invasion, such as sandy deserts or desert margins, and seafronts worldwide are constantly threatened by sand invasion, mobile dunes, dust storms and dry winds. The openness of the ground and prevailing high winds in these areas lead to rapid movement of dunes from place to place with concomitant disturbance of residential areas, road and railway networks and agricultural fields.

9. These communities have consequently developed a wide range of mechanical and biological measures, largely through experimentation using available materials and in consistence with prevailing factors for mitigating aeolian effects. These technologies are particularly important because their moderating influences produce amiable and pleasant conditions that are critical for provision of a healthy environment, development of reliable transport systems, increased crop and livestock yields. Land degradation as a consequence of shifting sand dunes has obliterated many civilizations in virtually all continents, in the past.

A. Mechanical measures

10. These have one common feature, operating on the principle of creating a barrier to the wind by producing areas of reduced sand-carrying capacity ahead of and behind the belt. Locally available materials are preferred: straw grids supported with wooden posts, stone walls or terraces and clay/pebble platforms. The palisade or terrace erected on top of a dune on the windward side or in checkerboard patterns such as U, V, or L-shaped configurations along the property or seafront has been used successfully in Africa, the Caribbean, the Middle East, West Asia, China, South America and elsewhere. Ditches or dykes from 50 to 100 metres wide excavated upwind between a property and the sand line also provide efficient defense against dunes.

11. Mulching with brushwood or man-made materials such as plastic, polyfibre, nylon, acrylic netting or other products derived from petroleum have been used where these materials are available, such as by oil companies in the Taklimakan desert of China. Binding the surface by wetting in areas where water is available also minimizes sand movement. Chemical fixation of shifting sand by applying saline water or products such as asphalt is successfully used in China.

B. Biological measures

12. These include establishment of live fences, shelter belts or windbreaks upwind of areas requiring protection from drifting sand. Different configurations of multi-fence belts are used in dryland areas worldwide as an integral component of rehabilitation programmes and/or integrated land-use systems.

13. Shelter belts and windbreaks provide several benefits, such as protection against wind erosion, and sand drifting, sources of fuelwood or poles, wildlife refuge, enhanced aesthetic value and micro-climatic advantages to human beings. They reduce the wind speed and evaporation rates and hence ameliorate the microclimate and increase crop yields.

14. Several communities have instituted dune stabilization programmes which embrace schemes for dune fixation, afforestation and attainment of goods – such as fuelwood – as programme objectives. The size, porosity, morphology and composition of fences vary between places but operate on the same principle of creating a barrier and producing areas of reduced sand-carrying capacity ahead of and behind the vegetation belts. Establishment is contingent on the availability of drought tolerant woody plants and application of suitable planting techniques. Sand binder species with tolerance to hot temperatures, aridity and infertile soils, fast growth, large crowns and well developed root systems have provided good results.

15. Multipurpose fence belts incorporating a combination of perennial herbs mixed with shrubs and trees under arrangements and densities that allow each component to contribute its desirable traits fully is considered advantageous. Woody multipurpose trees and shrubs, if used, provide a supplementary source of forage and fuelwood from pruning and soil improvement. Live fences of proven species may also be established alongside a stabilized mechanical structure. Wood lots of multipurpose trees and shrubs established between the edge of the sand and a given property also fix dunes while providing forage and other utility products.

16. The rehabilitation of saline environments that are common in drylands is also dependent on successful establishment of a vegetative cover. Depending on the site conditions, grasses or trees may be suitable. In severe cases, "pioneer" species are often used to ameliorate the site sufficiently before the more desirable plants can be established.

17. There are many isolated cases of successful application of biological measures. In Bouza in southern Niger, every street is lined with trees, and the town is being encircled by woods. Green belts are being planted around the capital cities of Ouagadougou and Niamey in Burkina Faso and Niger. The Tunisia-Morocco green belt is also noteworthy.

18. Integrated programmes for sand dune fixation on the northern littoral and the protection of adjacent market gardens in Senegal, and regional programmes for sand dune fixation in Mauritania, the State of Rajasthan in India, North Africa, the Middle East, and the former states of the USSR are important landmarks demonstrating the efficacy of road-side shelter belts in protecting road and rail networks. Windbreaks are also of considerable importance where they have been established, on the large plains and windy southern part of South America, such as Patagonia. Sudan is restocking its gum belt, which acts as a barrier to the desert, while Peru has an ambitious programme for the rehabilitation of its Andean sierra.
19. Irrigated agriculture in these countries would be inconceivable without the protection of windbreaks to afford protection from the hot winds and sand dunes. An irrigation project in Tunisia with wooded surrounds has increased agricultural yields many times over. The application of windbreaks for the protection of agricultural crops is highly developed in the drylands of China in order to protect crops from desiccation and physical damage from wind-blown sand and loess.
20. Vast areas of farmland and villages in northern China which had been buried by shifting sands were rehabilitated from the mid 1950s onward through these technologies. In this instance straw barriers were erected at the foot of megadunes and inter-dune depressions, and vegetation belts subsequently established behind the straw checkerboard. Consequently the southward movement of sand dunes was completely controlled and large areas of farmland were brought under effective protection by the shelterbelts.

III. SOIL AND WATER CONSERVATION PRACTICES

21. Prior to the emergence of farming communities in dry zones, these areas were occupied by hunter-gatherers and fishing communities who depended entirely on subsistence under nomadic or semi-nomadic modes. Gathering, hunting and fishing remained paramount for many years. The settlement of farming communities in the drylands marked the introduction of traditional patterns of shifting cultivation in areas amenable to crop production such as forests and riverine belts, introducing a much wider range and variety of land use than their hunter-gatherer and pastoralist neighbours could employ.
22. Slash-and-burn agriculture, one of the first systems of crop production, was efficient and sustainable in the absence of land hunger when the number of people and livestock was low. People understood that it was necessary to leave the land fallow for sufficient time to allow enough tree re-growth to provide sufficient ash and heating of the soil. During colonial times and the emergence of modern states with increased numbers of people and livestock, adequate fallow periods became unachievable. Consequently, the farming communities began to build up complex economic systems and agricultural production systems. But following wide adoption of intensive land use, land degradation became the contentious issue, particularly in drylands.
23. Alarms raised from the 1930s about the potentially damaging consequences of soil erosion prompted a long history of external interventions by governments that enforced mass adoption of traditional soil and water conservation systems. The experience of the "Dust Bowl" in the United States proved highly influential in policy thinking from this time onwards. The prospects of such disasters afflicting the newly established colonies worried many administrators and politicians of the day and major programmes of soil conservation were initiated in countries where state control was strong. The result was the emergence of a set of interventions focused on mechanical and agronomic soil and water conservation technologies.
24. By the late 1940s, a wider environmental awareness had become paramount in framing land-use policy. Soil fertility decline, overgrazing and deforestation were added to the list of ills inflicted on the land by non-sustainable farming and livestock husbandry. Thus the scope of soil conservation in the drylands has remained wide, embracing soil, water, and farm management and addressing enhanced, sustainable soil fertility, and soil-water-plant relationships for sustained crop yields.
25. The water relationships of dry zones are perhaps the most critical for determining the basic life support systems. Techniques of water and soil conservation are crucial because water shortage and soil infertility are often the most important constraints to production. From years of experience, farmers across drylands have built up an intimate understanding of the mechanics of soil and water resources management, and practices for managing different soil types, slopes and production systems. Under this process, the management of watersheds has primarily focused on the conservation of soils and control of surface water derived from the upper reaches, and the subsequent run-off impounded or absorbed in the landscape. On the slopes, technologies aim at minimizing run-off and soil loss and promoting infiltration. In the lowlands and bottomlands, dominated by alluvial plains, the major technologies are concerned with prevention of flash floods and sedimentation, enhancement of recharge of aquifers, water storage, and maintaining and improving soil fertility through good husbandry.
26. In the case of irrigation, proper application of water, prevention of salinity/alkalinity and minimization of sand encroachment are paramount. The most common conservation structures are cut-off drains, waterways, various types of terraces, and retention ditches that are built of earth, stones, pebbles or masonry. With the benefit of hindsight, many farmers, pastoralists and resource managers now clearly see the benefits of soil and water conservation and related practices. Cut-off drains (diversion ditches) and waterways
27. These are graded channels with a supporting ridge or bank on the lower side constructed across a slope to intercept surface run-off and convey it safely to an outlet such as a waterway. They may also be used to protect cultivated land. Such structures are usually trapezoidal in shape and have larger capacities than ordinary terraces. Farmers often introduce a good grass cover (trimmed from time to time) on the embankment and along the upper edge of the bank for stability.

Infiltration (or retention) trenches

28. These are made by excavating affected sites over 30-50 m, backfilling with stones and wood and then covering with soil, to retain run-off. Well planned and managed cut-off drains, waterways and infiltration trenches are commonly used by peasant farmers in sub-humid land areas.

Terraces

29. Different types of terraces ranging from rudimentary stone lines to sophisticated terracing are built mainly to conserve the soil and stabilize steep land, while providing level areas for sustained cropping. At a rudimentary level, lines of stones are laid out in parallel or along a grid pattern on compacted, denuded land. In this situation the stone bunds present a semi-permeable barrier which allows the passage of excess run-off while trapping sediments. The level of sophistication is greatest where the process of leveling behind the bunds is accomplished by deliberate landscaping. In some cases the process of cultivation leads to the natural formation of benches over time.
30. Terracing is widely used in dry farming on hillsides and in irrigated farming in suitable areas. Some practices involve systems of intense and permanent cultivation on hills, using terraces protected by storm drains and with woody plants and grass planted on ridges along the contour that date from early times. In most cases, farmers maintain pre-existing trees and shrubs on undisturbed parts of a slope or by adjusting terrace design and construction. Such terraces established by sedentary farmers in the Kainam hills south-west of Lake Manyara, United Republic of Tanzania, in the late 18 century, are still well conserved after almost 200 years of cultivation, and feed a large, growing population.
31. Bench terraces comprising a series of more or less horizontal steps cut along the contours, with the excavated material placed on the outside of the cut and embankment so that the cuts and fills create level platforms for cultivation are widely applied in crop lands. Where soils are readily erodible, fairly level benches may develop between the trenches in two to six years. Woody plants and fodder grasses are often planted on the risers where the soil is the deepest and most fertile. When covered with vegetation, the ridges catch eroding soil which helps to build them up further and create substantial flat areas behind them. The natural process of water carrying sediment is strengthened by planted vegetation.
32. The construction of bench terraces with stone walls is justified where stones can be found in adequate quantities close to the site, and the potential productivity of the land justifies the expense. The construction of stone wall terraces at intervals on the contour not only protects the land from erosion but simultaneously clears stones, which facilitates cultivation and increases crop production.
33. Besides protecting and improving the existing cropping system, terraces provide new planting niches with favourable conditions for speciality crops or for establishing valuable trees. For example, farmers may plant fruit and nut trees along the toe of terrace rises and thereby allow the successful establishment of tree crops that would otherwise be unable to survive under dry conditions. Bench terraces are found in all the three continents where farmers find them appropriate.
34. Examples of stone bunding and terracing on hillsides occur on the Jos Plateau in Nigeria, and

in several regions of Ethiopia, Sierra Leone, the Sahelian countries, Rwanda, Yemen, different regions of China, North Africa particularly Tunisia, Algeria and Morocco, the Middle East, etc.

IV. AGRICULTURAL PRACTICES

35. A relatively small portion of drylands is amenable to rain-fed crop production. The harsh climatic conditions make crop production a risky undertaking, leaving pastoralism as the mainstay of the economy. Currently agricultural production is limited to pockets of relatively wet areas where crop production is possible under rain-fed conditions, in irrigated and wetland areas, and under water harvesting systems.

36. Traditional farming systems are characterized by diverse varieties and species of crops and domestic animals, with higher proportions of indigenous species and varieties or breeds. The living mode itself is based on the use of a vast number of domesticated and wild taxa. Indigenous perceptions of biodiversity are evident in social values, beliefs and practices that sometimes make reference to the importance of biodiversity, including reverence for such biological units as forests, trees and some animals.

37. Dryland communities have, through different epochs and civilizations, learned and accumulated precise technologies for managing their resources. Traditional technologies have assured sustainable crop production through minimizing soil erosion by water and wind and improving productivity through appropriate practices that were consistent with biophysical features such as the slope, microclimate, and soil characteristics. This understanding continues to guide the farmer as to where a crop should be grown, what crop is to be cultivated, and how the fertility of the soil is to be maintained. Farmers use such traditional knowledge in recognizing different soil types, and site potentials for growing different crops. For instance, in the Sahel farmers limit cultivation to north-west facing slopes, where the soil remains moist for long, and the plateau on the cloud belts. The ability of the soil to support a good crop and increased production depends on the soil type, and how the soil is treated and managed. Peasants have evolved efficient methods of land preparation and agronomic practices appropriate to specific soil types, rainfall regimes and crops. These include tillage practices, nutrient and moisture management and cropping systems.

A. Conservation Tillage

38. Conservation tillage, also often called minimum tillage, is an approach that has become popular with mechanized farmers in the last 30 years in areas that are subject to drought or erosion. But this practice has been widely used by farmers since the dawn of agriculture. Conservation tillage systems involve:

- Improving soil structure;
- Reducing the amount of soil inverted during cultivation;
- Leaving residues on the surface;
- Disturbing the soil no more than required to promote infiltration of water and germination of seeds;
- Reducing the cost of cultivation.

The following systems of conservation tillage have been well developed by small-scale dryland farmers:

Slash-and-burn agriculture

39. Slash-and-burn or shifting cultivation is one of the traditional cropping systems. In early times, clearing of the bushland with hand axes and hoes was limited to removing branches of trees, leaving tree stumps to regrow (coppice). The surrounding field was cleared of grass, most of the organic material burnt and the residual material including ashes spread over the field. Local variations were developed to suit different conditions. The cleared area varied from small patches, such as a circle around prominent trees (the Chitemene system practiced in central Africa) to open patches in the woodlands. Shifting cultivation was also practiced in non-wooded areas along the desert margins, when the cultivated field became degraded due to loss of nutrients or salinization.

40. Slash-and-burn agriculture was efficient and sustainable when human and livestock populations were low. Burning leaves a clean seedbed in which crops are planted directly without disturbing the soil. The ash fertilizes the soil and the heating destroys weeds and soil-borne pests and diseases. The garden, also known as swidden fields, was cultivated for one to three years. In the past, the land could be given up to 20-30 years to recover, hence assuring sustainability. But today, with increased numbers of people and livestock, adequate fallow periods are not possible and the trees do not have enough time to regenerate. Slash-and-burn agriculture is still practiced in developing countries but the fallow period has been shortened to eight years or less in the Sudan and elsewhere and the large circles have shrunk with declining tree resources.

Hand hoeing

41. This is the main tillage technique used by the majority of small-scale farmers who do not have oxen. The seedbed is dug to a depth of about 20 cm. Large clods are obtained and the surface is rough. The technique does not spoil the soil structure and it encourages high infiltration of water into the soil. Another hand hoeing may be required before planting to remove grass weeds and a further hoeing is normally done at weeding time.

Ploughing and harrowing

42. These are conventional tillage methods that involve primary and secondary cultivation by ox-drawn implements. The ploughing and harrowing operations depend on the type of seedbed required. Small grains require a fine tilth, which is obtained by harrowing after ploughing. Large grains can do with a much rougher seedbed. A rough surface with clods improves infiltration and minimizes the risk of erosion. Ploughs range from the simple chisel type to the mould board type.

Stubble mulch tillage and trash farming

43. This involves chopping crop residues and spreading them on the surface. Cultivation is usually done with a sharp implement such as a chisel plough. Another technique that is similar to stubble-mulch tillage is trash farming. The technique entails harvesting the standing crop, then cutting and spreading the crop residues on the surface then ploughing and cultivating in the normal manner. A certain amount of residue remains on the surface, thereby promoting soil and water conservation.

B. Nutrient Management

44. Experience has shown that repeated cultivation without fertilization reduces the content of nitrogen, carbon and exchangeable cations to low levels. Even long fallowing under grazing fails to restore soil nutrients to the levels found on uncultivated land. Fertility management is therefore critically important for the sustainability of arable farming. Dryland farmers practice different soil improvement options: inorganic fertilizers, boma (farmyard) manure, alternative organic sources (compost, mulches, green manure), and use of nitrogen-fixing legumes as inter-crops, crop rotations or farm trees. Except for the use of nitrogen fertilizers on profitable crops, manure has been the mainstay of soil improvement efforts since the 1930s and 1940s, when it acquired a commercial value. Adoption is widespread. However, supply constraints (number of livestock or working capital available) restrict its application on most farms to levels well below those desired for optimal nutrient supply.

Farmyard manure

45. This is available on most farms where there are livestock but the quality is often low due to poor methods of preparation and utilization. Some farmers in dry areas have been reluctant to use manure because of the risk of burning the crop if the weather is dry. But many farmers have realized that this problem can be overcome by using more bedding to increase the quantity but lower the strength of the manure, as it matures after removing it from the boma, or using it together with crop residues and other materials to make compost.

Compost

46. Composting is a natural process of turning organic material into a valuable plant food called humus. Humus is a blackish substance which gives a dark colour to the topsoil. It is a complex colloid preserved by tannins that break down relatively slowly. The material has a sponge-like capacity to retain water and cements soil particles together to give a crumb-like structure. When properly made and applied, compost provides readily available plant food and does not contain as many weed seeds and pests as farmyard manure, because of the heat generated. Compost manure can easily be made on the farm using crop residues, garden weeds, kitchen and household wastes, hedge cuttings and any other vegetative material.

47. Composting offers an additional avenue for nutrient management and by combining manure with plant materials, it can double the supply of organic materials available. It was first promoted by missionaries in the 1930s, but did not become popular then. Recently, it has been taken up again by NGOs promoting organic farming.

Green manuring

48. Green manuring is the practice of growing a crop, usually a legume, and ploughing it under when the crop is young and green or at the flowering stage. Small-scale farmers do not usually find it profitable to grow a crop and then plough it under, considering this to be costly, and seem to prefer other types of manure. However some annual legumes such as Crotolaria ochraleuca, are advantageously used for this purpose in central and southern Africa. Such nitrogen-fixing legumes are also inter-planted with cereals such as maize. After the maize is harvested, it provides forage for livestock, which in turn produces manure for enhanced fertility. In this way a whole season's harvest is not lost through green manuring. A closely related species, Crotolaria juncea (sun hemp), is also widely used for this purpose in Zambia and Zimbabwe.

49. Another legume which is excellent at fixing nitrogen and has given good results in Central America, Indonesia, Kenya and Zambia under green manuring and fodder is the belvet bean (Mucuna sp.). The lupin (Lupinus albus), also a legume, suited to cooler climates around 2000 m above sea level, is commonly grown by smallscale farmers in the African highlands.

Mulching and use of crop residues

50. Dead plant material such as dry grass, straw, maize stalks, dry leaves, banana leaves, sugarcane trash and other crop residues that are spread on the bare soil surface or placed around the stems of plants can be used to control soil erosion and conserve moisture. The mulch protects the soil from surface sealing, holds water and allows it to infiltrate slowly into the soil.

51. Besides helping to control erosion, mulches also reduce water loss through evaporation, improve water retention, increase the number and activity of microorganisms in the topsoil, and suppress weeds. An experiment in Laikipia, Kenya, under semi-arid to sub-humid conditions showed that, in the absence of a mulch, 40-60 per cent of the rain that fell was lost as evaporation from the ground. If 40-50 per cent of the ground surface was covered with a mulch, run-off losses were reduced almost to zero and evaporation losses were halved. The result was a doubling or tripling of maize yields and a major increase in the yield of stover, part of which could be fed to livestock and part kept for mulch in the following season. Mulches also tend to lower the soil temperatures during the day and reduce heat losses during the night.

Optimization of the crop residue and woody plants

52. With the gradual onset of settled living followed by a diminution of the grazing area, the dynamics of the indigenous innovations have entered a cycle embracing the use of the crop residue in which the animal is allowed to consume a small portion in the field, while the rest is transported using draught power close to the living quarters and skillfully piled singly or mixed with other agricultural wastes such as bean husks. Such concentrated feed stock is fed to milking cows or draught animals.

53. The level of use of crop residues indicates the level of scarcity of animal feedstuffs. Hence this technology allows farmers to raise the carrying capacity of their land through a process of recycling.

Land fallowing

54. In this system, which was also introduced through early missionary and government intervention, farmers cultivate the land for three to eight years and allow it to rest for two to four years. This practice is basically akin to shifting cultivation, is low-input and familiar to local communities. But the shortage of agricultural land has tended to work against this technology.

Relay cropping

55. Relay cropping is the practice of planting a second crop as an inter-crop after the first crop has reached its reproductive stage, or after a certain amount of growth, but before it is ready for harvest. In areas where maize is grown during the short and long rains, relay cropping is practiced at the start of the second season to avoid delay in planting. This method provides soil cover all the year round because when the field is prepared for planting the second crop, cover is still provided by the first crop. Similarly when the first crop is harvested, the second crop takes over immediately to protect the soil from the raindrop impact and excessive heat of the sun. Work done by the International Council for Research in Agroforestry (ICRAF) in Chipata, Zambia, has demonstrated marked increases in maize yields under Sesbania relay fallows (ICRAF 1996).

Nurse cropping

56. The practice of inter-cropping a newly established perennial crop with an annual crop, to increase production and maintain a good ground cover, is common with peasant farmers. Once the main crop is capable of providing the required ground cover, the nurse is discontinued. Farmers in East Africa always inter-plant millet with sesame. Nurse cropping is also practiced in afforestation programmes under the taungya system, whereby annual crops are inter-planted with trees for a few years until the trees reach a level at which they cannot be smothered by weeds. The young tree seedlings are given the necessary care during crop cultivation, leading to high rates of seedling survival and establishment.

Cover cropping

57. Cover cropping is a practice used to provide the cultivated ground with protection from erosion by raindrop splash and overland flow. The cover crop also protects the soil from excessive heat from the sun and creates a good environment for micro-organisms. The fallen leaves of the cover crop decompose and add organic matter to the soil, thereby reducing its erodibility.
A quick-growing crop, such as sunflower, can be used as a cover crop, but because of the cost involved, most farmers would expect to harvest seed before ploughing it in.

Crop rotation

58. Subject to land availability farmers practice crop rotation, a land-use practice that simulates nature, introduced by early missionaries and government extension services. The practice of crop rotation entails growing different crops in sequence. Crops vary in their nutrient demands, susceptibility to pests and diseases and ability to cope with erosion. A good system of crop rotation facilitates restoration of the soil structure and fertility, the controls erosion and reduces pests and diseases. Certain weeds such as Striga, can be controlled or limited by crop rotation. On many small-scale farms, cereals are rotated with pulses, root crops and occasionally grass. Grain crops are relayed after two to three years of each, followed by a legume crop such as beans, groundnuts or sunflower. It has since been tried by virtually all communities practicing crop farming in drylands. Some Brazilian communities practice rotations between crop and livestock production.

Strip cropping

59. Strip cropping is the practice of growing alternate strips of different crops in the same field. The practice, which is also called contour strip cropping when contours are employed, can be used to control water and wind erosion. For controlling water erosion, the strips are always on the contour but in areas prone to wind erosion, they may be placed perpendicular to the direction of the prevailing wind.

60. A fallow strip comprising a narrow band of grass usually about 0.5-1 m wide and spaced at normal terrace spacing which depends mainly on the slope planted to a fodder grass such as Napier or left unploughed with natural grasses. Grass strips are often allowed to develop a thick basal growth to slow down run-off and retain eroded soil material. Hedges also serve as barriers but they are inclined to be gappy at the bottom and are most effective when combined with a narrow strip of grass on the upper side. As run-off is usually only a few centimetres deep, it is most important that the grass strip is dense at ground level and without gaps. Direct grazing of grass strips is avoided. Such grass strips may over time lead to the formation of terraces, mainly because of deposition on the upper side, but also because of the practice of pulling soil away from the lower side of the strip during weeding.

61. Although most grass strips are established on a permanent basis, some farmers tend to plant them on a rotational basis. After a few years new strips are established between the old ones and the latter are uprooted. In this way the productivity of the strips is maintained and the benefit of increased organic matter is distributed more widely.

62. In general, close-growing crops such as grass are alternated with strips of wider spaced row crops such as maize. When water flowing from the crop reaches a strip of grass, its speed is reduced and silt is deposited. Contour strip cropping combined with crop rotations, the use of manures and fertilizers, and minimum tillage is an effective method of soil and water conservation.

Trash-lines

63. Trash-lines are constructed by laying plant residues or trash in lines along the contour. Trash-lines help slow down the flow of run-off and trap eroded soil. The trapped soil assists in building up bench terraces over time but only if the trash-lines are kept in the same place from year to year. On very steep land, farmers sometimes put in pegs on the lower side to prevent the trash-lines being wasted away. They also combine trash-lines with grass strips.

Contour ridging

64. Contour ridging is commonly practiced for growing potatoes or other low crops. The ridges are constructed across the slope. Ridging is often done during weeding. The crop is earthed up to increase room for the formation of tubers. The spaces between the ridges form depressions or furrows in which rainwater collects and infiltrates into the soil. Contour ridging can be done by hand, or by ox-drawn or tractor-drawn implements. For small fields, hand ridging is the better option, while large fields require animal or tractor power. Contour ridging can be very effective at preventing run-off from small storms, but during heavy storms water tends to collect at the low points and can break through.

Mound cultivation

65. Mound cultivation is another successful traditional farming method practiced by dryland farmers. It involves incorporating grass into the soil so that it rots and fertilizes the soil. This method has the advantage of allowing people to settle and work the same land for a long time. It is also practiced in fields susceptible to temporary water-logging.

C. Multi-cropping systems

66. Dryland farmers practice different cropping systems according to site technology compatibility and potential gains to the farmer. Trees maintained under parklands or agroforestry systems support self-sustainability by providing products such as fruits, leaves and roots for daily use or as emergency food, energy in the form of fuelwood and charcoal, wood for building and farm implements, poles and posts, medicine for both people and livestock, fibre and other material for handicrafts, fodder for livestock, bee forage and beehives, material for thatching and mulch, etc. They can also provide a variety of services such as shade and shelter, boundary marking, windbreak, erosion control, soil fertility improvement (acting as nutrient pumps), environmental protection, restoration of degraded areas, micro-climate improvement, employment opportunities and income generation. The following systems are commonly practiced.

Parkland

67. The parkland system, characterized by mature trees dispersed in croplands, is probably the leading agricultural land-use system in sub-Saharan Africa and other tropical countries. The ability of parklands, or multi-tiered systems, to enhance and stabilize crop production has been much studied over the past 20 years, particularly the Faidherbia albida/Prosopis grain systems predominating in the Sahelian zone and in some parts of East Africa and Prosopis and/or other woody legumes or grain in Asia and South America. The increases in yields under this system range as high as 100 per cent compared with crops grown away from the trees (CTFT, 1988).

Agroforestry

68. Agroforestry is defined as any land-use practice that involves the deliberate retention, introduction and management of trees or shrubs in agricultural systems, where ecological, economic or social benefits result from interaction between agriculture and/or livestock and tree husbandry. This involves raising crops or animals among trees especially managed as a way to conserve the soil and improve crop yields.

69. Trees may be grown with crops or in pastures at the same time and in the same field or at the same time in adjoining fields, or at different times in a variety of ways such as:

- In cropland, either scattered or planted in lines;
- Along boundaries, paths and roads or as live fences;
- Along soil conservation structures;
- For windbreaks;
- Around homesteads for shade or beauty;
- In fruit orchards and home gardens;
- For improved fallows using nitrogen-fixing species;
- In small wood lots for poles and fuelwood;
- In cropland or pasture land for fodder or browse;
- For gully reclamation and stream-bank stabilization.

70. In practice, farmers apply agroforestry technologies that they have refined in their own fields. The most outstanding of these include: multi-strata home gardens, live fences and hedges along residences, wind belts in fields and plots, hedges along terraces, inter-cropping, mulching, fodder banks, wood lots, parklands, etc.

Inter-cropping

71. Despite the strong campaign for promoting the packages of the green revolution under a strong drive for decentralization, individualization and monocropping, the majority of small-scale farmers have continued to practice intercropping. In the Sudan, millet and sorghum are inter-cropped with sesame in the same hole to serve as windbreaks. Wind erosion is a major constraint to sesame production in the area, and farmers have found that inter-cropping with sorghum helps guard against wind damage.

72. Inter-cropping (also referred to as mixed cropping) refers to the growing of two or more crops (companion crops) simultaneously in the same field in the same season. Leguminous and non-leguminous crops are commonly inter-cropped. Production is intensified in both time and space and the farmer spreads the labour requirements for the different crops throughout the year. Inter-cropping ensures the spread of risks should one crop fail, and enhances food security for the farmer. Common examples of inter-cropping are maize with beans, peas, groundnuts, cowpeas, pigeon peas or sweet potatoes, cotton with beans, and kales with beans.

73. Fast-growing legumes, such as beans and cowpeas, provide soil cover early in the season before maize or cotton develops and adequate canopy to shield the soil from the impact of raindrops. When maize, beans and pigeon peas are grown together, the beans provide soil cover through the dry season and into the next rainy season. Leguminous crops fix nitrogen and make it available to other crops, either through leaf fall or root exudate. This transfer of nitrogen helps to maintain fertility and crop yields.

74. The idea behind inter-cropping is that different crops are grown in one field to ensure that some output can be obtained from the field. Should drought conditions or pests adversely affect one crop, the other crops might produce some yield. Under conditions of limited resources and erratic rainfall, inter-cropping enjoys wide appeal. In the event of rain failure, a single crop would spell disaster to a whole household. Moreover, because many farmers cannot afford to expand their cultivation through land clearing, they grow several crops on the same field to take advantage of the limited area they have cultivated.

75. Intense inter-cropping is particularly prominent in the home gardens. Fertility is maintained by use of organic manure, crop residues and household refuse. This practice also helps cut down weeding costs since several crops are weeded at once when they are in the same field. The dense cover during the cropping season greatly minimizes erosion while enhancing nutrient management by capturing the full nutritive contents of the harvest.

Multi-storey cropping

76. The practice of growing tall and short crops simultaneously in the same field is known as multi-storey cropping. Often multi-purpose trees form the top canopy, followed by moderate-sized crops such as bananas, coffee, beans and vegetables. Each of the different crops grows to a different height. The deep-rooted crops draw water and nutrients from the lower horizons of the soil. They shed leaves and twigs, which provide mulch. Mulch adds organic matter to the soil, prevents excessive evaporation and encourages microbial activity. This benefits shallow-rooted crops that utilize the recycled nutrients, moisture and improved soil aeration. The system is almost self sustaining; it requires very little external input, and soil erosion is minimized. However, it is only suitable for areas with moderate to good rainfall.

Alley cropping

77. This practice involves growing annual or biannual crops between rows of leguminous trees and shrubs. The shrubs fix nitrogen and make it available to crops. The legumes can also be cut down and the green biomass buried in the soil to provide nitrogen and other plant nutrients, or fed to livestock. Experiments show that alley cropping enhances soil structure, fertility and productivity but it has not yet been widely adopted because of the work involved in maintaining the shrubs and the risk of competition with the food crop when rains are poor.

V. WATER MANAGEMENT TECHNIQUES AND PRACTICES

78. Dry zones are characterized by deficient and erratic rainfall. Water is generally scarce and underground water, where available, is exceedingly brackish with very few pockets of sweet water for drinking. Droughts, which can last for up to three to five years, resulting in much distress to the

population and animals, are a common phenomena. At such times people and livestock are forced to travel over long distances in search of water. The major driving force to establish authentic technologies for water harvesting and management is influenced by the need to provide all seasonal supply for domestic and livestock consumption, and to irrigate small fields.

79. Thus land use and economic activities in drylands are strongly influenced by the availability and distribution of water resources. To a large extent, their inadequacy is the main limitation to sustainable development. Water is not always readily available to all communities, except during the rainy season. During the dry season, water becomes scarce and may only be found in water bodies such as lakes, rivers, reservoirs, and various pristine areas, and in maintained wells and boreholes. Marshy areas also constitute important water bodies supporting many people and animals for at least a part of the year. Marshes also provide natural sinks an important water-purification function, absorbing wastes from contaminated water.

80. Experience in the dry zones under review shows a great deal of commonality in approaches to soil conservation and water management. But the finer detail of water collection techniques varies from region to region according to the nature of the countryside, namely topography, importance of wetness or aridity, nature of soils and the usage of collected water. The main technologies for water harvesting and conservation, detention, dispersion and diversion structures and/or their modifications are found in virtually all dryland areas.

81. The story of conservation and water management can be traced back to the dawn of human civilization. For example, researchers have found signs of early water harvesting facilities believed to date from over 9000 years ago in the Edom mountains of southern Jordan (Bruins et al., 1986). These monumental achievements comprised integrated approaches to soil, water and farm management, in which all physical soil conservation practices contributed toward the overall targets of improving and maintaining soil fertility and soil-water-plant relationships, and subsequently, the attainment of sustainable and productive agriculture.

82. It can be calculated that 1 mm of rain represents 10,000 litres (10 m_) of water per hectare. Although this would not have any effect on biological productivity in a hectare of land, if such a millimetre is collected and stocked, it can be used for domestic needs, plant cultivation, and for livestock use.

83. In addition to the soil and water conservation practices already discussed, the following are among the common water collection techniques in drylands.

Roof catchment

84. This technique was popularized by early European influence and currently provides reliable results when used on tin or tile-roofed houses with maintained gutters. Tanks are constructed using natural stones, cement blocks, ferro-cement or reinforced concrete. They range in capacity from 100-200 litres, to large structures of 200–500 m_ built with stone masonry. But the use of small water jars (13-50 m_) or metal drums is also common. Development projects and NGOs have been promoting reinforced concrete and ferro-cement tanks of about 2–46 m_ in schools and community centres. For example, a roof of 120 sq.m in an area of 300 mm annual precipitation will yield approximately 45,500 litres of water annually (Khan et al., 1988).

Rock catchment

85. In rock catchment, rainfall on exposed rock or a hardened raised surface is collected and directed through gutters into a reservoir, with a capacity of about 8000 m_. Materials generally used for surface hardening are plastic sheeting, butyl rubber, metal foil, etc. But the most effective and economical treatment being used for rain water harvesting is the application of mud plaster (soil and wheat straw), which can yield an average maximum run-off of 78.14 per cent of the total rainfall received by the catchment plot. Rock catchments are useful where the right conditions exist but have inherent problems including:

- Low water quality due to open reservoir;
- Difficulty in keeping the catchment area clean and free of vegetation or silt;
- Difficulties in waterproofing and sealing the reservoir; and
- High evaporation losses from the reservoir surface.

Ground and road catchments

86. In this system, the ground is cleared of the vegetation to induce increased surface flow or road run-off and the water is subsequently diverted into underground tanks or ponds. Such tanks are

excavated and lined with concrete, stone masonry, ferro-cement or murram. The major problem with this technique is low water quality because run-off causes erosion and the water carries a large amount of clay, silt and organic debris. Thus periodical maintenance and de-silting is necessary. This system is suited to watering crops and livestock.

Sub-surface dams

87. Sub-surface dams consist of sub-surface vertical barriers across the river bottom established to intercept water flowing within the alluvium as well as part of surface floods. The water is collected in the sub-surface reservoir created by the barrier. Evaporation losses are minimal, and expensive spillways are avoided, as peak discharges flow down the stream channel undisturbed. The problem with subsurface dams is the limited space and the need for a secure foundation and waterproofing of the barrier. Water quantity is better than from open surface reservoirs, since it is less accessible to contamination. Deflection dams and gravity canals have also been observed in the very ancient urban settlements of Jawa (3200 BC) in the North East of Jordan. These communities had pioneered hydraulic technology, soil and moisture conservation technologies especially the well-known stone mounds that had served as "stone mulch" and "air wells" protecting the surface soil from excessive heating and drying. These technologies had supported vines growing in these arid environments in the region.

Desert sand tanks

88. Low rainfall coupled with extreme heat make it necessary to conserve water in some sort of concealed water tanks in arid and desert areas. A unique type of reservoir called the 'desert sand tank' was introduced more than a century ago and is still being used in some areas of the Middle East and Pakistan. A sand tank consists of a dam or other impervious structure built across a stream bed or large desert "sand wash", preferably at a place where there is a rock outcrop. The dam is firmly bound to the bed rock and canal walls. In this way, evaporation losses are very much reduced and water is kept for a longer time free of contamination from animals and insects, since it lies in a relatively deep bed of sand. Such dams may be privately or communally owned. In North Africa, such dams support irrigation in regions where surrounding mountains supply abundant water.

Detention structures

89. These are built of locally available materials such as soil, gravel, stone, boulders, and roots. The purpose is to slow down and retain flood water as well as to heal gullies. The detention structures are suitable for water detention in relatively deep wadis with gullied sides. Such structures are therefore site specific and require a considerable amount of stones and haulage of construction material.

Diversion structures

90. These structures are designed to divert flood flows partially through a channel other than the main course of the wadis in order to benefit additional areas from the detention site through dispersion of flood water. This technology is found in the very ancient human settlements in the Middle East and West Asia. Diversion structures may be led to large individual community ponds or dams for longer-term storage, a practice that is common throughout the drylands of sub-Saharan Africa.

Dispersion structures

91. Dispersion structures are overflow structures designed to spread flood water over larger areas in the flood plain. They are low-level structures (2-4 m high) constructed of gabions extending across a portion of the alluvial plain. The dams are located at raised sites, and flood flow is caused to disperse over large areas of the flood plain, without allowing back flooding of upstream communities. The result is an increased amount of water flowing into the alluvium outside the banks of the normal channel. These structures are found in areas where big rivers traverse dryland plains, such as the Nile valley, where farmers synchronize planting with flood recession and the subsequent rains.

92. The rainy season brings river flooding, covering huge flood plains with biomass, water, silt and nutrients. This regular flooding gives rise to localized areas of nutritious grassland for grazing of wildlife and livestock, and also provides the basis for flood plain agriculture.

93. Water spreading and infiltration may be aided by permeable bunds (ridges) which follow the contour lines. The bunds, which are made of soil, stones, bundled sticks, crop residues or living fences, are used to channel run-off into a depression, a seasonal streambed, or agricultural fields. The silt accumulates at the dam entry and builds terraces which are used for agriculture, while the

infiltrated water makes crop production possible.
94. In some situations fish also follow the water and nutrients, breeding and feeding in the flood plain. The fish spawn and the fingerlings grow before they return to the rivers, while insects found in the flood plains provide food for the small fish. Flood plains are thus very productive environments.
95. Run-off trapped in diversion or dispersion structures may also be stored in underground storage systems such as water pools whose surfaces are lined with stone and mud or subsoil water reservoirs found in central Gansu Province, China.

Underground canals
96. Drought in areas below mountain ranges is traditionally mitigated by the construction of deep tunnels dug into the hillside wherever base flow is detected. The tunnels may extend over a wide area of farm lands to living settlements. Aquifers in these areas benefit from run-off from the mountains. In sub-temperate areas and areas close to ice-capped mountains such as Mt. Kilimanjaro, the catchments benefit from melting ice during the warm or hot seasons or in spring time.
97. The canals called Qanat in Iran, Faggaros in North Africa and Cyprus, Aflaj in Oman, Karez wells in Pakistan and Magara in Jordan may extend for several hundred metres and serve to capture groundwater mainly for drinking purposes and to a lesser extent for irrigation. This technique is well established in almost all old cities in the Middle East, China and elsewhere, and is effective in preserving water from excessive evaporation, especially in the hot summer times.
98. As a strategy for protecting water from evapotranspiration, local residents engaged in crop cultivation in Turpan, China, have recently dug canals on the alluvial fans from the foothill to the depression, covering a long stretch with wells located every 100-200 metres. The density of the wells is designed according to the frequency of irrigation and the extent of irrigated farmland.
99. Similar channels are used for water transport on the Peruvian coast in South America. Deflection dams and gravity canals developed by the Nabataeans around 3200 B.C. (Helms 1981) in the ancient sites of Jawa, an urban settlement located in the north-east of Jordan, are living relics of man's age-old battle with drought. Structurally, the entire water scheme at Jawa is a matter of earth and stone. The low soil infiltration rate makes it an ideal fill for deflection past a series of irrigable fields to a sluice gate, where some flows into an underground cistern. The main canal continues to another sluice gate where it divides to serve the town's drinking water containers then passing into a field. Similar structures have been reported from the Negev in Israel, where it was extended into irrigation fields.
100. Karez wells are ancient systems of water management that are common in the arid highlands of Balochistan in Pakistan. In this case, water is taken from its original source, generally a spring, to low-lying areas for human and animal consumption. It flows through an underground canal (2 to 2.5 m deep) dug with intermittent openings to the surface spaced out at suitable intervals, to serve communities along the route over which the main channel passes, as it traverses several kilometres of settled area, before coming to a final outlet. This system is still widely used in Balochistan for irrigation of fruits and vegetables, etc.

Nabataean dams
101. The Nabataean wadi barrier differs from the modern examples in being constructed of large boulders rather than of earth or small stones. Clearing and terracing of slopes was a method used by the Nabataeans along with most other Near Eastern peoples. The technique aims at improving and protecting arable land on such terrains. In addition, the terraces help prevent water from running off the slopes following rainfall, thus increasing moisture storage in the soil profile.
102. One dam is 10.66 m long x 4.36 m wide x 3.65 m high, beautifully constructed and located in a small canyon just south of Humayma. The dam was built of blocks of limestone set in mortar in a head-and-stretcher arrangement and recharged by an aqueduct, the most remarkable surviving example of Nabataean hydraulic technology so far reported anywhere. The main line extends from an elevation of 1,425 m for 18.9 km to the Nabataean reservoir at the north end of the habitation centre, at 955 m above sea level. The aqueduct consists of a heavy rubble foundation wall 0.8 m across, carrying long stone conduit blocks framed by rubble packing set in mortar. Untrimmed but for the most part, flat, slabs of limestone were laid over the top, covering the water course. This roofing was designed to protect the water from excessive evaporation, contamination, obstruction by falling debris, and possibly from unauthorized diversions.

Shallow wells
103. Shallow wells are fed by the recharge from surface water and rain that filters into the ground until it reaches the base-rock where it sits in spaces in the soil or in porous and fractured rock as aquifers. Groundwater is very important all the year round throughout the regions, particularly during the dry season. The depth at which water is found ranges from 30 m to over 100 m. Water quality varies greatly, especially the level of dissolved solids that make water salty, but groundwater is protected from evaporation, so much less water is lost than from reservoirs, and it is more reliable. Hand-dug wells are one of the oldest means of water supply. They began as simple water holes in sand rivers, but the concept of finding water by digging in riparian areas has since spread away from the river course itself, reaching up to 100 m in depth.
104. Wells dug by hand may be helicoidal in shape and wider at the bottom, with narrow platforms at various depths to enable the drawers of water to pass the buckets from hand to hand to the surface, or they may be more or less vertical, with the water being drawn off by buckets on ropes, or with hand pumps.
105. Improvements in well-digging techniques are mainly aimed at making the work easier and safer, and at the same time improving the sanitary integrity of the well to prevent pollution. Any water-lifting technique involving the introduction into the well of ropes and buckets calls for care because contamination will create a possible source of unhealthy pollution. More sophisticated lifting devices such as hand pumps have been installed by some villagers, who have been trained in pump operation and maintenance.
106. The water may also be drawn up from the well by draught animals such as bulls, donkeys or camels. A rope is passed through a pulley, one end being fastened to a bucket and the other end harnessed to the animal, with two operators, one unloading the bucket and the other taking care of the animal.
107. Some appropriate technologies have been adapted by communities of South America, such as the irrigation systems developed by Welsh communities using wind driven pumps.
108. If geological conditions do not guarantee free-standing well sides which are unlikely to collapse, the sides are lined with concrete culverts about 1 m in diameter. Alternatively, the lined portion of the well may be confined to the bottom of the hole, extending to about 1 m below the water table. This allows the hole to be backfilled on top of a concrete slab, which seals off the reservoir.
109. In completing the well at the surface, whether it is left open or covered with a slab and a pump, the top is grouted or sealed to prevent contaminated surface water from infiltrating down to the water table.
110. Modern development projects have introduced deep-tube wells with enhanced availability of clean water, outside the normal range of traditional wells. Due to high construction, equipment and operational costs, these are unsustainable under communities' own management.
111. One advantage of a dug well over a borehole is that community participation is assured from the start. Self-help labour is usually used to dig the well, and women and children can all help with the fetching and carrying of sand and gravel. The immediate rural economy thus identifies itself with the construction of the dug well, and establishes a sense of communal ownership that is vital for the sustainability of the water point.

Wetland patches
112. Wetlands include flood plains, banks of streams, rivers, lakes, swamps, estuaries and coastal plains that are dotted in the dryland landscape. They provide water for domestic livestock and wildlife as well as for irrigation. They are important dry season grazing areas but also provide temporary habitats for migratory species, a refuge for some wildlife during droughts and a breeding ground for fish.
113. Dryland communities have developed sustainable packages for wetland management, practices that constitute valuable drought-coping strategies. Under these use patterns, pastoralists keep away from wetlands during the wet season to avoid cattle-foot fungal diseases, while at the same time observing unwritten rules of reserving these areas for dry season grazing, and allowing off-season crops to mature. Wetland farming increases food security by providing crops when other plots fail and hence opens up opportunities for cash cropping of vegetables and other utility products.
Integrated approaches for establishing desert oasis
114. In China, due to the existence of mountains and river valleys and the wide distribution of snow, most desert and sandy lands are rich in underground, meltwater. In North Africa, such water sources are recharged through run-off from the surrounding mountains. In order to protect the oasis and villages from sand movement, sandbreaks, windbreaks and farmland protective shelter

belts are established. Inside the oasis, narrow tree belts are designed to form a reticulate structure that is moderately penetrable by wind. This increases the protective effects and prevents sand from being deposited around the tree belts. The main tree belts are perpendicular to the directions of the prevailing winds, and may be followed by a plantation of multi-purpose species of varying sizes. These tree belts not only protect oases, villages, farmland and crops and improve the microclimate, but also provide timber, fuelwood, fodder and shade to animals in the hot and dry season.

VI. ENERGY

115. Wood is still by far the most widely used domestic fuel in drylands and virtually every family in the rural areas relies on wood for all or part of its domestic heating, cooking and to some extent lighting needs. Fuelwood accounts for more than 70 per cent of total energy use. In most places, dead wood which has naturally dried is collected in the form of twigs and branches. Even where cutting tools are available, the felling of whole trees for domestic rural firewood is rare, though live branches and twigs are frequently lopped. These are stored and dried, preferably during the dry season. Wet wood tends to be smoky and generally yield low heat. The collection of fuel is frequently the responsibility of women and children, who carry the wood home in head loads. Men may also bring wood home on a cart or vehicle but often the men collect wood for sale.

116. Charcoal is the fuel of choice in big cities but wood is also used, particularly by the urban poor. Traditional food-processing industries also rely heavily on fuelwood, as in the case of beer brewing, and smoking of fish and meat. Agro-processing (e.g., tobacco curing and jaggery processing) and rural cottage industries (e.g. brickmaking, salt drying, and ceramics production) are two other important users of fuelwood.

117. Hard-wood trees are preferred because their charcoal does not spark. In charcoal-making the wood is cut usually with an axe, and stacked in a big heap about 4 by 4 by 4 m. The stacked wood is then covered with a layer of grass or leafy twigs about 10 cm thick and then a layer of earth 10 to 15 cm thick, and the pile is ignited. Charcoal is harvested after 36 to 48 hours, and is produced by specialists who learn the job as apprentices.

118. Generally, the availability of wood does not preclude the use of other fuels. Materials such as coconut shells and maize cobs, various crop residues such as cotton stalks, rice husks and straw, millet, tobacco, and maize stalks, twigs, leaves and other light combustible materials provide common fuel.

119. Dung is one of the most common biomass fuels in areas where the land is unproductive and wood is scarce. Indeed the use of dung and agricultural waste as fuel has persisted for hundreds of years and is deeply ingrained in the customs of communities in Africa and Asia. The dung is dried and made into bricks, or cakes, dried and kindled with brushwood and burned in a perforated tin or other burners. Dung tends to burn slowly and may give off an acid smoke. Despite its smokiness, in southern Africa it is preferred to brushwood as a cold-season fuel because it burns slowly and provides warmth for the dwelling as well as heat for cooking. The bushes, in contrast, burn quickly without creating coals or giving off much heat.

120. Elsewhere, charcoal briquettes made from charcoal fines and biomass, such as wood wastes and crop residues (such as cotton stalks, coffee husks) are currently gaining interest and can make a substantial contribution to the fuelwood balance. By this means, materials that are otherwise wastes, often an environmental nuisance and difficult to handle, are converted into a form suitable for the large urban market. The residues are briquetted before or after carbonizing.

121. The types of wood stoves commonly used in the villages are of low efficiency. The improvement of wood-burning stoves is, therefore, an imperative task that is essential for redressing the demand side of the rural energy equation. It is technically feasible to save one third or more of fuel and hence to lower fuelwood requirements by this amount, by using stoves that are better designed and better used. The wood stoves commonly used in Asian, African and South American countries have recently been improved from the point of view of combustion and smoke reduction. These have been found to reduce the consumption of fuelwood for cooking by up to 70 per cent. Better charcoal stoves in many countries have also brought about a marked reduction in consumption. Improved crematoria also save as much as 40 per cent of the fuel needs.

A considerable saving of fuelwood could also be achieved by improved charcoal conversion and processing techniques like briquetting.

Windmills and wind energy

122. Wind energy and windmills are used widely to generate electricity for villagers in rangeland areas in northern China, South America and parts of Africa. Small windmills are constructed around the settlements to meet daily needs for pumping water and generating of electricity. The potential for wind power in dryland development is immense, but cannot be tapped unless the capital costs are affordable.

Biogas and solar power

123. Biogas and solar power are viewed as environmentally sound alternative sources of energy for cooking and lighting. Biogas is popular in Asia, especially China, while solar power has yet to find its niche in developing countries. The current costs of applying any of these technologies for rural domestic use are prohibitive and hence remain unsustainable, under available technical pathways.

Solar energy-powered greenhouses

124. The building and running of greenhouses using solar energy is very popular in northern China, especially in desert areas where the human population pressure causes heavy losses of the vegetative cover. Greenhouses made of clay are normally screened with a straw matrix, internal walls painted black to enhance solar heat absorption, and the outside wall protected with a belt of some evergreen trees and shrubs. These arrangements are aimed at protecting the greenhouse from heavy wind and rain impact, increasing soil moisture and air temperature in winter or decreasing air temperature and humidity inside the greenhouse in summer. Successful models are available in Gansu, Xinjiang, Shaanxi, Inner Mongolia, Heilongjiang and other arid and semi-arid provinces.

VII. PASTURE AND RANGE

125. Livestock keeping is the most widespread form of land use in drylands. Animal production dominates land use, with crop cultivation being limited to irrigation, riverine agriculture and water harvesting systems. The land is either state owned or tribally owned and used communally. Pasturage and water are the two essential elements for pastoral production, and are primarily managed by the customary principles which sanction their unlimited access. Pastoralism has been practiced widely for centuries over large areas in harmony with the environment. Cattle, sheep and goats are common, as are donkeys, mules, poultry and pigs. Camels are found in eastern and North Africa, West Asia, and the Middle East. Many native species such as llama and alpaca in South America, and guinea fowls in Africa have been domesticated and managed under traditional systems. Partial domestication of wild fauna such as ostriches, carpincho and the honey bee is gaining popularity. The ability to train animals is particularly noteworthy.

126. Many pastoralists practice some form of transhumance, particularly for cattle. In the transhumance system which dominated land use in the past, a pasture was intensively used for a short period and then left to rest. This was successful because overgrazing is not so much a function of animal numbers but the of time the pasture is exposed to grazing. In more recent times, increased sedentarization of herders has led to more permanent grazing in one location, with little or no time for the pasture to rest, resulting in localized degradation. Prior to the colonial period and the advent of modern governments, pastoralists were able to move over large areas, practising wet season grazing in the lowland areas, taking advantage of the annual flush of vegetation after the rains, and dry season grazing in the hilly or wetter areas. In subtemperate to temperate zones, the movement is between summer and winter grazing areas. Some communities set aside large tracts of land for use in times of drought.

127. The marked population increase in recent times has generated pressure for the settlement of people from the wet areas in the drylands. The creation of national parks, forests and game reserves has further reduced flexibility of seasonal grazing orbits by pushing many lowland and coastal communities into the more arid lands. These developments have triggered an inexorable disruption of the traditional economy although a number of traditional technologies are still practiced widely, of which the following are recognisable.

A. Herd diversification and flexibility

128. Pastoralists often maintain a diverse portfolio of animals, some of which may be split into separate herds according to age, sex, type, productivity, etc. Herd diversification, including taming of local wildlife species, constitutes an efficient land-use option, offers a broad spectrum of animal products and secures a steadier supply of products, spreading risks and maximizing opportunities

for tiding over difficult times.
129. Sheep and goats are particularly important in household nutrition, being sources of milk, meat and cash income. Camels and goats give milk even in dry periods, when lactating cows can hardly be milked. As well as the overall milk yield, the waiting time for the first availability of milk after a drought is vital for the nomadic household: goats lactate after five months, cattle after nine months and camels after one year. The other aspect of a herd's productivity is its fertility. Camels are fertile at four years old, cattle at three and sheep and goats at one year old. Goats and sheep which have a 30-40 per cent yearly reproduction rate can easily compensate for the high cattle losses which occur in times of drought. Since they can be exchanged later against cattle, they play an important role in post-drought recovery. Camels, donkeys and llamas provide essential draught power.
130. Pastoralists worldwide have maintained multiple animal management systems that accommodate wild game. In Africa, this includes antelopes, ostrich, giraffe, etc., while in South America the range supports native animals such as the llama, alpaca, and deer. The camelids of South America, and camels of Africa and the Middle East are adaptable to extreme conditions, have less impact on the environment and provide a wide range of products.
131. Some communities in Ethiopia promote the use of mules (hinnies), hybrids of donkeys and horses, as draught animals because of their superiority in strength, feed requirements, hoof quality, longevity and endurance.

B. Livestock breeding
132. Indigenous cattle and camelids are resilient and well adapted to the harsh environment. Traditional cattle breeding strategy emphasizes drought- and disease resistant animals, with only strong and healthy bulls used for breeding. These communities have resisted pressure from governments to adopt exotic breeds. Mules are gaining popularity in parts of Africa and South America. While the productivity of a herd is important, its ability to survive is crucial for the nomadic household. In South America, many communities are taking advantage of the superiority of the native livestock (camelids). Increasing efforts to domesticate wildlife such as ostriches and guinea fowl (in Africa) and carpincho and birds in South America are also noteworthy.

C. Herd management and production technologies
133. Pastoralism is a highly specialized subsistence activity in the dryland ecosystems and is sharply synchronized with the productivity, security, and continuity of the main resource bases that are also the most important building blocks for achieving sustainability in these ecosystems.
134. The associated adaptations are reflected in different styles of herd management, including regular movements of transhumant pastoralists and the movements of nomadic pastoralists that are dictated by the need to find water and pasturage, which fluctuate in geographical availability both seasonally and annually. This is closely tied up with herd diversification and breeding strategies and other practices designed to cope with the risks and challenges of drylands, as described below: Mobility
135. Transhumance is practiced in all dryland areas. It is a system that uses rationally the forage resources in time and space. Mobility of herds is the basic requirement for pastoralism to avoid overexploitation of pastures. The head of the household chooses a different grazing orbit at least every two days according to the herd's forage needs and to prevent deterioration of particular points in the pasture. Daily migration rarely exceeds a distance of 5 km from the homestead. Small blocks of up to 400 ha per household (range reserves) are maintained around the homestead for grazing small stock and sick cattle among some pastoralists in sub-Saharan Africa.

(a) Seasonal migration
136. This is a regular pattern of land use and pasture management. Pastoralists continue to employ this centuries-old system of nomadic herding of livestock by moving from place to place in search of feed and water. In the past, they managed to carry on this activity in a sustainable manner despite keeping herd sizes much larger than the carrying capacity. The traditional routes of movement are strictly followed and the length of stay at a particular point is determined by the amount of forage available.
137. The routes followed enable herds to spend winters or wet seasons in appropriate areas and obtain summer grazing in the highlands or appropriate dry season grazing enclaves. In North and Southern Africa, the Middle East and Asia, migration alternates between the summer and winter grazing fields. In South America, herds move according to the seasonally determined availability of

pastures and water, such as between central Chile and Argentina. There is virtually no control of the stocking rates on the open access land and the major migration routes are severely grazed by passing livestock. At this time, their use of pasture and water holes is based on a negotiated understanding with the resident landowners. In Botswana and Lesotho, cattle are driven to the mountains during the summer to avoid conflict with crop production and to stay away from maboella; and are returned to the village zone during the winter after crop harvest. Elsewhere herders similarly move their animals from the crop lands and return after the harvest, at which time the animals are still left to feed on the crop residues and produce manure. In some cases, herders contract with the cultivators to ensure mutual benefits of access to feed stock.

(b) Shifting of household
138. Among the Masai, migration of entire households occurs once every five or more years, mostly in times of severe drought. The main reasons for shifting the household are decreasing quality of pasture or shortage of water in the neighbourhood. But displacement may also be triggered by outbreaks of disease, quarrels within the neighbourhood, or the fear of inter-tribal warfare or civil war.
139. In some areas the competition between the settled farmers and nomadic pastoralists has gone beyond the level of mutual accommodation, particularly in the wetlands and the plateau. This has led to a displacement of pastoralists, forcing them to move to drier areas. But a few have settled into sedentary agriculture under a mixed farming system.

D. Herd dispersion
140. All forms of herd dispersion have the same goal: minimizing risks and hedging options by spreading chances. Among some East African pastoralists, the cattle herd is often divided up during the dry season, with the sub-herds of small ruminants, camels and some lactating cows remaining close to the family settlement. A few lactating cows accompany the herders to supply them with milk during their time away. However, in hard times such as severe droughts, when there is very little decent pasture to be found, the whole herd migrates. Some communities spread risk by distributing their cattle to relatives and friends. Pastoralists in East and Southern Africa enjoy traditional systems of reciprocal exchange of cattle, locally recognized as tilia and mafisa respectively.

E. Dry season reserves
141. Many pastoral communities have designated certain areas to be closed from use in normal seasons, and used exclusively during drought years. Among the northern Somali, the Pokot, the Masai (Warren, Skikkerveer and Bokensha, 1995), and the settled pastoralists in Pakistan, the local council of elders can impose penalties on those who illegally enter the dry season reserves. These reserves are kept closed during the wet season so that the vegetation can recover. The elders decide when to open and close the pastures, after a prior inspection. The closed areas are guarded, with fines imposed by elders on violators. This system does not only allow the pasture to rest, but also provides a reservoir of seed of the palatable species that are likely to be selectively depleted in the open areas. Some traditional communities continue to practice rotational grazing to improve the range condition and to avoid degradation.

F. Animal health
142. Pastoralists recognize and avoid areas infested with pests. Riverine areas and wetlands are also avoided during the rainy season. This is because wet heavy soils cause foot diseases if the herd is kept in them for a long time during the rainy season.
134. The communities use a wide range of plants in treating sick animals for common diseases, such as intestinal worms, East Coast fever, and ticks. Mathias-Mundy and McCorkle (1995) have made a comprehensive literature review on the development of ethno-veterinary medicine. Other examples include vaccination against infectious diseases such as bovine pleuro-pneumonia by the Masai and against rinderpest by Somalis. Even where modern medicine is available, there is continued reliance on traditional methods for animal health care.

G. Division of labour and production
144. Pastoralists have strong culturally prescribed norms for the division of tasks and responsibilities between age groups and sexes. Although this varies between communities under the eroding Western influences, adult married men are responsible for governance and political affairs. They further enjoy overall managerial responsibility for planning grazing orbits, herding

movements, animal health and welfare, herd splitting, watering and location of residences. They also organize and undertake construction and maintenance of water points and enclosures for livestock.
145. In some communities, children and women are responsible for watching animals during the cropping season. Generally, adult women make all major domestic decisions, particularly those relating to child care, food preparation, collection of water and fuelwood, milking, looking after young and sick animals, and other duties which vary between communities. In practice, the women shoulder numerous and heavy duties and responsibilities, but their contribution to the traditional economies remains shielded by the "kitchen and household curtains". The children do almost all the herding and house chores.
146. In households that engage in cropping, women do the planting with some help from men on land preparation. Where the men are involved in trade or have taken jobs in the towns and cities, their wives assume the daily responsibilities of household heads.

H. Soil and water management for range rehabilitation
147. Some communities practice precise technologies for combating erosion and range rehabilitation by pitting, stripping and planting aloes or sisal across the gullies to form a natural barricade for site amelioration, and soil and water conservation. This may be reinforced by piling brushwood along the row of aloes. The barricade slows down the speed of run-off, trapping sediments and debris. As the aloe grows, the barricade catches more soil until the gulley is gradually healed.
148. Pitting is a technique used to rehabilitate grossly degraded, eroded, and unproductive range. It involves construction of a series of small pits of varying width and length, supported by the construction of short trenches 2.5–3 m long, 0.75 m deep and 0.75 m wide, spaced at 0.9–1.2 m and overlapping each other along the contours. A 50 cm deep hole is dug at the centre of the pit to act as reservoir for the mini-catchment. The pits collect water and allow it to infiltrate and trees are planted on the trench embankment. When the area is closed for 2-3 seasons it allows natural regeneration of grass between the trenches. Although not widespread, some communities are practicing different aspects of these treatments, albeit in small scales.

I. Water use
149. Water management is the key to increasing and sustaining productivity of croplands and pastures. Information already reported shows that these communities have developed a wide variety of water harvesting and conservation techniques for different soils and climatic conditions. The provision of sufficient and well distributed watering points not only assures easy access to drinking water but also enables uniform use to be made of the grazing land. During the dry season animals are watered every second to third day, as opposed to daily watering. This is important for assuring the animals' proper forage-to-water intake.

J. Fire as a management tool
150. Traditional societies found burning a useful tool, and depended on it for centuries in their day-to-day activities. Among agriculturists it was (and still is) used to clear bush for settlements and gardens. Fire was also used to improve grazing, eliminate ticks and other pests, and increase wildlife numbers by maximizing production of food supplies. Traditional hunters used fire not only as a hunting weapon to force animals out of hiding from particular sites held sacred, but also to direct them into open areas for an easy kill.

K. Training of animals
151. Use of cattle for ploughing and drawing carts, and of donkeys, llamas, mules, camels and horses for transportation is practiced widely, depending on availability and economic circumstances of a given area. Some communities train livestock on grazing orbits, an achievement that makes grazing an easy and low labour input task. Quite often, herds return home on their own. The highest level of animal training has been achieved in Asia, with buffaloes and elephants, but these do not seem to support dryland economies.

VIII. FOREST DEVELOPMENT
152. Forest development is a kingpin of all land-use programmes. Forests regulate ambient temperatures and shield against dunes and harsh winds that stress the living environment and property. Properly distributed tree growth is beneficial to agriculture, conserves soil moisture,

and increases atmospheric humidity and crop yields.
153. Woody plants provide shade for grazing animals and are important sources of timber and fuel. They further provide nutritious browse and fodder in the form of leaves and pods during lean periods of the year. By virtue of their deep root systems, such trees bind the soil, reducing erosion risk. In addition to ameliorating climatic conditions, trees supply readily available fuelwood, thatching materials for huts, food, medicine and a wide range of non-wood products for domestic use and industries.
154. Traditional forestry was mainly based on observing patterns of low impact harvesting of plant resources for wood and non-wood products, reverence for certain plants and sacred groves, and the natural regeneration of native species. Harvesting was totally prohibited in sacred groves, and sacred trees were exempt from felling in parts of Africa and the Indian sub-continent. Such trees could not be cut or uprooted except under specific circumstances and cutting was accompanied by organized community rituals.
155. Following the introduction of tree planting and the awareness of the consequences of degradation, the number one priority has been to restore the natural frontiers of trees that served as the final barrier between the human settlements around the oases and the desert. Tree planting has been used as a first line of defense against sand dunes in all affected areas, including regions affected by high dry winds, for protecting farmlands, settlements, pastures and communication networks. In arid and semi-arid hilly areas, various dryland afforestation techniques have been used by the people to establish plant cover by conserving moisture. These rain-water harvesting and moisture conservation techniques include contour trenches, ditches, different designs of micro-catchments, water spreading, low technology drip irrigation (earthen tubes or pitcher planting), and planting of roots or cuttings.
156. Once an area has been selected for treatment, the first step is to employ water management techniques, such as flood water spreading on the land that is to be reclaimed. The techniques vary widely between sites; some use simple earth embankments while others involve complex dams and delivery channels.
157. Reclamation of degraded areas has also been facilitated through the use of resilient tree species such as Tamarix and Atriplex which are adapted to salinized soils and irregular rainfall. By using the flood water to raise woody plants, the expense and complication of tree nurseries has become unnecessary. Water is simply diverted to a new location and then nature takes its course, because these species colonize through natural regeneration from seeds.
158. In China, a wide range of concepts and techniques have been demonstrated, such as the establishment of particularly wide belts of trees and shrubs to reduce the sand content of desert winds; systems of multiple belts and ditches; purposeful variation of rows of species of varying final heights in order to enhance roughness; combinations of species to match different sites; planting on the windward side of dunes in order to reduce their height; planting tall cuttings on the lee side depressions of dunes in order to block their advance and gradually level them off; combinations of lower windward side planting with later shrub planting to consolidate leveled areas; and stabilization of lower dunes with tree, shrub and grass mixtures. A wide range of woody species are used with these technologies, in different areas of dry zones.
159. Once the sheltered trees have matured they provide a much needed source of fuelwood and fodder. By modifying the microclimate, the shelter belts have succeeded in greatly reducing the frequency and force of the sandstorms that otherwise batter the region and the accompanying moisture loss through excessive evapo-transpiration. Consequently, larger areas have been planted, especially during the season following the rains. As more crops are harvested in protected fields, more money is pumped into the local economy, allowing people to make improvements. Reports from the Middle East, the Sahel, North America, and Asia including India, Pakistan and China show that crop and livestock production has doubled in the past decade through benefits from planted woody species, meaning more food for local people, for their livestock and for sale.
160. Most countries in dry regions have attempted to rehabilitate the forest resources base by promoting the planting of fast-growing exotic species. But this has not been popular with rural people for many reasons. Although these trees provide good poles, they lack the array of benefits associated with natural woodlands, and in some cases they provide resting sites for pests such as quelea birds in western Tanzania. Eucalyptus, an important rural forest tree, is currently resented for its allelopathic effects on other crops and excessive water use.

IX. UTILIZATION OF WILDLIFE

161. Many species of wild animals have distinct physiological and ecological advantages over traditional domesticated livestock species in arid and semi-arid areas. Amongst the most significant are their ability to thrive in the absence of surface water (by movement in time and space) and make optimal use of vegetative resources, and their minimal impact on the environment. They also have tolerance to diseases, heat and drought.

162. Hunter-gatherers, who have existed in arid zones from prehistoric times, rely heavily on harvesting, processing and utilization of wildlife products as the basis of their livelihoods. This way of life persists today in remote arid areas. But to pastoralists and marginal cultivators in these zones, wildlife has often represented an emergency food resource, particularly in times of drought, and a source of supplement and variety during normal seasons.

163. These societies had well developed wildlife conservation strategies that helped to regulate exploitation of wildlife, and ensure that the communities had adequate natural resources readily available. These strategies were deliberately aimed at the preservation of the resource bases for the benefit of the present and future generations, and were deeply enshrined in the traditional values of the societies.

164. Some African communities enforced wildlife conservation measures with varying degrees of effectiveness, through seasonal hunting and trapping of animals and birds for home consumption. This practice discouraged indiscriminate hunting, and encouraged selectivity in killing wildlife.

165. Various communities have evolved distinctive hunting traditions. According to the chacu system found in the Andean and some peripheral areas, a group of wild animals is surrounded, and the sick, injured and old are identified and detained. The rest are left unharmed and set free. Indigenous perceptions of biodiversity are evident in social values, beliefs and practices that sometimes make reference to the importance of biodiversity, including reverence for some biological units such as forests, trees and animals. Many communities observed widespread cultural beliefs in abstinence from wanton killing of wild animals, especially those which the society held in contempt such as hyenas and monkeys, and also the young of all species. Fish were also protected, with some sites held sacred. Some communities, such as the Masai of East Africa, hold wildlife as a last-resort resource that must remain untouched in normal seasons.

166. The Ila-speaking peoples of Zambia practiced a well-known traditional wildlife management system, the chilla. This was a system of seasonal hunting expeditions either once a year or at intervals of two to three years, depending on the population of the animals. There were strict rules governing such hunts. Chiefs and elders were the only people with authority to sanction chilla and they could do so only after ascertaining that animal populations were not declining to extinction. Oral history further suggests that there was an element of selectivity in the actual hunt, with females and juveniles spared while males were targeted.

167. Subsistence hunters trap, snare, shoot with bows and firearms, and spear their quarry. Fire is also used to drive animals from cover, and smoke to eject rodents from their holes. Trapping and snaring enable the animals to be caught alive so that slaughter can be delayed until an opportune moment. These methods, in general, cause relatively little disturbance to wildlife populations provided that techniques remain traditional and undue commercialization has not crept in.

168. The meat acquired by subsistence hunters is either eaten fresh or preserved by drying and/or smoking for later consumption. When large animals are killed, the reduction in weight of the meat by drying is an important consideration in relation to transport back to the village by head load. After evisceration, small animals are often dried and smoked whole, whereas larger ones must be cut into strips to facilitate drying.

169. Apart from domestication of camelids in South America, and guineafowl and ostriches in Africa, little attention has been accorded to planned management of these resources. But considerable progress has been recorded on programmes of consumptive and non-consumptive utilization of wildlife under joint community and government initiatives in some developing countries.

170. Examples of ungulates that thrive in the harsh environments of drylands in Africa, Asia and South America are:

Western Africa: cimitar-horned oryx (Oryx dammah); addax (Addax nasomaculatus); gazelle (Gazella dorcas, G. dama, G. leptoceros).
Eastern Africa: East African oryx (O. gazella); gazelle (G. granti, G. soemmeningi, etc.).
Southern Africa: Gemsbok (O. gazella); springbok (Antidorcas marsupialis).

West Asia: Arabian or white oryx (O. leucoryx); gazelle (G. gazella, G. subgutturosa, G. dorcas).
Central Asia: (G. gutturosa, G. subgutturosa).
South America: Vicuna (Vicugna vicugna), pampas deer (Blastoceros campestris), guanaco (Lama guanacoe).

171. Wild animals further provide the basis for foreign-exchange-earning tourist industries and are an important subject for the conservation of biodiversity. To a much lesser extent, in some localities hides and other products are traditionally processed for domestic use. In recent times, skins and animal trophies have been processed to meet the demand for these articles from tourism through local crafts and rural industries. Export demands for certain products exist in some countries.

172. Income from wildlife management and rational harvesting is particularly important for the drier lands of central, eastern and southern Africa as well as parts of the former USSR. Strategies for the shared use of land by domestic livestock and wildlife have been advanced in Africa and are being tested, together with the possibilities of game ranching.

173. Apiculture, involving domestication of native bees, is practiced in many countries of Africa and South America, for production of honey and beeswax. These products are important for local consumption and sale. Wax and honey, together with carmine (a colorant extracted from insects), were the most important exchangeable products in South America in the colonial times.

174. A number of insects, particularly termites in East and West Africa, caterpillars in central Africa, rodents in central Africa, West Africa and South America and mushrooms in nearly all regions, provide important food supplements to dryland communities.

X. SPECIALIST SKILLS

A. Traditional management systems

175. Virtually all communities had well established governance structures, with well articulated customary laws that accommodated inter-personal relations, property ownership and protocols for resources use. Such structures have evolved as unique social, economic and political grass-roots governance organs, that provide effective mechanisms for environmental conservation. Primacy of community ownership and/or access to land with specific rights of individual families and collective obligations for the care of the resource bases is strongly established. In practice the system enjoys decentralization in centralism, in which power is rested on the clan (tribal) chief and his committee of elders with defined roles and responsibility stretching down to households. Policy "fences" placed by elders are observed through total community compliance, under the influence of seers and warriors, underpinned by a strong commitment to traditional religion, taboos and beliefs.

176. All community members are responsible for overseeing what the others are doing and any act of violation is reported to the elders. Shared beliefs provide a strong sense of group solidarity. An infringement of a taboo or act that compromises the community's security is a concern of the whole community. After all, any subsequent punishment or retribution is likely to affect all, not the offender alone.

177. Production is embedded in the socio-spatial matrix, enriched by crosslinking relationships with well recognized social equity and sustainability rules. Despite the absence of a written medium of communication, the structure of governance, lifestyle, and resource management rules have been transmitted effectively from generation to generation. This has left local communities with great organizational prowess, buttressed by an entrenched sense of solidarity and reciprocity.

178. The creation of institutional curbs, such as sacred areas for purposes of worshipping ancestral spirits, spirit mediums and rain-making oracles, served to regulate societal attitudes toward the natural environment. Spirit mediums, particularly, controlled large ritual groves and protected forests where no one was allowed to hunt, graze livestock or cultivate. The management of resources under customary law endured for centuries due mainly to this strong link with the ancestors and the low population densities, which helped to maintain a sound ecological balance. Despite the eroding forces of modern governments, religion and affluence, traditional resource-management systems remain promising for building community-driven resource management paradigms.

B. Harvesting of wood and non-wood products

179. Virtually all communities are cognizant of the importance of biodiversity conservation practices that they have evolved over many years. Such conservation rules vary between communities but are all associated with respect for all forms of life (plants and animals), a feature that is strongly

embedded in taboos and respect for ancestral spirits. Common examples include reverence for totems, sacred plants, sacred groves and sites.

180. In the past, farmers and pastoralists applied conservative and low-impact methods for harvesting wood and non-wood products and generally refrained from wanton cutting of trees. Harvesting of woody plants was largely restricted to chopping and pollarding of branches in a manner that allowed re-growth from the main stem. Harvesting of medicinal plants was also discrete, and limited to old people. Unless it was extremely necessary, only leaves, pieces of bark and lateral roots were cropped. Collectors avoided tapping freshly exploited plants and often covered exposed root areas, purportedly to avoid recognition by passers-by. This gave the target plants time to recover prior to the next harvest.

181. Households involved in tapping gums, resins, oils, dyes, etc. have also developed non-destructive tapping methods, with the bulk of the products coming from naturally exuded materials. Such trees were further conserved under the tree tenurial rules, which are well developed for acacias in Sudan and frankincense in Somalia. Many communities have domesticated a wide range of dryland plants particularly in dune fixation, parklands and other agroforestry systems and along irrigation canals, with a very favourable pay-off.

C. Traditional crop knowledge

182. Traditional crop knowledge is omnipresent in many traditional societies.
They are particularly conscious of the value of biodiversity as a form of food security, insurance against crop failure and source of dietary variety. Based on simple but practical criteria, farmers and pastoralists tend to stick to crops and breeds that (i) they know; (ii) suit local agro-ecological conditions and cropping/land use patterns; (iii) meet dietary acceptance; (iv) fit production costs; and (v) have market potential. A study carried out in 1998 showed that 614 out of 740 ethnic groups in Africa derived their livelihood from the wild woods around them (Makombe 1993).

D. Seed selection, storage and planting methods

183. Farmers have an extensive knowledge of the taxonomy of species of food crops such as millet, sorghum, maize, groundnuts, beans, rice and multi-purpose plants. They recognize varieties suited to the uplands, lowlands, wetlands and saline soils and those that would remain productive well into the dry season, and often strive to improve these through breeding.

1. Selection of locally adapted seed

184. A strong commitment to using drought-tolerant and/or drought-evading crops such as millet, sorghum, pumpkin, groundnuts, cassava and sweet potatoes, is evident among all communities. The modern cultivars have proved to be far less resistant to drought, pests and diseases and to depend on inputs such as fertilizer and pesticides, which are often unavailable.

185. Seed selection for planting is comprehensive, generally based on seed quality, emphasizing the following, among other parameters: head weight for sorghum and cob weight for maize, size of the grains, length of husks and absence of pests and diseases, seed colour, grain size and agronomic stability, suitability to different types of soil and terrain, drought and disease tolerance, palatability, storage and processing.

2. Seed storage

186. In Africa, selected seed for the following season's planting is often kept above the fireplace inside the house. The storage systems are well adapted to the ecosystem. Groundnuts, maize, millet grains and beans are often mixed with ash and kept in bins made from straw and loam. In humid areas, traditional granaries are used for the storage of maize. The principle in use is the need for good ventilation of the often wet-harvested maize. Some farmers store maize seed on the cobs hung from a tree.

187. Some farmers mix plants with botanical potential such as leaves with their stored products. Beans may also be stored mixed with sand in bins. The farmers tap the storage bins lightly so that the beans are completely surrounded by sand. This results in a situation where beetles cannot move enough to copulate, and the sand damages their shields, which causes them to dry out.

3. Pre-sowing seed treatment

188. In addition to planting selected seeds, some farmers soak the seeds in water. By this slight pre-germination treatment, the plants grow faster and develop an advantageous young growth, which gives them a head start over other plants. The wet seeds may also be mixed with ash. According to the farmers,

the dark colour camouflages the seed to rodents and birds. Another method, less used, is to soak maize seeds in water mixed with botanicals such as neem tree leaves. The germinating seeds absorb some of the bitterness of this extract, which makes the seed unattractive for termites, birds and fowls.

E. Storage of foodstuffs

189. Techniques for processing food of plant and animal origin for an extended shelf life provide important food reserves for hard times. Dried vegetables, fish sun-dried or smoked, sour milk or butter converted into cheese or ghee, meat smoked or cooked, boiled in fat and dried, tubers pounded or allowed to grow some moulds and dried, and grains mixed with ash or sand stored in bins indoors maintain good condition for a long time and assure supplies through lean times.

190. Dryland communities possess a wide range of traditional biotechnology skills for food preservation and fermentation. In South America, fermented foods such as chicha and aloja are still popular.

191. An indigenous, low-input, food preservation technique is the production of masi, the local name for fermented foods made by Polynesians in the Solomon Islands. Foods most commonly used include breadfruit, cassava, unripe plantain or banana and tenatu, a popular forest fruit (Burkella obovata). After harvesting, the cassava is peeled, cut into large pieces and either placed in baskets and submerged in fresh water for three days or soaked in a plastic bucket, changing the water once or twice during the three days, (probably to drain off cyanide). Most other foods are prepared for fermentation without soaking. Once softened, the cassava is crumbled by hand into granules and is ready for fermentation in pits on the well-drained soils on higher ground. The pits range in size from 70 cm diameter / 70 cm deep for family use, to large communal pits used for storage in case of natural disaster and for use during feasts.

192. The prepared cassava is put into the pit and packed firmly to remove any air pockets. This is extremely important because it is an anaerobic fermentation process, and spoilage will occur around an air pocket. The pit is then sealed by covering the food with layers of Heliconia leaf and coconut-leaf panels on top, similar to the pit lining. Clean rocks are piled on top of the covered food to press and seal it off.

193. Initially, food is kept in the pit for at least six weeks, during which fermentation occurs. After this period, the masi stabilizes and ages. The pit is periodically opened to remove masi for use, or to add additional food to ferment. The masi is eaten as a traditional island pudding by mixing it with coconut milk, wrapping it in banana leaves and baking it in a stone oven.

194. Like other fermented foods such as cheese and wine, flavour develops as the masi ages. Pits are maintained for many years. Periodically, when the leaves of the lining begin to deteriorate due to the weather and soil moisture levels, the masi must be removed and the pit relined. Islanders have added a final lining of polythene sheets in a recent innovation that extends the life of the lining.

195. Communities living in sub-temperate areas in South America use the first frost to convert potatoes to cuno for long storage.

F. Home gardens and backyard plots

196. Farmers generally build their houses outside the farming area, usually in a site considered to be of marginal agricultural productivity. Animals are kept in shelters close to the houses, with concomitant accumulation of manure and enhanced fertility in the site. The animal shelter is subsequently shifted to a new site near the house, leaving the fertilized site for gardening. Sometimes the oxen are fed inside the farms and the place for feeding is moved annually to in less fertile spots. The farmer gradually cultivates the fertilized land around the house, often starting with pioneer crops such as spices including garlic, basil, peppers, onions and vegetables like kales, cabbages, cucurbits, potatoes and medicinal plants. Soleri and Cleveland (1989) have observed that this assemblage of crops in time constitutes an important source of staples and cash crops for the family. Such household gardens have significant promise in bringing about sustainable development by improving family and community well-being and promoting environmental upkeep.

197. The home garden may be used for a few years but when the soil gains fertility, the house and the garden are shifted to a less fertile location while the original garden site reverts to cultivation of major field crops. This practice is particularly important for resource-poor communities as it recycles nutrients efficiently through application of manure and crop residues, crop rotation and inter-cropping.

G. Mixed crops and livestock farming

198. The agro-pastoral system has evolved as a twin system of cultivation and animal husbandry. Initially the two systems were separate, but later on their mutual support was understood, as animal power was found to be essential for cultivation and crop residues important as animal food.

199. The practice of traditional agroforestry makes the overall farming system a complex three-in-one system that may be referred to as the agro-pastoral-forestry complex. At the family level, there is complete integration between crop agriculture and livestock production, in which one is dependent on the other for various purposes. The resultant synergistic effect is quite considerable. The fields and gardens produce supplementary feed and support the animals while the latter in turn support the production potential of fields and gardens through manure production. The entire system is highly integrated, with mutual support for, and stimulation of increasing production, land fertility and biodiversity conservation.

H. Pests and diseases

200. Rats affect all crops particularly groundnuts at the planting stage. Locusts and grasshoppers, quelea birds, aphids, stem borers of cereals, etc. are all important pests in crop production areas. Diseases include fungal and viral infestations. Farmers know the relationship between the incidence of pests and diseases and the breeding cycles in relation to prevailing weather and the seasons.

201. Because late clearing of land gives more time for pests to breed in the fields, farmers clear their fields early but leave slash and crop residue to protect the soil from wind erosion. Some farmers practise direct sowing under zero tillage condition to capture any rainfall and repeat sowing if the first seed fails. This provides optimum crop germination and establishment and hence optimum crop yields and enables the crops to mature before the peak season of major pests such as quelea birds.

202. Different communities have elaborate indigenous pest control and plant protection measures such as careful field sanitation, replacing susceptible types by more resistant seed, and using only adaptable local crop species in mixtures rather than monocultures. Proper soil tillage, inter-cropping, altering planting dates, and balanced crop rotations are also used widely. In traditional farming systems, the burning of brushwood and branches kills large numbers of pest and disease organisms, while shifts in the cultivated fields, relay cropping and mixtures provide effective remedial cultural control. Other notable cultural practices include cultivating several widely separated fields, distributing cattle to relatives and friends, early and timely sowing of cereals to evade stock borers, bird damage and bad weather. Some communities use infusions of toxic plants to treat insect pests. These constitutes traditional, sophisticated and effective integrated pest management packages.

I. Grass-roots indicators

203. Traditional communities use calendars based on the major seasons similar to Western calendars. Knowledge and use of natural indicators enable prediction of seasonal events important for planning crop and animal management. Climatic indicators such as trends in the prevailing wind and fog conditions, astronomic features, such as shapes and tilts of the moon, and alignment of the stars, and biological features, particularly the behaviour of plants and animals, enable local communities to predict changes, rain failure or arrival and other phenomena.

204. Traditional signposting of ecosystems with the life forms they support, including indicators of site quality, ecosystem dynamics and weather variations, that have guided communities for many years, are prime candidates for scientific validation. Traditional indicators such as systems used in soil classification, site quality and ecological assessment would provide useful building blocks to systems of early warning, drought preparedness and management, that are understood at local, national and international levels. Drawing on numerous eyes and ears would enhance local participation and greatly reduce the burden of monitoring the implementation of programmes to combat desertification.

J. Range reserves

205. The settled pastoralist communities have long adopted a simple method of resting a piece of grazing land for one or two seasons and grazing it in rotation in order to improve the range condition and avoid excessive degradation. Such practices of using communal rangelands on a rotational basis have been practiced in isolation by some tribes and villages in many parts of Pakistan, the Sahel and eastern and southern Africa for a long time.

206. In other instances, the dry season grazing areas are kept closed during the wet season so that the vegetation can recover. The elders decide when to open and close the pastures, after a prior inspection. The closed areas are guarded, with fines imposed on offenders. This system does not only allow the pasture to rest, but also provides a reservoir of seed of the palatable species that are likely to be selectively depleted in the open areas. As the drought continues and people cannot find enough pasture in the common ground, decisions concerning pasture and herd management are made by herd owners. In instances where crops and livestock conflict, such as in Lesotho, management encourages an exodus of livestock from villages to high mountain 'cattle post' areas during the summer months. In Lesotho, grazing in the village during the summer is further prohibited under the maboella system.

207. These formal and informal rules are important in determining the principles that govern everyday decisions made by the herders and thereby avoid the 'tragedy of the commons' syndrome.

K. Human and animal health

208. Pastoralists recognize and avoid areas infested with pests such as the tsetse fly, which transmits trypanosomiasis, and resort to such vegetation only during the peak dry season when flies are fewer in number and when alternative pastures are impoverished. Riverine areas and wetlands are also avoided during the rainy season because of the risk of fungal foot diseases in the wet, heavy soil.

209. Pastoralists and farmers use a wide range of plants in treating themselves and their sick animals against common diseases, and have different levels of specialization in specific conditions, such as pregnancies, infant diseases and digestive diseases. Living in the remote corners of various countries, dryland communities rarely benefit from public medical and veterinary facilities, and hence rely on natural remedies.

L. Biodiversity management

210. Many traditional societies have developed wildlife conservation strategies that are deliberately aimed at the preservation of these resources for the benefit of present and future generations. Regulatory measures include prohibition of indiscriminate hunting, and promotion of selectivity in capturing wildlife. The Masai regard wildlife as a last resort resource, only to be used after livestock has gone. In southern Africa many cultural beliefs exhort abstinence from wanton killing of wild animals, especially those which society holds in contempt such as hyenas, monkeys, and the young of all species. Fish are also protected through regulated fishing patterns. Family totems, whereby some groups of people are prohibited from eating certain fish, animals or birds, also offer protection. There can be little doubt that these strategies emanated from people who had a concern for their environment and its ecosystems, an attitude which enabled societies to conserve their resources through oral policy "fences", without written legislation or rangers.

211. In a few cases, rights over the resource may be specific if the resource is strategic or subject to very personal investments, such as the Acacia senegal gum-producing trees in the Sudan, and riverine A. tortilis ekwar along the Turkwell valley, Kenya, which are privately owned and used by families. Among the southern Somali, pasturage water and natural wild products occurring in the fields are communal property but the system of land use establishes prescriptive rights over territorially-bounded frankincense collection areas, locally known as incense fields, to a core of closely related agnostic families.

M. Dryland afforestation

212. Plenty of indigenous knowledge exists in the field of dryland forest techniques, which are being adopted widely, especially in sandy areas along the desert margins. Some of the local technologies that are employed for tree establishment to rehabilitate degraded ranges in drylands, using proven site amelioration treatments and adapted plant species, include:

- Earthen tubes: These are baked earthen tubes that have long been used in sandy deserts for planting seedlings of fodder and fuelwood trees. Small holes in the sides of the tubes provide aeration and drainage. Tree saplings are planted in these tubes and are irrigated with a little water at critical times. The earthen tubes keep the moisture for a long period of time and help root establishment and deep penetration into the moist soil.
- Pitcher planting: Locally made pitchers are used in this technique for establishing fodder trees in desert ranges. Round earthen pitchers are dug into a hole near the root zone of the newly planted sapling. The sides of the pitcher are covered with coal tar except the one pointing toward the sapling. The pitchers are filled with water every 15-20 days during summer and it helps the plant

establish its root in the moist soil zone. After two to three seasons, watering is stopped and the plant is entirely rain-fed thereafter.

- Trench irrigation and related water harvesting techniques for tree planting: Trees or shrubs are planted in 50-75 cm deep channels with catchments almost 3 metres wide to collect water. These trenches can retain moisture for sufficiently long periods. Other techniques include a wide range of soil and water management technologies, depending on what is appropriate for a given site, such as limans common in the Middle East and flood-water spreading techniques.

N. Knowledge of crafts and fittings

213. Craft skills ranging from house building, thatching, furniture and farm tool making, wood carving, basketry and leather tanning to metalwork are well developed among dryland communities. The hoe, developed many years ago, continues to be an effective tool for land preparation that ensures even distribution of water over the land. But apart from a few areas where wood carving and basketry have found lucrative markets in the tourist industry, these potentials remain largely untapped.

O. Training of animals

214. Animals are widely used for draught purposes and for transportation, depending on the economic circumstances of the given area. Knowledge of draught animals is particularly developed in Asia and Latin America. In Asia, farmers have astounding skills in handling elephants, oxen and water buffaloes. In South America, camelids provide the bulk of draught power. In Africa, oxen, donkeys, mules and camels are used, while camels are also common in the Middle East. These skills deserve to be respected, incorporated in the development process and exploited to the maximum for development.

XI. COMMUNITY-BASED ORGANIZATIONS

215. Responsibility for development rests with communities, who stand to benefit from the fruits of development and/or suffer from the consequences of delayed development. Today the effects of land degradation are felt principally by the rural poor, particularly the landless and near-landless peasant farmers, pastoralists with lower status or smaller herds, and ethnic or religious groups who, while not necessarily constituting minorities, are subordinate and marginalized.

216. In all the regions under review, communities have established grass-roots welfare and development groups such as landowners' associations and women's self-help groups that constitute community-based organizations (CBOs). Ongoing drives to promote such informal movements, encouraged by leaders and aid agencies, have institutionalized grass-roots CBOs as important entry points for development intervention. Many such CBOs have also made substantial contributions to setting grass-roots development agendas, and drawing up strategies for achieving national development.

217. Communities are obviously anxious to assume control over their land and land-based resources, although their functions are still constrained by lack of legitimacy, positive policies and political support. In many instances, efforts to include community participation directed by donors have assumed that communities have decision-making powers and the authority to implement resource management programmes, a role which governments have continued to deny them. To have true, community-based, natural resource management requires ownership of the resources: sanctioned rights of access and the right to benefit fully from use and management. Such group ownership would allow communities to negotiate resource management arrangements with government agencies in a manner which takes advantage of multiple-use opportunities, with adequate benefit to the groups. Meaningful decentralization of power to grass-roots structures particularly requires that the state, donors and other interested parties devolve a substantial portion of authority and responsibility to concerned CBOs.

218. The CBOs are well placed to promote the application of traditional technologies in combating desertification because they are people-driven and therefore hold a positive appreciation of the role and potential of such technologies in development, which they know and understand well.

Non-governmental organization partners

219. These include non-profit-making bodies having development, training or extension functions in land use, environmental management and related fields of production. Local NGOs, including registered international bodies, their local counterparts, locally (country) registered and non-registered grass-roots, member-run, self-reliant bodies such as women's self-help groups and community associations, have taken a central role in community development activities over the past few decades in all the regions covered by the Convention. The number is large and continues to grow by the day. The strength of these NGOs lies in their decentralized and modest structure, operating in close proximity to local communities with an administrative simplicity that allows pluralistic decision-making.

220. In a number of countries, some NGOs play a positive role in research and extension activities on dryland resources management, although many lack the capacity to respond to problems as they are perceived by the people as constraints to development and often act spontaneously on crises. Thus vulnerable groups sometimes do not participate in setting the agenda and in subsequent programme administration.

Moreover, many desertification control programmes and policies favour elite groups, with little attention being paid to the most vulnerable groups and to promoting real popular participation. Contradictory policies and institutions have been listed among prominent obstacles.

221. This notwithstanding, a number of local, regional and international NGOs working at different levels have exerted much influence in global policy development on biodiversity management, food security and hunger and human rights issues. Many local NGOs have accumulated much information on traditional knowledge and practices that would provide useful entry points.

222. A new crop of influential environmental NGOs is working with communities on new paradigms for sustainable development and enjoying good grass-roots contacts. In some situations such NGOs and or development agencies have catalysed the formation of local governance structures (CBOs) and strengthened existing ones. They are therefore well placed to disseminate information efficiently.

XII. RECOMMENDATIONS

223. Despite past neglect and active marginalization of traditional technologies, many dryland communities continue to respect and use a wide array of traditional and local technical knowledge, know-how and practices. Economic necessity and improper guidance may have forced the people to neglect their valuable traditional systems in the immediate past. Since many of these traditional systems are environment-friendly and sustainable, efforts should be made to restore them and back them up with modern approaches to enable their effective mainstreaming in local and national development agenda. Many traditional technologies, some of which have been discussed in this paper, offer promising entry points for building packages on community-based dryland resource management technologies. The following mode of implementation is proposed.

(a) Collection and documentation of traditional technologies

224. The first step should include raising the awareness of all stakeholders of the important role of traditional technologies and their potential in promoting sustainable development and combating desertification, in order to clear the existing prejudices. Collection and documentation of traditional technologies should be undertaken through a partnership between community CBOs, NGOs, government and where feasible the private sector. Participatory rapid appraisal (or related models) conducted through thematic workshops of peasants and pastoralists would provide appropriate forums for documentation. This would constitute a first level of the documentation/screening process. For ease of documentation, separate sessions should be conducted for plant and animal systems, their products, uses, nutritional and medicinal potentials, processing pathways, etc. Such structures should recognize technologies that are not used currently. These may be tapped from oral literature and report by earlier writers on management techniques, tools, and practices and integral production systems practiced by named communities under specified ecosystem and geographical entity.

(b) Screening and assessment

225. Screening and assessment should be undertaken by examining candidate traditional technologies against application criteria, considering questions of economic, technological and socio-cultural sustainability as follows:

- Economic sustainability – capital input should be low, relying on local resources (e.g, family labour and skills). Leading questions should include: Does it generate self-management opportunities? Does it use locally available resources?
- Technological sustainability – it should be small-sized, low input based and energy efficient. Relevant questions are: Is it transformable locally, nationally, or regionally?

Is it environment-friendly?

- Socio-cultural sustainability – does it satisfy the community's basic needs while incorporating their intrinsic values? Such a screening and evaluation process would foster the rational capture and restoration of traditional practices and optimization of their uses.

(c) Analysis and evaluation

226. This step should examine the flexibility, adaptability and sustainability of traditional technologies in new situations and environments different from the original ones. It is anticipated that the proposed work will generate comprehensive databases of traditional technologies that highlight promising practices, their strengths and shortcomings for different production and livelihood systems, by communities, geographical areas, countries and regions. Teams of biological social scientists, and community partners would participate in the next level of work on traditional technologies, focusing on the validation and valorization of promising practices through modern methodologies, including taxonomic identification, screening of active principles, identifying nutritive values and related areas of knowledge. The work should
particularly employ standard common methodologies to enable comparability of results at the national, regional and international levels. Thematic networks run by national liaison centres in participating countries and coordinated at subregional level (such as IGAD, SADC) and regional units (to be based in Africa, South America, West Africa, China, etc.), would provide a useful approach in tackling this momentous task. But such a network must incorporate safeguards for traditional technologies to avoid loss of proprietary rights of community owners.

(d) Training and capacity-building

227. To secure effective participation on the ground, involved NGOs, local populations, both women and men, particularly resource users, from the farming and pastoral communities and their representative organizations should be trained through short seminars, visits, etc. on policy issues, planning, decision-making, programme implementation and review of action plans. This would strengthen the civic societies and empower communities for meaningful decision-making by enabling them to act from positions of strength and knowledge.

228. A new programme of training for scientific and technical staff, embracing short refresher courses, reorientation seminars, study tours, and degree and certificate courses, should be developed to promote appropriation of methodology for interfacing local knowledge with modern technologies and other avenues to foster effective valorization. Such training opportunities would equip the graduate for promoting dialogue and exchange between the partners, endow traditional technologies with fresh values, and cultivate cultural identity for communities and their role in development.

229. Research and development on community organization, promising traditional technologies, and related policy and legal issues would provide an invaluable base for the process of learning and recreating the knowledge base on traditional techniques. But the informal experimental nature of traditional knowledge is extremely important and should be encouraged to run parallel under community management, to formal activities of the programmes.

230. The new initiative should further provide forums for the exchange of information and experience, to enable development of common or comparable methodologies and approaches. The need to recognize the roles of the church, the state, donors, universities, the private sector, women and the elderly, technicians and youth in a consolidated community-driven programme will continue to be a compelling task.

REFERENCES

1. Bruins, H.J., Evenari, M, and Nessles, H. 1986. Rainwater-harvesting agriculture for food production in arid zones: the challenge to Africa's famine Applied Geography 6:13-32.
2. CTFT, 1988. Faitherbia albida. (monograph) Nogent-sur-Marne, France, Centre technique forestier tropical.
3. Helms, S. W. 1981. Jawa: Lost city of the black deserts. Cornell University Press. Ithaca NY.
4. ICRAF, 1996. International Centre For Research in Agroforestry. Annual Report 1996.
5. Khan, M.A., S.N. Mirza, and M. S. Naz. 1988. Range improvement through water conservation in Pakistan. Progressive Farming. 5 (5): 44-51.
6. Makombe, K. (ed) 1993 Sharing the land: wildlife, people and development in Africa. Issues services # 1, IUCN- ROSA. Harare & IUCN-SUMP. Washington DC.
7. Mathias-Mundy, E., and C. McCorkle. 1995. Ethno veterinary medicine and development – a review of the literature. In "Cultural dimension of development: Indigenous knowledge systems". Intermediate Technology Publications 1995.
8. Soleri, D. and D.A. Cleveland, 1989. Dryland household gardens in development. Arid lands Newsletter. 29:5-10
9. Warren, M. D., Slikkerveer, L. and D. Brokensha 1995. The cultural dimension of development Indigenous knowledge systems. Intermediate Technology Publications.
10. UNEP 1992. World atlas of desertification. UNEP-United Nations Environment Programme by E. Arnold, London, 1992.

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Traditional Knowledge and Technologies within the United Nations Convention to Combat Desertification: South America. Ulf Ola Karlin. Consultant FCA UNC.
Technologies traditionnelles et savoir local en Amérique Centrale et dans les Caraïbes. Maria Nery Urquiza Rodriguez, Engineer. Cuba, June 1998.
Etude relative aux connaissances et pratiques traditionnelles en matière de lutte contre la désertification dans la région d'Afrique du Nord. Habib Kraiem Consultant, November 1998.
Indigenous Knowledge of Combating Desertification in Pakistan. Anonymous, 1998.
Proposition d'appui au travail demandé par la première session de la Conférence des Parties sur les connaissances et techniques traditionnelles en matière de lutte contre la désertification. Minoun Haddocs, Consultant, Algeria.
Connaissances techniques traditionnelles en matière de lutte contre la désertification en Afrique de l'Ouest: Burkina, Niger, Cap Vert. Elisabeth Toe, Géographe Consultante, September 1998.
Panorama des techniques traditionnelles: des connaissances et du savoir-faire technologique dans le domaine de l'utilisation de l'environnement, Asie Centrale. Oleg Tsriuk, Tachkent, Uzbekistan, June 1998.
Preliminary Inventory of Traditional and Local Technical Knowledge, Know-How and Practises in Combating Desertification in Eastern and Southern Africa. J.A. Odera, August 1998.

Additional information was drawn from on-line databases.

1.4 Report of the First Ad Hoc Panel on Traditional Knowledge ICCD/COP(3)/CST/3

I. BACKGROUND

1. In accordance with decision 14/COP.2 of the Conference of the Parties, an ad hoc panel composed of ten experts was appointed with the following terms of reference:

(a) To draw upon a synthesis report (ICCD/COP(3)/CST/2) prepared by the secretariat on the most important and widely applied traditional knowledge on a regional and subregional basis and on a national scale, where appropriate, to identify successful experiences and conclusions relating to:

(i) Threats and other constraints, including socio-economic impacts, confronting such traditional knowledge and practices;

(ii) Strategies for integrating traditional and local knowledge, know-how and practices with modern knowledge based on specific case histories; and

(iii) Mechanisms for promoting and exchanging successful approaches;

(b) To report accordingly to the Conference of the Parties at its third session.

2. The ad hoc panel was subsequently convened in Matera, Italy from 15 to 18 July 1999. Mr. Jean-Claude Bomba (Central African Republic), chaired the meeting.
3. The members of the panel at the Matera meeting are listed in annex I.
4. The panel reviewed the background documents listed in annex II, which included an interesting variety of useful techniques and practices to combat desertification and reflected the value residing in the diversity of traditional knowledge.
5. Based on these documents, the panel had a rich discussion and developed a common understanding of the term "traditional knowledge" and its systemic and dynamic characteristics. The key elements of the work of the panel are summarized in the following report.

II. COMMON UNDERSTANDING OF THE TERM TRADITIONAL KNOWLEDGE

6. The compilation of the most important and widely applied traditional knowledge on a subregional and regional basis allowed the panel to generate a common understanding of the term "traditional knowledge", which synthesizes the characteristics of traditional knowledge in its cultural diversity.
7. In the discussion by the Panel it was stated that traditional knowledge:

(a) Has an important economic role; generates social and cultural benefits and values; is dynamic and adapts to change; needs an enabling environment to be developed and to reproduce itself; cannot just be listed, as it is not static information but rather time, context and actor-specific living knowledge.

(b) Moreover, traditional knowledge also integrates modern knowledge, evolves, and spreads to create regional traditions; it should not be glorified blindly but carefully evaluated in its contribution to sustainable resource management; the term "traditional knowledge" also includes very old, forgotten techniques; it is a plural term, indicating the diversity of the knowledge of other cultures; and it is often not understood and negatively valorized by representatives of modern knowledge using top-down approaches rather than dialogue methods.

8. The panel appointed a small working group to formulate a common understanding of the term "traditional knowledge":

(a) By recalling that there is a set of terms which are used sometimes interchangeably with traditional knowledge and yet have another meaning such as local knowledge, indigenous knowledge, endogenous knowledge, sustainable knowledge, folk knowledge, cultural knowledge etc., all terms indicating that a simple listing of various examples of traditional knowledge cannot express the specific characteristic of this type of knowledge;

(b) By recalling the background of the UNCCD as a follow-up to the United Nations Conference on Environment and Development, which arose out of the concern to combat environmental degradation through poverty alleviation and sustainable development;

(c) By reviewing the use of the term "traditional and local technology, knowledge, know-how and practices..." in the text of the Convention to Combat Desertification (Art. 18.2) in four of the six official languages of the United Nations; and

(d) By listening to the various dimensions of the term's meaning as used and expressed by the members of the panel.The working group developed a common understanding of the term "traditional knowledge" which was thereafter adopted by panel.

10. Traditional knowledge consists of practical (instrumental) and normative (enabling) knowledge about the ecological, socio-economic and cultural environment.
11. Traditional knowledge is people-centred (generated and transmitted by people as knowledgeable, competent and entitled actors), systemic (inter-sectorial and holistic), experimental (empirical and practical), transmitted from one generation to the next and culturally valorized.
12. This type of knowledge promotes diversity; it valorizes and reproduces the local (internal) resources. Successful experiences based on traditional knowledge.
13. The panel members presented successful experiences of local development based on traditional knowledge in all continents and developed criteria for building on traditional knowledge to generate sustainable development at local level. A summary of the case studies presented is contained in the background documentation listed in annex II.
14. Several interesting examples were recalled; the following serve solely as a brief illustration.
15. One of the most successful techniques for the rehabilitation of strongly degraded land in the Sahel is the improved traditional planting pit or „zai". This traditional technique was improved in the early 1980's by a farmer in the Yatenga region of Burkina Faso. He increased the diameter and the depth of the traditional pits and put manure in them during the dry season.
By concentrating water and soil fertility in one spot, millet and sorghum grow well and can survive dry spells during the rainy season. Tens of thousands of hectares of degraded land have been brought back into production in the Sahel using this technique, either on its own or in combination with another improved traditional technique, the contour stone bunds. The "zai", which in some cases are also used for tree planting, allow the regeneration of trees. For instance, in the Yatenga region of Burkina Faso, one now finds considerably more trees on farmers' fields han 15-20 years ago. One farmer remembered that he had nine trees on his barren fields in 1983, but 2000 trees in 1999, and he is not an exception. The "zai" technique has spread rapidly, because it permits a harvest in years of low rainfall (300-400 kg/ha of millet) and yields are high in good years (1,500-2,000 kg/ha). The "zai" have substantially improved food security at family level and at the same time have improved the environment. This innovation has spread across country and cultural boundaries.
16. The most widespread system characteristic of the Mediterranean area is the terracing system that can be found in the Middle East, Greece, Italy and Portugal. These sites adopt the techniques of rainfall harvesting, protected vegetable gardens, the use of organic waste for the creation of compost and fuel, the methods of passive architecture and of climate control for food storage and for energy saving as well as the practices of recycling productive and food residues. The aesthetic qualities, the beauty of natural materials, the comfort of architecture and spaces, the organic relationship with the landscape that the ancient towns of the area boast are especially due to the qualities of traditional techniques and to the search for symbiosis and harmony intrinsic in local knowledge. The survival of traditional societies in the whole Mediterranean area depends on the effective, economic and sustainable management of natural resources. In the Mediterranean area, which is characterised by intensive settlement, the environment is not only the result of natural processes, but rather represents a cultural landscape where historical centres are the crystallization of knowledge appropriate to environmental management and maintenance.
17. In the Indian Himalayas, in oases situated above 3,200 m altitude in a cold desert, the Ladakhi people obtain high crop productivity on terraces irrigated by making use of the seasonal melted snow. The careful management of water (200 mm precipitation per year) relies on the interrelatedness between social, institutional, technological, economic and spiritual aspects of water management which are managed in a decentralized way by the oases' inhabitants themselves. They thus control their water system, which in turn is interlinked with the agricultural calendar. Processes of modernization, such as demographic growth and economic change, have not affected the rules governing the water management system. Instead the communities careful select certain modern technologies (e.g., solar energy) while rejecting others (e.g., chemical fertilization which cannot be absorbed by these high-altitude, sandy soils).Conservation and improvement of soils
18. The use of organic materials and mechanical barriers is a widespread practice in the Latin

America and the Caribbean region, consisting of the application of diverse organic materials and other waste from agricultural and industrial production by incorporating them in the earth. The benefits are that the application of this organic material has low costs, depending on how far the material has to be transported. Therefore, it is considered desirable to use local materials. With this procedure, it is possible to obtain more economical use of water, to diminish soil erosion, to control weeds, to incorporate organic material into the soil and thus to ameliorate its chemical and physical consistency, to re-inject nutrients and to influence the thermo-regulation of the soil.

19. Other successful experiences in the construction of mechanical barriers consist of the use of special plants and objects or the combination of both to build a continuous barrier of vegetation which follows the contours of the slope. These barriers reduce the flow of water, and slow run-off and erosion. After several years these barriers form small terraces which accumulate soil and water and thus become productive for agriculture. The cost of this practice is low and does not require high financial investments. The most direct benefits are a reduction of soil loss, a reduction of water loss, a reduction of slope steepness, a better diffusion of soil humidity, regulation of temperature and an increase of organic materials as well as an improvement of the physical and chemical soil conditions.
20. To evaluate whether traditional technologies can be applied successfully to combat desertification, the following criteria were identified:

(a) They must have as their objective the solution of a specific problem or various specific problems;
(b) Local cultural, social, economic, political and environmental conditions have to be considered when applying traditional technologies;
(c) The community must consider these technologies to be in accordance with its own objectives and priorities and their adoption is the result of a horizontal dialogue and not a vertical decision;
(d) The general principles of traditional technologies should be extracted and adapted to the specific local conditions;
(e) They should allow for gradual adaptation to local conditions and level of technology; and
(f) Successful adoption of a traditional technology should be preceded by an open dialogue between those who propose the technology and the end-users.

III. THREATS AND CONSTRAINTS

21. The following threats and constraints to the maintenance and development of traditional knowledge were discussed by the panel:

(a) Poverty leads to abandonment of traditional technologies (hard work and low returns on labour), but it can also act as an incentive to innovate and to invest labour in these technologies;
(b) The undermining of local entitlements to the use and management of natural resources, particularly land and water;
(c) The lack of recognition of the value and specifically the economic benefits of traditional knowledge;
(d) The failure to evaluate cultural and social effects of technological change;
(e) The failure to recognize the complementarity of traditional and modern knowledge;
(f) The non-recognition of the importance of women's roles in managing natural resources in areas affected by desertification;
(g) The lack of recognition of the role that women play as innovators in developing local technologies;
(h) The lack of recognition of the diverse and systemic (holistic) nature of traditional knowledge;
(i) Attitudes of extension services that "modern" is better and that "traditional" is backwards.

IV. STRATEGIES TO INTEGRATE TRADITIONAL AND MODERN KNOWLEDGE

22. Taking as a starting point that traditional knowledge is in a continuous process of change, adaptation and innovation, the panel discussed the questions: What can be learned from traditional knowledge? What makes traditional knowledge successful? And how can it be linked with modern knowledge?
23. To create an enabling environment in which traditional knowledge can be maintained and further developed requires a careful analysis of the culture-specific division of roles and power relationships which determine the possible roles of innovators and the extent to which inventions are shared amongst the community. It also requires security, time and resources to embark upon risks and innovations. Important elements can be learned from the systemic and complex character of traditional knowledge which is embedded in its ecological context and cycles. Furthermore, traditional models of development can be revitalized and provide a basis for developing a new technological paradigm. Finally, ecological and cultural side-effects of technologies should be evaluated, including considerations about the sustainability of the whole system and an analysis of its resource use (e.g., energy). The following strategies to integrate traditional and modern knowledge were suggested:

(a) To adopt a bottom-up approach in research and development which puts the farmer-innovator at the centre;
(b) External experts should learn to listen and to enter into dialogue with the knowledgeable local actors;
(c) Mechanisms to share and disseminate traditional knowledge and its innovations horizontally can be set up and supported (e.g. regional radio programmes, farmer-to-farmer networks);
(d) There is a relationship between the capacity of decision-making and the capacity of realizing innovations. Therefore, empowerment is an essential dimension of encouraging innovations, especially among women;
(e) Local entitlements on the use and management of natural resources should be strengthened and consolidated when modern knowledge or technologies enter into traditional settings;
(f) Mechanisms to valorize and recognize the achievements of knowledgeable local actors and inventors should be developed;
(g) Truly participatory bottom-up approaches to development are necessary. Their adaptation includes a change of attitude among experts. The role of external (national and international) experts should be critically assessed;
(h) Because women are essential managers of natural resources and therefore possess extensive traditional knowledge concerning the natural environment, extension services should have a better gender ratio. Furthermore, the relationship between gender, science and technology should be carefully investigated. There are very few women researchers and recognized innovators. The role of science in traditional technology has thus to be viewed from a gender perspective;
(i) Horizontal dialogues between members of different cultures and an understanding of the cultural specificity and diversity in which traditional knowledge is reproduced and expressed (in practices, in festivities, in rituals etc.) are two key elements of the anthropological methodology which permits the understanding of „agri-cultures" as complex systems of knowledge and practice. A „culture to culture" relationship should replace the „I (expert) will capacitate and instruct you" approach.

V. MECHANISMS FOR PROMOTING AND EXCHANGING SUCCESSFUL APPROACHES

24. Several mechanisms can be used to effectively promote and exchange approaches and innovations developed by local communities, as for example:

(a) Farmer study and exchange visits should be organized in areas with similar agro-ecological conditions in such a way that their impact can be maximized through better preparation, implementation and follow-up and that women and men land managers benefit equally. Adequate restitution of information is required after participation in such visits. Furthermore, successful natural resource management experiences should be systematically collected for further use;
(b) The media can be an effective means of spreading information concerning local innovations, specifically when used in a systematic way.

VI. RECOMMENDATIONS

25. Taking into account that local and traditional knowledge is dynamic and includes processes of innovation relevant to combating desertification, the ad hoc panel recommends that the Conference of the Parties identify and support local processes of innovation in natural resource management and include them as starting points, in the implementation of the national action programmes.
26. It therefore recommends that the Conference of the Parties:

(a) For the implementation of the national action programmes, consider:
(i) Facilitating a compilation of research and information on traditional knowledge in databases

and developing adequate methods and procedures for their compilation, storage and dissemination;

(ii) Setting up a system of monitoring and backstopping and adequate mechanisms which ensure that a dialogue between communities affected by desertification, planners and external support agencies effectively takes place;

(iii) Developing and promoting adequate methodologies and procedures which ensure that action-oriented research is carried out as a truly horizontal dialogue to promote bottom-up development approaches to combating desertification;

(iv) Including farmer study and exchange visits on traditional knowledge and local innovations;

Consider the content of the following activities and their implementation:

i) To monitor and follow up the mechanisms by which reciprocity between traditional and modern knowledge is being addressed and promoted as well as how cultural diversity is being recognized in the implementation of national action programmes;

(ii) To evaluate how the networks and mechanisms created by the UNCCD (regional networks, regional coordination bodies, national focal points) are incorporating traditional and local knowledge and to develop appropriate recommendations;

(iii) To ensure that the concerns identified by the ad hoc panel relating to traditional and local knowledge are included in the national action programmes and in the survey and evaluation of networks at the national level;

(c) Reappoint the present panel in order to develop appropriate criteria, methodology and mechanisms for implementation of the above-mentioned activities.

Annex I. Members of the Ad Hoc Panel on Traditional Knowledge Appointed by the Conference of the Parties.

Mr. Jean-Claude Bomba	Central African Republic
Mr. Michael Tim Hoffman	South Africa
Ms. Marie Nery Urquiza Rodriguez	Cuba
Mr. Christiaan Reij	Netherlands
Ms. Sunita Narain	India
Mr. Sulemana Osman Saaka	Ghana
Mr. Muhammad Shatanawi	Jordan
Mr. Juan Torres Guevara	Peru
Mr. Ashot Vardevanyan	Armenia
Ms. Corinne Wacker	Switzerland

Consultants Presenting Reports at the Matera Meeting

Mr. Pietro Laureano (Italy)
Ms. Rebeca Leonard (U.K.)
Mr. Salah Tahoun (Egypt)

1.5 Building Linkages Between Environmental Conventions and Initiatives ICCD/COP(3)/CST/3/Add.1

Pakistan. Eucalyptus trees planted to shelter fields from the wind.
Photo: G. Bizzarri. FAO/17199.

Executive summary

The purpose of this report is to explore the means of linking work being done by the Committee on Science and Technology of the United Nations Convention to Combat Desertification on traditional knowledge, with similar activity being undertaken under other related conventions.

Given the number of international initiatives stemming from the 1992 United Nations Conference on Environment and Development, held in Rio de Janeiro, some level of collaboration is essential.

The report begins with a short exposition of key concepts involved in the discussion. Thus it describes the attributes of traditional knowledge and clarifies the distinctions between traditional and modern scientific methods. The importance of traditional knowledge for the development of drylands is highlighted: harnessing the know-how of local people to develop appropriate technologies aimed at improving conditions and incomes in affected dryland areas.

The main chapters of the report discuss the provisions of the conventions which relate to the promotion of traditional and local knowledge and the rights of knowledge holders and the initiatives of the various convention institutions. The work of the UNCCD Committee on Science and Technology in this field is described, as well as the decision of the Conference of the Parties at its second session, which provides for a review of initiatives on traditional knowledge. The work of the Convention on Biological Diversity has a very high profile and the links established with the other environmental conventions are discussed. The CBD has appointed a programme officer to look in detail at the implementation of the Convention's provisions in relation to traditional knowledge.

Several initiatives to look further into the role of the Convention in this field have been taken, such as the holding of a workshop on traditional knowledge and biodiversity in 1997 and the decision to convene an ad hoc working group meeting early in 2000. This meeting could represent a good forum in which the UNCCD secretariat could highlight its own role and concerns related to traditional knowledge.

As far as traditional forest-related knowledge is concerned, this was one of the issues left pending at the conclusion of the International Panel on Forests meeting in 1997. It has since been considered by the Intergovernmental Forum on Forests, with the CBD, as a member of the Inter-Agency Task Force on Forests, taking a leading role in developing the conclusions of the Forum on traditional knowledge.

The Ramsar Convention on Wetlands was originally oriented towards the conservation of nature without a specific emphasis on the people who made their livelihoods from these critical resources.

The Convention has not focused its attention on traditional knowledge and methods thus far.

However, in 1997, it began a process of examining the vital link between wetlands and people. This process culminated in the recently approved guidelines for the greater involvement of local people in the management of wetlands, which could be instructive for other conventions to consider.

Much of the debate at the international level focuses on the intellectual property rights of indigenous and local peoples, with reference to the past exploitation of less developed legal systems to protect the resources of developing countries. The relevance of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs) is outlined. Currently plant breeders' rights are given greater protection than farmers' rights. However, the important initiatives of FAO in the negotiations on the International Undertaking on Plant Genetic Resources are also highlighted.

The experience of other organizations should not be overlooked. UNESCO is responsible for a number of conventions which promote the cultural and heritage rights of indigenous peoples.

In this report, the recent initiative to set up a database of best practices relating to traditional knowledge is highlighted and considered useful. UNEP is taking important steps to facilitate the coordination of environmental conventions and the initiatives could provide valuable opportunities

for greater collaboration and cooperation.The conclusions of the report relate to the importance of sharing information concerning these initiatives, at the international level. This applies to all the relevant convention institutions, which should be apprised of the interests of the UNCCD in this field. There is a potential risk of duplication of efforts if coordination is not increased. It is important also to minimize requests for information at the national level unless there is clear guidance as to how this might be useful in the effective implementation of the Convention. Although there is a great deal of complementarity between the UNCCD and the CBD, there is also a difference in emphasis between the two. The CBD places emphasis on the rights of indigenous and local knowledge holders over their knowledge base, often with reference to preventing exploitation by foreign companies. The UNCCD focus, on the other hand, is concentrated on the value of this knowledge in the improvement of rural livelihoods in dryland areas. The UNCCD could usefully highlight at international forums the importance of facilitating participatory methods of research and extension, farmer and resource user networks and broader participatory development. The question of incentives for cooperation is another issue that could be highlighted.

National level coordination is essential in the implementation of the UNCCD. There is a need to ensure that policies which aim to promote the contribution of local and traditional knowledge are coherent with other social, economic and cross-sectoral policies. Coordinating the work of the conventions at the international level can facilitate their more effective implementation at the national and local levels and avoid duplication of time and effort.

I. INTRODUCTION

1. The purpose of this report is to explore the means of linking work being done by the Committee on Science and Technology of the UNCCD on traditional knowledge, with similar activity being undertaken under other related conventions. Given the number of international initiatives stemming from the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, some level of collaboration is essential. Joint work makes it possible to improve the quality of activities being undertaken, avoid the duplication of efforts, build on what has been learnt and focus on areas where attention is still required. But collaboration, though it saves human and financial resources, also imposes demands on staff and funds. As a result, it is important to clarify, in any particular instance, the goal sought by collaboration, and how best to achieve this. While this report will explore areas for synergy between the international conventions, it is also vitally important to encourage coordination at national level, particularly in the formulation of strategies and action plans. It should be remembered that the ultimate beneficiaries of the UNCCD are intended to be the inhabitants of those areas affected by desertification.

2. Human activities are recognized as a cause of dryland degradation in the definition of desertification provided by Article 1 of the UNCCD. However, human action can also be seen as providing a key to the better management of dryland areas. Actions are shaped by knowledge, experience, incentives and habit, and are by no means unchanging. Traditional knowledge evolves through observation, experimentation and experience, given changing circumstances and opportunities. Thus, approaches to drylands management need to identify ways of building on the knowledge of different stakeholders – farmers, herders, local and national government officials, the private sector, nongovernmental organizations, researchers, extension agents, donors, and project staff. The sharing of knowledge from these different sources should aim at a marriage of experience and ideas, which builds on lessons of the past in order to develop better policies and interventions to combat desertification.

3. This report is set out in four sections. The first section focuses on key concepts and analyses the importance of traditional knowledge. The second discusses the work of the institutions of the United Nations Convention to Combat Desertification, the Convention on Biological Diversity and the Forest Principles. These three agreements were all products of UNCED in 1992 and thus share common objectives. In order to discuss their interrelation, each section begins with a discussion of the main principles and articles and how they might be implemented to promote the knowledge and technologies of traditional and local communities. The third section examines other conventions whose terms have an important bearing on the work discussed in the previous section. The new initiatives of the Ramsar Convention on Wetlands are reviewed first. Thereafter, the implications for traditional and local communities of the main international instruments relatingto intellectual property rights are considered, including the FAO farmers' rights initiative.

4. The fourth section looks at the UNESCO MOST programme, which seeks to publicize best practices of indigenous knowledge, and UNEP, which is taking important steps to develop synergies between the related conventions. The final chapter draws together the conclusions of the report and puts forward some recommendations to the UNCCD.

A. Key concepts

5. Before beginning the substance of this report, it is sensible to outline the key concepts used, although it may be difficult to give precise definitions of some of the complex issues involved.

6. The word "traditional", when taken to describe the knowledge systems of local communities, implies a contrast with modern systems, but this should not mean that such knowledge is backward, or inappropriate. In this report, and in all of the texts quoted, the knowledge and technologies that may be considered "traditional" are those which are adopted in accordance with customary rules, institutions and practices such as spoken transmission. As Dutfield (1999) points out, local people develop, through continuous experimentation and observation, their own methods which are attuned to their needs, environmental conditions and other socio-economic factors. Thus, there is no contradiction in speaking of "traditional innovation". For example, the zai of northern Burkina Faso represent a soil and water conservation method which has evolved to suit the increased urgency of capturing limited rainfall, and maximize use of limited supplies of manure (Reij et al, 1996). Methods of conservation tillage, which are currently widely promoted as a sensible method of managing fragile or less fertile soils, are essentially based on traditional methods. Tightly woven rope baskets used in parts of India can keep rice free from rats for up to five years, unlike the plastic alternatives which can now be seen in many areas. Indeed, given the well publicized contribution of traditional knowledge to environmental management, such know-how and technology are now widely recognized as forming part of the body of science.

7. Certain characteristics tend to distinguish western or modern science from traditional knowledge. In the main, traditional knowledge is acquired through observation and "hands-on" experience or through personal reporting and a mix of trial and error (Scoones and Thompson, 1994). Often natural resources, such as land, are seen as part of the spiritual world, which needs to be placated through ritual offerings. Traditional approaches tend towards the holistic and qualitative, in contrast to the quantitative methods of Western science. In rural areas, the rural people do theorize about agro-ecosystem processes and dynamics. resource users are themselves the researchers, which allows an appreciation of many locally specific factors in assessing the viability of a particular technology or new practice. This adaptability or flexibility is useful, given the variability associated with dryland ecosystems. For example, indigenous soil and water conservation measures tend to be iterative in approach, which spreads labour requirements for construction and maintenance, in contrast to a single major investment of capital and labour at the start, which is necessary for most introduced techniques (Reij et al., 1996).

8. The approach of the UNCCD in addressing traditional and local technologies does not necessarily imply a concern solely with the purely technical aspects of such knowledge. Traditional environmental knowledge and practices are often inextricably integrated with socio-economic, institutional and cultural values, which should not be overlooked. Indeed, divorcing the socio-cultural values linked with a practice can significantly devalue it in the eyes of the local people. Thus, for example, project interventions should be selected with care, to avoid sacred burial grounds and other sites. At the same time, it makes sense to work with and build on existing social structures, rather than assuming the need to establish new institutional forms. For this reason as well as many others, it is essential that resource users are involved in the process of development and research for it to be sensitive to those wider concerns of local people.

9. Outside observers often assume that traditional knowledge is vested in the broader community, in a general sense. Though this may be the case in some areas, elsewhere knowledge holders may be clearly identifiable individuals or groups within communities. Particularly in the case of medical knowledge, secrets may be held by "wise women" or "wise men" and passed on through restricted channels (Dutfield, 1999). It is important to involve such individuals, since ignoring their concerns can be counterproductive. Agricultural knowledge tends to be much more widely spread than medical wisdom, due to its greater visibility and more tangible qualities.

Nevertheless, it has been observed that farmers often do not stray into the fields of their neighbours to observe what they are doing there, for fear of accusations of mischief-making. Even where knowledge is shared amongst all members of a community, opinions regarding that knowledge are not universally held. For this reason, it is important to ensure that community-level activities systematically involve all stakeholders.

10. A number of writers note the difference between what may be termed "technology" as opposed to "practice", and what constitutes "knowledge" as opposed to "know-how". However, for the purposes of this report, the terms are used here interchangeably.

B. Why is traditional knowledge important?

11. The provisions of the UNCCD recognize "traditional and local knowledge" as part of the range of technologies and techniques which could be harnessed to manage dryland ecosystems in a more sustainable way. The benefits of such knowledge relate to identification of useful farm practices, plant and animal species, and forms of social organization which function well in a particular agro-ecosystem. Farmers understand many aspects of soil, water, plants and other living organisms and apply them in combination with ecological processes. In many parts of Africa, for example, knowledge of plant succession is used to assess the condition of rangelands and to regulate grazing intensity. Equally, many farmers are well aware that the appearance of certain plants on their land provides a warning that soils are becoming exhausted. Such knowledge can supplement scientific analyses and extension advice by offering valuable insights into the complex interactions within natural systems. However, farmer knowledge is by no means perfect. In particular, there are frequently shortcomings in their understanding of below-ground, or microscopic processes, or those which take place sufficiently slowly for them to be less clearly apparent. It is for this reason that in Australia, the Landcare approach has encouraged use of aerial photography to help farmers understand broader patterns of land degradation which are not so apparent when standing on the ground. Equally, farmer field schools have aimed to give farmers a better grasp of those factors which they are less able to monitor without proper equipment.

12. One indirect, but extremely important, benefit to be gained from placing increased value on the cultures and knowledge of local communities and recognizing their stake in these resources is the greater incentive for conservation which this should bring. Much of the world's crop diversity is in the custody of farmers. Such diversity is of great local benefit to diets, income generation, stability of output, risk minimization, insect and disease resistance, more effective use of labour, and maximization of returns under low levels of technology. But this diversity also consitutes a global asset of very great significance with many, as yet unknown, benefits.

13. Finally, the strengths of traditional know-how are not limited to the tangible. Supporting and developing traditional knowledge, and the institutions and values linked to them, are essential building blocks for a process of community empowerment.

II. THE RIO AGREEMENTS

14. In order to discuss the synergies between the institutions and international organizations which implement the conventions, it is necessary to establish the common ground between the provisions and objectives of these international instruments. In the following sections, we examine first the provisions of the related conventions which are relevant in this field and then the programmes of work of the secretariats and other convention institutions which are important to the protection and promotion of traditional knowledge. At the close of each section, some points of guidance and recommendation are suggested.

A. United Nations Convention to Combat Desertification

15. The aim of the Convention is not simply to combat desertification but to work for sustainable development and improved living conditions of the people who depend on affected dryland areas (art. 2). The primary obligations of the Parties to the UNCCD relating to traditional knowledge are found in three articles within the text. The most detailed provisions are set out in paragraph 2 of article 18 on transfer, acquisition, adaptation and development of technology (see box 1). Others relate to the collection, analysis and exchange of information (art. 16) and research and development (art. 17).

Box 1: United Nations Convention to Combat Desertification, article 18.2

The Parties shall, according to their respective capabilities, and subject to their respective national legislation and/or policies, protect, promote and use in particular relevant traditional and local technology, knowledge, know-how and practices and, to that end, they undertake to:

(a) make inventories of such technology, knowledge, know-how and practices and their potential uses with the participation of local populations, and disseminate such information, where appropriate, in cooperation with relevant intergovernmental and non-governmental organizations;

(b) ensure that such technology, knowledge, know-how and practices are adequately protected and that local populations benefit directly, on an equitable basis and as mutually agreed, from any commercial utilization of them or from any technological development derived there from;

(c) encourage and actively support the improvement and dissemination of such technology, knowledge, know-how and practices or of the development of new technology based on them; and

(d) facilitate, as appropriate, the adaptation of such technology, knowledge, know-how and practices to wide use and integrate them with modern technology, as appropriate.

16. Thus, the Convention sets out four specific activities which Parties are called on to implement according to their respective capacities, and subject to national legislation and policies. The first of these is the obligation to collect information on traditional and local knowledge and techniques, with the participation of the knowledge holders and, more broadly, local populations. Here, echoing article 18.2 as a whole, attention is drawn particularly to the potential use of such know-how. Any such inventories which aim to record traditional knowledge should therefore also present the environmental, socio-economic and cultural context, as these factors may have an important bearing on the replicability of the practices described. As well as a clear exposition of the research methodology, reports should also identify the organizations and persons involved in researching and supporting the know-how of rural communities, in order to ensure proper coordination at the various national levels. The UNCCD makes no mention of where such information might be stored. However, safeguarding information in remote databases may not be very productive as they cannot easily be updated and cannot contain a sufficient level of detail to reflect the local specificity of the techniques in question. Furthermore, technologies change continuously through the adaptive and flexible practices of local people. Thus, there is only a limited need to obtain archival documentation and this might be better sourced in local databases. Reports gathered by the secretariat and the experience with the UNESCO MOST database could prepare the way for an informed debate on the merit of establishing and maintaining such databases, the expenses involved and their overall utility.

17. It is also important to identify for whom the information is intended. In regard to the collection, analysis and exchange of information, article 16(b) calls for this to "address the needs of local communities and... decision makers". These needs are different, however, and different types of information resources are needed. For example, while some local people might benefit from recourse to very detailed information on a particular technique, decision makers might require more general information about how best to incorporate local ideas into development programmes. The second obligation of the Parties is to develop adequate measures for the protection of traditional knowledge. As article 18.2(a) is partly concerned with the protection of knowledge from disappearance, we will discuss this with reference to protection from exploitation by others. Such protection need not be through national legislation. A mutually agreed contract between providers and developers may be a more effective device where foreign companies are involved, as long as ways can be found to bolster the bargaining power and negotiating skills of traditional communities (see Glowka, 1998). The UNCCD also goes beyond the requirement to ensure that communities are not impoverished by the sharing of their knowledge. Where financial benefits accrue to those who disseminate or develop the information commercially, a share of the profits or an acceptable equivalent should accrue directly to the originator of that knowledge.

18. Striving to protect knowledge should not prevent access to it completely, particularly if such knowledge can lead to the development of better and more appropriate ways of coping with desertification. The purpose is rather to prevent exploitation to the unfair advantage of traditional knowledge holders. The issues relating to the equitable sharing of benefits are discussed in section B below.

19. The third obligation recognizes that local people may lack access to information sources beyond their traditional channels. This lack of access is often a more significant reason for the slow pace of technical advance of traditional knowledge than any supposed lack of interest in change. Parties are called on to support communication of knowledge (see also article 16(g)). This can be achieved through documentation as discussed above. However, at least as important is the promotion of networking amongst farmers, forest users, herders, traditional healers etc., in order to foster the spread of ideas, tips and successful practices. In this way, information is communicated through direct experience - farmers speaking to and questioning other farmers from similar communities, in their own language and phrases. Similarly, support to farmer-managed demonstration plots enables farmers to see with their own eyes the practical implementation of proposed methods and results.
20. The fourth obligation of article 18.2 refers to the potential partnership between rural people's knowledge and formal knowledge. Not all rural practices and technologies are perfect. Many are extremely laborious and backbreaking and some can involve environmental destruction, such as deforestation for fuelwood or extensive land clearance. The potential for adapting these techniques and integrating them into introduced methods may be substantial, as can be seen from work in soil fertility management (Defoer et al., 1999) and farmer field schools (Scoones and Toulmin, 1999). This raises the challenge of building more effective partnerships between communities, researchers and extension agents. The UNCCD seeks to take up that challenge, firstly, through support for capacity-building and training of extension and other professional researchers to raise awareness of the need to move away from old style teaching methods towards facilitation of learning and interactive exchange (art. 19.1(c) and (h)). Secondly, it encourages participation of local people in the research process (art. 17.1(b) and (c)). The change in mentality which is needed to bring about a true partnership between the formally educated and the informally educated, may be easier to propose than to achieve.
21. However integration of traditional and modern knowledge is not only about encouraging collaboration of knowledge holders and decision makers. New technologies are not adopted or developed in a vacuum. People need to have a certain amount of income and tenure security to be able to think about undertaking new capital investments. The returns on these investments also need to be attractive and therefore price levels and market access (in terms of both infrastructure and transaction costs) cannot be overlooked. Article 18.1 addresses some of these points by calling on countries to "take appropriate measures to create domestic market conditions and incentives... conducive to the development [and] transfer... of suitable technology [and] knowledge". The issue of tenure security is also touched upon in the regional annex for Africa (arts. 4.2(b) and 8.3(c)(iii)).

1. National action programmes

22. Parties to the Convention are committed to develop a national action programme to incorporate long-term strategies to combat desertification (arts. 9 and 10). Where possible, the national UNCCD agenda should be integrated within any existing environmental plans or conservation strategies. The NAP is meant to follow a process-oriented, bottom-up approach, which should build on local level development activities to preserve and/or restore the resource base and improve the livelihood security of affected populations. Increased flexibility in project design, funding and implementation is required by article 13, in keeping with the experimental, interactive approach indicated for participatory action at the local community level.
23. The Office to Combat Desertification and Drought reviewed the experiences of the NAP process in a number of countries, particularly in Africa, and found that although many are at the initial phase, substantial progress has been achieved. With respect to effective stakeholder participation, it noted that this was difficult to achieve in some countries due to logistic constraints, such as language barriers, and traveling distances. They also warned that the traditional knowledge of women, in particular, was generally excluded, and would continue to be sidelined unless recognition of women's specific roles and responsibilities in management of resources and drylands became an integral feature of the NAP process (UNSO, 1998).

2. The COP and the CST

24. The commitments contained in the UNCCD were taken up by the Conference of the Parties at its first session (COP 1), which encouraged the Parties and observers to collate information on the use of traditional and local technology, etc. In response, information was submitted by 12 Parties and 5 observers

to the secretariat, which subsequently compiled a summary outlining the variety of techniques identified by the individual reports. The main techniques reported related to: control of wind and water erosion, water conservation, improvement of soil fertility, plant protection, forestry, social structures, housing and architecture. The synopsis was presented to the Committee on Science and Technology at the second session of the COP in December 1998. Among the issues highlighted for attention were the legal implications of intellectual property rights, ways of harnessing the positive attributes of traditional knowledge and the greater inclusion of traditional communities in the preparatory stages of national action programmes. The Committee, recognizing the role of women in food production and the management of natural resources, also discussed the importance of including women in indigenous knowledge networks and the need for gender-sensitive policies and programming.
25. Also at COP 2, the secretariat was requested to complete its ongoing work on compiling the regional and subregional reports on the most important and widely applied examples of traditional knowledge. The Conference also requested the secretariat to prepare a report on traditional knowledge in dryland ecosystems, drawing on the discussions that took place at the second session of the Committee and the synthesis report. The present report was commissioned as a follow-up to decision 14/COP.2.
26. An ad hoc panel of 10 experts was appointed to assist the CST. The two reports referred to above were presented to the first meeting of this panel in July 1999. Drawing upon the secretariat's synthesis of traditional technologies for dryland management, the panel was charged with identifying successful experiences and drawing conclusions related to threats and other constraints. The threats identified by the CST were encroachment by inappropriate modern technologies and pest invasions, biodiversity loss and climate change as well as population dynamics, the marginalization of women and widespread poverty. Specific case histories for integrating traditional and local knowledge into modern knowledge were also discussed by the panel, based on specific case histories; and mechanisms for promoting and exchanging successful approaches. The conclusions and recommendations of this panel will be communicated to the COP at its third session.

3. Guidance and recommendations

27. The concern of UNCCD with promoting, protecting and using traditional and local knowledge seemed to be little known to many of the people contacted in the preparation of this report. The ongoing information-gathering exercise of the secretariat on compiling regional and subregional reports on widely applied traditional knowledge, generated interest amongst the other secretariats, in particular the CBD. It would seem worthwhile, therefore, to circulate more information about such initiatives amongst other organizations that are currently proposing to undertake similar exercises.
28. It might also be worth undertaking a joint reflection with other convention secretariats regarding the utility of further inventories of indigenous ecological and technical knowledge. It might be useful to move from a listing of technologies towards indentifying how these can provide the basis for more effective action in partnership with local people. The approach of the UNESCO/CIRAN database described below could be particularly instructive in this regard. What is important therefore is less the technical aspects and dimensions, and more the broader facilitating environment which can ensure that local ideas are respected and the valuable skills of local people harnessed.

B. Convention on Biological Diversity

29. The Convention on Biological Diversity was the first international treaty to acknowledge the vital role of traditional knowledge, innovations and practices in environmental conservation and sustainable development, as well as the need to guarantee their protection whether through intellectual property rights protection or other means. The Convention was adopted at UNCED in 1992 and, in common with the UNCCD, upholds the principles of Agenda 21 and the Rio Declaration. The three overall objectives of the CBD are: the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. It is useful to point out also that, whereas the UNCCD refers to affected dryland countries and has a particular focus on Africa, the CBD may apply all over the world. However, the CBD is currently developing an "ecosystem approach" which will focus discussions on systems such as forests, inland waters, marine and coastal areas etc. The next COP in May 2000 will concentrate its efforts on biodiversity in dryland environments.

30. The conservation of livestock and plant diversity is complementary to the goal of countering land degradation. Crop diversity can be harnessed to maintain soil structure and fertility, provide some protection against risk and prevent pest damage. Herd diversity allows several species with different dietary preferences to forage efficiently in the same range, as well as constituting a well-tested risk diversification strategy. Indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biodiversity are seen as important actors in the implementation of the CBD and many indigenous groups are represented at the meetings of the Convention as observers or are included in national delegations.
31. The main obligations under the Convention concerning knowledge, innovations and practices of indigenous and local communities are contained among the provisions for in situ conservation. In the main, they are very similar to article 18.2 of the UNCCD, though their focus is on biodiversity conservation. The Parties are called on wherever possible to respect, preserve, maintain and promote such knowledge and practices (see box 2), with the approval and involvement of the people concerned and to encourage the equitable sharing of benefits. The COP has expressly acknowledged the need to recognize traditional knowledge as being of similar importance to high-tech science and worthy of respect. The Convention does not elaborate on how this knowledge should be preserved, maintained or promoted.

Box 2: Convention on Biological Diversity, article 8(j)

Each Contracting Party shall, as far as possible and as appropriate ...

- Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity;
- Promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices; and
- Encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.

32. Several other provisions of the Convention are also relevant to this discussion. Article 10(c) for example, seeks to protect and encourage customary use of biological resources in accordance with ecologically sound traditional cultural practices. As with the UNCCD, the exchange of information on indigenous and traditional knowledge as such and in combination with other technologies is also highlighted (CBD art. 17.2) and Parties are required to encourage and develop methods of scientific and technical cooperation for the development of traditional technologies (CBD art. 18.4).
The provisions of the CBD must be seen against the background of the substantial commercial interest in the chemical and genetic aspects of biological diversity. However, biodiversity is not solely the preserve of the humid tropics. Dryland areas are home to a wealth of plant and animal species, many of which are, and have been, commercially important for agriculture, the pharmaceutical industry and tourism. Successful exploitation of genetic resources can be very profitable but the risks are also high. Much of the world's biodiversity is found in rural areas of developing countries. Furthermore, much of the knowledge which is used to identify the potential beneficial properties of little known species is in the hands of traditional communities. However, in the past, developing countries received few of the benefits from "bioprospecting", while successful companies in developed countries benefited greatly (see Swiderska, 1999). This background of concern about the risks of exploitation has led to emphasis throughout the CBD text on the "equitable sharing of benefits" (see art. 8(j) above). Many provisions of the CBD concern access to genetic resources and fair access to any technology derived from them, whether or not these are covered by patents, etc. (arts. 15.7, 16.3 and 19.2). To this end, the CBD expressly requires "prior informed consent" before a contract to provide genetic resources can be validly executed. This is important in that it places a burden on prospecting companies to explain their actions and motives before attempting to secure agreement on "mutually agreed terms".
34. As the ownership of such resources is claimed by the State (art. 3), however, the agreement and consent discussed above are the prerogatives of the government. This contrasts with the UNCCD which holds that "owners of that knowledge will directly benefit on an equitable basis and on mutually agreed terms" (UNCCD art. 17.1(c)). Nonetheless, "approval and involvement" of local people is required

under article 8(j) of the CBD, as far as indigenous knowledge, innovations and practices is concerned. Several interesting pilot projects are currently being carried out to set up information directories that take account of the rights and concerns of traditional and local peoples. See, for example, the People's Biodiversity Register in India (Amruth, 1996) and the Geographical Information Systems database in construction in New Zealand (Harmsworth, 1998).
35. Parties to the CBD are also required to legislate and pursue policies to share fairly the results of research and development and the benefits arising from commercial and other utilization of genetic resources (art. 15.7). Article 17.2 calls for the repatriation of information, which can be very important in the effort to regenerate some of the knowledge lost in the decades of "modernization" and rekindle enthusiasm and pride in traditional knowledge.
36. The provisions of the CBD relating to indigenous and local communities are reflected in many other texts and policies.

1. National Biodiversity Strategies and Action Plans

37. As with the UNCCD, a major part of the CBD agenda is meant to be carried out at the national and local levels. One important obligation of the Parties is the development of national biodiversity strategies and action plans, though, in contrast to the UNCCD, little guidance on these plans is provided in the text of the Convention. UNEP is supporting the preparation of several such plans, with Global Environment Facility (GEF) funding. Article 6(a) recommends adapting existing strategies, plans or programmes, so as not to duplicate planning instruments unnecessarily. However, there is no central repository of national BSAPs, making it difficult for the secretariat to examine the extent to which they incorporate cross-sectional environmental issues and are integrated into existing strategies. Coordinated planning at the national level is important in terms of minimizing the time spent in consultation of the same groups for similar purposes. A recent UNSO report on the NAP process under the UNCCD noted that, in several countries, "local communities feel overloaded with consultations for various development programmes" (UNSO, 1998).

2. The COP and the SBSTTA

38. The programme of work for implementation of the CBD, as with the UNCCD, is governed by the Conference of the Parties, assisted by the Subsidiary Body on Scientific, Technical and Technological Advice and serviced by a secretariat. Following an initiative of COP.2, the secretariat appointed a programme officer on traditional knowledge in 1996 to work full-time on issues of implementation of article 8(j) and related provisions and the integration of traditional and local knowledge into the other thematic areas developed under the Convention, such as agricultural biodiversity (see below), forest biodiversity, biodiversity of inland waters and incentive measures. The programme officer is the main point of contact for indigenous and community groups wishing to find out more about the Convention and its programme of work and also to make their views heard within the secretariat.
39. An important early initiative of the CBD was to set up the clearing-house mechanism (CHM), which aims to promote technical and scientific cooperation at all levels among parties to the CBD through facilitating access to information. The clearing-house depends on a decentralized process to gather and organize the information needed by its users. Driving this process are the networks of focal points - national and international institutions. These centres coordinate initiatives on topics of common interest, encourage networking among government agencies, expert groups, non-governmental organizations and private enterprise at all levels. Each focal point also contributes to the clearing-house information system, which is accessible via the Internet. The CHM works with the Biodiversity Information Network, actively promoting synergies between conventions. An Indigenous Peoples Biodiversity Information Network has also been set up with the aim of assisting indigenous peoples to lobby for the implementation of article 8(j). It is currently in a pilot phase and seeks to support existing networks and broaden access to information on the CBD and related processes.

The Madrid workshop

40. At its third session, the COP called on those Parties that had not yet done so to develop national legislation and corresponding strategies for the implementation of article 8(j) in consultation, particularly, with representatives of their indigenous and local communities. Following the interest expressed at COP 3, the secretariat produced a report which considered the linkages between article 8(j) and related issues and provided some elaboration of the concepts underlying its key terms. The report also provided a survey of activities undertaken by other organizations and their possible

contribution to the work of the Convention on article 8(j).

41. Towards the end of 1997, a workshop on traditional knowledge and biodiversity was held in Madrid, for which case studies were invited. In response, 44 submissions were received from Parties, though only 10 countries were involved. Submissions were also received from 22 indigenous and local communities and 8 nongovernmental organizations and other organizations. The workshop itself was well attended, with representatives of 62 governments and 148 indigenous and local community groups and non-governmental organizations present. The reports of the two working groups provided advice to the COP on developing a workplace with respect to traditional knowledge issues and proposed a working group or a subsidiary body to consider the means of implementing article 8(j) and related provisions.

A new working group

42. Taking up the momentum created by the workshop, the Conference of the Parties at its fourth session recognized that traditional knowledge should be given the same respect as any other form of knowledge in the implementation of the Convention. The need for sustained dialogue with the representatives of local communities was strongly emphasized. This was reflected in one of the main outcomes of the session relevant to traditional and local knowledge, namely, the decision to set up an ad hoc open-ended inter-sessional working group. The mandate of this working group is outlined in box 3. The group is to be composed of Parties and observers including, in particular, representation from indigenous and local communities. Parties were requested to facilitate this and according to their capabilities to provide support for active participation by indigenous and local communities from their own countries.

Box 3: Mandate of the ad hoc open-ended working group concerning the implementation of article 8(j)

1. To provide advice as a priority on the application and development of legal and other appropriate forms of protection for the knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity;
2. To provide the Conference of the Parties with advice relating to the implementation of article 8(j) and related provisions, in particular on the development and implementation of a programme of work at national and international levels;
3. To develop a programme of work, based on the structure of the elements in the Madrid workshop report;
4. To identify those objectives and activities falling within the scope of the Convention; to recommend priorities taking into account the programme of work of the Conference of the Parties, such as the equitable sharing of benefits; to identify for which work-plan objectives and activities advice should be directed to the Conference of the Parties and which should be directed to the Subsidiary Body on Scientific, Technical and Technological Advice; to recommend which of the work-plan objectives and activities should be referred to other international bodies or processes; to identify opportunities for collaboration and coordination with other international bodies or processes with the aim of fostering synergy and avoiding duplication of work; and
5. To provide advice to the Conference of the Parties on measures to strengthen cooperation at the international level among indigenous and local communities embodying traditional lifestyles relevant to the conservation and sustainable use of biological diversity and make proposals for the strengthening of mechanisms that support such cooperation.

43. Of the short-term activities proposed by COP.4 in preparation for this meeting, the most prominent is the invitation to governments and international agencies, research institutions, and representatives of indigenous and local communities in 135 countries to submit case studies. Guidance for these studies indicates the five areas of concern: the interaction between traditional and other forms of knowledge on biodiversity; the influence of international instruments, intellectual property rights, current law and policies; the extent to which traditional knowledge has been incorporated into development and resource management decision-making processes; ethical guidance for the conduct of research about traditional knowledge; and matters of prior informed consent, fair and equitable sharing of benefits and in situ conservation.

Agricultural biodiversity

46. The work of the CBD on thematic areas such as traditional and local knowledge is coordinated with other main thematic areas of work under the Convention. Perhaps the most relevant to the overall work of the UNCCD is that of agricultural biodiversity. The term encompasses "the variety and variability of animals, plants and micro-organisms which are necessary to sustain key functions of the agro-ecosystem, its structure and processes for, and in support of food production and food security". Work in this sector is undertaken in close collaboration with FAO and an FAO officer has been seconded to the CBD secretariat to oversee activities in this regard. A joint FAO and CBD workshop on sustaining agro-biodiversity, held in Rome, December 1998, recognized the knowledge, innovations and practices of local farmers, herders and fishermen, as essential for the conservation and sustainable use of agricultural biodiversity, and highlighted the need for improved south-south exchanges of electronic information.

3. Guidance and recommendations

47. The CBD has continued to give high priority to the concerns of traditional and local knowledge holders throughout the discussions of the Conference of the Parties and SBSTTA meetings. The new initiatives under way represent good opportunities for sharing of information on traditional and local knowledge at the international policy level and exchange of national and local level experience.

49. Another point to signal is that a further round of case studies has been requested from Parties but few have so far been submitted. It would be wise to refrain from calling for more case studies on related subjects, without a proper examination of the value of these previous exercises (see also that of the IUCN Social Policy Group for the Ramsar Convention described below).

51. As concerns the national action strategies, there are signs that integration is taking place at the national level (UNSO, 1998). Clearly this is an area in which collaboration would be of great benefit. A multiplicity of plans with room for possible conflict is of little practical benefit. Encouraging the location of units dealing with desertification, biodiversity, forests and wetlands in the same department within a single ministry could pave the way to greater coordination, not just of logistical preparations for planning but of ideas arising from the stakeholders involved in the different conventions. The possibility of commissioning pilot studies to examine how countries are attempting to coordinate the related agendas could be of benefit.

C. Forest Principles

52. The Forest Principles adopted at UNCED share many of the same approaches as the CBD and the UNCCD relating to sustainable participatory development. Though the principles have not been incorporated into a formal convention, they nevertheless represent an important statement at the international level. The first of these principles recognizes the multiple uses of forest products and services.

53. Principle 12d provides that "appropriate indigenous capacity and local knowledge regarding the conservation and sustainable development of forests should, through institutional and financial support and in collaboration with the people in the local communities concerned, be recognized, respected, recorded, developed and, as appropriate, introduced in the implementation of programmes".

54. Principle 2d urges governments to promote opportunities for the participation of local communities, including forest dwellers, non-governmental organizations and women. Perhaps most significant is principle 5, which states that national forest policies should recognize and duly support the identity, culture and rights of indigenous people, their communities and other communities and forest dwellers. It goes on to recognize the need for local communities to have an economic stake in forest use and that this might be achieved by strengthening the rights they can claim over these resources.

55. These principles are often criticized for their lack of coherence and "internal logic" (Posey, 1996). However, they remain the main agreed statement of international policy on forests.

1. The forum and the task force

56. Following the establishment of the ad hoc Intergovernmental Panel on Forests in 1995, an informal Inter-Agency Task Force on Forests was set up in Geneva to coordinate the inputs of international organizations to the forest policy process. Within this task force, the CBD is the lead agency in relation to issues of traditional forest-related knowledge. At the conclusion of the IPF in 1997, it was decided to continue the intergovernmental policy dialogue on forests, and consequently the ad hoc open-ended Intergovernmental Forum on Forests was set up within the Commission on

Sustainable Development. This Forum will run at least until 2000, and is serviced by a secretariat which depends entirely on voluntary financial contributions and mainly on staff seconded from the Task Force. The final report of the IPF emphasized the need for further research and discussions on the role of traditional forest-related knowledge in the conservation of biodiversity and sustainable forest management.

57. During its third meeting in Geneva, in May 1999, the IFF called upon countries to implement measures for greater recognition, respect and protection of traditional forest-related knowledge, taking account of the work being advanced by the CBD, the working group meeting scheduled for January 2000 and the development of a forest biodiversity work programme.

58. The IFF invited the CBD secretariat in collaboration with CIFOR, FAO and others to prepare an overview of the possible approaches to identify, collect, and record traditional forest-related knowledge in consultation and cooperation with the knowledge holders. Finally, the IFF also proposed the development, at national level, of legislation and policies to achieve the objectives of articles 8(j), 15, 16, and 19 of the CBD, relating to the equitable sharing of benefits.

2. Guidelines and recommendations

59. The attention of the IFF has turned more recently to the importance of dryland forests, major rainforest regions of the world having tended to dominate earlier discussions. The UNCCD should keep the IFF informed of any initiatives it is taking in relation to traditional forest-related knowledge in dryland areas. Greater cooperation with the CBD, as discussed in the previous section, should encompass cooperation with the Inter-Agency Task Force on Forests, in view of the leading role of the CBD on this issue.

60. There is thus a large area of common ground related to this subject amongst the three environmental agreements which resulted from UNCED. In addition, the United Nations Framework Convention on Climate Change should not be overlooked in this report, although it appears that the question of indigenous knowledge has not been directly taken up by its subsidiary body, the SBSTA. Traditional knowledge can, in fact, provide valuable indicators of climatic variation. For example, the cyclical existence of the El Niño Southern Oscillation and its local consequences were widely known amongst local people along the western seaboard of South America well before the scientific research establishment took an interest and began to discover its global significance.

61. However, the Rio conventions and agreements are not the only international policy instruments relevant to this discussion. Some others are discussed below.

III. OTHER RELEVANT CONVENTIONS

A. Ramsar Convention on Wetlands

62. The Ramsar Convention on Wetlands was signed in 1971 and concerns the conservation and "wise use" of wetlands. The text drafted in the 1960s "largely reflects the conservation ethics of that era" (Finlayson, 1999) and it is not at all clear, from the text, how such conservation and wise use might best be achieved. However, the Convention has responded to the broad changes in views on environmental management over the last 20 years, as demonstrated by the recently adopted Guidelines on involvement of local people (see below). The definition of "wise use" was agreed in 1987 as the "sustainable utilization of wetlands for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem". In contrast to the later conventions described above, the Ramsar Convention does not extend express protection to traditional or local knowledge.

63. Wetlands are extremely important to the livelihoods of inhabitants of arid areas around the world. The bas fonds, flood plains and lakes of the world's drylands are critical for sustaining human populations. Such resources can provide water for irrigation, livestock, fishing and domestic consumption. Wetland areas also support significant numbers of wildlife and bird species which can be important for tourism and for broader ecosystem management and biodiversity in dryland countries (see Kingsford, 1997 for a comparison with the UNCCD).

1. The COP and the STRP

64. The Ramsar Convention is governed by a Conference of the Parties, assisted by a Scientific and Technical Review Panel and is serviced by a small Bureau hosted by IUCN. In 1990, the COP established guidelines for the implementation of the "wise use" concept.

These included provision for the establishment, implementation and periodic revision of management plans "which involve local people and take account of their requirements". Despite this, the subject of local participation in wetland management was not a major feature of the work of the Convention until 1996, when it was the focus of a technical session of COP.6 on community involvement. At this meeting, the Ramsar Convention Parties and its Bureau were recommended "to make specific efforts to encourage active and informed participation of local and indigenous people at Ramsar listed sites and other wetlands and their catchments and their direct involvement through appropriate mechanisms, in wetland management".

Case studies and the new guidelines

65. A project set up by the IUCN Social Policy Group began in May 1997 with three workshops to plan work on the guidelines for the involvement of local people. Twenty-one case studies were selected covering areas from each of the seven Ramsar Convention regions representing a variety of wetland ecosystem types, conservation issues and forms of local involvement. Some of these were in dryland areas relevant to the UNCCD. From the case study material, the Group synthesized the lessons learned and formulated policy recommendations to produce a first draft of guidelines for local people's involvement in wetlands management.

66. They concluded that incentives for local involvement and wise use are essential: everyone must benefit in the long term. The guidelines recognize that there are various benefits which local people may derive from participatory management arrangements. These include, as well as progress towards sustainable incomes and livelihoods, the maintenance of spiritual and cultural values associated with a wetland, more equitable access to wetland resources, increased local empowerment, reduced conflicts among stakeholders, and the maintenance of ecosystem functions such as flood control and improved water quality. Government agencies, for their part, may benefit from participatory management arrangements through "improved ecosystem viability, reduced management costs, assistance with monitoring and surveillance, fewer infringements and enhanced social sustainability".

67. Trust among stakeholders was also recognized as essential for agreement to be reached and adhered to, but trust takes time to develop. Recognizing that no one approach to participation will fit all contexts, flexibility is called for along with an ongoing reflection on processes and outcomes. A checklist of indicators for measuring the extent of local involvement through incentives, trust building, flexibility, etc. was also developed. Knowledge exchange and capacity-building are also seen as fundamental. The guidelines acknowledge that "local environmental knowledge can make a significant contribution to wetland management strategies, especially when blended with the best available science". Finally, a long-term commitment of resources and effort is also important.

COP 7 and joint work plan with CBD

68. The seventh session of the Ramsar Convention's Conference of the Parties, held in May 1999, had the "vital link between people and wetlands" as its overall theme. The workshop of the STRP (the Convention's equivalent of the CST) met to discuss the involvement of local and indigenous communities in the wise use of wetlands. During these meetings the final text of the guidelines described above was adopted as resolution VII.8. These guidelines represent an important statement of good practice and are a significant step in reflecting the Parties' concern for the participation and involvement of local and indigenous communities.

69. The links between the Ramsar Convention and the CBD are institutionally enshrined in the Memorandum of Cooperation between the two conventions. In view of this, a joint work plan was endorsed by the CBD COP at its fourth session "as a framework for enhanced cooperation" and is being implemented.

2. Guidance and recommendations

70. The Ramsar Convention guidelines on involvement of local people provide useful food for thought. They could provide the basis for any UNCCD guidelines on this matter. As with the other conventions and agreements reviewed above, it is important that all institutions keep abreast of the initiatives and outputs of their counterparts elsewhere, in order to build on what has been learned.

B. TRIPS, UPOV and farmers' rights

TRIPS

71. The question of intellectual property rights over traditional knowledge is circumscribed by several international agreements, in particular, the Trade-Related Aspects of Intellectual Property Rights Agreement, which was adopted as an annex to the Uruguay Round of the GATT. This Agreement, signed in 1994, obliges nation states to set up legal regimes to protect the intellectual property rights of innovators, whether national or foreign, for a minimum of 20 years.
72. The regulations adopted in the TRIPs agreement apply the European or United States intellectual property rights model, whereby patent protection may be granted for any process, machine or "composition of nature" which is novel, capable of industrial application and involves an inventive step (thus excluding simple discovery of a naturally occurring process). This regime serves to protect the rights of commercial breeders, biotechnologists and other industrial innovators but is seen as inadequate for the protection of the traditional knowledge of local communities, despite the fact that such knowledge is increasingly the starting point in industrial research of genetic resources. Traditional knowledge rarely qualifies for patent protection, as it does not pass the test of novelty. Even where technologies are relatively recent developments, knowledge held by traditional communities is often held "in the public domain" - that is, it is commonly known or shared amongst a wider group of people. Without legal recognition of the community unit, such groups cannot apply for patent protection. Moreover, where knowledge is individually held, it is highly unlikely that the TRIPs system could benefit these individuals, due to the expense of applying for, monitoring and enforcing patents.

Other intellectual property rights regimes

73. The TRIPs agreement sets the minimum standards for patents but allows countries to opt out of these regulations in the case of plant varieties and animal species, as long as they develop their own dedicated (sui generis) systems as an alternative means of protection. Three such regimes are relevant to this report. The first is the CBD, which offers protection to knowledge, innovations, and practices, as described above. However, it is possible that such protection may need to be incorporated into national legislation before it can have legal effect. The second regime is that of the conventions of International Union for the Protection of New Varieties of Plants, as modified by the International Undertaking on Plant Genetic Resources (IUPGR) described below. The third could be any national laws which give adequate protection to the intellectual property rights of both foreigners and nationals. Indeed, many local communities possess their own legal systems which deal with the classification of different types of knowledge, procedures for acquiring and sharing knowledge and the rights and responsibilities which attach to possessing knowledge. Customary practices relating to resource use have been recognized by some countries and incorporated into statutory law in various ways, but such recognition is less likely in areas where indigenous and rural communities are marginalized and are poorly represented in national forums. Such has been the situation faced, for example, by many pastoral groups.
74. The first UPOV convention set up a sui generis system in 1961 (amended in 1971 and 1978), which granted patent rights over resource use but allowed what became known as a "farmer's privilege" to reuse seed from the new varieties of plant for planting in the following season. This allowed traditional communities the means with which to continue experimenting with production and providing for domestic consumption without infringing the plant breeder's intellectual property rights. However, this was revised, resulting in the 1991 UPOV convention, which withdrew this privilege and restricted all use - commercial or otherwise - of new plant varieties. While plant genetic resources are essential for crop improvement and increased food security, sound policy also needs to consider the overall picture, and in particular, the supply of raw materials. Protection of plant breeders' rights places an annual economic burden on farmers, who are often the original providers of germ plasm to plant breeders.

Farmers' rights

75. The Commission on Genetic Resources for Food and Agriculture (CGRFA) sought to address the disparity which had emerged between plant breeders and farmers. Ten years of debate culminated in the parallel recognition of plant breeders' and farmers' rights by more than 170 countries in a resolution of the 1989 FAO Conference which is now an annex to the International Undertaking on Plant Genetic Resources. These are defined as "rights arising from the past, present and future contribution of farmers in conserving, improving and making available plant genetic resources, particularly those in the centres of origin/diversity. These rights are vested in the international community, as trustees for present and future generations of farmers, for the purpose of ensuring full benefits to farmers and supporting the continuation of their contributions". Note that plant breeders' rights are vested in individuals and companies, whereas farmers' rights are vested in the international community. However it is unlikely that this disparity will be resolved in the negotiations that are to continue later this year. The latest negotiating session of the Commission, in April 1999, agreed on a new article 15, „Farmers' rights" (see box 4).
76. The concept of farmers' rights, unanimously adopted at the 1989 FAO Conference, is intended to form the basis of a formal recognition and reward system to encourage and enhance the continued role of farmers and rural communities in the conservation and use of plant genetic resources. A 1991 resolution proposed an international fund to implement farmers' rights on plant genetic resources. The fund has not been successful due to lack of contributions and has been opposed by some indigenous peasant and farmers' groups, who distrust governments' ability to administer funds fairly.

Box 4: International Undertaking on Plant Genetic resources, article 15

15.1 The Parties recognize the enormous contribution that the local and indigenous communities and farmers of all regions of the world, particularly those in the centres of origin and crop diversity, have made and will continue to make for the conservation and development of plant genetic resources, which constitute the basis of food and agriculture production throughout the world.
15.2 The Parties agree that the responsibility for realizing farmers' rights, as they relate to plant genetic resources for food and agriculture, rests with national governments. In accordance with their needs and priorities, each Party should, as appropriate, and subject to its national legislation, take measures to protect and promote farmers' rights, including:
- protection of traditional knowledge relevant to plant genetic resources for food and agriculture;
- the right to equitably participate in sharing benefits arising from the utilization of plant genetic resources for food and agriculture;
- the right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture.

15.3 Nothing in this article shall be interpreted to limit any rights that farmers have to save, use, exchange and sell farm-saved seed/propagating material, subject to national law and as appropriate.

1. World Intellectual Property Organization

77. WIPO has a programme on intellectual property rights of "new beneficiaries", including the holders of indigenous knowledge. There are six main activities within the current programme (1998-1999). A public panel discussion was held in December 1998, which took as its basis a collection of expert studies on the legal character of intellectual property rights arising in various multilateral instruments. The panel produced reports on intellectual property topics such as health, competition, trade, and human rights.
78. Another activity was the study of current approaches to the protection of intellectual property rights of holders of indigenous knowledge and dissemination of information. Fact-finding missions were undertaken on "traditional knowledge, innovations and culture of indigenous peoples, local communities and other holders of traditional knowledge and culture" to North, South and Central America, the South Pacific, West, Southern and Eastern Africa and South Asia. Interviews with groups from various countries in Africa were carried out and, in some cases, round-table discussions were established with representatives of institutions and nongovernmental organizations from around the country. Many of the concerns raised in these missions related to the protection of musical rights, folklore and traditional medicine, but traditional ecological knowledge was also discussed. UNEP is collaborating with WIPO to study the impact of intellectual property rights systems and traditional knowledge on the conservation and sustainable use of biodiversity and the equitable sharing of benefits derived from it.
79. The CBD COP has encouraged the negotiation of a memorandum of understanding with WIPO to enhance cooperation between the CBD and WIPO on issues arising from article 8(j) and related provisions. The secretariat has been requested to compile case studies relating to existing sui generis systems for transmission to WIPO and for use in legislating on implementation of article 8(j) and related provisions.

80. WIPO also provides technical advice, when requested by countries or specialized agencies, and often participates in conferences and seminars to explain the role of WIPO. Mostly, this advice is focused on assisting developing countries to meet their obligations under the TRIPs agreement which, in some cases, must be implemented by 1 January 2000. So far, very few countries have requested advice on the protection of traditional knowledge.
81. Another planned activity is the commissioning of a feasibility study on establishing a database on traditional knowledge. Pilot projects are planned to test new approaches to the use of the intellectual property system.
82. Finally, WIPO also set up a round-table on intellectual property and indigenous peoples in connection with the United Nations Working Group on Indigenous People, which meets every year in July, to facilitate an exchange of views among policy makers and indigenous people. The meeting in 1998 covered a broad range of issues, and six papers were presented on the protection of rights of holders of traditional knowledge, indigenous peoples and local communities.
83. IUCN has launched a four-year project aimed at achieving coherence between the CBD and the WTO, seeking to avoid conflicts and reinforce synergies between the TRIPs regimes and the CBD, most notably in relation to the access to genetic resources and traditional knowledge.

2. Guidance and recommendations

84. WIPO has significant expertise which could be useful to the CST. The reports of the fact-finding missions in countries affected by desertification could provide useful insights into problems of relevance to local people in this field. WIPO is interested in knowing more about the work of the UNCCD. It has established links with the CBD, reinforced at COP.4 by the proposal for a memorandum of understanding between the two organizations, and WIPO will be represented at the CBD ad hoc open-ended working group meeting in January 2000.
85. The CST has pointed out that the protection of intellectual property rights is a concern. The initiative to promote farmers' rights is of direct relevance to the UNCCD and should be supported. Negotiations to revise the IUPGR have taken account of the provisions of the CBD and the need for harmonization has been recognized. However, this is a crowded field. Many of the complex issues of how to ensure legislative protection are already being developed in forums such as the CBD, WIPO, and the WTO. The CST might consider letting the CBD take the lead in these discussions as the latter has a greater stake in them and receive feedback as relevant.

IV. OTHER ORGANIZATIONS

A. UNESCO

86. Various UNESCO conventions are relevant to the protection of the rights of indigenous populations and local communities. Examples are the protection of cultural landscapes in the 1992 World Heritage Convention, the protection against the illicit exploitation of expressions of folklore such as indigenous art and traditional storytelling in the UNESCO-WIPO Model Provisions on Folklore (for others, see Posey, 1996).
87. However, for the purposes of this report, what seems more relevant is the UNESCO Management of Social Transformations (MOST) programme, designed to promote international comparative social science research. The long-term objective of the programme is to establish better links between researchers and policy makers and to emphasize the relevance of social science research for policy formulation. MOST concentrates its activities on the management of change in multi-cultural and multiethnic societies. It has a clearing-house offering up-to-date information on the projects, publications and activities of the programme including a "database of best practices".
88. One of the new initiatives of the programme is to include best practices on indigenous knowledge. The database will provide examples that illustrate the appropriate use of indigenous knowledge in "developing cost-effective and sustainable survival strategies for poverty alleviation and income generation". Examples of this might include promoting indigenous land management systems to encourage community control over common property resources, and using existing in digenous institutions to extend credit facilities. Another suggestion is to use indigenous knowledge to increase the fuel efficiency of local stoves instead of replacing them. In collecting the information, MOST is not interested in the details of the indigenous knowledge itself (e.g. the technical specification of the stove) but in the ways that knowledge has been adapted, applied and disseminated.
89. Spreading this kind of information on a globally accessible database can be extremely useful, in order to inform the policy-making process and provide clear examples of best practice. A questionnaire was posted on the web for people to identify and describe any such successful project or activity. After screening by the Centre for International Research and Advisory Networks (CIRAN) and other referees, 27 submissions were approved for inclusion in the database. Most of these examples come from Africa, but there are others from Latin America and Asia. A report outlining the lessons learned from the exercise as well as the practices themselves will be published and posted on the web.

Guidance and recommendations

90. These data could be very interesting for the CST by demonstrating how information on traditional knowledge can be used to good effect for practical purposes. The next steps are currently being discussed by UNESCO and CIRAN.

B. United Nations Environment Programme

91. UNEP is fostering cooperation among the various environmental conventions through a number of activities, including the recently published report by UNEP and the World Bank on interlinkages between the environment conventions. No specific activity relates to traditional knowledge. However, it has been proposed that an inaugural meeting of the subsidiary bodies of the environment conventions be held in Bonn in October 1999. Prior to this, in September, there will be a coordination meeting of the convention secretariats in Geneva. These meetings could provide an opportunity to discuss what each convention is doing in the field of traditional knowledge.
92. UNEP is undertaking a study of the development of desertification assessment methodologies and land quality indicators, which will address the amalgamation of modern and traditional scientific knowledge in the sustainable use p nal fic nal fic

to promote activities which create or add value to indigenous knowledge. By supporting national participatory networks, it was suggested that information exchange could be developed, along with appropriate research methodologies and a database on traditional knowledge. With regard to intellectual property rights and benefit sharing, it was recommended that the UNCCD should work with WIPO in developing appropriate mechanisms to protect such rights and to stop the rapid erosion of traditional knowledge relevant to combating desertification. Increased support to enable stakeholders, particularly indigenous and local communities, to participate in the implementation of the UNCCD was also called for.

97. Another workshop on linking biodiversity and desertification took a strategic look at the efforts to promote synergy initiated by the secretariats, and sought to remove perverse policy, legal, institutional and economic obstacles to synergy. Among its recommendations were an appeal to create opportunities for learning from case studies and best practices and improve communications between different stakeholders.

Guidance and recommendations

98. The mandate to oversee the coordination of efforts under the Rio agreements, gives UNEP an important role. The proposed meetings of the secretariats and subsidiary bodies will provide important opportunities to discuss ways of harmonizing programmes at the international level. Given the large number of international institutions which have direct responsibilities for protecting and promoting traditional knowledge, it might be sensible to include this issue within the agenda for discussion at the meetings planned. Among the ideas that could be discussed are the establishment of an informal joint committee to share information on initiatives in this field. Such a committee should not be restricted to the Rio conventions, as input from the Ramsar Convention and WIPO would be particularly helpful.

C. Others

99. Several other organizations have made important contributions to understanding the role of traditional knowledge. Only a few can be mentioned here. An Organization of African Unity (OAU) task force on community rights and access to biological resources met in Addis Ababa in March 1998 to draft model legislation on community rights and access to biological resources which would ensure the continuing control by local communities of their natural resources, knowledge and technologies. This legislation is expected to provide a model for African nations to develop national codes on community rights and access to biological resources, community knowledge and technologies. The model law is largely based on article 8(j) and related provisions of the CBD and on the decisions of the COP at its fourth session (Ezhabier, 1999). The Southern African Development Community is discussing the adoption of a regional framework based on the OAU model.

100. Other relevant international organizations and bodies are the International Centre for Agriculture and Biosciences (CAB International), the Consultative Group on International Agricultural Research (CGIAR), the International Crops Research Institute for the Semi-arid Tropics (ICRISAT), the International Fund for Agricultural Development (IFAD), the International Forum on Forests (IFF), the Intergovernmental Authority on Development (IGAD), the Observatory of the Sahara and the Sahel (OSS), the United Nations Conference on Trade and Development (UNCTAD), the United Nations Economic and Social Council (ECOSOC), the Centre for Science and Technology for Development (CSTD), the United Nations Institute for Training and Research (UNITAR), the United Nations Development Programme (UNDP), the Arab Centre for the Study of Arid Zones and Dry Lands (ACSAD), the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS), the Southern African Development Community (SADC), the World Bank, etc. This list is not exhaustive. Countless non-governmental organizations and community-based organizations are also looking into these issues. While it has not been possible to describe here the programmes of these institutions, they could provide a very important contribution in terms of support to work at the grass-roots level.

V. CONCLUSIONS AND RECOMMENDATIONS

101. This report demonstrates that there is no shortage of organizations working on the issue of traditional knowledge at the international level and there are many benefits to be gained from the experience of other bodies. There is clearly a great deal of experience and documentation which should be collected and heeded before any new initiatives are suggested.

102. This report also demonstrates that many of the issues surrounding the promotion, protection and use of traditional and local knowledge are being addressed through international collaborative efforts. However, interpretation of these efforts at the local level may be another story. Yet, it is at this local level that the ultimate fruits of such work should be harvested.

103. The CBD secretariat has done much to spread the word about the important provisions of that Convention and how they can be extended to help local community groups. Most organizations and many authors look to the terms of this Convention as providing an international standard and a new legal framework for the rights of traditional and local communities. It could be suggested, however, that the global debate has been dominated by the CBD and its priorities. Much of the discussion in biodiversity forums concerns the position of indigenous and local peoples in the face of predatory practices of companies eager to prospect and patent biodiversity. The questions of equitable sharing of benefits and ensuring that knowledge is shared on mutually agreed terms is certainly relevant to the dryland areas covered in the UNCCD. However, many of the practices and much of the know-how that can be used to develop better ways to resolve the present problems of land degradation are not likely to be incorporated into a patent application. This includes, for example, know-how relating to practices for use of mulch and minimum tillage, and techniques for water harvesting.

104. On the other hand, the crucial importance of research and development agencies which seek to work with communities in situ to develop their technologies is less well addressed. All instruments and organizations outlined above subscribe to the view that traditional knowledge is valuable and participation essential. However, few cases exist where interventions are actually based on incorporation and full development of this knowledge (van Leeuwen, 1999).

105. Within the international debate, the CST can usefully emphasize the importance of cooperation with local people, and ensure that their voices are heard at the policy planning stage. The obligations of the UNCCD to promote training and capacity-building among various agencies and government departments should be highlighted but the question of incentives for cooperation also needs to be addressed. The Ramsar Convention guidelines could provide a useful basis for seeing how best to involve local people in participatory management.

Recommendations

106. A closer working relationship between the secretariat and the various institutions related to other conventions also working in this field seems essential. The secretariat could usefully be involved in key meetings and initiatives currently proposed, especially those by the CBD and UNEP.

107. Greater attention needs to be focused on questions of in situ research and development, capacity-building for extension services and incentives for collaboration at the local level. This should highlight not only technical but also institutional issues, such as tenure security, customary law and processes of decentralization.

108. The convention secretariats have a role to play in letting people know about the UNCCD and the opportunities it fosters. They can usefully put people in touch with best practices and experienced practitioners. Monitoring the impact of the Convention is also of value. However, there is a need to avoid creating new initiatives at the international level, given the ongoing work programmes of the various conventions. Rather there is a need to generate synergies through collaboration.

109. Coordination at the national level is essential to the effective implementation of the UNCCD and the other related conventions. In many cases, decision and policy makers in charge of implementation of the various conventions belong to the same government ministry, but not necessarily the same unit. Encouraging linkages at this level is very important. The national focal points of the UNCCD and CBD have an important role in spreading information about the implementation of the conventions. They should be encouraged to collaborate and could usefully be listed in one central database.

110. There is a great deal of discussion of the issues surrounding the protection and potential use of traditional knowledge. It is questionable how much of it is of direct benefit to policy makers, decision makers and local communities. Careful reflection on the aims and outputs of any information-gathering exercises needs to be encouraged and a clear identification of how these might serve the interests of local people. It should be remembered that the ultimate test of the UNCCD is the improvement of conditions on the ground, for those in countries affected by desertification.

List of abbreviations

BSAP	biodiversity strategy and action plan
CBD	Convention on Biological Diversity
CIRAN	Centre for International Research and Advisory Networks
COP	Conference of the Parties
CST	Committee on Science and Technology (of the UNCCD)
FAO	United Nations Food and Agriculture Organization
GATT	General Agreement on Tariffs and Trade
IFF	Intergovernmental Forum on Forests
IIED	International Institute for Environment and Development
IPF	Intergovernmental Panel on Forests
ITFF	Inter-Agency Task Force on Forests
IUCN	World Conservation Union
IUPGR	International Undertaking on Plant Genetic Resources
MOST	Management of Social Transformations Programme
NAP	national action programme
SBSTA	Subsidiary Body for Scientific and Technological Advice (of the UNFCCC)
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice (of the CBD)
STRP	Scientific and Technical Review Panel (of the Ramsar Convention)
TRIPs	Trade-Related Aspects of Intellectual Property Rights Agreement
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNSO	Office to Combat Desertification and Drought
UPOV	International Union for the Protection of New Varieties of Plants
WGTRR	Working Group on Traditional Resource Rights
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

List of references

1. Abu-Shara (1998) Traditional methods of soil conservation and water harvesting in West Asia: a case study from Jordan, Lebanon and Syria.
2. Allen, L. Gliese J and Ledgar, R (1998) The Combat of Desertification in Global Partnership: A challenge for civil society, At Verband, TEW Frankfurt.
3. Amruth, (1996) Peoples Biodiversity Register, A Record of India's Wealth, mimeo.
4. Baer, L. A.(1998) "Initiatives for Protection of Rights of holders of Traditional Knowledge indigenous peoples and local communities" Paper prepared for the roundtable on Intellectual Property and Indigenous Peoples, Geneva July 23-24 1998.
5. Blench, R. M. (1999) "Progress towards implementing the CCD in SADC countries". Prepared for the third meeting of the EC/MS Expert Group on Desertification, Brussels, Centre Borschette, 7 April 1999.
6. Chambers, R. (1995) Poverty and Livelihoods: Whose Reality Counts?
7. Critchley, W (1999) Inquiry, Initiative and Inventiveness: Farmer Innovators in East Africa, paper prepared for presentation at: European Geographical Society XXIV General Assembly, The Hague, 19-23 April 1999.
8. Defoer T, Kante S, Hilhorst, De Groote, H (1996) Towards more sustainable soil fertility management, AgREN Network Paper no 63, July 1996.
9. Dutfield, G (1999) The Public and Private Domains: Intellectual Property Rights in Traditional Ecological Knowledge, Oxford Intellectual Property Research Centre Working Paper 3/99.
10. Earth Negotiations Bulletin, A reporting service for Environment and Development Negotiations Vol. 4 No 127 (CCD COP 2 Dakar, Senegal).
11. Ezhabier, Third World Network, the Future of Genetic resources: south faces critical choices, Dossier for the fourth meeting of the SBSTTA, June 21-25 1999 and the Intersessional Meeting of the CBD (June 28-30, 1999).
12. Finlayson, C. M. (1999) Synergies amongst international instruments for involving indigenous people an local communities in Wetland Management: the Ramsar Convention on Wetlands.
13. Glowka, L. (1998) A Guide to Designing Legal Frameworks to Determine Access to Genetic Resources, Environmental Policy and Law Paper, No 34, IUCN, Gland.
14. Honey Bee Newsletter - A newsletter of Creativity and Innovation at the Grassroots - Current pilot projects.
15. IPGRI - Issues in genetic resources no 6 Jun 1998 - Intellectual Property Rights and Plant Genetic Resources: Options for a sui generis system, D. Leskian and M. Flitner, abstract and 5 chapter summaries.
16. IPGRI - Issues in genetic resources no 7 Jun 1998 - Recent policy trends and developments related to the conservation, use and development of genetic resources, S. Brandon & D. Downes abstract.Kingsford, R.T. (Wetlands of the world's arid zones, Ramsar Convention Bureau, Gland.LEISA, Leisa in perspective: 15 years ILEIA.
17. Mosse D. (1994) Authority, Gender and Knowledge: Theoretical Reflections on the Practice of Participatory Rural Appraisal, Development and Change Vol. 25 (1994) 497-526.
18. Odera, J. A. (1998) "Preliminary inventory of traditional and local technical knowledge, know-how and practices in combating desertification in Eastern and Southern Africa".
19. Odera, J. A. (1998) Traditional technologies use in dryland areas of Asia, Middle East, West Asia, Africa, and Latin America an the Caribbean in combating desertification: a Global Synthesis. ICCD/COP(3)/CST/2/.
20. Okali, C. Sumberg and Farrington, (1994) Farmer Participatory Research, IT, London. Ola Karlin U. (1998) "Traditional Knowledge and technologies within the United Nations Convention to Combat Desertification: South America" .
21. Posey D. (1996) Traditional Resource Rights: International Instruments for Protection and Compensation for Indigenous Peoples and Local communities, IUCN, Gland.
22. Rabhi, P. (1998) Synthèse sur les methodes traditionelles de lutte contre la desertification: Document réalisé sur la base de 10 rapports nationaux, 2 rapports émanant de structures internationales et d'un resumé des travaux de la sous region de l'Amérique Centrale et des Caraïbes.Ramsar Convention Bureau, (1999) Case Studies on Local and Indigenous Peoples Involvement in Wetland Management.
23. Reij C., Scoones I., and Toulmin C. (1996) Sustaining the Soil, Earthscan, London. République du Sénégal, Programme d'action de lutte contre la desertification (PAN/LCD): Actes de la Première Réunion du Forum, Dakar, 28-29 mai 1997, CONSERE, Ministère de l'Environnement et de la Protection de la Nature.
24. Scoones I. and Thompson J. (1994) Beyond Farmer First: Rural People's knowledge, agricultural research and extension practice, IT, London.
25. Swiderska K. (1999) Developing Regulations for Access to genetic resources: Overview of the experience with stakeholder participation" IIED, London.
26. Toe E. (1998) "Connaissances techniques et pratiques traditionnelles en matière de lutte contre la desertification en Afrique de l'Ouest : Burkina Faso, Niger, Cap Vert" Working paper for the CCD secretariat.
27. Toulmin C. (1995) Tackling dryland Degradation: will a Convention Help? IIED, London.
28. Tsariuk O. (1998) "Asie Centrale: Panorama des techniques traditionelles, des connaisances et du savoir-faire technologique dans le domaine de l'utlisation de l'environnement".
29. Urquiza Rodriguez M. N. (1998) "Technologies traditionelles et savoir local en Amérique centrale et dans les Caraïbes" (résumé).
30. Van Leeuwen, L. (1998) "Approaches for successful merging of indigenous forest related management: How can modern science and traditions join hands for sustainable forest management?" Werkdocument IKC Natuurbeheer Nr W-165, Wageningen 1998.
31. Youlin Y. (1998) Traditional Knowledge and Practical Techniques for Combating Desertification in China. Traditional Resources Rights web pages (http://users.ox.ac.uk/~wgtrr/).

Official documents

CBD Convention - Decision IV/15: Relationship of the Convention with the CSD and biodiversity related conventions other international agreements and processes of relevance.
UNCCD decision 14/COP.2, document ICCD/COP(2)/14/Add.1.
UNCCD document ICCD/COP(2)/7 - Promotion and strengthening of relationships with other relevant conventions.
UNCCD COP 2 - Report of the work of the bodies performing work similar to that envisioned for the Committee on Science and Technology.
UNCCD document ICCD/COP(2)/CST/2 - Survey and evaluation of existing networks, institutions, agencies and bodies.
UNCCD document ICCD/COP(2)/CST/5 - Synopsis of reports on traditional knowledge.
Commission on Sustainable Development "Issues needing Further Clarification: Traditional Forest related Knowledge : Secretary General Report for the third session of the IFF, Geneva 3-14 May 1999.
Commission on Sustainable Development (1997) "Elements of a Draft Report" Ad Hoc Intergovernmental Panel on Forests, UN DPCSD.
Draft Code of Ethics and Standards of Practice of the International Society o f Ethnobiology, Nairobi, Kenya, Sept 1996 (http://users.ox.ac.uk/~wgtrr/isecode.htm).
ITFF (1997) "InterAgency Partnership on Forests: Implementation of IPF Proposals for Action by the ITFF".
Preliminary working paper for the International Conference of Social Sciences and social Policy Linkages 13-14 September 1999 Netherlands, organised by MOST and Dutch commission for UNESCO.
Ramsar Convention Bureau (1999) Progress Report on implementation of the Joint Work Plan 19998-99 between the Convention on Wetlands (Ramsar, Iran 1971) and the Convention on Biological Diversity .
Ramsar Convention Bureau, (1999) Guidelines for establishing participatory processes to involve local communities and indigenous people in the management of wetlands Ref COP7 Doc 15.8.
Ramsar Convention Bureau, (1999) Participatory processes to involve local communities and indigenous people in the management of wetlands, Ref COP7 Doc 18.1.
UNEP/CBD/TKBD/1/2 - Traditional Knowledge and Biological Diversity – Executive Summary, critical linkages - key terms - activities of relevant organisations - elements for a work programme.
UNEP/CBD/TKBD/1/3 - Report of the workshop on traditional knowledge and biological diversity.
UNSO (1998) A preliminary Overview of National Action Programme (NAP) Processes of the UN CCD, UNSO/UNDP.
WIPO (1999) "Traditional Knowledge, Innovations and Culture of Indigenous Peoples, Local Communities and other Holders of Traditional Knowledge and Culture" Interim Mission report of Fact Finding Mission to Southern and Eastern Africa, Sept 4-20 1998 .

Web Sites visited

CBD -	http://www.biodiv.org
UNCCD -	http://www.unccd.int
UNFCCC -	http://www.unfccc.int
Ramsar -	http://www.ramsar.org
MOST Best Practices on Indigenous Knowledge -	http://www.unesco.org/most/bpindi.htm
UNEP -	http://www.unep.org
CIKARD -	web page (http://monet.npi.msi.su/iitap-mirror/cikard/CIKIntro.html)
CIRAN -	http://ww.nuffic.nl/ciran
WGTRR -	Working Group on Traditional Resource Rights http://users.ox.ac.uk/~wgtrr/
IKDM (Monitor)	Dec 98 Differences between farmers and scientists in the perception of soil erosion: A South African case study, S. Cartier can Dissel and Jan de Graaff.
IKDM (Monitor)	Dec 98 Indigenous values and GIS: a method and a framework , G. Harmsworth
IKDM (Monitor)	Dec 98 Reactions to the definition of IK.IKS.ITK
IKDM (Monitor)	Jul 98 Learning local knowledge of soils: a focus on methodology by Deirdre M Birmingham
IKDM (Monitor)	July 98 Research Centres CIRAN - CIKARD - LEAD

1.6 Synthesis on Traditional Knowledge in Dryland Ecosystems ICCD/COP(3)/CST/3/Add.2

EXECUTIVE SUMMARY

1. Traditional knowledge (TK), as related to combating desertification in the ecosystem of the drylands, comprises a wide range of accumulated experience. This experience covers natural resource management techniques in both agricultural and pastoral systems, institutional and organizational arrangement, as well as beliefs and values. Article 18 of the United Nations Convention to Combat Desertification invites affected country Parties to incorporate TK in their national action programmes (NAPs) to combat desertification.
2. At its first session, the Conference of the Parties encouraged Parties to provide reports on TK and requested the secretariat to prepare a synopsis of these reports (decision 20/COP.1). The issue was again considered at the second session of the Committee on Science and Technology (CST) in 1998. Some representatives highlighted their experience with TK, and others emphasized the need to develop synergies by integrating TK with modern technology. At the end of its second session, the COP decided to appoint an ad hoc panel with the following terms of reference:
identification of successful experiences, strategies for integrating TK with modern technology and mechanisms for promoting successful approaches. Moreover, COP 2 requested the secretariat to complete work on compiling TK, and make a synthesis of this work available to the CST at its third session. The secretariat was further requested to (a) explore ways of linking the work of the CST on TK with similar work being done in other conventions, and (b) prepare a report on TK in dryland ecosystems.
3. The secretariat recruited consultants to prepare TK working papers to beexamined at subregional and regional meetings in countries of Asia, Africa, and Latin America and the Caribbean. At a later stage, these papers were compiled into a global report (ICCD/COP(3)/CST/2). The report includes an extensive list of information relevant to land-use systems, farming, and animal production, as well as food processing and storage. It also includes aspects of the social structure and the associated management of natural and wildlife resources.
4. The long list of TK in the dryland ecosystem is indicative that TK is dynamic and has built-in mechanisms that enable local communities to survive the unfavourable topographic, edaphic and climatic conditions which characterize their fragile environment. However, a more differential approach to studying the TK system is needed to cope with the new facts of modern life. The study should take account of the recent fundamental changes in power relations between local, national and international actors. Moreover, adjustments are inevitable for any progress towards the sustainable use of natural resources in an intimately interconnected, global environment.
5. There is general agreement that the best way out of the potential social instability of the dryland communities is to integrate TK with modern technology. Three possible approaches are available: (a) scientists may take certain elements of TK and incorporate them into the body of Western expert knowledge; the hybrid knowledge is subsequently disseminated more widely; (b) the relevance of non-Western cultures and their respective knowledge systems may be validated holistically, at the same time recognizing the problem of its appropriation by Western scientists; and (c) the so-called "actor-oriented approach" may be adopted, where the dualistic distinction between Western and non-Western knowledge is abandoned. The objective is an elucidation of the actor's own interpretations and strategies, and how these interlock through negotiation and accommodation.
6. The compilation of validated TK in the dryland areas is the first step forward. Community-based organizations and non-governmental organizations have a significant role to play in this connection. It is fortunate that several national and international centres and networks are now completely devoted to TK systems. The functions of these centres include providing national data, designing training methodologies, and linking between national and international partners.
7. It may be said in conclusion that farmer-scientist or pastoralist-scientist interaction is the best way to help all parties learn simultaneously. The results of farmer and pastoralist experimentation would be the baseline for disseminating the improved dryland technologies on a wide scale.
It is necessary for sociocultural, economic and institutional factors to be assessed, to confer credibility on the whole process of integrating TK with modern technology.

I. INTRODUCTION

Addressing natural resources management in drylands

8. The stability of many communities in dryland areas has been coming under increasing social and economic pressures in the last few decades. Small-scale farmers and pastoralists constitute the majority of the rural population, affording only a low input production system. The high rate of population growth adds negatively to the problem, as farmers and pastoralists are obliged to produce their energy, food, fodder, and income from decreasing supplies of land. This process often leads to land degradation, and woodland and pasture destruction in many rural parts of the developing countries. The problem becomes more acute given the high expectations of many people seeking an easy way to a softer life.

9. Many detailed investigations have been undertaken to define a set of rational solutions to this complicated problem. It was once assumed that the transfer of technology, such as large-scale irrigation schemes, and the implementation of rigorous national or regional policies, such as settlement of pastoralists, might offer an ideal solution. However, time and experience have demonstrated that this classic top-down approach, which developed and imposed inappropriate policies and imported inappropriate technologies was not only a waste of resources, but also serve d in many cases to exacerbate the life support system of the people living in the affected areas (Thompson, 1994). A report in 1990 by the World Bank stated that "lack of understanding of traditional production systems, which were developed over time through adaptation to difficult conditions" is a key reason for the lack of success of most development efforts in the drylands.

10. Aside from the dominant top-down approach, the most important reasons for failure in the soil and water management programmes in the dryland areas include the use of production systems which are complicated, expensive, and difficult to maintain in terms of both labour and capital. Therefore, such systems may be difficult to replicate at a reasonable cost and sustainable output. There is also insufficient training of local users of the system, and a heavy reliance on imported machinery for the construction of conservation works (Barraclough, 1993). The literature indicates a consensus that appropriate policy and technology are vital and must be developed with the participation of local people, who would find a policy or a technology appropriate based on a specific combination of factors. In this context, socio-economic, gender, and cultural considerations are key factors.

Definition and characteristics of traditional knowledge

11. Over the past two decades, many scientists and social workers have been closely associated with the dryland ecosystems, watching how local people manage their resources and could survive the often harsh circumstances of their life. A set of knowledge systems was identified and subsequently given interchangeable names by different workers: 'indigenous knowledge' by Warren and Rajasekaran (1993), 'people's knowledge' by Gupta (1989), 'farmer's practices' by Kerr (1991), 'technical knowledge' by Mathias-Mundy (1992), and 'traditional knowledge' by Norgaard (1984) and IFAD (1993). The systems are often collectively referred to as traditional knowledge.

12. TK, as it relates to desertification processes, comprises a wide range of accumulated experience of natural resources and management techniques in both agricultural and pastoral systems, institutional and organizational arrangements, as well as beliefs and values. All these dimensions need to be duly considered in development decisions and interventions. Odera (1999) reported that TK represents accumulated cognitive and perceptive experiences of interactions between a group of people, their physical and biological environments, and the production systems. The quality and quantity of TK vary among community members, depending on age, gender, social status, intellectual capability and professional occupation. Language, religion and socio-cultural aspects are also important differentiating factors.

13. Warren and Rajasekaran (1993) reported that TK may be considered as a systematic body of knowledge acquired by local people through the accumulation of experience, informal experiments, and an intimate understanding of their environment in a given culture. Local people, including farmers, landless labourers, women, pastoralists, and cattle rearers are the custodians of the TK systems. These people are well informed about their own situations, their resources, what works and what does not work. They are also aware of the possible impact of a change in one factor on the other parts of the production system. Warren and Rajasekaran (1993) described TK as:

- Adaptive skills of local people, usually derived from experience and learned through family members over generations;
- Time-tested natural resource management practices;
- Strategies and techniques developed by local people to cope with socio-cultural and environmental changes;
- Practices that are accumulated by farmers due to traditional experimentation and innovation;
- Trial and error problem-solving approaches by groups of people to meet the challenges they face in their local environment; and
- Decision-making skills of local people to draw upon their resources.

II. INTEGRATING TRADITIONAL KNOWLEDGE WITH MODERN TECHNOLOGIES

A. Possible approaches

38. Many workers such as Hausler (1993), Barraclough (1993) and Seely (1998) are of the opinion that a more differential approach to TK systems is needed. They argue that it is essential to refrain from the simplistic notions of using TK as a new panacea or the latest fad in development practice, while distracting attention from the fundamental changes necessary for the sustainable environmental management of dryland resources. Hausler (1993) predicted that the effect of this would be a legitimization of "more of the same", with a slight improvement in business as usual. Fundamental changes in power relations between local, national, and international actors are inevitable for any meaningful changes towards the sustainable use of natural resources in an intimately interconnected, global environment. Most important of all is the sensitive approach to the interaction between TK and Western scientific technology.

39. In this context, Hausler (1993) outlined three possible approaches. In the first approach, natural scientists, anthropologists and development experts may take certain elements of TK and incorporate them into the body of Western expert knowledge. Such hybrid knowledge is subsequently disseminated to farmers and local people in a wider geographic extent. Even though it may yield important technical facts, this approach simply reifies existing power relations and the primacy of Western expert knowledge within the developmentalist framework. Moreover, it should be remembered that TK is highly location-specific and based on close observation over a long period of time. It is embedded in culturally based value systems, systems of production and consumption, and ways of living and relation to natural environment.

40. The second approach is the "knowledge system view" where two types of knowledge – Western scientific and TK – are distinguished on the basis of their characteristics. TK is personal, particular, intuitive, implicit, indecomposable, and orally transmitted. Western scientific knowledge is analytical, impersonal, universal, cerebral, and transmitted in written form. This approach validates the relevance of non-Western cultures and their respective knowledge systems holistically. At the same time, it recognizes the problem of its appropriation by Western scientists. Very informative comparisons and revealing accounts of the interaction between Western and TK systems were produced. However, the approach is conceptually seen in a dualistic and somewhat opposing relationship.

41. The third approach is the so-called "actor-oriented approach" where the dualistic distinction between Western and non-Western knowledge is abandoned. The objective is an elucidation of the actor's own interpretations and strategies, and how these interlock through processes of negotiation and accommodation. It is emphasized that our understanding of all knowledge is partial and is based on a particular perspective. What is needed in this approach is a set of methodologies for handling the complex relation evolving in interface situations of development interventions that would allow for a more differentiated understanding of how bodies of knowledge shape struggles and negotiations between local groups and intervening parties. Here, intervention is not seen as a linear process of implementing a plan of action, but rather as an ongoing transformation by which knowledge is negotiated and jointly created through social encounters in which certain power dynamics are operating.

B. Possible problems

42. A casual inspection of the life support system of dryland communities would reveal that things are not as easy as they may look. A descriptive analysis of the circumstances is even harder

because it is often postulated that an outside researcher who may wish to investigate these processes is really an intrinsic part of such studies.

43. Norton et al. (1998) later took up this particular concept. They argued that cross-cultural communication has always been an obstacle to positive interaction between local communities and the outsider. Each side has its own filter or frame of mind through which people perceive and make sense of the situations before them. Though this idea is better understood today, its extreme importance to agricultural development is not. Much of the logic and belief that makes farming behaviour "rational" is implicit even to possessors of that knowledge. Therefore, an outsider can easily miss key elements to conclude that actions are not rational, a phenomenon named "decontexturalized rationality" by sociologists. Anthropologists, and particularly ethno-scientists, have recently developed a theory and techniques to elicit components of the knowledge system and make concepts and principles clear and relevant to outsiders.

44. Warren and Rajasekaran (1993) are of the opinion that a good portion of the problem can be attributed to the fact that the TK systems, for the most part, have never been recorded systematically in written form. As such, they are not easily accessible to agricultural researchers, extension workers, and development practitioners. Hence, by recording these systems, outsiders can understand better the basis for decision-making within a given society. Furthermore, by comparing and contrasting TK systems with the scientific technologies generated through international and national research centres, it is possible to identify where exogenous technologies can be utilized to improve endogenous systems.

C. Effect of the market

45. There is a general tendency to support the notion that traditional cropping and pastoral systems, if judged by environmental and livelihood criteria, have often been superior to modern ones depending on new technologies and the purchase of many externally produced inputs. TK production systems were often less risky, more equitable, and made fuller productive use of available human and natural resources. There is no doubt that modern science and technology can make a big contribution in improving the cropping and pastoral systems. Nonetheless, introducing modern technologies without their negative social and environmental impacts is much more difficult and complex than has been widely assumed.

46. To the extent possible, improved farming systems should be based on the accumulated knowledge and experience of the local communities. Moreover, low-input production systems tend to be advantageous because they are less disruptive of traditional social systems and minimize dependency of local people on the volatile terms of trade in national and international markets. Intermediaries and officials at all levels also often exploit small farmers and pastoralists dependent on a high proportion of externally purchased inputs.

47. On the other side of the equation, three considerations emerge from the rational facts of life (Barraclough, 1993). First, outside entrepreneurs will not stop trying to exploit local communities, whenever profitable opportunities exist in national or international markets. Second, many traditional or transitional farmers and herdsmen will want to enjoy the convenience and perceived benefits of labour-saving machinery, chemical inputs, and consumer goods such as television and cars. Third, local
farming systems everywhere are becoming increasingly influenced by the production and consumption patterns that are dominant in national societies and in the industrialized countries.

48. Industrial production systems increasingly dominate the national and international markets. They largely determine what is available commercially, and at what price, in the way of consumer goods, production inputs, capital goods, and technologies. In such circumstances, self-reliance as a declared objective of some local community or a country should not compromise the question of sustainability. This question will not be resolved unless the relevant social and ecological issues are resolved.

III. LOOKING AHEAD

A. Research needs

49. It is conceded that there is a considerable qualitative gap between scientific knowledge and local traditional knowledge in many dryland areas. To close this gap, for the benefit of all

parties, it is necessary that documented and validated TK be integrated with modern scientific knowledge as well as with the latest resource management techniques that are applicable to a given area. As a prerequisite to this, a concerted community action should be initiated to compile an inventory of the relevant TK system.

50. CBOs and NGOs should have a prominent role in this undertaking. Such collected TK systems can provide scientists with a major source of information, a framework for interpreting information and data, and a way of solving some of the problems they may encounter in the field (Seely, 1998).

B. Traditional knowledge centres and networks

51. Several regional and national centres have already embarked on systematic recording of TK systems for use in development (Warren and Rajasekaran, 1993), with support from three institutions in the Netherlands and the United States. The two regional centres for Africa and Asia are located in Nigeria and the Philippines. National centres now exist in Brazil, Burkina Faso, Germany, Ghana, Indonesia, Kenya, Mexico, the Philippines, South Africa and Venezuela. The three institutions mentioned provide a partnership relation with the regional and national centres. This is accomplished by developing guidelines, coordinating activities, compiling documents, and capacity-building.

52. The functions of the national centres include:

- Providing a national database where published and unpublished information on TK is maintained;
- Designing training methodologies for recording TK systems in collaboration with research centres; and
- Initiating links between originators of TK in a country and the development community.

53. The establishment of more of these centres and the strengthening of their institutional capacity, both on the national and regional levels, are highly recommended. Appropriate cross-linking between centres would facilitate the desired exchange of information. Relevant parties in the dryland areas and within the scientific community should be aware of the potential role which can be played by these centres in their common effort to combat desertification.

C. Agro-ecological mapping

54. Analysis of the prevailing agro-ecosystems is the first step towards understanding the village environment and its physical conditions. Maps and transects are drawn with the participation of the local people to demarcate ecological zones and characterize the village in terms of crops, livestock, land-use patterns, watersheds, and soil types. Subsequently, the indigenous characterization of types of farmers would uncover the socio-cultural and economic variables used to distinguish locally important categories of producers. The identification of local organizations and associations is vital for understanding traditional approaches to identifying, evaluating, and disseminating sustainable dryland management technologies. In most cases, the social scientist, in coordination with respective disciplinary scientists should provide vision and leadership for recording the TK related to the management of natural resources.

D. Identifying research-based technologies

55. It is given that farmers, pastoralists and scientists each know and understand many things, but have little overlap between their domains of knowledge. Therefore, farmer-scientist or pastoralist-scientist interaction is the best way to help both groups to learn simultaneously. Involving research-minded community individuals during the phase of identifying research-based technologies is highly recommended. These individuals are encouraged to ask questions regarding the available technologies and to decide which one(s) they want to test. During the experimentation, community representatives must be allowed to use their evaluation criteria to assess the tested dryland management technologies. The final conclusion will be based on compatibility with ecological conditions, need for institutional support, profitability, risk involved, and need for external resources.

56. The results of farmer and pastoralist experimentation would be the baseline for disseminating the recommended dryland technologies on a wide scale. During the dissemination phase, socio-cultural, economic and institutional factors should be assessed to confer credibility and replicability on the integrated or hybrid technology.

57. The role of CBOs and NGOs in the different phases of this process is indispensable. With such integrated teamwork, combating desertification in the dryland areas would certainly be cost-effective.

LIST OF ABBREVIATIONS

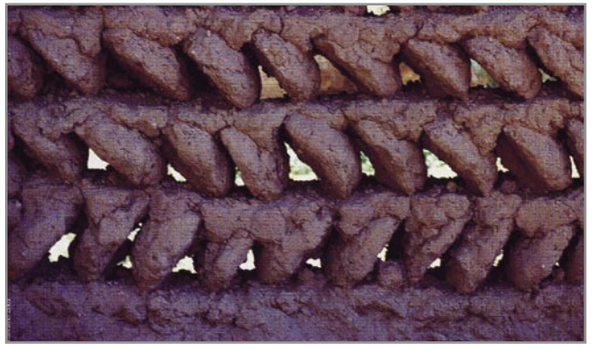
CBO	Community-based organization
CILSS	Permanent Inter-State Committee for Drought Control in the Sahel
COP	Conference of the Parties to the UNCCD
CST	Committee on Science and Technology of the UNCCD
IDRC	International Development Research Centre (Canada)
IFAD	International Fund for Agricultural Development
INCD	Intergovernmental Negotiating Committee for the UNCCD
NAP	National action programme (to combat desertification)
NGO	non-governmental organization
OSS	Observatory of the Sahara and the Sahel
TK	Traditional knowledge
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme

REFERENCES

1. Barraclough, S. 1993. "Social dimensions of desertification: a review of key issues emerging from literature." Pp 1-37 in Listening to the People: Social Aspects of Dry-Land Management. Daniel Stiles (ed.). UNEP, Nairobi, Kenya.
2. Gupta, A. (ed.) 1989. Honey Bee, a quarterly newsletter. Indian Institute of Management, Ahmedabad, India.
3. Hausler, S. 1993. "Some reflections on the use of indigenous knowledge in strategies to curb environmental degradation." Pp 47-53 in Listening to the People: Social Aspects of Dry-Land Management. Daniel Stiles (ed.). UNEP, Nairobi, Kenya.
4. IFAD. 1993. Building on Traditions - Conserving Land and Alleviating Poverty. A video tape. Rome, Italy.
5. Kerr, J. (ed.). 1991. Summary of Proceedings of the Workshop on Farmer's Practices and Soil and Water Conservation Programmes. ICRISAT, Patencheru, India.
6. E. Mathias-Mundy, E. Muchena, G. McKiernan, and P. Mundy. 1992. Indigenous Technical Knowledge of Private Tree Management. A Bibliographic Report. Iowa State University, Ames, Iowa, USA.
7. Norgaard, R. B. 1984. "Traditional agricultural knowledge: future, prospects,and institutional implications." Am. J. Agri. Econ. 66: 874-878.
8. Norton, J.B., R. R. Pawluk, and J. A. Sandor. 1998. "Observation and experience linking indigenous knowledge at Zuni, New Mexico." J. Arid Environ. 39: 331-340.
9. Seely, M. K. 1998. "Can science and community action connect to combat desertification?" J. Arid Environ. 39: 267-278.
10. Tahoun, S. A. 1999. "Traditional techniques used in the dryland areas of the world to combat desertification." UNCCD secretariat, Bonn, Germany.
11. Thompson, C. 1994. Lessons Learned from IDRC-supported Projects on Desertification and Land Degradation. A summary published by IDRC, Ottawa, Canada.
12. Warren, D. M., and B. Rajasekaran. 1993. "Using indigenous knowledge for sustainable dry-land management: a global perspective." Pp 89-100 in Listening to the People: Social Aspects of Dry-Land Management. Daniel Stiles (ed.). UNEP.

1.7 The System of Traditional Knowledge in the Mediterranean and its Classification with Reference to Different Social Groupings ICCD/COP(3)/CST/Misc.1

Pietro Laureano- Italian Research Centre- Local and Traditional Knowledge to Combat Desertification Matera, Italy



The adobe walls surround the small tilled parcels and contribute to the water balance. When the wind penetrates the narrow interstices in the plano-convex bricks it accelerates and expands making the temperature decrease. The raw earth mixture absorbs and releases humidity into the soil. **Photo: P. Laureano.**

1. Objectives of the study

a) The definition of the characteristics of traditional knowledge;
b) The study of the criteria according to which traditional knowledge should be classified;
c) Creating an inventory of traditional knowledge in the Mediterranean area and indication of successful techniques;
d) The assessment of the ways in which traditional techniques can be used by adopting modern technologies; and
e) Proposals and recommendations.

2. Traditional techniques or local science systems?

During the second Conference of the Parties that was held in Dakar in October 1998, the UNCCD secretariat brought up for discussion to the Committee on Science and Technology the synthesis of the reports on traditional knowledge submitted by different countries and by the experts who carried out the missions. The study (ICCD/COP(2)/CST/5) presents the inventory on traditional knowledge in the form of a list of 78 items of techniques or practices divided into 7 different topics:

- Combat against wind and water erosion (8 items);
- Hydraulic organization for water conservation (14 items);
- Improvement of soil fertility (20 items);
- Vegetation protection (9 items);
- Forestry (5 items);
- Social organization (9 items);
- Architecture and energy (13 items).

The reason why the inventory has been structured this way rises from the need of synthesizing a very wide topic that will be subsequently enriched and supplied with graphs on different techniques and procedures, thus representing a useful manual on traditional knowledge.

However, the classification, that is based on goals and functions, could impoverish the topic and not convey the meaning nor transmit the way in which traditional techniques work. Traditional and local knowledge is part of a complex system and cannot consist of a simple list of technical solutions and be limited to a series of different applications varying according to the results obtained. Their efficacy depends on the interaction among several factors. They must be carefully taken into account if the success accomplished in history by means of traditional knowledge and its logic are to be understood for a contemporary application.

Each traditional practice is not an expedient to solve a single problem, but it is an elaborated and often multipurpose system that is part of an integral approach (society, culture and economy) which is strictly linked to an idea of the world based on the careful management of local resources.
A terrace is a way to protect a slope, to reinstate the soil and to harvest water. It works within a

social organization and a shared system of values that supports it and that is, in turn, based on it. During flood periods, in dryland areas what seems to be a network of narrow streets is an important system of flood diversion having different functions according to season changes.

Modern technology tries to be immediately efficacious by using the specialization of knowledge managed by dominant structures that are able to mobilize resources that are external to the environment. In the long and very long period, traditional knowledge proves functional by using a shared knowledge created and handed down by different generations and social practices and uses internal renewable input. Thanks to modern technology it has been possible to excavate pits at high depths by pumping ground water. The results can be rapidly checked but the local resources can be depleted and sometimes, as time goes on, by fishing in fossil water beds, the resources can be completely depleted. On the other hand , traditional knowledge uses meteoric water harvesting systems or surface aquifers by using gravity or by adopting catchment systems that enable the reproduction of the resource and its durability in the long run.

Whereas traditional technological methods use separation and specialization, modern knowledge applies combination and integration. According to the traditional idea, the forest, the agriculture and the town are three items completely separated because they fulfil different needs, such as: wood, food, house. Each item avails itself of a specialized scientific system: forestry, agriculture and town-planning. According to local knowledge, the plant heritage is not artificially separated from the forest that provides commercial wood and from the farming land that provides food (Shiva,1993). Forests, fields and dwellings are unitary ecological systems. The forest and the other marginal areas which are apparently non-productive areas, like the steppes and the marshlands, provide considerable amount of food and water, fodder and fertilizers for agriculture. It is also possible to live in these marginal areas. The traditional town, in its turn, integrates with agriculture thus replacing, in desert areas, the forest for obtaining fertilizers that are produced by organic wastes of the inhabitants and for the production of the water caught on the roofs of the houses. As a result, the humus produced in the fields gives the soil its colloidal quality which is necessary for building houses in adobe towns. The hole made by excavating the land is used either as a gutter for water, or as a hole for the transformation of dung into humus, or as orchard whose contour is protected by excavation walls. Therefore, the activities are carried out in this feedback cycle where the result of one activity is the basis for the realization of the other. The architecture fulfils this need in every single detail. In Shibam, which is an adobe town located in Yemen, the town-plan is in harmony with the need to collect organic waste separately in two-outlet toilets. These toilets are necessary because they enable transform ation of the sand into fertile soil.

This principle which is very similar to the functioning of nature where each residue of a system is used by other systems, where the idea of waste or the possibility to resort to external resources does not exist, has allowed the survival of people throughout history. Multipurpose techniques have been successful even in hard times. The collaboration and the symbiosis by reusing what is produced within a system enabled the autopoiesis, the self-reproduction, the self-propulsive development, which does not depend on exogenous or occasional factors.

When this logic is supported by strong cohesion between society, culture and economy, a positive development is obtained in history. The synthesis between traditional knowledge and social systems leads to forms of intensification by appropriately using the resources and entailing positive status changes, thus realizing rural or urban ecosystems. This process enabled the success of important civilizations based on traditional techniques, thus producing important socio-economic results.

The wonderful civilization of Angkor owes its wealth to the excavation of monumental canals or ditches that in the North-East of Thailand surround human settlements with concentric circles. This is a traditional practice that has been used since prehistory. These works, which actually shape the landscape, are generally referred to as drainage or irrigation systems, although this definition is not comprehensive. As the ditches can be easily crossed, the defensive reason is not sufficient to explain why this technique was successfully adopted. Only by understanding their multipurpose use as water reserves in the cold season, protection against floods during the wet season, symbolic and identification value of the community, is it possible to explain the reason why this practice is successful.

Besides the interaction among environmental, productive, technological and social aspects, we should take into consideration both aesthetic and ethnic values. The traditional procedure works in harmony with the landscape, thus trying to meet the traditional aesthetic needs. A tool for water harvesting or conduction is not only a technical structure but it is also a beautiful structure. The oases are productive systems but at the same time they are places of contemplation and rest. Likewise in the south of Italy, the small farmlands of the desert are called gardens, thus eliminating the difference between orchards and gardens. The constructions and the methods often have a deep symbolic meaning that draw continuous analogies between technique, art and nature. The water repartition systems in the Sahara desert are reproduced on the patterns of carpets and in women's hairstyle. They are complex symbols linked to life, fertility and generations. Spiritual principles sanctify the rules thus guaranteeing their dissemination. This is the case of the holy woods in Africa that have limited access, or of taboo goods, that are practices which guarantee forest reinstatement, environmental and soil resources as reserve for nature and human communities.

Therefore, the traditional technique is an integral part of a set of links and relationships that is strongly integrated and supported by symbols and meanings. The traditional technique is performed thanks to a cultural structure that is socially shared: it is the system of the local historical science and knowledge.Therefore, it is wrong to isolate the single technology, which always relates to a context and is not only linked to an environmental situation but also to a precise historic period or to a complex social structure. These remarks are necessary in view of the dissemination, the reproducibility or the reuse of contemporary forms of traditional techniques. Actually, it is not true that a traditional technique always gives positive results in different situations and periods. The "slash and burn agriculture" or the "shifting agriculture" enabled the survival of human groupings for very long period of time in perfect harmony with resources but it can also turn out to be catastrophic if it is applied in a different environmental and demographic context.Traditional knowledge must not be meant as a set of expedients to be replaced by traditional background, but it must contribute to the formation of a new paradigm. What is possible to learn from traditional and local knowledge is not a series of miracle solutions that could be able to act in the same logic of modernity. It is the method on which it is based that can be put forward again by means of modern technologies.

Box. 1

MODERN KNOWLEDGE	TRADITIONAL KNOWLEDGE
Specific solution	**Multipurpose system**
Immediate efficacy	**Functionless in the long run**
Specialization	**Holism**
Dominant powers	**Autonomy**
Separation	**Integration**
External resources	**Internal inputs**
Conflicts	**Symbiosis**
Monoculture	**Relationship and complexity**
Uniformity	**Diversity**
Severity	**Flexibility**
Expensive maintenance	**Self-regulation and work intensity**
Internationalization	**Contextualizing**
Waste	**Saving**
Technicism and rationalism	**Symbolism and wealth of meanings**
Dependence	**Autopoiesis**

3. Intensification of resources and socio-cultural groupings

The fact that traditional knowledge is not considered as a simple set of techniques means that they are evaluated in the framework of environmental, productive and cultural conditions of societies. The inventory of technologies, knowledge, traditional and local practices is used as a study on social groupings. The relationship with nature is kept by means of a series of practices using resources which represent their technological aspect and are integral part of the cultural system.

Thanks to this knowledge, technologies and devices for environmental change, the people are able to obtain an increasing number of resources from the environment in comparison with the resources that nature offers. Therefore, the advantages increase, thus guaranteeing the best life conditions which can undergo further positive changes. The communities who live in harmony with the resources can endure for long periods of time. Deep changes can also occur either in longer periods of time or they can be concentrated in more rapid status revolutions that cause the passage from one social grouping to another.

Therefore, the topic of the study ranges through history without any constraints of time and space. For these reasons, this inventory does not mean to be comprehensive but it aims at highlighting a system, a reference point and an outline of classification within which it will be always possible to introduce new contributions. The traditional knowledge system is rebuilt according to the common classification of social groupings used in archaeology and anthropology:hunters-gatherers, farmers-breeders, agro-pastoralists that use metals. Besides these three categories there are two more synthesis represented by more complex traditional social systems of intensification and integration of knowledge. Within these systems the technologies of previous social groupings seem to be stratified and combined in a diversified way according to different social and environmental situations.

The first synthesis of a complex system is the oasis meant as the artificial formation thanks to a perfect environment knowledge. In the desert the environmental context of aridity is interrupted by specific situations which create niches and micro-environments that can becounter to the overall cycle. A shallow depression can collect moisture, a rock can cast a shadow, a seed can thrive. In this way positive feedback can begin: the plant will generate its own protection against the sun's rays, it will concentrate water vapour, attract insects which will produce biological material, it will create the soil which will then nourish it.

Thus, a biological system is created which can use other organisms making their own contribution. A symbiosis is set up, a micro-cosmos is created as the result of co-existence. The peoples inhabiting the Sahara desert use theses processes to create their oases. The origin of an oasis was often a simple palm tree planted in a shallow depression in the soil and surrounded by dead branches protecting it from the sand. Over time, vast cultivated stretches grew along terraced canyons or else green archipelagoes rose up from the sand dunes thanks to diversified and complex water production techniques, land organization and the creation of a microclimate. Though on entirely different scales, the same principle, the oasis effect applies: a virtuous cycle is established which can run itself and regenerate itself. This process can be used as a pattern that can be applied for all the situations, also for non desert lands, whereby islands of fertility are created and defined as follows: an oasis is a human settlement in a harsh geographical situation that use rare resources which are available locally in order to spark off a rising amplification of positive interactions and create a fertile, self-sustaining environmental niche which is in direct contrast with the unfavourable surroundings (Laureano, 1988). Therefore, there are adobe oases in the Sahara desert, stone oases in rocky plateaux and sea oases in the isles. Even in rainforest, the settlements of Maya, in Yucatan, can be referred to as an oasis system because they did not have any ground water courses due to special karst environments.

Niches of oasis intensification are found in the whole Mediterranean. These systems are particularly widespread in the southern shore of the Mediterranean, in the southern Euro-Mediterranean part, in the isles and in the peninsulas and in all the situations where there are harsh and changing climate conditions, with torrential rainfalls in some months of the year and dry seasons. As a result, an accurate management of the water resource is necessary as well as technological measures to control its change throughout time.
The following complex system is the urban ecosystem that is the oasis model changed into town. This system consists of large caravan-route towns in the desert or urban clusters that are not as small as the oasis model. Irrigated areas are created by using favourable geomorphological situations in given geographic systems. A big capital dominates each unit of landscape: isolated basins in the middle of the desert; large plains among the mountains; oasis along hydrographic networks; crossroads of remote, international and intercontinental routes. However, these e cosystems are also traditional habitats that exploits the resources available, thus becoming important regional historic centres with urban characteristics. This classification enables the

continuous process of knowledge gathering and stratification in a chronological way since the first three social groupings correspond to the passage from the Palaeolithic, the Neolithic and the Metal Age to more complex systems of oases and ecosystems. However, if it is useful for classification purposes it could be misleading to outline a theoretical idea. In our pattern, the kinds of social groupings do not represent development phases of human history, but rather are the conditions that characterize precise periods of time and can live together in the same historic periods. In the long run they realize continuity, over-lappings and integrations. The socio-cultural groupings, which dominated the dawn of human history are still present in human groupings that have similar knowledge to those found during the palaeontologic and archaeologic studies. Of course, there are some differences among the communities belonging to the same social grouping of the same historic period.

The kinds of socio-cultural groupings must not be meant as universal characteristics: they change according to the geographical context and to the characteristics of dominant ideas. The distinction and the classification rise from a stratification of technological levels and cultures, the current diversified climate and environmental conditions, the synchronic experiences of humankind and different social patterns. Both the environment and the idea of the world as a community contributes to the establishment and the safeguard of specific characters. Both factors vary continuously in time and from one place to the other, thus creating and preserving the cultural diversity.

3.1 Hunters-Gatherers

Socio-cultural groupings: Hunters-Gatherers
Environmental system: mobility, routes along the ridges, savannah, dissemination all over the planet
Local and traditional knowledge:

- Hunting and fishing tools, portable multipurpose tools;
- Traps;
- Holders;
- Use of cave-dwellings;
- Use, transport or stoke of the fire;
- Water harvesting in cave-dwellings by water dripping and percolation;
- Food harvesting near the springs, torrents and dried beds of water courses;
- Salt collection and food conservation;
- Soil sprinkling near the spring by aspersion to facilitate the growth of edible wild plants;
- Stone arrangement and first forms of irrigation;
- Natural rudimental agriculture depending on rainfall;
- Small rough stone "dams" to retain water and excavate streams to divert water towards the margin of the valley;
- Maize-like water traps;
- Role of women in recognizing useful and edible plants;
- "Cultivation" of insects and larvae, capture and killing of small animals;
- Taboo-goods (animals, plants and places) and resource saving;
- Movable "gardens".

3.2 Farmers-Breeders

Socio-Cultural Groupings: Farmers-Breeders
Environmental system: sedentariness, settlement on the plateaux, demographic growth.
Local and traditional knowledge:

- Animal and plant domestication;
- Slash and burn agriculture (shifting agriculture);
- Breeding;
- Fishing;
- Natural forage collection and fire for a better regeneration;
- Use of residues to feed animals;
- Excavation and drainage techniques used in mines;
- Rainwater harvested in pits and cisterns;
- Animal shelter and grain storage;
- Pit courtyard;
- Villages with large ditches to drain the land and harvest water;

- Multipurpose system: the ditches delimit the area, protect it from water. They are used as cisterns and drinking troughs; they collect sewage for the formation of humus;
- Adobe architecture and circular stone huts;
- Walled gardens;
- Sabean agriculture.

3.3 Agro-pastoralists

Socio-Cultural Groupings: Agro-pastoralists Environmental system: Colonization of the slopes

Local and traditional knowledge:

- Terraces for soil conservation and plants;
- Dry walls;
- Bisse;
- Diversion and control of rainfalls along the slopes;
- Excavation of cave-dwellings for cultural purpose and for diverting waters;
- Use of the principles of moisture condensation;
- Water conservation in jar-like cisterns;
- Tumulus and stone arrangement;
- Devices for the formation of humus;
- Soil fertility improvement;
- Megalithic monuments, tholos, trulli, mounds of stones, cisterns, sheep folds, jazzi;
- Water intakes and canals to irrigate by gravity the dry slopes which are situated above the riverbed;
- Salinas;
- Caves;
- Rock-salt mines and metals;
- Nomadism and Transhumance as a way to manage differentiated resources of the territory;
- Threshing-floors - "garden";
- Olive-tree domestication and spreading: fortified and terraced olive groves;
- Nabataean agriculture.

3.4 Oasis

Social grouping: Oasis and other forms of agricultural intensification

Environmental system: Creating fertility and good life conditions in a harsh environment

Local and traditional knowledge:

- Symbiosis: different contributions for the realization of the ecosystem (an excavation favours condensation, a plant casts a shadow, an insect finds shelter and when it decomposes it produces humus);
- Autopoiesis: realization of a virtuous cycle of reproduction and self-sustainability;
- Important camel nomadism that appropriately manage the rare resources organizing breeding on very large areas;
- Underground dams and realization of "gardens" on the sides of the riverbed;
- Underground catchment systems (e.g., foggara, qanat);
- Hydro-genesis and use of hidden rainfalls;
- Atmospheric spring, condensators and moisture catchers;
- Systems of formation of artificial dunes (afreg) used for protection
- Systems of clustered or underground habitats;
- Soil formation;
- Horticulture combined with taller plants (e.g., palm tree, papaya, banana);
- Walled gardens;
- Palm-tree domestication and spreading;
- Oasis effect under the palm-tree leafage and three-storey agriculture;
- Forms of social solidarity;
- Water corporations and hydraulic law;
- Andalusia agriculture;
- Motselo;
- Floating gardens (Chinanpas Mexico).

3.5 Urban Ecosystems

Socio-cultural groupings: Urban ecosystems

Environmental systems: Oasis town: poles of geographic basins (canyons, large fossil beds, extinct craters, caravan routes and communication corridors) managed in harmony with renewable resources.

Local and Traditional Knowledge:

- Canyon and gravina settlements: vertical integration of geographic systems: plateaux-slopes-valley;
- Diversion and use of floods for irrigation;
- Integrated use of water catchment systems, condensation, harvesting, canals and distribution;
- Collection of urban organic waste to obtain fertile soil;
- Dwellings made of traditional materials that are useful for energy saving, water harvesting and recycling;
- Integration of building, consumption and agricultural production cycles;
- Systems of traditional habitats: towns, adobe stone and sea oasis.

4. The application of the model to a typical Mediterranean case study: The "Sassi" of Matera

A typical example of a traditional use of resources in the Mediterranean is represented by the Sassi of Matera and the similar settlements of the Murge plateau until Taranto. The local knowledge system adopted is found in a wide set of situations ranging from the troglodytic dwellings of the Loire valley, in France, to Petra, in Jordan, to the towns carved out of the calcareous rock in Cappadocia, in Turkey, to the underground settlements of Matmata in Tunisia, to the villages along the canyons in Algeria and in Morocco up to Andalusia and Nabataean water farming techniques. The towns are built along the borders of deep valleys, the Gravine, that have a small water carrying capacity or do not have any. The settlements are not placed on the bottom of the canyon like one could expect if it were to provide water, but on the upper part, along the plateau and its steep slopes. In fact, the resources of the maze-like troglodytic dwellings of the Sassi of Matera and of the other stone towns of the Gravine are the rain and the dew that are harvested in drains and in cave-dwellings (Laureano,1995). The time stratification of traditional knowledge according to the classification adopted for social groupings, hunters-gatherers, farmers, breeders, agro-pastoralists shows the progressive determination of a complex system of knowledge and appropriate use of resources until the creation of stone oasis and of the urban ecosystem.

4.1 Hunters-Gatherers **(Water harvesting in the cave dwellings by dripping and percolation)**

Human beings have settled the area from the Palaeolithic onwards, as evidenced by a number of stone findings in the Grotta dei Pipistrelli (The Cave of Bats) and by an intact skeleton of a hominoid found in a karst pit near Altamura which has been dated at about 250,000 years old. The Grotta dei Pipistrelli is a natural formation but its structure is made up of a passageway, the entrance of which gives out onto the slope and the other end of which emerges through a karst sink hole onto the plain and is a model for later artificial constructions.

4.2 Farmers-Breeders **(Rainwater harvesting in wells and cisterns; villages with large ditches to drain the soil and harvest water; multipurpose system)**

During the neolithic age, a number of techniques were developed for digging in the calcareous highland and for harvesting water. Bell-shaped cisterns, huts and small canals were enclosed in deep ditches, forming circles and ellipses and were therefore called entrenched villages. It is nonetheless likely that the ditches were not used for defensive purposes, but rather they were used in neolithic practices of animal husbandry and farming. An analysis of aerial photographs showing where vegetation grew more thickly also show drainage systems (Tiné, 1983), that is used for water harvesting or humus collection, and the maze-like systems called corral that were necessary for agricultural and animal grazing. The recent excavation of the neolithic complex of Casale del Dolce near Anagni underpins this hypothesis (Zarattini and Petrassi, 1999).

4.3 Agro-Pastoralists **(Cave excavation for worshipping purpose and for intercepting water; pit courtyards; terracing for soil conservation and plants; dry walls; megalithic monuments; moisture condensators; barrows and stone arrangement)**

The Age of Metals provided new tools, which made it easier to excavate caves and pits. As the environment deteriorated, these caves became ever more attractive as human dwellings. In fact, the progressive loss of the vegetation cover left the surface villages without shelter, left the land unprotected, thus causing a shortage of wood for building and heating purposes. The climate ranged from freezing winters to broiling summers.

The absolute lack of water in the rivers or on the slope made it necessary to harvest meteoric water in underground cisterns. An increasing popular form of dwelling was the pit courtyard, which had been developed during the neolithic age subsequent to the development of excavation techniques where tunnels radiated out from a central shaft.

This dwelling model also arose in remote areas such as Matmata, in Tunisia and on the dry plains of China and was the origin of the courtyard dwelling used by the Sumerians, both in antiquity and during the Islamic era. An excavated house near the neolithic site of Murgia Timone, across from the Sassi of Matera, proves just how effective this type of construction is. The house is rectangular in shape like the megaron of Crete and is divided into three spaces made up of two open rooms and a third underground room. The courtyard is used as a water reservoir, it is an open and sunny space, which is protected by its walls and which can be used for the preparation of the food. At the opposite end is a garden, that is used for waste and as a compost heap, which has been carved out of the rock. The garden is absolutely necessary given the poor soil and the need to protect plants. The caves keep a constant temperature throughout the whole year and are ideal shelters for men and animals, for the storage of grains and water conservation.

It is interesting to remark that after the structure was discovered and freed of sediments, the underground part of the cistern soon filled up with water, even though there had been no rainfall. Therefore, the system started working again using capillary infiltration and condensation. Even the barrows of the Bronze Age took their shape from water harvesting practices, both functionally and ritually. The barrows were basically a double circle through which ran a corridor with a room excavated down the centre. What is interesting to notice is that these structures were introduced along the excavation of the archaic neolithic walls, which had been abandoned when the buildings were constructed, but which can still be used as moisture diversion systems.

What has been found in Matera is quite similar to prehistoric structures made up of barrows and underground rooms in the Sahara desert. Actually, these are solar tombs made up of concentric circles around the barrow. They could also be ancient methods for the collection of moisture and dew and could belong to cults devoted to the practice of water harvesting.

Similar interpretations could be made of the dry stone structures spread throughout the dry lands of Apulia where stone mounds harvest the night dew thus replenishing the soil with moisture. Indeed, the roots of centuries old olive trees all point to the low walls that are a staple of the farmland. The walls, the barrows, the "trulli" and the mounds of calcareous rock called "specchie" are all structures of water condensation and conservation. These structures carry out their tasks during the day and at night. In the broiling sun, the wind carries traces of moisture which seeps into the interstices of the stone mounds, whose internal temperature is lower than the outside temperature because it is not exposed to the sun and because it has an underground chamber. The decrease in temperature causes the condensation of drops that fall into the cavity. That same water accumulates and provides further moisture and coolness by amplifying the efficiency of the condensation chamber. Overnight, the process is reversed and condensation occurs externally so that dew settles on the surface; the dew slides into the interstices and is harvested in the underground chamber.

4.4 Stone Oases **(Canyon and Gravina settlement: vertical integration of the systems; terracing, realization of ecosystems; dwellings built in traditional materials for energy saving, water harvesting and recycling)**

By developing the original prehistoric techniques, an adapted habitat system that uses the combination of different water production techniques: catchment, distillation and condensation is carried out in the Sassi of Matera. During the torrential rainfalls, the terracing and the water collection systems protect the slopes from erosion and gravity pulls the water down towards the cisterns in the caves. During dry spells, the dug out caves suck out the moisture in the air at night: the moisture condenses

in the final underground cistern, which is always full even if it is not connected to outside canals or ducts. The result is a multitude of underground storeys topped by long tunnels, which lead downward underground. Their slope allows the sun's rays to penetrate down to the bottom when heat is most necessary. In winter, the sun's rays are more oblique and can penetrate the underground areas. During the warm season, when the sun is at its zenith, it shines only on the entrance to the underground caves, which thus remain fresh and humid.

There are existing sites of up to ten storeys of caves one atop the other, with dozens of bell-shaped cisterns all connected to each other by means of canals and water filter systems. Like in the Sahara oasis the system of local knowledge enables, in a situation without water resources, to realize good living conditions thanks to the appropriate use of techniques and to their perfect interaction with the environment.

4.5 The Urban Ecosystem

The Medieval monasticism contributed to this archaic texture. The hermitages, the parish churches, the farmhouses that are located in check points of hydraulic works represent the poles of the urban growth process. The two main drainage systems called "grabiglioni" that provide tillable land and humus by sewage collection are surrounded by two urban sections called Sasso Caveoso and Sasso Barisano. In the middle there is the Civita, the fortified acropolis that represents the ancient shelter in case of danger where the Cathedral was built. At the foot of the plateau where there are large cisterns and ditches as well as rupestral silos for grain storage there are the craftsman's workshops.

The vertical structure of the town allows the use of gravity for water distribution and protects from wind blowing on the plateau. Matera boasts hundreds of rock-hewn churches, which are decorated with beautiful Byzantine frescoes. The churches can also be found on the plateau with sculptured tufa-stone monumental facades belonging to the medieval, classic or baroque style. However, the whole arrangement of narrow streets, stairs and underground passages continues to follow the ancient urban hydraulic system, Therefore, it is still possible to understand the urban texture of the Sassi of Matera starting from the original texture of the underground areas, of the cisterns and of the terraced gardens as well as from that system of traditional knowledge that allowed an increasing use of resources without depleting them.

5. The system of traditional knowledge in the Mediterranean area

Three sides of the Mediterranean basin are connected with areas where humankind had to cope with dryland areas; its isles are completely lacking in underground or ground water where complex civilizations developed and even in its more northern areas it undergoes a changing and catastrophic environment. Therefore, most of the traditional techniques relative to water harvesting, conservation and diversion are widespread as well as the systems of slope protection and the creation of soil that have different characteristics according to the environment. In southern Italy and in Spain there are also systems such as underground drainage tunnels that are common in oasis towns, in North Africa and in the Eastern World that have been handed down by Islamic civilization or by more ancient civilizations.

The water saving techniques used by the Nabataean agriculture, the condensation caves and pits, the stone arrangement for rainfall harvesting, the underground dams are not only widespread in the Negev desert but also in the whole Mediterranean area. In Petra (Jordan) they present their urban ecosystem synthesis but they can be also found in Tunisia, in Libya and in southern Italy and in particular in the isles thanks to the influence of prehistoric or widespread traditions. The techniques of Andalusia agriculture in Spain are widely represented because of the influence of the Islamic civilization. In the isle of Ibiza there is a similar irrigation practice called feixes designed according to an ingenious hydraulic organization. The fields are divided into long and narrow rectangular plots by means of a network of canals having the twofold function of draining the water in excess, thus collecting and saving it and of irrigating the fields during drought seasons. In fact, if these works were not carried out it would be a swampy area in some seasons and arid or flooded by sea water in other seasons. In this way, it is possible to carry out a self-regulating process which allows the practice of intensive cultivation of both marshlands and arid lands. Open canals are about one-metre deep and flow at a lower level than the plots of land thus keeping

them dry. The land excavated for building the canals is used to raise the level of the cultivated land. During hot seasons when the land undergoes high evaporation, the plots absorb the necessary quantity of moisture directly from the subsoil and from the walls of the canals by osmosis and capillarity. The process is then fostered by further underground canals excavated in the plots. These underground canals are built with porous stones and pine-tree branches covered with a layer of Posidonia algae collected along the coast. This method ensures the good running water piping and at the same time it allows a certain level of permeability, in order to give the land the quantity of water necessary to keep it humid. Therefore, the irrigation is carried out from the subsoil directly to the plant roots. This technique enables to save water that would be lost because of evaporation by using open irrigation methods.

Traditional techniques are not only adopted in the southern shore of the Mediterranean basin and in the southern areas of the European side but also in northern areas like in France and even in the mountains of Switzerland where particular geomorphologic conditions bring about aridity conditions. This situation is due to the direction of the mountain slopes according to the dominant winds that give out all their moisture when they go up the slopes. Once they have reached the peak, they beat the slope downhill with dry high-pressure winds that disperses the clouds. This is the phenomenon of the Piedmont desert that in Swiss conditions creates valleys characterized by drought and aridity. These sites of the Valais region and of the province of Sion are characterized by green rangelands and a rich vineyard cultivation. The landscape is not the result of natural condition, but of a wise use of a traditional technique that is called bisse. These are wood diversion systems that can also be cut in the rock and extend in the high mountains, the sources of the streams up to the permanent glaciers. They extend for many kilometres with minimum slopes along the steep contours keeping a high altitude to divert the waters upstream in order to irrigate the remote valleys, that otherwise would be lacking in water, by using only gravity. The system is supported by a social cohesion, by corporations and waterworks companies similar to those that manage the Andalusia agriculture or the Saharan drainage tunnels. As in North Africa and in Spain, it produces a particular kind of landscape where the location of the settling is characterized by the texture and by the outlets of the bisse canals.

The most widespread system characteristic of the Mediterranean area is the terracing system that can be found in the Middle East, in Greece, in Italy and Portugal. This system represents a real element of landscape building especially when it is combined with olive tree or vineyard cultivation. The slopes and the hills of northern Mediterranean have resisted to erosion and their shape results from this titanic and long-lasting work. Besides the dry walls, the mounds of stones (specchie), and the tholos architectures (trulli), they represent the typical landscape of Apulia in southern Italy. On the other hand, in central and northern Italy with the terraced slopes of Amalfi and of the Cinque Terre in Liguria they create beautiful and traditional urban ecosystems. The Sardinia and the isle of Ibiza boast systems of fields protected by dry walls that are called "tanka", a name deriving from an ancient Mediterranean toponym.

The majority of the ancient Mediterranean sites follow terracing and hydraulic systems. These sites adopt the techniques of rainfall harvesting, protected vegetable gardens, the use of organic waste for the creation of humus, the methods of passive architecture and of climate control for food storage and for energy saving as well as the practices of recycling productive and food residues. The aesthetic qualities, the beauty of natural materials, the comfort of architecture and spaces, the organic relationship with the landscape that these ancient towns boast are especially due to the intrinsic qualities of traditional techniques and to the search for symbiosis and harmony intrinsic to local knowledge.The survival of the poor archaic societies of the whole Mediterranean areas depends on the accurate and economical management of natural resources. In the Mediterranean area, which is characterized by intensive historical settlements, each part of the environment is not only the result of natural process, but rather represents a cultural landscape where historical centres are the crystallization of knowledge appropriate to the correct environmental management and maintenance.

6. Crisis of the traditional historic centres, desertification and degradation of the Mediterranean land

When the balance between resources and their productive use, painstakingly maintained over the

centuries, is lost, then the urban ecosystem collapses and sets off a process of deterioration of the hinterland as well. In the Mediterranean basin and in its islands and peninsulas, in Syria, Lebanon, Mesopotamia, Palestine, Arabia and Northern Africa, the sites of the most ancient civilizations, where archaeological excavations brought to light cities which were once surrounded by immense greenery, with fertile fields and thriving gardens, are now abandoned and buried in sand. For three thousand years now, the process of desertification has marched onwards; it has worsened during the industrial age and has reached catastrophic proportions over the last fifty years.

This continuous natural deterioration is not due to natural and climatic conditions, but rather is due to indiscriminate pressures being brought to bear on natural resources. In developed countries, the traditional models of life, of production and of consumption have been cast aside in favour of a system, which totally depletes local resources; this fosters overgrowth of the developed areas by means of massive recourse to external resources, first from the hinterland and then from more and more remote areas. Thus, the entire planet is involved in this mechanism of destruction of our plant heritage and our landscapes and that chain of transmission of knowledge telling how to deal with environment that has been handed down from generation to generation over thousands of years. This destruction cause the end of our capability of maintaining and managing lands whose balanced and harmonious arrangement is the result of labour and culture.

To the urbanization of new areas corresponds the abandonment of ancient centres with the loss of territories that are able to correctly manage the environment. As a result, a physical and social desertification process occurs. The architectural degradation, the slope erosion, the coast soil degradation bring about the depletion of human resources. Migration, the loss of identity and valueare are socio-cultural aspects of desertification caused by the loss of traditional knowledge.

In modern societies the goods necessary to survival are supplied by world trade and globalization. Both valuable goods and consumer goods and often the food itself come from very remote places. Also in small-scale societies there is an exchange of food and materials, although the resources enabling life, the most part of which were hunting products and cultivation taking place in nearby places. This happens in societies living on local means. The crisis of this model led to a change of humankind from protector of the environment into wrecker of the environment.
The modern urban areas contribute to the desertification process either in a direct or in an indirect way. In the former case the massive urbanization process itself is desertification because of the presence of constructions on very large natural areas; it is indirect because it occurs through the absorption and the destruction of natural resources in high-demographic areas.

This close relationship between urbanization and desertification can be found in both non-industrialized and in developed countries. In Africa and in the Sahel areas where desertification is more severe, the degradation process has started and it extends from areas undergoing a modern and rapid urbanization process that deplete the surrounding territories in order to meet their needs. In the Mediterranean the development of the desertification process is in direct relationship with the crisis of historic urban centres where the traditional arrangement of the landscape made up of natural houses built with a low consumption of resources has been cast aside in favour of a model based on the massive building, energy waste and environmental pollution. The increase of urban centres, the increase of produces demand and the consumer goods cause the abandonment of traditional farming systems and the introduction of new methods and agricultural policies based on mono-cropping. The uprooting, the lost or the redefinition of elderly people or women's roles who own the knowledge entail the loss of management capabilities for resources and traditional knowledge.

7. Recommendations: The traditional model for a new technological paradigm

The populations of the regions that mainly undergo desertification and degradation and the knowledge they gathered represent an important resource because the local know-how that was improved in the harshest environmental conditions and the existence of intact ancient structures are valuable heritage on which new models of sustainability should be shaped. The Mediterranean countries play a key role as they represent the link between the most affected areas and developed economies. The historic settlements, the traditional landscape, and the local knowledge offer a

wide range of solutions to be safeguarded and can be reused, adjusted and renewed thanks to modern technology. In reusing them the specific procedure is not important,
but rather the logic they bear must fulfil the following principles:

- The enhancement of local resources;
- The ability of local management;
- Low costs that can be spent at a local level;
- The preference for a high quantity of labour force rather than capital;
- The close relationship with the environment;
- The production cycles and consumption that mutually integrate ;
- The propensity towards zero emissions, which means that every activity can feed another one;
- The self-enhancement and the autopoiesis (self-regeneration);
- A multipurpose system and the interrelationship between technological results, cultural and aesthetic values;
- The accurate resource management;
- The place and energy saving;
- The ecosystem management;
- The integrated project.

In southern Italy traditional sites like Matera were completely abandoned in the 50s and 60s because they were considered as ancient places. Nowadays, they have been restored and repopulated by using traditional and local materials aiming to save energy, harvesting rainfall in cisterns and recycling the wastes. The enhancement process has started with the creation of a new paradigm: to use places that once were symbols of poverty and famine are now leisure areas and models for the future.

The abandoned slopes that were affected by soil erosion and degradation have been reinstated with dry walls and terracing systems. The works that are being carried out by employing a large labour force make use of the ancient knowledge and perform the consolidation of the slopes by creating, at the same time, gardens for the population and cultural areas. Therefore, these projects also realizes tourist attractions bringing additional benefits to the population. The traditional systems are archaeologically, historically and anthropologically interesting, thus adding a cultural value that produces other kinds of wealth. This process can be applied in the whole Mediterranean from the Casbah and the Medinas of North Africa to the Middle East traditional systems.

According to the logic of the traditional knowledge system the new model of environmental management to combat desertification and the soil degradation in the Mediterranean should be based on the following guidelines:

(a) In the rural areas agriculture shall not be considered as a simple production system but as a necessary action to maintain the soil;

b) In urban areas environment and town shall integrate and action plans shall be carried out in order to realize a sustainable human settlement and the management of the town as an ecosystem.
The programmes must address innovative actions concerning the soil, water and energy management. In particular it is necessary:

- To use, in a different way, those funds that can cause the destruction of local knowledge, fires, soil degradation and dangerous landscape changes;
- To foster the traditional systems of water production, harvesting and distribution;
- To foster traditional practices for integrated cycle production organization;
- To encourage the programmes of autopoiesis and sustainability of the urban system;
- To foster the systems of integration among the segments of the urban cycles (production, consumption and wastes);
- To involve the population by highlighting the roles of elderly people, women, children and marginal strata of society establishing territorial networks between municipalities, territorial pacts, communities and parks.

New forms and solutions of local knowledge and traditional territorial arrangement shall be put forward again to safeguard and keep the quality of the typical Mediterranean landscape in order to:

a) Play a new global role that can be adopted in those traditional rural systems aiming at soil conservation and resource saving. These activities can be sustainable thanks to the integration with other economies like cultural tourism, archaeology and the use of the environment. As a result, the change of farming methods, desertification factors and the reinstatement of those natural areas that have been upheavaled by industrial agriculture can be put forward;

b) Adopt new integrated production cycles, consumption and recycling in urban areas with the enhancement of ancient centres and the use of traditional building techniques for new constructions, the proposal of new quarters based on the saving and appropriate use of resources, and the environmental restoration of areas undergoing urban or industrial desertification;

c) Draw up new programmes of territorial arrangement that take into consideration the aesthetic, cultural and economic values of the landscape meant as a typical quality of the Mediterranean area in general and of the Italian one in particular. This landscape is the result of the millenary relationship between man and nature aiming at the consolidation of this aspect through the characterization of the typical elements and the innovative reuse of the traditional logic by soil enrichment, aquifer reinstatement and resource saving.

BIBLIOGRAPHY

1. AA. VV. Water Management, World Archeology, vol. II N. 3, February 1980.
2. AA. VV. 1996, Elles et L'Eau, UNESCO, Programme Hydrologique International, Paris, 1996.
3. Barker G., 1996, Farming the Desert, The UNESCO Libyan Valleys Archeological Survey, Unesco Publishing, the Department of Antiquities, Tripoli, and the Society for Libyan Studies, London.
4. Chaptal L., La lutte contre la sécheresse. La captation de la vapeur d'eau atmosphérique, in La Nature, 60 année, 1932/2.
5. Drower M. S. 1954, A History of Technology, Clarendon Press, Oxford, V. I.
6. Gérard R. D. and Worzel J. L., Condensation of Atmospheric Moisture from Tropical Maritime Air Masses as a Freshwater Resources, in Science, vol. 157, 15 September 1967.
Ginestous, Hydogenèse aérienne au Sahara, in Revue agricole de l'Afrique du Nord, n. 670, juin 1932.
7. Hitier H., Condensateurs des vapeurs atmosphériques dans l'Antiquité, in C. R. des Séances de l'Académie d'Agriculture de France, XI, 1925, p. 679-683.
8. Joachim F. – Rottier Ph. Ibiza Le Palays Paysan – Essai sur les formes et les techniques dans l'habitat archaïque – AAM Editions 1988.
9. Laureano P., 1988, Sahara, giardino sconosciuto, Giunti, Firenze, II edizione 1989, edizione francese Sahara jardin méconnu, Larousse, Paris, 1991.
10. Laureano P. 1993, Giardini di Pietra, i Sassi di Matera e la civiltà mediterranea, Bollati Boringhieri, Torino, II edizione 1997.
11. Laureano P. 1995, La Piramide Rovesciata, il modello dell'oasi per il pianeta Terra, Bollati Boringhieri, Torino, II edizione 1998.
12. Laureano P.,1998, Proper Uses of natural resources, Environmental architecture and hydraulic technologies for self - sustainable and resources-sparing projects, in Human Evolution, Vol. 13 - N. 1 (29-44), 1998.
13. Lee, R. B., e de Vore, Ied. 1968, Man the Hunter, Aldine, Chicago.
14. Lee, R. B. 1969, Kung Bushman subsistence: an input-output analysis, in A. P. Vayda, Environment and Cultural Behaviour, Natural History Press, New York.
15. Lourandos H. Change or stability?: hydraulics, hunter-gatherers and population in temperate Australia in World Archeology, vol. II N. 3, February.
16. Masson H., La rosée et la possibilité de son utilisation, in UNESCO,
Annales de l'École supérieure de sciences, tome I (Institut des hautes études de Dakar), 1954.
17. Mazaheri A., La civilisation des eaux cachées, Université de Nice (IDERIC), April 1973.
18. Métral J. and Sanlaville P.1981, L'homme et l'eau en Méditerranée et au Proche Orient, Maison de l'Orient, Presses Universitaires de Lyon.
19. Nebbia G. Il problema dell'acqua nelle zone aride: l'estrazione dell'acqua dall'atmosfera, in Annali della Facoltà di Economia e Commercio, nuova serie, XVII, 1961, Bari.

20. Neveux V., Pour puiser l'eau de l'atmosphère dans les pays chauds. Le puits aérien, système Knapen, in La nature, 1928/2.
21. Orme B., 1981, Anthropology for Archaeologists, Duckworth, London.
22. Pasteur E., Hydrogenèse aérienne et terrestre, in La Nature, n. 2902, April 1933.
23. Pauli G., 1999, Il progetto zeri, Il Sole 24 ore, Milano.
24. Pirenne J.1977, La Maitrise de l'Eau En Arabie du sud Antique, Paris.
25. D. Prinz - Water Harvesting for Crop production – Published on the magazine Seitschrift fur die Wasserungswirdshaft 1998.
26. Richter J., Wolff P., Franzen H., Heim F., 1997, Strategies for Intersectorial Water Management in Developing Countries – Challenges and Consequences for Agriculture, Proceedings of the international Workshop held in Berlin Germany May 1996, ATSAF, DSE Berlin.
27. Ridola D., Le grandi trincee preistoriche di Matera, estratto del Bollettino di Paleoetnologia Italiana, Roma, 1926.
28. Sahlins, M. 1968, Notes on the original affluent society, in R. B. Lee e I De Vore, Man the Hunter, Aldine, Chicago.
29. Sahlins, M. 1974, Stone Age Economics, (I ed. 1972) Tavistock, London.
30. Shiva, V. 1993, Monocultures of the Mind. Perspectives on Biodiversity and Biotechnology, Zed Books Ltd, London.
31. Tiné S. 1983 Passo di corvo e la civiltà neolitica del Tavoliere, Genova.
32. Tolle Kastenbein R. 1990,, Antike Wasserkultur, Munchen, Archeologia dell'acqua, Longanesi, Milano, 1993.
33. Ibiza Biodiversidad y Cultura – Tomo I Bienes Culturales – Primera Parte – UNESCO – Espana 1998. Vincent L. 1995, Hill Irrigation, Water and Development in Mountain Agriculture, Overseas Development Institute, London, 1995.
34. Wittfogel K. A. 1957 Oriental Dispotism, Yale University Press, Il dispotismo orientale, Vallecchi Firenze, 1968.
35. Zarattini A. e Petrassi L., 1997, Casale del Dolce, Ambiente, economia e cultura di una comunità preistorica della Valle del Sacco, Baioni stampa, Roma.

1.8 A Participatory Approach to Research and Extension in Africa

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Niger. Dune fixation under the Keita (funded by Italian Government) project. Dune fences are made from dried millet stalks..
Photo: F. Paladini FAO/15337.

1. Introduction

The Resource Development Unit of the Netherlands Center for Development Cooperation Services (CDCS) is coordinating two regional programmes in Africa, which promote a participatory approach to research and extension. One is the second phase of Indigenous Soil and Water Conservation in Africa (ISWC) and the other is Promoting Farmer Innovation (PFI). ISWC is working in 7 African countries: Tunisia, Burkina Faso, Cameroon, Ethiopia, Uganda, Tanzania and Zimbabwe, whereas PFI intervenes in Uganda, Kenya and Tanzania. Both programmes are funded by the Government of the Netherlands. ISWC and PFI collaborate closely and their methodologies show considerable similarities. The intention is to merge and expand both programmes in the next phase.

The accent in this article will be on a presentation of the methodology of ISWC. This is of interest, because there is relatively little experience with participatory approaches to research and extension in the field of Natural Resource Management. Despite much rhetoric about the need for more demand-driven approaches to research and extension, the Transfer-of -Technology (ToT) model continues to be the dominant paradigm. This model implies that researchers generate new or improved technologies, which are transferred by extension staff to farmers. Practice shows that technologies generated in this way are not acceptable to most small-scale farmers especially in semi-arid areas. They have many reasons for not accepting the technologies promoted; they can be too expensive for the hundreds of millions of small-scale farmers, who can't afford the investment in a package of inputs, or the technologies are not well adapted to the specific agro-ecological conditions in which the farmers are working. The World Bank has for a long time strongly pushed a form of ToT-model called the Training and Visit system, which has an in-built feedback loop. Technologies are transferred to farmers, but through the extension agents farmers can inform the researchers of their assessment of the technologies. However, practice shows that this feedback loop usually does not work (Bauer et.al., 1998).

As the world population continues to grow and many farmers do not accept the technologies offered to them by the conventional research and extension system it is important to explore new approaches. It is well known that farmers in many regions experiment and innovate themselves. Both ISWC and PFI decided to try to build on farmer innovators, who we define as farmers spontaneously trying out new things. This distinguishes them from ‚model farmers' and ‚progressive farmers' who have often been selected by projects for testing of new crop varieties or input packages. The starting point is the farmers and their innovations and not the researchers and their technologies. This does not mean that researchers don't have an important role to play. Both programmes try to link researchers, extension agents and farmer innovators in a joint effort to improve modern and traditional land and water management practices.

After a presentation of the ten methodological steps used by ISWC to make this approach operational, first impressions will be given of innovators and innovations and three cases of farmer innovators will be briefly presented to illustrate the concepts of innovators and innovations. Subsequently we will look at what triggers farmers to innovate and finally some initial lessons will be drawn from programme experience.

2. Methodological steps

Although ten methodological steps are presented here this does not mean that they are neatly implemented one after the other. In practice several steps run parallel and in some countries the order may be changed.

Step 1. Training in Participatory Rural Appraisal (PRA) and Participatory Technology Development (PTD)

PRA is a growing family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions, to plan, act, monitor and evaluate. Past dominant behaviour by outsiders goes far to explain why it is only in the 1990s that these participatory approaches and methods have come together and spread (Chambers, 1997). PTD is essentially a process of purposeful and creative interaction between rural people and outside facilitators. Through this interaction, the partners try to increase their understanding of the main traits and dynamics of local farming systems, to define priority problems and opportunities, and to experiment with a selection of „best-bet" options for improvement (Veldhuizen, L.v. et al. 1997).

Although there are good exceptions, many researchers and extension agents are not able to communicate eye-to-eye with farmers. Their training and experience have often imbibed them with a sense of superiority. They teach and train the farmers and to most of them it is unimaginable that they can also learn from (illiterate) farmers. Regional and national training workshops in PRA/PTD have been organised in all participating countries. An important objective of this training was to change the attitudes of researchers and extension agents and to increase their gender sensitivity. In Tunisia, for instance, a national PRA/PTD training workshop was held in October 1997. It was obvious that the participants were surprised by the level of local knowledge and experience they discovered during fieldwork, which served as an eye-opener. Some participants continued to use PRA techniques and got actively involved in the identification of farmer innovators.

Step 2. Identification and verification of farmer innovators

The identification of farmer innovators has been done by extension agents, by field staff of NGOs, by students doing fieldwork and also by researchers. In some cases farmer innovators have been asked to identify other innovators. It is obvious that the detailed local knowledge of extension agents and field staff is an important asset. The identification of innovators is not always an easy process, because innovators are not always aware that they innovate. Farmers in a village who just copy what another farmer in the same village has tried out are not real innovators. This means that a first round of identification will be necessarily followed by a process of verification. In each country the programme concentrates on a region, for instance Tigray in Ethiopia and the Central and Southern parts of Tunisia. In all regions between 30 and 80 farmer innovators have been identified.

Step 3. Characterisation and analysis of farmer innovators and innovations

It is important to get a better picture of innovators and their innovations. Some relevant questions are whether innovators are old or young, rich or poor, educated or illiterate. Do women also innovate and are their innovations similar or different to those of men? What kind of innovations have farmers experimented with? What is the potential of an innovation to be adopted by other farmers? In section 3 some initial results of this analysis will be presented.

Step 4. Setting up monitoring and evaluation systems

Forms and formats have been devised which should make it possible to monitor progress and to assess the impact of the various programme activities. They incorporate both conventional and participatory Monitoring and Evaluation. In the end both programmes must be able to demonstrate whether or not they have enhanced the capacity of farmers to experiment and whether or not they

have contributed to an improvement of land and water management techniques. It is critically important to produce numbers, but it is as important to document and analyse processes: who has done what, where, how and why? The challenge is to select a minimum number of key indicators, to minimise and simplify the questions and to involve all partners in monitoring and evaluating programme activities. A proposal has been made to the partners in all participating countries and it is up to them to adapt the proposal to the local conditions and local capacities to handle and analyse the information generated.

Step 5. Organising farmer innovators in networks (cross visits)

Both programmes provide farmer innovators with an opportunity to visit each other's fields and to exchange information and experience about their innovations. Practice shows that upon return many innovators start to try out for themselves what they have observed. The question is not whether such study visits are effective, but rather how to maximize their impact. Creating networks of farmer innovators enhances their capacity to experiment. In the PFI countries innovators are organized in clusters of 8 farmers (a guideline and not imposed). In the ISWC countries it is left to the innovators to decide how they want to organize themselves (see also step 9).

Step 6. Lobbying for policy change

Lobbying for policy change is an important component of the ISWC programme, in all participating countries the partners have occasionally had access to the radio, TV and press. In Tigray, Ethiopia, the programme has excellent links with the Bureau of Agriculture and Natural Resources, which actively supports programme activities; village workshops are held all over Tigray to evaluate local innovations (see step 7) and its staff is increasingly trained in PRA and in Participatory Technology Development. In Tunisia the partners have organized systematic access to the regional radio for Central and Southern Tunisia with a two hour programme on „Agriculture and Innovation", which is broadcast once a week during a full year. Each week farmer innovators feature prominently in this programme. At the end of 1999 two regional workshops were organized for Anglophone and Francophone Africa respectively to which representatives of international organizations were invited. PFI is now in the process of producing a video on farmer innovators of which versions will be produced in English, French and in Swahili.
Various other activities also contribute to enhancing policy dialogue. They include systematic documentation of experience in all countries through project reports and publications in international newsletters and journals as well as networking between projects and programmes of a similar nature. For instance, in Tanzania a workshop was organized in early 1998 attended by a number of Participatory Natural Resource Management Projects.

Step 7. Village workshops

Farmer innovators are sometimes isolated from their fellow villagers, because they are more successful or because they behave differently. Village workshops during which villagers evaluate innovations and identify their potential for adoption are a tool to reduce this risk of isolation. At the same time such village workshops, which can be organized by the extension agents, can be used as a starting point for joint experimentation involving members farmers selected by the community. Farmer innovators and their innovations can be used as a source of inspiration, but experimentation should become a social process.

Step 8. Supporting (or initiating) processes of experimentation

In most participating countries joint experimentation by researchers and innovators has timidly started in the third year. Ideally the research agenda should be set by the innovators and based on their priorities. The role of researchers is to propose elements for testing, which can be included if farmers agree. An important role of the researchers is to train farmers in the design of simple experiments, which allows the generation of ‚hard' data that can be used, for instance, to convince Ministries of Agriculture and donor agencies. In reality the agenda setting is less straightforward. In Cameroon workshops of farmer innovators have been held to elicit their priorities. In Tunisia the national coordinator initiated research to reduce maintenance requirements of a key traditional water harvesting system and also on a more efficient use of the limited water resources available in

the region. Some farmers observed his experiments and started to conduct their own experiments or they adapted the technologies to their specific conditions or to specific crops. In another country the initial reaction of the researchers was, when they were briefed about the farmers' priorities, „but we have already done research on this, so we don't need to do this „. It is obvious that it is not always easy for the farmers to identify their needs and priorities and it requires a considerable change in attitude of the researchers to support experiments by farmers. Nevertheless a process of experimentation is started and new dynamics are created.

Step 9. Dissemination of tested technologies through farmer-to-farmer visits

It is not sufficient just to try to improve land and water management practices. A component of the programme is also to disseminate tested technologies through farmer-to-farmer visits, which is probably the most efficient way of spreading innovations. An effort will be made to monitor the impact of such visits in terms of adoption and adaptation of technologies.

It is obvious that the programme believes in the efficiency of spreading messages through direct exchange of experience between farmers. Different types of exchange visits can be distinguished. Exchange visits are organized between farmer innovators (FI to FI), farmers visit farmer innovators (Fs to FIs) to learn from their experience and farmer innovators will visit farmers to inform and train them in the use of improved technologies (Fis to Fs), which is an example of farmer-led extension.

Step 10. Institutionalisation of participatory research and extension

Both ISWC and PFI promote an alternative approach to research and extension. The challenge is to institutionalise this participatory approach. Will this approach be continued in the post-project phase or is it entirely dependent on external funding and technical support? Virtually all partners involved in the programme show a great deal of enthusiasm about the approach and it is obvious that most of the participating researchers are infected by the knowledge and skills of farmer-innovators. But only parts of national extension agencies and the national research institutions are interested in a participatory approach to research and extension and although not everyone needs to work along these lines, it is obvious that much lobbying remains to be done.

Will groups of farmers be interested and able to continue research in the post-project phase? Will they be able to bear the costs of research and the costs of study visits? Again it is too early to answer these questions, but it is obvious that limited cost-sharing arrangements for cross-visits are just a first step in the right direction. It will also be useful to compare and draw lessons from the ways in which the spontaneous and the planned networks of farmer researchers are functioning. The experience in Colombia with farmer research committees could produce useful inspiration (Ashby et al., 1997).

3. Innovators and innovations: some initial impressions

The following remarks are based on first impressions. The programme partners in the participating countries currently work on a more detailed analysis.

Innovators

Most of the innovators so far identified are men and about 20 to 30 percent are women. Although women often provide the major share of farm family labour, in most cases men take the decisions about how the family land is used. Where women were involved in the identification of innovators it was generally easier to identify women innovators. In Ethiopia innovations by women all concern agricultural practices, but in Tunisia many innovations by women concern the transformation of the management and health of small livestock as well as the transformation of agricultural produce.

Some innovators are resource-poor, but many are relatively resource-rich. What is significant is that, for instance in Burkina Faso and in Tanzania, many innovators were poor 15 or 20 years ago, but due to experimentation and investment in better land and water management practices, they gradually expanded and diversified their resource base and improved their yields. Even in drought years many innovators appear to harvest sufficiently to meet family food needs, which means that through experimentation and investment they have improved their food security. The year 1997 was a serious drought year in Burkina Faso, but all innovators seemed to have harvested enough to meet family food needs. The reason is that innovators tend to apply a range of water harvesting and soil fertility management practices.

Although some innovators are quite young, the majority is relatively old and experienced. The average age of farmer innovators under PFI is 44 years (Critchley, 1999). Many of them have had exposure to other regions, for instance through labour migration. They have picked up ideas during their travel to and stay in other regions and labour migration also earned them some income that could be invested in their land. The first impression is that many innovators are fulltime farmers. They spend most of their time on their fields digging pits or constructing bunds, planting trees, tending their livestock, producing more and better quality manure to maintain and improve soil fertility. In most African countries the majority of farmers are engaged in a range of non-farm activities, in particular in the dry season, which together make up their rural livelihoods. The implication appears to be that innovators have less diverse livelihood strategies than non-innovators. This remains to be substantiated.

With regard to the promotion of innovations by the innovators a wide range of situations can be observed. On the one hand innovators can be found who actively promote their innovations. Some appear to be motivated by a mixture of personal pride. They want everyone to know that they have improved production and the environment in their regions. In some cases the innovators even created local organisations to promote their innovations. The other extreme is that some innovators are not at all interested in the spreading of their innovations.

Finally, literacy does not seem to determine whether farmers experiment or not. Some of the remarkable innovators are illiterate.

Innovations

Many types of innovations in land husbandry are found. They include the harvesting of runoff water, gully control, tillage methods, the introduction of new crop or tree species or new varieties, crop residue management, improved soil fertility management, pest control and improvement of tools. It is not surprising that the accent in the arid and semi-arid regions is on innovations in water harvesting for plant production. Well-known examples are the improved traditional planting pits in the West African Sahel and the infiltration ditches in Southern Zimbabwe. In East Africa improved management of organic matter ranks second in a list of technical categories of innovations (Critchley, 1999). Market demand does play a role in the spread of innovations.

In the Matmata range in Southern Tunisia the production system was always dominated by olives, figs and palm trees. The substantial diversification of fruit trees during the last three decades is triggered by the demand of the urban sector and the emergence of the tourist sector. Some innovations have a high potential for adoption by other farmers, for instance simple water harvesting techniques, but others are less easy to adopt, such as gully control practices, which require a substantial multi-annual investment.

4. Some remarkable innovators

Mr.Barthelemy Kameni Djambou who lives in the village of Babone in West Cameroon returned to his village in 1988 when his father died. He used to be a taxi driver in Douala. As he inherited poor quality fields, it was obvious to him that he had to improve the 3 ha of land if he wanted to create a better life for his family. Mr. Djambou, who has finished primary school, contacts local NGOs as well as the extension service to collect all information about agricultural methods. He is trained as an agricultural technician, but remains a farmer. In 1995 he receives training in agro-forestry through the UNDP Africa 2000 network. From that moment Mr. Djambou starts to experiment with nitrogen-fixing species of trees and shrubs, contour cultivation and with the integration of livestock raising, fish culture and agriculture. He creates a farmers' group in Babone and he trains both farmers and extension agents in agroforestry, contour cultivation and various other themes. Training takes place mostly on his fields where the farmers' group has also constructed a room, which is used as a training centre. Most male farmers in the region concentrate on growing coffee, but the focus of Mr. Djambou's innovations is on vegetable growing and on the improvement of soil fertility. Because women concentrate on food crops, it appears that they are the ones most interested in his innovations (Tchawa et al., 1998).

Mr. Yacouba Sawadogo, who lives in the Yatenga region in Burkina Faso, started to experiment with traditional planting pits at the end of the 1970s. He improved the pits by increasing their diameter and their depth as well as by putting some manure into them during the dry season. This manure attracts termites, which dig channels and increase soil porosity. These improved traditional planting pits or 'zais' have become the most successful technique for the rehabilitation of strongly degraded land in the West African Sahel. Mr. Sawadogo, who does not read or write, has continued to experiment and to innovate (introduction of trees in the planting pits and a seed bank with local grains). He created an Association for the Promotion of Zais and he organizes annually a Zai market where all farmers can exchange experience with the use of these improved traditional planting pits. Mr. Sawadogo has become a famous innovator, who has received a Presidential Award.

Mrs. Tensue Gebremedhin, a 30-year-old widow, who lives in the Central Zone of Tigray, Ethiopia, is the head of a household with 6 persons. She cultivates 1.25 hectares. After her husband died she started ploughing the land using an ox and a donkey. She broke the taboo of women ploughing. Other female household heads would hire a man to plough for them or go into a sharecropping arrangement, which means that they receive only half the harvest from their fields, in addition to breaking the taboo of ploughing, Mrs. Gebremedhin broke a second taboo: ploughing by donkey. She decided to use a donkey rather than buying a second ox, because a donkey is cheaper and it is a multipurpose pack animal. She has overcome some technical problems of using a donkey-ox pair for draft. Her neighbours and others have criticized her: using donkeys for ploughing has not come down from the ancestors, they say. However, the local council and the extension agent give her their backing, and encourage her in this innovative practice (Abay et. Al., 1998).

5. What triggers farmers to innovate?

Population pressure on a limited natural resource base is an important incentive for innovation and investment. This is translated into processes of agricultural diversification and intensification. It means that where farmers are with their back against the wall and have few options left, experimentation and innovation find a ‚fertile ground'. Farmer innovators frequently tell that they are driven by the need to create a better life for themselves and a better future for their children. They are keen to experiment with technologies, which create ‚win-win' conditions, which means technologies, which substantially increase production and improve the environment at the same time. Increases in production do not only mean increased food security, but it also means that they have more cash to spend. Water harvesting techniques and gully control techniques all create such ‚win-win' situations and many such techniques tend to spread largely spontaneously.

6. Some lessons drawn at mid-term.

One thing that strikes all involved is the enthusiasm and energy, which is generated by this participatory approach to research and extension. Putting farmer innovators in a key role is stimulating to them, because they feel empowered. Finally outsiders listen and learn rather than teach and train. It is stimulating to researchers, because they literally discover the knowledge and skills of farmers, which often amazes them and they also have a lot to offer themselves. It is also motivating to extension agents, because they have a new role to play, as they are responsible for the organisation of farmer innovators in networks and for the organisation of cross-visits. In their new role they feel appreciated by the farmers. It is a learning process for all involved.

The role of outsiders has changed considerably. From teachers and trainers they have become facilitators. They support processes of innovation and they untap the creativity of local farmers. This implies a demystification of the role of experts and a revitalisation of local culture.
Another lesson is that institutions and habits change slowly. To incorporate participatory research and extension approaches in national organisations is not something that can be achieved in 4 years. The implication is that it is important to step up lobbying and training efforts at the level of relevant Ministries and national research organisations. Having said this, the programme has changed the perception and activities of participating researchers and extension agents and most of them will probably not revert to „business as usual".

One hypothesis was that technologies generated by farmers would often be acceptable to resource-poor farmers. This is often the case, but there are exceptions. For instance, some

innovators who have invested in gully control have invested so heavily in this over the years that their example is hard to follow by others.

It was mentioned earlier (under step 2) that many farmer innovators are now relatively resource-rich, but most of them started as resource-poor farmers. They experimented and invested and gradually improved and expanded their resource base. This incrementality is an important characteristic. Many farmers in the Sahel who invest labour and financial resources in improved traditional planting pits usually do so at a slow rate. They tend to rehabilitate maybe a percentage of one ha per year; some do more and others do less. One should not expect miracles overnight. As a farmer innovator from Southern Zimbabwe, Mr. Cleopat Banda, remarked: „I started my experiments in 1987 and I felt in 1994 that I really benefited from them".

Innovation is a continuous process. Innovators tend to continue to experiment and new innovators emerge. The process of joint experimentation by researchers, field agents and farmers, which has just been started up under the programme will most likely not produce improved land and water management technologies within the next two years, but it will have triggered processes of experimentation by a growing number of farmers, both men and women. However, some innovations are already technically valid and their spreading can be stimulated.

7. What's new?

Is there anything new in what both ISWC and PFI try to achieve? The answer to this question is essentially negative. In 1989 Robert Chambers and colleagues published their seminal book , Farmer First: farmer innovation and agricultural research', which was based on a wide range of interesting contributions most of which emphasized that farmers continuously experiment, adapt and innovate. Since then many research and development projects in Africa, Asia and in Latin America have tried to work with farmers to improve land and water management practices.

The only new aspect of ISWC and PFI is that they try to promote a participatory approach to research and extension on a regional basis in a large number of countries, while using a similar methodology. All activities are carried out by local partners (research institutions, universities, Ministries of Agriculture, NGOs, bilateral projects) and a small consortium based in the Netherlands and the UK provides methodological support. Efforts are being made to expand the programme within Africa as well to Asia and to Latin America.

References

1. Abay, F., M.Haile and A. Waters-Bayer (1998). Dynamics in indigenous knowledge: innovation in land husbandry in Ethiopia. Paper submitted for publication.
2. Ashby, J.; T.Garcia, M.del Pilar Guerrero, C.A.Patino, C.A.Quiroz and J.I.Roa (1997). Supporting local farmers research committees. In: Veldhuizen, L.van, A. Waters-Bayer, R.Ramirez, D.A.Johnson and J.Thompson; Farmers' Research in Practice: Lessons from the field. IT Publications: 245 - 261.
3. Bauer, E., V.Hoffmann et P. Keller (1998). La vulgarisation agricole: un apercu historique. In: Agriculture + Développement Rural, vol.5 (1): 3-6.
4. Chambers, R., A.Pacey and L.A. Thrupp (1989) Farmer First: Farmer innovation and agricultural research. London, IT Publications.
5. Chambers, R. (1997) Whose Reality Counts? Putting the first last. London, IT Publications.
6. Critchley, W. (l999).Who are the farmer innovators and what are their innovations? Paper presented to the sub-Regional Workshop on ‚Promoting Farmer Innovation' in Dodoma, Tanzania, February 1999.
7. Tchawa, P., J.B.Noubissi et B.Yossa (I998). ltinéraire et impacts des réalisations de Barthélémy Kamenidjambou, paysan innovateur en agroforesterie et en agriculture integrée (Babone, Quest Cameroon). Working paper to be published.
8. Veldhuizen, L.v., A.Waters-Bayer and H. de Zeeuw (1997) Developing technology with farmers: a trainer's guide for participatory learning. London. Zed Books Ltd.

Section 2.

COP Decision and the Second Ad Hoc Panel on Traditional Knowledge

2.1 Decision 12/COP.3 Traditional knowledge

The Conference of the Parties,

Recalling its decision 14/COP.2 on traditional knowledge,
Taking note of the report of the ad hoc panel on traditional knowledge , the relevant documents prepared for the Committee on Science and Technology at its third session, and the recommendations of the Bureau of the Committee on Science and Technology on this subject,

1. Requests the secretariat to develop a closer working relationship with related institutions and to generate synergies through collaboration. Such collaboration should also foster coordination and linkages at the national level between the national focal points of the different environment conventions and facilitate both the dissemination of information about the conventions and action to implement them;

2. Invites Parties to include in their national reports on implementation, as well as follow-up on recommendations made in document ICCD/COP(3)/CST/3, the use made of traditional knowledge in the implementation of the national action programmes;

3. Appoints an ad hoc panel on traditional knowledge composed of 10 experts to develop further appropriate criteria in line with future work on benchmarks and indicators, to be used by national focal points so as to:

(a) Measure the reciprocity between traditional and modern knowledge and/or promote it;
(b) Assess how networks and mechanisms created by the secretariat (regional networks, regional coordinating bodies, national focal points) are incorporating traditional and local knowledge in their work programmes;
(c) Assess the socio-economic and ecological benefits of traditional knowledge in the light of environmental changes.

11th plenary
25 November 1999

2.2 Report of the Second Ad Hoc Panel on Traditional Knowledge ICCD/COP(4)/CST/2

I. INTRODUCTION

1. In accordance with decision 12/COP.3 of the Conference of the Parties, an ad hoc panel composed of 10 experts on traditional knowledge was appointed to develop further appropriate criteria in line with future work on benchmarks and indicators to be used by National Focal Points, as follows:
(a) To measure the reciprocity between traditional and modern knowledge and/or promote it;
(b) To assess how networks and mechanisms created by the secretariat (regional networks, regional coordinating bodies, national focal points) are incorporating traditional and local knowledge in their work programmes;
(c) To assess the socio-economic and ecological benefits of traditional knowledge in the light of environmental changes.
2. The ad hoc Panel was subsequently convened in Matera, Italy, from 8 to 12 May 2000. Mr. Pietro Laureano (Italy), was elected Chairman of the meeting and Mrs. Corinne Wacker (Switzerland) was elected Vice-Chair of the meeting. Mr. Falah Abounukta (Syrian Arab Republic) was elected Rapporteur. The members of the Panel and other participants at the Matera meeting are listed in annex I.
3. The UNCCD secretariat briefly summarized the work carried out during previous years. The participants were informed of the work on benchmarks and indicators, on traditional knowledge, on surveys and evaluations of existing networks and on the terms of reference of the Committee of Science and Technology and of the ad hoc panels.
4. Based on decision 12/COP.3, the Panel had a detailed discussion on the terms of reference defined in paragraph 1 above, and agreed to focus on recommendations at the national level and to underline the socio-economic and ecological benefits of traditional knowledge. Such knowledge should be considered and promoted as an important tool of sustainable development to alleviate poverty and environmental degradation. Moreover, the Panel highlighted that:
(a) Benchmarks and indicators had a significant importance on the process of reciprocity between traditional and modern technology;
(b) The recommendation in ICCD/COP(3)/CST/3, paragraph 26 (b) (iii), had been taken into account in other relevant decisions of the Conference of the Parties.
5. The Panel reviewed the reports presented by the consultants (annex I).

II. SUMMARY OF DISCUSSION

6. The Ad Hoc Panel on Traditional Knowledge reviewed the various articles of the UNCCD relating to traditional knowledge and considered that those addressed, in particular, to local populations in the affected areas were Articles 2, 16(g), 17.1(c), 18.2(a), and 18.2(b). Within the spirit of the Convention, the Panel recalled that the Convention aims to act towards the prevention, recovery and rehabilitation of sensitive areas so as to ensure social, economic and environmental sustainability and viability.
7. The Panel recommended to the Parties of the Convention that they take appropriate measures in order to implement mechanisms of assessment according to their respective capacities by taking into account the social, cultural and economic aspects of each Party, in order to carry out activities of evaluation and promotion. The national liaison centres should be informed of those measures.
8. Considering that the proposed criteria take into account, whenever possible, prospective future work on benchmarks and indicators, the Panel proposes, within the traditional knowledge field, an assessment of the following criteria:
(a) The use of techniques at the local level in order to improve the living conditions of the populations in the affected areas;
(b) The ability of the population to adapt as appropriate the proposed technologies in the affected areas;
(c) The validity of the technology in the long term;
(d) The institutional measures of the Parties in accordance with their ability to develop an inventory of traditional knowledge and create a context favourable to its safeguarding, valorization and promotion;
(e) The actions carried out in order to encourage the diffusion of traditional knowledge and of the innovations in this field;

(f) The actions of the national liaison centres according to their ability to allow the production and promotion of local knowledge;
(g) The proposed technologies in accordance with their impact within a larger context with reference to the specific problem to be solved, that is, inter alia, the social, cultural and economic context as well as an integrated and holistic approach;
(h) The functional relationship between sustainable traditional management of the environment and the social, cultural and spiritual system of the local population within the framework of the management of natural resources.

9. Finally, the Panel proposed to consider benchmarks relating to the threshold of poverty, to the decrease of emigration and to the promotion of certain social categories, in particular, women and youth.
10. In the reports submitted by the Parties of the Convention, the Panel at the third session of the COP in Recife, Brazil, noticed that traditional knowledge had not been sufficiently taken into account. That was due not only to the fact that the Parties had had a very short time to elaborate their national reports, but also to the lack of terms of reference on this issue on the format and content of reports adopted by COP in its decision 11/COP.1. Some of the national and subregional reports do mention traditional knowledge and some regional thematic networks included traditional knowledge within their activities.
11. Within the formats adopted by the Conference of the Parties in its decision 11/COP.1 relating to the procedures for communication of information and review of the implementation of the Convention, traditional knowledge is not mentioned among the elements that should be included in the reports on the measures that each Party has taken in order to implement the Convention. Furthermore, the non-integration of traditional knowledge results in the regional networks, regional coordinating units and national centres of liaison created within the framework of the implementation of the Convention from:

(a) Non-efficient integration between traditional knowledge and scientific and technological experience;
(b) Lack of promotion of information and communication channels and supports;
(c) Weakness of the systems to collect data and make an inventory of knowledge; and
(d) Weak enhancement of local knowledge.

12. In order to solve the above-mentioned problems, it is necessary to evaluate the existing methods and/or, if need be, develop a method taking into account the following items:

(a) Strengthening the capacity of basic community organizations;
(b) Developing a partnership and exchanges between the different actors;
(c) Improving the systems of data collection and inventory of local knowledge;
(d) Promoting channels and supports to disseminate information;
(e) Elaborating methods and procedures of integrating traditional knowledge and technical-scientific experience.

13. In the Rio conventions, which are similar to the UNCCD, elements such as deforestation, greenhouse gas and loss of biological species can be measured. In the UNCCD there are some key issues, such as traditional knowledge, that take into account socio-cultural, economic and ecological dimensions. Some of these components can hardly be measured for several reasons:

(a) Lack of available information and data;
(b) The socio-cultural contexts can only be analysed in terms of quality rather than quantity; and
(c) In the field, given the interaction between the different elements, quantification is not always feasible.

14. The reasons why traditional techniques are not applied can be summarized as follows:

(a) A lack of awareness that environmental damage, soil degradation and desertification mostly result from the loss of traditional knowledge;
(b) A lack of information from technicians involved in national planning on the validity and benefits of traditional knowledge;
(c) A lack of information on the role to be assigned to traditional techniques and their operation;
(d) A lack of communication and exchange of successful experiences;
(e) A lack of awareness of the innovative use of traditional knowledge; and
(f) Prejudices and the dissemination of criticisms of traditional knowledge.

15. The problems mentioned above result from a lack of information and communication. Some common prejudices, as mentioned in the last point, are given below, each with a refutation.

1. Traditional techniques constitute a specific and limited series of technical solutions.

16. The proposal is contradicted by the very same definition of traditional knowledge as an integrated learning organization, a complex system with multifunctional characteristics, an integral part of the collective identity as well as social cohesion's construction process. Taking it as a series of expedients to solve specific problems is reductive and deceptive. Each traditional practice responds to a specific necessity but is highly integrated with the environmental and social context, and is part of a complex whole of social, ecological but also symbolic and aesthetic values.

2. They are not technologically competitive, with the result that they are technologically inefficient and less productive than modern technologies.

17. This critique is not justified since there is no reason to consider traditional techniques as less competitive, inefficient or unproductive than modern techniques. Traditional technology considers a series of contextual factors omitted by modern techniques, and results differ. The results from the traditional procedures are sometimes not that immediate and needs more work, however, this does not represent a negative feature in many countries that face unemployment problems. In order to assess the efficiency of a process, both internal and external aspects are considered. Indeed, the application of a technique determines the effects from the cradle to the grave of the necessary use of resources and has more general consequences on the entire economic, social and environmental system. These interactions are not taken into account in a modern technique based on specific and immediate yield criteria. On the contrary, traditional techniques are selected and accepted through a process of environmental, historical and social comparisons. Their efficiency is appraised according to their validity over the long term, their contextual benefits and their full sustainability.

3. Traditional techniques concern the developing world and are marginal compared to great economic and technological processes.

18. This is contradicted by the fact that the continuing consolidation and stabilization of the role of traditional technologies in society and in the economy can be verified, specifically in the more advanced countries. The traditional values, manufacturing practices and artisan capacities of traditional technologies are the basis on which is founded the great added value yields of enormous economic importance for many advanced countries. In particular, typical alimentary produce (such as oil, cheese and wine) safeguards the quality of the land, both aesthetic and environmental, since old production systems are available thanks to the maintenance of traditional techniques of soil management. In the same field, increasing agricultural yields and quantities of biologically controlled meat are the result of even more interest in traditional techniques of cultivation and breeding. These considerations are true even in other sectors from quality gadgets to haute couture and from real estate to the building market. It is an advantage for the most renowned manufacturers to be able to list the traditional techniques they use and the success of many companies is actually due to having incorporated traditional techniques into their processes or to be located in traditional environments or historical centres.

4. They are proposed because of an ideological anti-technology vision.

19. The fourth critique is to be rejected since, even if in the traditional knowledge movement there are some anti-technological components, on the whole, it is not true at all. Traditional knowledge is not proposed because it contains less technology compared to the conventional ones, but because it has better results, technologically speaking, compared to the determined environmental and social context. Sometimes, it has the most refined technologies, other times, it is very simple but still more appropriate, and is ecologically compatible and locally manageable. Furthermore, traditional knowledge is re-proposed through each single possible innovative use that is in conjunction with modern technologies which can operate within the same logic. This is due to the use of advanced technologies in the field of eco-energies, recycling, pollution-free production, and maintenance of low-impact processes of mechanization that are self-manageable.

20. The benefits of a technology are multifaceted according to the scales through which they can be observed. Within a macro-economic framework based on modern econometric principles, traditional technologies can be considered as marginal. However, from local and environmental points of view, traditional knowledge and its technology plays a primary role.
21. In order to understand the benefits of traditional knowledge, it is necessary to take into account the desertification process. Therefore, we can state that traditional knowledge:

- is ecologically adapted and viable;
- represents the skills of populations; and
- is less expensive.

22. From a different point of view and taking into consideration external constraints, modern technologies can be transferred more easily than traditional knowledge which must be considered within its socio-cultural context. However, this is not easily done since the transfer method is not always available.
23. At a national level, a State must take the above-mentioned consideration into account. Moreover, in order to encourage the interest raised by traditional knowledge at the socio-economic and ecological levels, the UNCCD Parties play a crucial role in creating an enabling environment and mentioning general obligations as well as the obligations of the affected country Parties under Articles 4 and 5 of the Convention.
24. Furthermore, the Parties should make sure that technologies, knowledge, know-how and traditional practices are adequately protected and that local populations benefit on an equitable basis (in accordance with Articles 1 and 5 of the Convention) of any resulting commercial activity or of any resulting technological development. These activities carried out by the States could create favourable conditions to maintain, produce and reproduce further knowledge and integrate it with modern technology and innovations.
25. Our environment is changing more and more rapidly in an unpredictable way due to internal and external pressures such as industrialization, agricultural mechanization, and the burden of debt, thus hindering the proper control of a sustainable nature resource management. At a local and national level, the enhancement of traditional knowledge and its integration within a cultural context could be a possible answer to such pressures.
26. The answer to these pressures could be given by a small number of pertinent indicators of the key issues. The indicators should be simple, user-friendly and based on the existing and obtainable data. Such indicators will take into account the following environmental and socio-economic conditions: poverty, land abandonment, emigration, cultural dependency and loss of cultural identity.
27. They should also take into account the following socio-economic and environmental impact:

(a) Creation of new needs and expectations;
(b) The real participation of women, the elders as well as others from traditional and social categories;
(c) The loss of traditional rights; and
(d) Changes in the ways of access to water and land.

28. At the forums organized by the UNCCD secretariat in collaboration with the Mayor of Rome and the Mayor of Bonn, the mayors have shown their interest in the UNCCD. These forums focused on uncontrolled urbanization due to its high costs in terms of infrastructure, crime and urban equipment. These towns can no longer afford such high costs.
29. One example of how it is possible to decrease such costs is Cinque Terre, located in Liguria, Italy. In a village where the land has been completely abandoned and subsequently become subject to degradation, the mayors have granted parcels of land to persons who committed themselves to cultivate them by means of traditional techniques. Therefore, agricultural terraces have been re-built, crops re-planted and the soil replenished, thus increasing tourism. Nowadays, the resulting products are considered as traditional biological products and sold at a higher price. Some innovations have been implemented in order to enable terrace management along the slopes, thus avoiding the hard work that was required in the past for its maintenance. Marketing products on the internet has made it possible to sell the products all over the world.

III. COMMON UNDERSTANDING OF THE TERM TRADITIONAL KNOWLEDGE

30. "Traditional knowledge consists of practical (instrumental) and normative (enabling) knowledge about the ecological, socio-economic and cultural environment. Traditional knowledge is people-centred (generated and transmitted by people as knowledgeable, competent and entitled actors), systemic (intersectorial and holistic), experimental (empirical and practical), transmitted from one generation to the next and culturally valorised. This type of knowledge promotes diversity; it valorises and reproduces the local (internal) resources."

IV. RECOMMENDATIONS

A. Criteria to measure the reciprocity between traditional knowledge and modern knowledge and/or promote it

31. To assess reciprocity, the Ad Hoc Panel understands, on the basis of the common understanding of traditional knowledge that:

(a) Traditional knowledge consists of practical (instrumental) and normative (enabling) knowledge about the ecological, socio-economic and cultural environment, as defined in ICCD/COP(3)/CST/3;
(b) The term "knowledge" is defined as a knowledge system (traditional knowledge and modern knowledge) composed of content, roles, institutions and theoretical concepts, which are produced and reproduced in an enabling cultural and natural environment;
(c) The term "reciprocity" is defined as a relationship between two knowledge systems based on equity and mutual benefit.

32. To promote reciprocity between traditional and modern knowledge to implement programmes to combat desertification, the following questions should be asked:

(a) Do the mechanisms enable and promote affected communities to use and develop their traditional knowledge in combating drought and desertification?
(b) If yes, are the means adequate to meet their needs?

33. The measurable indicators to assess if the above criteria are fulfilled include, as a ratio between traditional and modern knowledge:

(a) The amount of funds given to communities who apply traditional knowledge;
(b) The number of contracts and/or projects given to them to utilize traditional knowledge;
(c) The number of research projects and projects on traditional knowledge implemented in partnership with communities.

B. Criteria to assess how networks and mechanisms created by the secretariat (regional) networks, regional coordinating bodies, national focal points) are incorporating traditional knowledge and local knowledge in their work programmes

34. The ad hoc Panel invites the COP to encourage Parties, through National Focal Points, according to their respective capabilities and subject to their respective national legislation and/or policies:

(a) To analyse the existing mechanisms;
(b) To recognize the role, utility and sustainability of traditional knowledge;
(c) To assess how networks incorporate traditional and local knowledge into their work programme by using following criteria; and
(d) To assess the number of research and development projects implemented by the National Action Programmes in partnership with experts of traditional knowledge using the following indicators: (i) to prevent the loss of traditional knowledge; (ii) to rehabilitate institutions of traditional knowledge; and (iii) to rebuild, where necessary, adequate mechanisms that generate, test and disseminate traditional knowledge.

C. Criteria to assess the socio-economic and ecological benefits of traditional knowledge in the light of environmental changes

35. To assess the socio-economic benefits of traditional knowledge, the ad hoc Panel recommends assessment of the National Action Programmes to discover if they have established mechanisms that allow communities affected by drought and desertification:

(a) To choose between remedies derived from traditional knowledge and modern knowledge to revitalize and reclaim affected areas;
(b) To carefully pre-evaluate and document proposed projects by using an evaluation grid including the five dimensions of sustainability (institutional, social, technical, economic and environmental); and
(c) To maintain and, if necessary, develop long-term entitlements of local communities to the land and water resources of their environment.

36. The Ad Hoc Panel further recommends the use of criteria derived from the policies of the Convention to assess the benefits of traditional knowledge in the light of environmental changes based on the following steps:
(a) To take traditional knowledge as a starting point of the assessment;
(b) To evaluate the social, institutional, ecological and economic conditions of reproduction of traditional knowledge;
(c) To assess its instrumentality for the implementation of the objectives of the Convention; and
(d) To evaluate its socio-economic and environmental benefits using UNCCD criteria.

37. The proposed UNCCD criteria are:
(a) In the area of socio-economic benefits, inter alia: self-sufficiency in food production, poverty alleviation and improvement of livelihood, gender equality and employment; and
(b) In the area of environmental benefits, inter alia: adaptation to a changing environment, improvement of the ecosystem, protection of natural resources and protection of fragile eco systems and their biodiversity.

38. The Ad Hoc Panel also recommends an assessment of the existence of instruments to protect traditional knowledge in the context of a free-market competition, in accordance with Article 18.1(e) of the Convention.

39. To develop criteria to assist in the selection of suitable technologies, the following should be taken into consideration:
(a) Social, economic and environmental sustainability;
(b) Socio-economic conditions of the area/ecosystem to which such technologies will be applied;
(c) Role of traditional knowledge and of the communities that are applying, reproducing and improving the said knowledge; and
(d) Process of reciprocity of traditional and modern knowledge, to be furthered through appropriate arrangements.

V. FURTHER RECOMMENDATIONS

40. The Ad Hoc Panel reviewed the whole work undertaken on traditional knowledge and the documents endorsed by the different sessions of the Conference of the Parties. Taking into account the outcome of the discussions held in Matera, the Ad Hoc Panel also recommended the following:

41. A network of experts, institutions, organizations and bodies having experience in the field of traditional knowledge should be established. This network should comprise experts on traditional as well as modern knowledge and having expertise on dialogues between different knowledge systems. These experts should:
(a) Compile data on existing traditional knowledge;
(b) Advise decision makers on the design and implementation of research and development programmes related to the Convention, as well as assist in monitoring and evaluating them;
(c) Advise National Focal Points and National Coordination Bodies on how to establish cooperation in the fields of transfer, adaptation and dissemination of traditional and modern knowledge;
(d) Encourage National Focal Points to promote communications and technical exchanges on traditional and modern knowledge between the Parties; and
(e) Disseminate information to the public on imported technologies through the appropriate channels.

42. A working group of representatives of institutions should be set up with the purpose of defining terms of reference for national and regional inventories of traditional and local knowledge. These inventories should contain data and information on:
(a) Social and economic benefits;
(b) Environmental benefits; and
(c) Conditions of reproduction and evolution of traditional knowledge.

43. The Ad Hoc Panel took note that the Italian authorities are in the process of establishing an international research centre on traditional knowledge in Matera, Italy, in collaboration with UNESCO and the secretariat of UNCCD. The Ad Hoc Panel congratulates such initiatives and encourages all countries or regions to do same and/or to create linkages with the centre in Matera.

44. In consideration of the effectiveness of the implementation of the UNCCD at national level, the A d Hoc Panel also recommends:
(a) Dissemination of information on the basis of the existing inventories;
(b) Identification of specific action to be incorporated into national action programs; and
(c) Identification of possible technical and financial support to implement these complementary activities.

45. The Panel also recommended consideration by the network of the importance of dialogue between traditional and modern knowledge prior to the implementation of an imported practice.

46. Recalling COP Decisions on the UNCCD of independent experts, the Ad Hoc Panel invites Parties to ensure better representation of disciplines in the area of cultural anthropology, oral history, history of technology and law, and encourages the inclusion of experts on traditional knowledge in the roster.

Annex I. List of Participants

Members of the Ad Hoc Panel on Traditional Knowledge Appointed by the Conference of the Parties and consultants presenting reports at the Matera Meeting	
Dr. Falah Abounukta	Syrian Arab Republic
Mr. Etumesaku Diunganumbe	Democratic Republic of Congo
Dr. Pietro Laureano	Italy
Mrs. Nery Urquiza	Cuba
Mr. Ashot Verdevanian	Armenia
Dr. Corinne Wacker	Switzerland
Consultants	
Mr. Emmanuel Seck:	Senegal
Mr. Yang Youlin	China
Observers at the Ad Hoc Panel	
Dr. Thomas Schaaf	UNESCO
Dr. Domenica Sabia	Italy
Dr. Maurizio Sciortino	Italy
Mrs. Stefania Viti	Italy

2.3 Rapport portant sur la prise en compte du savoir local par les programmes d'action, réseaux et mécanismes mis en place par le secrétariat de la CCD pour promouvoir les programmes de lutte contre la désertification a l'échelle régionale et nationale.

Emmanuel Seck, Consultant to the Second Ad Hoc Panel on Traditional Knowledge Secrétaire Exécutif Relations Internationales Environnémént et Développement du Tiers Monde Dakar, Sénégal

Zer-El-Ghilbi oasis. Mauritania. In an attempt to block the shifting sand, barriers are made from palm leaves. **Photo: I. Balderi. FAO/18833.**

1. CONTEXTE ET OBJECTIFS DE LA MISSION

Dans le secteur de l'environnement, les leçons fournies par les expériences engagées dans différentes régions du Monde, montrent clairement que la problématique de la gestion des ressources naturelles par les collectivités locales est au coeur des tentatives de recherche de solutions aux crises qui affectent les modes de mise en valeur du milieu. Par conséquent, la redéfinition des modes de maîtrise et d'utilisation de l'espace constitue la base de tout processus de gestion durable des ressources naturelles.
L'adoption des nouvelles approches impliquant les collectivités locales dans la gestion des ressources naturelles a permis de prendre conscience de l'importance des interventions aux échelles locales et de la nécessité de prendre en compte les savoirs et savoir-faire traditionnels. En effet, ces populations ont, depuis longtemps, accumulé de riches expériences en matière de lutte contre la désertification et mis au point des techniques de gestion des ressources naturelles dans les domaines de l'agriculture, du pastoralisme, de la foresterie, etc.

C'est dans cette logique que la Convention de la lutte contra la désertification (UNCCD) a recommandé la valorisation efficiente du capital de connaissances, savoir-faire et technologies traditionnelles, la mise en place de mécanismes de collecte, de préservation et de diffusion de ces acquis ainsi que leur adaptation et, au besoin, leur intégration aux technologies modernes (article 18).

La prise en charge de cette recommandation s'est traduite par son intégration comme axe prioritaire de travail par le Comité de la Science et de la Technologie (CST). Une telle perspective avait déjà été esquissée au cours du processus de négociation de la convention. En effet, le Comité Intergouvernemental de Négociation sur la Convention de lutte contre la Désertification a recommandé, lors de la dixième session, que le CST inventorie les connaissances traditionnelles et élabore un rapport sur la base des communications reçues.

La première Conférence des Parties tenue en 1997 a exhorté les Parties et les observateurs à collecter les informations disponibles sur des technologies traditionnelles, les savoirs locaux et les pratiques éprouvées en matière de gestion des ressources naturelles. Sur recommandation du CST, un groupe spécial a été établi pour la supervision du processus d'évaluation des repères et indicateurs. Par ailleurs, la Conférence a décidé d'inscrire à l'ordre du jour de sa prochaine session l'examen des liens entre les connaissances traditionnelles et la technologie moderne dans la perspective d'un partenariat entre experts scientifiques et experts locaux.

Au cours de la deuxième session de la Conférence des Parties, les travaux du CST ont été, pour une large part, consacrés à l'examen du rapport du Secrétariat de la CCD portant sur les connaissances traditionnelles. Sur la base d'une décision de cette Conférence, un groupe spécial de dix experts s'est réuni à Matera (Italie), en juillet 1999, pour identifier les expériences probantes ainsi que les

menaces et autres contraintes qui pèsent sur les connaissances traditionnelles et/ou qui entravent leur intégration avec les connaissances modernes.

Dans le cadre de la poursuite du travail du groupe spécial sur les connaissances traditionnelles, la troisième Conférence des Parties tenue fin 1999 a pris la décision d'inviter les Parties à inclure dans leurs rapports nationaux une présentation du schéma d'intégration des connaissances traditionnelles dans la mise en œuvre des programmes d'action.

En outre, la Conférence a mis en place un groupe de travail pour élaborer d'autres critères appropriés. Ces critères, dans la ligne des travaux futurs sur les repères et indicateurs, seront utilisés par les points focaux nationaux en vue de mesurer le degré de synergie entre les connaissances traditionnelles et modernes, déterminer la manière dont les mécanismes créés par la CCD s'emploient à intégrer les connaissances traditionnelles et locales dans leurs programmes de travail et évaluer les avantages économiques, écologiques et sociaux apportés par les connaissances traditionnelles dans le contexte des mutations en cours.

La présente étude s'inscrit dans le cadre de la mise en oeuvre de cette recommandation. De façon plus spécifique, elle se donne pour objectif d'examiner les modalités d'intégration des connaissances traditionnelles et locales dans les programmes d'action et les plans de travail des réseaux régionaux, des organismes de coordination et des centres de liaison nationaux. Cette approche devrait permettre de mettre en lumière les impacts positifs des connaissances traditionnelles sur les plans socio-économiques et écologiques.

Du point de vue méthodologique, l'étude s'est appuyée principalement sur les informations fournies par le Secrétariat de la CCD ainsi que sur des recherches documentaires complémentaires, y compris par Internet. Le caractère limité de ces sources d'informations impose de considérer ce travail comme un document de réflexion d'étape qui devrait être complété et enrichi par des enquêtes ultérieures systématiques auprès des institutions et des structures concernées.

2. ENJEUX DE LA CCD ET PROBLEMATIQUE DES SAVOIRS LOCAUX ET DES STRATEGIES TRADITIONNELLES DE LUTTE CONTRE LA DESERTIFICATION

La CCD s'inscrit dans le prolongement des efforts entrepris par la communauté internationale depuis la fin des années 1960. Ces efforts se sont traduits, entre autres, par l'adoption en 1977 à Nairobi du plan d'action de lutte contre la désertification ainsi que la tenue en juin 1992 de la Conférence de Rio de Janeiro au cours de laquelle l'Afrique et le Groupe des 77 ont plaidé pour l'élaboration d'une convention capable d'impulser une dynamique plus vigoureuse de lutte contre la désertification.

Il faut rappeler qu'au cours des décennies écoulées, le processus de dégradation des écosystèmes a connu une amplification considérable dans différentes régions du Monde. Qu'il s'agisse des pays du Sahel ou des confins de l'Australie, de l'Asie centrale ou du pourtour méditerranéen, on constate dans toutes ces zones des déficits pluviométriques répétés, une régression accrue de la couverture végétale, une forte dégradation des sols, une baisse accélérée du débit des cours d'eau et du niveau des nappes phréatiques. Le cumul de tous ces facteurs a engendré des déséquilibres écologiques majeurs.

Les zones arides et semi-arides sont les plus durement éprouvées par ces processus de dégradation des écosystèmes. La désertification affecte actuellement plus d'un milliard d'hectares de terres en Afrique et au moins autant en Asie. D'autres régions, comme l'Amérique du Nord, sont affectées dans des proportions équivalentes ou supérieures par les phénomènes de perte de terres arables, de disparition d'espèces végétales et animales, de pollution des eaux, etc.

Les conséquences qui découlent de cette dégradation de l'environnement se traduisent notamment, par la crise des systèmes de production agricole, la perte des filets de sécurité pour des centaines de millions de ruraux confinés sur des terres de moins en moins productives et l'amplification des phénomènes de paupérisation et de développement des flux migratoires.

Dans de telles conditions, l'un des défis majeurs qui se pose à la communauté internationale réside dans la création de mécanismes susceptibles de garantir une prise en charge concertée des problèmes découlant de l'aggravation des phénomènes de dégradation des terres. C'est précisément cela qui constitue l'objectif primordial de la UNCCD.

2.1 Principes directeurs et enjeux de la CCD

Comme nous l'avons indiqué, l'ambition de la UNCCD est de susciter l'émergence de nouvelles solidarités planétaires permettant de prendre en compte les préoccupations des populations défavorisées et de produire des résultats significatifs afférents aux problèmes de gestion des ressources naturelles et de lutte contre la pauvreté.

Ainsi, la convention de lutte contre la désertification constitue un cadre stratégique important pour promouvoir les actions de lutte contre la dégradation des terres et la pauvreté dans la perspective d'un développement durable. L'intérêt que suscite cette convention s'explique par le fait qu'elle présente des caractéristiques originales par rapport à d'autres accords internationaux relatifs à la protection de l'environnement. En effet, la CCD se fonde sur des principes novateurs, notamment i) la recherche d'une plus grande participation des différents acteurs sociaux dans les processus de prise de décisions, ii) la promotion d'une cohérence horizontale plus affirmée et l'identification de passerelles à établir entre les différentes politiques sectorielles et transversales et iii) la nécessité d'établir les bases d'un partenariat plus solide à l'échelle locale et nationale, mais aussi entre les pays du Nord et ceux du Sud.

Pour accroître l'efficacité des actions de lutte contre la désertification, la convention recommande de préparer des programmes d'action qui seront mis en œuvre à différentes échelles (régionale, sous-régionale et nationale). Ces programmes d'action de lutte contre la désertification devront s'appuyer sur des stratégies et des priorités à long terme pour garantir une gestion efficace et durable des ressources. Dans le cadre du processus d'élaboration des programmes d'action, l'une des exigences essentielles formulées par la CCD concerne la promotion d'une approche participative en vue d'un renforcement du dialogue et de la concertation entre l'ensemble des acteurs du développement.

Condition préalable à l'élaboration des programmes d'action de lutte contre la désertification, la participation populaire doit être sollicitée pour plusieurs raisons : elle permet de valoriser les compétences locales, de garantir la prise en compte effective des préoccupations des populations dans la définition des lignes d'action et de procéder à une délimitation concertée des rôles et des responsabilités de chaque catégorie d'acteurs dans la mise en œuvre des actions de lutte contre la désertification.

La formulation des programmes doit s'appuyer sur l'option méthodologique visant à promouvoir la lutte contre la désertification en l'insérant dans le contexte plus large d'une harmonisation des politiques sectorielles et transversales, voire d'une intégration de la dimension environnementale dans la planification stratégique du développement à l'échelle régionale, sous-régionale et nationale. La CCD fait le pari d'une modification profonde des méthodes de conduite des politiques de

développement et des systèmes de coopération. C'est là l'expression d'une volonté de remise en cause des démarches antérieures, d'un souci de tirer les leçons du passé et d'inciter les acteurs du développement à formaliser les acquis de ces expériences dans des contrats de partenariat. La modification des méthodologies d'intervention et des paradigmes qui sous-tendaient les

politiques antérieures de gestion des ressources naturelles ouvre des perspectives intéressantes dans la mesure où elle incite à inscrire toute action sur l'environnement dans une logique de développement durable réellement maîtrisée par les populations. L'option de la CCD porte sur la mise en place d'une série de mécanismes impliquant i) l'appui à des changements profonds sur les plans politiques et institutionnels en vue de conférer des droits fonciers aux exploitants de la terre et de renforcer le processus de décentralisation de la gestion des ressources naturelles, ii) l'adoption de mesures économiques et financières permettant de générer des bénéfices économiques à partir de l'intensification de la gestion et de l'investissement et iii) l'impulsion de l'ensemble des actions avec la cohérence souhaitée grâce à une mobilisation optimale de toutes les ressources humaines, financières et techniques disponibles.
Une autre orientation importante de la convention concerne l'amélioration de la coordination intersectorielle. Dans l'esprit de la CCD, la progression de la cohérence horizontale constitue un élément essentiel pour garantir une meilleure efficacité des actions engagées sur le terrain.

Dans plusieurs pays, on constate que l'efficacité des dispositifs de coordination des différentes politiques sectorielles reste faible. Bien que la volonté d'une meilleure cohérence des interventions soit exprimée par la plupart des acteurs, notamment en milieu rural, les méthodes et les moyens utilisés pour y parvenir ne produisent pas toujours les résultats escomptés. Il s'y ajoute que la visibilité d'ensemble des interventions fait le plus souvent défaut. Cette limite dans la conduite des programmes en cours d'exécution et dans la maîtrise des investissements mobilisés induit des processus de planification sectoriels qui ne permettent pas une réelle optimisation du potentiel existant.

Pour toutes ces raisons, la formulation des programmes d'action, notamment à l'échelle nationale doit prendre en compte la nécessité d'identifier des mécanismes adéquats d'articulation entre le programme d'action nationaux (PAN) et les autres politiques sectorielles et transversales (PASA, décentralisation, lutte contre la pauvreté). Une telle option méthodologique contribue à garantir la cohérence des orientations et recommandations formulées dans le domaine de la gestion des ressources naturelles.

Pareille démarche permet en outre de promouvoir une cohérence intersectorielle plus affirmée et une convergence progressive des interventions vers des lignes stratégiques définies pour la lutte contre la désertification, le renforcement du processus de décentralisation, la promotion du développement agricole et le combat contre la pauvreté.

2.2 Paramètres de prise en compte des savoirs traditionnels et locaux

Les propositions de canevas de travail faites par le Secrétariat de la CCD ont permis, dans le cadre de la formulation des programmes d'action, de définir une démarche globale visant à construire le processus d'élaboration de ces programmes sur la base d'un état des lieux et d'une maîtrise de la situation de référence. Pour rendre opérationnelle cette option méthodologique, l'effort d'investigation devra s'articuler autour de deux axes prioritaires.

Le premier concerne l'établissement d'un état des lieux sur les ressources naturelles. Il permet de procéder à un diagnostic général sur les ressources naturelles afin de compiler un certain nombre d'informations utiles et actuelles. Dans cette perspective, la mise à contribution des différentes institutions de recherche détentrices d'informations permet de procéder à une revue des connaissances sur les ressources naturelles.

Le deuxième a trait à l'évaluation des programmes et projets antérieurs ou en cours. Cette revue des expériences engagées en matière de lutte contre la désertification doit reposer sur un effort de réflexion critique permettant de tirer quelques enseignements utiles pour l'avenir du processus. La volonté de valoriser les acquis existants est à l'origine de l'intérêt accordé aux techniques et stratégies produites par le savoir local entendu comme savoir concret (opérationnel) et normatif (habilitant) touchant à la fois les conditions écologiques, socio-économiques et culturelles. Dans ce cadre, la mise en œuvre des programmes d'action doit capitaliser les expériences antérieures et actuelles, en tirer des enseignements pour l'avenir et exploiter de façon judicieuse le savoir-faire local ainsi que les techniques et pratiques traditionnelles qui ont fait preuve de leur efficacité en matière de lutte contre la désertification.

Cette prise en compte du savoir local et son articulation au système moderne d'information et de communication est conforme au principe de la nécessaire participation des populations. En effet, la reconnaissance des populations comme des interlocuteurs devant s'impliquer dans la mise en œuvre de la CCD implique que l'on prenne en compte les connaissances qu'elles ont élaborées au cours des âges, dans différents contextes, pour s'adapter aux mutations de leur environnement et assurer la reproduction de leurs systèmes socio-économiques.

La maîtrise des modes d'adaptation des populations à leur environnement peut constituer une source importante d'innovation et de progrès. Mais, cela suppose que l'on prenne en compte les concepts de base, les axiomes et les significations qui fondent l'édifice du système de représentations des populations. C'est à partir de tous ces éléments, qui sous-tendent les logiques internes à l'œuvre dans le champ du réel de leur vécu quotidien, que l'on peut poser les bases d'une articulation possible entre les techniques et les stratégies produites par le savoir local d'une part et, les sciences et techniques modernes d'autre part.

Autrement dit, pour être cohérentes, les politiques de participation des populations doivent se fonder sur une prise en compte de leur vision de la réalité. C'est à partir d'une bonne intelligence des systèmes de représentations des populations que l'on pourra tenir un langage qui soit accessible et créer ainsi les conditions d'un dialogue fécond. En outre, l'option consistant à affirmer la nécessité de prendre en compte les savoirs et savoir-faire des populations constitue une garantie pour leur redonner confiance, libérer leur ingéniosité et leur créativité dans la recherche de solutions aux problèmes qui les interpellent.
Il reste que les connaissances traditionnelles ou plutôt l'application de ces techniques et stratégies aux différents milieux pour en exploiter les ressources ne suffisent pas, à elles seules, pour faire face aux problèmes qui se posent actuellement en matière de gestion durable des ressources.
Il est indispensable que ces connaissances soient renforcées par les acquis des sciences et techniques de l'époque actuelle.

3. MODALITES DE CONDUITE DES PROCESSUS DE PREPARATION DES PROGRAMMES D'ACTION

Avec l'entrée en vigueur de la convention en décembre 1996, tous les pays Parties affectés par le fléau de la désertification se sont engagés dans la préparation de leurs PAN. Dans le même temps, les organisations intergouvernementales ont entrepris d'élaborer des programmes d'action régionaux et sous-régionaux. A l'occasion de la deuxième Conférence des Parties, tous ces acteurs ont marqué leur détermination à poursuivre le processus de finalisation des programmes d'action.

Il faut rappeler que l'élaboration et la mise en œuvre des PAN constituent les principaux engagements contractuels des pays touchés Parties. Elément central du dispositif proposé par la CCD, les PAN devraient permettre d'analyser les processus de désertification dans un cadre global et multisectoriel

Les dispositions du texte de base de la convention recommandent de concevoir la préparation des PAN comme un processus participatif et itératif qui interpelle l'ensemble des acteurs sociaux impliqués dans la gestion des ressources naturelles. Par rapport aux processus antérieurs de planification nationale, l'exercice de préparation des PAN présente une tonalité originale. En effet, la plupart des pays et des organisations intergouvernementales ont consenti des efforts substantiels en matière d'information et de sensibilisation du public sur les enjeux de la CCD, mais aussi dans le domaine de l'élargissement du champ de la concertation (décentralisation des activités de concertation et de consultation populaire).

Quel que soit leur stade d'avancement dans la formulation des programmes d'action, les pays touchés Parties et les organisations intergouvernementales ont mis en place des mécanismes appropriés de pilotage et/ou de coordination. Ces dispositifs qui doivent servir de cadres de concertation constituent un espace de mobilisation de toutes les catégories d'acteurs dans une dynamique de collaboration, de coopération, d'échanges de vue et de prise de décisions sur la base d'un consensus élargi.

Au niveau de la plupart des pays, le processus d'élaboration des programmes d'action a cherché à aller au-delà des institutions étatiques et des corps constitués pour impulser une dynamique d'ouverture à la société civile, certains pays offrant même des gages d'une volonté réelle de collaborer avec les acteurs non gouvernementaux (paysans, femmes, jeunes, éleveurs, organisations non gouvernementales).

En résumé, il convient de souligner que les principes directeurs de la CCD relatifs à la recherche d'une plus grande participation des acteurs ainsi qu'à l'établissement d'un partenariat rénové sont maintenant admis par les différentes catégories d'acteurs impliqués dans la préparation des programmes d'action. Mais, l'application de ces principes reste encore incertaine et se heurte à de nombreuses difficultés repérables à plusieurs niveaux.

Par exemple, les acteurs du développement n'ont pas toujours une vision partagée des enjeux et des défis qui les interpellent dans le cadre de la lutte contre la désertification. Dans plusieurs pays, surtout en Afrique, le déroulement du processus de préparation des programmes d'action révèle un intérêt relativement faible de la plupart des départements ministériels vis-à-vis d'un exercice qu'ils perçoivent comme une initiative sectorielle qui ne concerne que les Ministères chargés de l'environnement ou des ressources naturelles.

S'agissant des acteurs ruraux, on constate le plus souvent, qu'ils n'ont pas une appréhension claire des enjeux de ce processus, à cause de leur implication faible et aléatoire. En tout état de cause, le niveau de participation de la société civile au processus d'élaboration des programmes d'action est largement tributaire de la capacité institutionnelle des différentes catégories d'acteurs à faire prendre en compte leurs préoccupations. Cette question interpelle au premier chef les organisations paysannes et les ONG dont l'ambition proclamée est de jouer un rôle moteur dans le processus de préparation et de mise en œuvre des programmes d'action.

Sur un autre plan, il est à noter que les programmes d'action ne se fondent pas toujours sur une réelle optimisation des différents dispositifs existants. En outre, l'articulation avec les autres politiques sectorielles et transversales (en particulier les programmes d'ajustement, la décentralisation, l'aménagement du territoire et la lutte contre la pauvreté) est généralement faible, voire inexistante. Tout en affirmant la nécessité d'une mise en cohérence des processus engagés, notamment dans le secteur rural, les programmes d'action ne fournissent pas d'indications précises sur les modalités d'opérationnalisation d'une telle démarche.

La question de la cohérence d'ensemble des interventions aux échelles locales n'est pas toujours clairement prise en compte par les programmes d'action de lutte contre la désertification, notamment les PAN. Or, les interventions aux échelles locales sont mises en œuvre par plusieurs types de dispositifs institutionnels censés être complémentaires, mais qui sont généralement concurrents (services étatiques, agences de coopération, collectivités locales, ONG, organisations socio-professionnelles, etc.). Cette absence d'articulation entre les interventions à l'échelle locale et les orientations des politiques sectorielles et transversales induit plusieurs distorsions. Les principes d'interventions ne sont pas cohérents entre eux et s'avèrent parfois contradictoires; ce qui aboutit à l'affaiblissement de la stratégie d'appui au développement local.

Enfin, il convient de mentionner qu'en dépit de leur implication dans diverses thématiques environnementales sectorielles, certaines agences de coopération restent en marge des processus de mise en œuvre de la CCD. En revanche, d'autres partenaires de coopération s'impliquent activement dans la préparation et la mise en œuvre des programmes d'action, au travers de mécanismes de concertation spécifiques. Une telle dynamique ne manque pas d'intérêt même si elle ne couvre pour l'instant qu'un champ restreint qu'il conviendrait d'élargir à d'autres composantes du secteur rural (agriculture, décentralisation, lutte contre la pauvreté, aménagement du territoire, etc.).
A l'état actuel des choses, l'exercice de planification ne s'est pas encore achevé au niveau de tous les pays touchés Parties. Les travaux de la troisième Conférence des Parties ont permis de mesurer les progrès accomplis dans la mise en œuvre de la CCD dans la région Afrique. Si tous les pays du continent ne disposent pas encore de programmes d'action officiellement approuvés et qui constituent la base de leurs politiques de lutte contre la désertification, 80% ont cependant rendu compte de l'état d'avancement de l'application de la CCD.

Il ressort de ces rapports que le succès de la mise en œuvre des programmes d'action repose sur l'engagement soutenu des populations et prend racine dans la mise en pratique des principes directeurs de la convention. De ce point de vue, il importe de noter que la convention apparaît de plus en plus comme un instrument permettant de mobiliser et d'optimiser les ressources disponibles aux différents niveaux d'intervention, d'apporter des appuis ciblés aux producteurs pour le développement de méthodes et de pratiques plus durables fondées sur les systèmes traditionnels et le savoir-faire local.

4. PROGRAMMES D'ACTION DE LUTTE CONTRE LA DESERTIFICATION ET PROBLEMATIQUE DU SAVOIR LOCAL

Il convient de rappeler que la préparation des programmes d'action s'est fondée sur une démarche participative et itérative soucieuse d'approcher au plus près les préoccupations des acteurs concernés et de garantir leur implication effective dans la définition des orientations et des lignes d'action des politiques de lutte contre la désertification. Pour l'essentiel, les options méthodologiques retenues ont conduit à structurer les processus de préparation des programmes d'action en plusieurs phases, avec une combinaison de trois grandes séries d'activités portant sur : i) l'information et la sensibilisation des acteurs sur les enjeux de la CCD, ii) la réalisation d'études et d'investigations sur des thématiques ciblées et iii) l'organisation de concertations et d'échanges de vue entre plusieurs catégories d'acteurs intervenant à différentes échelles.

Au final, on constate que les programmes d'action sont constitués de matériaux d'études, de réflexions concertées et de propositions formulées par les diverses catégories d'acteurs. Ces programmes ont en commun le fait d'être conçus comme des cadres d'actions susceptibles de favoriser une mobilisation durable de l'ensemble des acteurs et une convergence des initiatives vers des axes stratégiques d'intervention articulés autour de la lutte contre la dégradation des ressources naturelles et la pauvreté.

L'examen des rapports sur la mise en œuvre de la CCD présentés lors de la troisième Conférence des Parties par les pays et les institutions intergouvernementales, permet de repérer un certain nombre de composantes communes aux programmes d'action. Ces composantes s'articulent autour des axes suivants :

- établissement d'un diagnostic exhaustif sur l'état des ressources naturelles afin de disposer d'une situation de référence. En adoptant plusieurs angles de vue et en combinant différents paramètres d'analyse. Un tel travail permet d'identifier les problèmes majeurs qui se posent à différentes échelles, de mesurer de façon précise leur acuité et d'élaborer des propositions de solutions appropriées ;
- évaluation des politiques et programmes sur la base d'une lecture critique commune des actions entreprises. Une telle démarche répond au souci de tirer profit du capital d'expériences accumulée grâce à l'identification précise des facteurs de réussite et d'échec des politiques et programmes en cours. S'il est vrai que le bilan des expériences n'est pas toujours aisé à établir, cet exercice n'en demeure pas moins indispensable dans le cadre de la préparation des programmes d'action parce qu'il permet de i) délimiter les types d'interventions et les approches susceptibles d'assurer le maintien du potentiel productif et la protection de l'environnement, ii) définir les mécanismes pouvant garantir une participation effective des différentes catégories d'acteurs dans la mise en œuvre des politiques et des stratégies de gestion des ressources naturelles et iii) créer les conditions de renforcement de la collaboration et du partenariat entre différentes catégories d'acteurs mobilisées autour d'objectifs communs ; formulation d'axes d'orientations stratégiques prenant en compte la nécessité de croiser des domaines d'intervention prioritaire avec des mesures de soutien conçues comme des axes horizontaux d'actions intersectorielles par rapport à la gestion des ressources naturelles et à la lutte contre la désertification. Ces mesures s'articulent principalement autour de i) la lutte contre la pauvreté, ii) la politique de population, iii) le renforcement des capacités des structures organisationnelles, iv) la place des femmes et des jeunes dans la mise en œuvre de la politique de lutte contre la désertification, v) l'amélioration de la coordination des politiques, vi) le renforcement du cadre institutionnel et juridique et vii) l'établissement de mécanismes de financement durable.

S'agissant de la problématique du savoir local, elle est prise en compte dans le cadre de la définition de démarches de planification et de programmation à l'échelle locale. Il convient de mentionner que l'une des fonctions d'un tel exercice est de favoriser la mise en place de mécanismes et de moyens financiers requis pour réaliser les objectifs de développement définis par les acteurs. Dans cette logique, la mise en œuvre des plans et programmes locaux devra s'appuyer sur un dispositif cohérent d'incitations (directes et indirectes) susceptibles d'impulser une dynamique de mobilisation durable des acteurs. A ce niveau précis, il s'avère indispensable d'intégrer les pratiques des populations pour en tirer le maximum d'enseignements en vue d'éviter certains dysfonctionnements préjudiciables à la réussite des programmes d'action.

4.1 PROGRAMMES D'ACTION REGIONAUX ET SOUS-REGIONAUX

Si le niveau national est le lieu où s'élaborent les politiques de gestion des ressources naturelles, les échelles sous-régionales et régionales n'en demeurent pas moins des niveaux spatiaux importants pour la mise en cohérence globale des stratégies nationales. Cela suggère que parallèlement au processus de préparation des programmes d'action nationaux et de renouvellement des instruments de politiques publiques, un exercice de planification soit entrepris à l'échelle régionale et sous-régionale en vue de favoriser une meilleure gestion des ressources partagées, d'assurer l'harmonisation des législations et des stratégies adoptées par les pays, d'impulser une dynamique de mise en œuvre concertée des conventions environnementales et d'établir des mécanismes de prise en charge des défis communs.

Il est évident que les problèmes d'environnement et de gestion des ressources naturelles se posent dans des contextes spécifiques et commandent d'agir localement. Mais, il existe une autre catégorie de problèmes environnementale qui ne se réduit pas à une problématique intéressant tel ou tel terroir pris isolément, mais qui concerne plusieurs pays, voire une région dans son ensemble. Cette dimension internationale signifie que certaines dynamiques locales ne peuvent pas être gérées comme telles, tout simplement parce qu'elles participent d'un mouvement d'ensemble impliquant plusieurs pays, ou parce que leur solution ne peut venir que d'efforts concertés et de transformations touchant le marché international ou les nouvelles normes technologiques.

Pareil constat explique la nécessité d'établir des passerelles étroites entre le niveau national et le niveau sous-régional et régional dans la définition des politiques de lutte contre la désertification. Autrement dit, la mise en œuvre de la CCD devra s'appuyer sur des processus articulés et cohérents d'élaboration d'outils de pilotage au niveau national et sur l'établissement de cadres référentiels globaux à l'échelle sous-régionale et régionale.

L'itinéraire technique des programmes d'action régionaux et sous-régionaux part de la définition des orientations stratégiques et des priorités communes pour aboutir à l'identification des domaines d'intervention à forte valeur ajoutée et des principales lignes d'actions. Par-delà la diversité des contextes écologiques, économiques et socio-politiques des différentes sous-régions de l'Afrique, on retrouve dans les programmes d'action élaborés par les OIG certaines préoccupations communes portant sur :

- l'amélioration de l'efficacité des mécanismes de coordination des politiques nationales de gestion des ressources naturelles ;
- le renforcement de la coopération scientifique et technique ;
- l'établissement de systèmes performants d'information sur la désertification ;
- le développement de la communication et de la formation environnementale ;
- l'établissement de dispositifs de suivi/évaluation.

Partant du constat de la faible valorisation du potentiel qu'offre le savoir local, les programmes d'action préconisent l'établissement de mécanismes de diffusion des expériences réussies en matière de lutte contre la désertification. "Les expériences [en cours] n'ont pas su s'enrichir des modes anciens et contemporains de lutte contre la désertification et la sécheresse, en particulier dans le sens de l'adaptation des technologies locales et des techniques ayant fait la preuve de leur efficacité sur d'autres continents".

En effet, la promotion des expériences réussies constitue une condition essentielle pour le développement de systèmes de gestion efficaces des ressources naturelles. D'autres facteurs sont à prendre en compte dans la perspective de l'émergence de tels systèmes (niveau élevé de participation des acteurs au processus de prise de décision, reconnaissance de droits fonciers clairement établis, mécanismes transparents de gestion et de règlement des conflits, etc.). Par rapport à ces facteurs, la valorisation du savoir local apparaît comme un élément à forte valeur ajoutée dans la mesure où elle induit des effets bras de leviers significatifs grâce au renforcement des capacités des institutions locales et à la libération des capacités d'innovation des communautés de base.

C'est pour cette raison que la valorisation du savoir local est inscrite dans les lignes d'action définies par les programmes d'actions régionaux et sous-régionaux. Par exemple, le programme d'action adopté par l'Union du Maghreb Arabe qui constitue l'un des cinq projets majeurs dont la mise en œuvre est envisagée au niveau de la sous-région accorde un rang de haute priorité à la promotion des techniques traditionnelles de lutte contre la désertification.

En ce qui concerne l'Afrique de l'Ouest, le programme d'action élaboré par le CILSS et la CEDEAO met l'accent sur la nécessité d'exploiter au mieux le capital d'expériences accumulées pour trouver des réponses appropriées aux contraintes liées à la gestion des ressources naturelles. L'option d'adaptation de l'héritage culturel à la problématique de gestion de l'environnement préconisée par le programme sous-régional vise à i) répondre aux défis d'aujourd'hui, ii) garantir la pérennité des initiatives en matière de lutte contre la désertification et iii) impulser une dynamique de participation des acteurs.

De la même manière, le document de référence préparé pour l'Asie, préconise la mise en place d'un

réseau à l'échelle de la région Asie/Pacifique afin de promouvoir la recherche et la formation en rapport avec la valorisation des expériences réussies et du savoir local.

Si la pertinence de cette option de valorisation des connaissances traditionnelles n'est pas discutable, en revanche les modalités de son opérationnalisation méritent d'être précisées. Or, les programmes d'action ne fournissent pas toujours d'indications claires sur les stratégies de collecte et de préservation des connaissances traditionnelles, les modes de diffusion des savoirs locaux et les articulations à établir avec les sciences et techniques modernes. Il est indispensable d'approfondir la réflexion sur ces questions en mettant à contribution les forces sociales qui doivent être à impliquées directement ou indirectement dans l'application des techniques et stratégies produites par le savoir local.

4.2 PROGRAMMES D'ACTION NATIONAUX

Le processus d'élaboration et de mise en œuvre des programmes d'action nationaux s'inscrit dans une dynamique d'ensemble visant à construire les bases de systèmes plus performants de gestion des ressources naturelles et à définir de nouvelles perspectives stratégiques articulées autour des préoccupations de durabilité.

L'ambition proclamée de ces programmes d'action est d'établir un cadre d'orientation devant servir de trame de cohérence et de coordination pour toutes les actions de gestion des ressources naturelles et de lutte contre la désertification. Pour réussir, la mise en œuvre des PAN doit s'appuyer sur des initiatives pertinentes par rapport aux enjeux et défis environnementaux, mais aussi porteuses de valeur ajoutée. Cela signifie que les PAN devront s'inscrire dans une logique de complémentarité susceptible de corriger les faiblesses des démarches en cours et de renforcer leurs acquis.L'un des moyens permettant d'y parvenir consiste à évaluer les dispositifs existants pour appréhender la pertinence des choix arrêtés en matière de démarches d'intervention et de stratégies de lutte contre la désertification. C'est sur la base de ces éléments que l'on pourra réajuster les priorités et les axes d'intervention et définir les canaux et supports les plus appropriés pour une diffusion des expériences probantes.

Il ressort de la lecture des rapports présentés lors de la troisième Conférence des Parties que la place accordée par les pays africains à la problématique du savoir local dans le champ de leurs préoccupations varie en fonction de leur perception de l'importance que revêt cette question. L'autre paramètre de variabilité concerne les caractéristiques spécifiques aux contextes d'évolution socio-politique des pays concernés, notamment en termes d'approfondissement du processus de décentralisation et de démocratisation.

Dans le souci de prendre en compte ces facteurs, nous avons choisi de façon aléatoire un échantillon de pays dans chaque sous-région. L'exploitation des rapports de ces pays relatifs à l'application de la convention permet de proposer quelques éléments de réflexion.

Il convient de noter que ces documents ont été élaborés sur la base d'un schéma proposé par le Secrétariat de la CCD. Ce canevas global ne comporte pas de chapitre consacré de façon spécifique à la problématique du savoir local. Toutefois, il ne s'agit pas là d'une omission dans la mesure où cette question peut être traitée à l'intérieur de l'un des chapitres généraux retenus et qui portent sur :

- les stratégies et priorités établies dans le cadre des plans et des politiques de développement durable ;
- les mesures institutionnelles prises pour la mise en œuvre de la convention ;
- le processus participatif à l'appui de l'élaboration et de la mise en œuvre des programmes d'action ;
- le processus consultatif à l'appui de l'élaboration et de la mise en œuvre des programmes d'action et des accords de partenariat avec les pays développés et les autres entités intéressées ;
- les mesures prises ou prévues dans le cadre des programmes d'action, notamment pour améliorer le climat économique et l'organisation institutionnelle, conserver les ressources naturelles, parfaire les connaissances sur la désertification, surveiller et évaluer les effets de la sécheresse ;
- l'examen des repères et indicateurs utilisés pour mesurer les progrès accomplis dans la lutte contre la désertification et l'évaluation de ceux-ci.

En l'état actuel des choses, les modalités de prise en compte de la problématique du savoir local dans l'élaboration des programmes d'action nationaux sont très variables et mettent en jeu des démarches contrastées.

Dans le premier cas de figure, la problématique des connaissances locales n'est pas vraiment prise en compte dans le champ de la réflexion engagée pour définir les orientations du programme d'action. C'est ainsi, par exemple, que la lecture du rapport de Djibouti ne permet pas de saisir les axes relatifs au savoir local dans les orientations des politiques sectorielles (agriculture, hydraulique, élevage, etc.) ni dans celles des programmes majeurs en cours d'exécution, notamment les programmes concernant l'éducation environnementale et l'éducation en matière de population.

Dans le deuxième cas de figure, la problématique du savoir local est analysée dans le cadre de l'évaluation globale des dispositifs existants avec un accent particulier sur les impératifs de sensibilisation et de responsabilisation des acteurs à la base. Une telle démarche a été adoptée par des pays comme le Maroc, l'Algérie et la Tanzanie.

Box 1: Previous initiatives in Tanzania

Programmes and strategies for combatting the effects of land degradation date back to those which were implemented before independence. Initiatives continued even after independence. Post independence stategies have included : soil conservation programmes, the afforestation campaigns and village afforestation programmes, the arid zone afforestation. Most of these programmes have collapsed because of number of reasons including lack of funds, lack of involment of local communities in their planning and implementation, lack of the use and appreciation of indigenous techniques and knowledge.

Il convient de mentionner que cette option de principe n'a pas toujours une incidence réelle sur les orientations et les lignes d'action retenues dans le cadre du PAN ainsi que le montre l'exemple de l'Ethiopie. Toutefois, la volonté d'établir un cadre institutionnel adéquat en vue d'une maîtrise fonctionnelle des processus de désertification a conduit ce programme d'action à proposer le renforcement de la Commission sur la Science et la Technologie, ainsi que le développement de programmes de recherches incluant la prise en compte des savoir locaux et des techniques traditionnelles.

Box 2: Improved knowledge on desertification in Ethiopia

In the course of NAP formulation process, past experiences in relation to effort to sustainably manage the drylands of Ethiopia have been, to some extend, reviewed and evaluated. However, these efforts are not considered adequate and as the implementation of the National Action Programme commences and continues, attention should also be given to research and studies on various issues required to enhance knowledge about desertification and ways of combatting it, including indigenous knowledge.

Box 3: Institutional measures taken to implement the Convention in Ethiopia

The need to have a strong institutional framework for coherent and functional desertification control has been given emphasis in the NAP. Ethiopian Science and Technology Commission is established to support, encourage and assist the establishment of research centers at all levels and create a conducive condition enhancing the participation of peasants and rural communities in science and technology actvities. The Commission has, among other responsibilities, with regard to popularizing research findings in order to facilitate their diffusion into the various social and economic sectors, of encouraging studies and application of findings designed to improve and develop the indigenous technologies as well as of developing the capacity required for searching, selecting, negoiating, procuring and importing technologies that are appropriate to the Ethiopian socio-economic conditions".

Dans le troisième cas de figure, les questions relatives aux connaissances traditionnelles sont analysées en rapport avec les mesures institutionnelles adoptées dans le cadre du programme d'action. En Namibie et au Lesotho par exemple, les problèmes sont abordés dans le cadre de la mise en place d'institutions

étatiques ayant pour objectif le renforcement des capacités de planification et de gestion des ressources naturelles. Au Burkina Faso, les mesures institutionnelles arrêtées pour appuyer la mise en œuvre de la Convention mettent l'accent sur la responsabilisation des populations et le renforcement des capacités locales en matière d'utilisation durable des terres en rapport avec le processus de décentralisation.

Box 4: Les domaines d'intervention prioritaires du PAN du Burkina Faso

Le PAN a identifié sept domaines d'intervention prioritaire auxquels devront se référer désormais tous les programmes et projets de lutte contre la désertification. Ces domaines portent sur :

- la gestion durable des ressources naturelles ;
- l'amélioration des conditions de vie des populations rurales et semi-urbaines ;
- la création d'un environnement économique, politique, législatif et institutionnel porteur ;
- le développement des compétences ;
- la coopération scientifique et technique ;
- le renforcement des capacités économiques et de négociation des groupes sensibles ;
- la coopération régionale.Les perspectives de valorisation du savoir local sont évoquées de façon transversale dans plusieurs domaines d'intervention qui mettent l'accent sur :
  - la diffusion des connaissances concernant les techniques de gestion durable des ressources naturelles ;
  - la promotion des technologies et des savoir-faire appropriés ;
  - la sauvegarde, l'intégration et la valorisation des connaissances, savoir-faire et pratiques locale et traditionnels.

Dans le quatrième cas de figure, la valorisation des savoirs locaux est prise en compte dans les lignes d'action ou les projets du programme d'action. Au Botswana, le PAN préconise la mise en œuvre d'un projet de conservation des sols ayant pour objectif la promotion de pratiques de gestion durable, en particulier au niveau des systèmes agricoles de type intensif. Le PAN de la Tanzanie comporte six nouveaux programmes dont l'un porte de façon spécifique sur la collecte et la diffusion des technologies et des connaissances traditionnelles. Au Sénégal, les initiatives retenues s'articulent autour de l'aménagement des terroirs, l'amendement organique des sols, la réalisation de digues de retenue anti-sel, le captage et l'utilisation efficiente des eaux de pluie en s'appuyant sur les savoir-faire locaux.

Dans tous les cas de figure examinés, on constate que la préoccupation des acteurs tourne autour de la nécessité de parvenir à une gestion durable des ressources naturelles en combinant les potentiels que recèle des connaissances et techniques traditionnelles d'une part et, les acquis scientifiques et techniques d'autre part. L'avantage de cette option réside dans sa capacité à développer le sens de l'initiative et de l'innovation et à garantir la participation effective des populations, surtout si les efforts s'appuient sur une utilisation judicieuse des langues nationales et des dispositifs institutionnels mis en place par les collectivités locales elles-mêmes.

5. INTEGRATION DES STRATEGIES ET TECHNIQUES PRODUITES PAR LE SAVOIR LOCAL DANS LES PROGRAMMES DE TRAVAIL DES RESEAUX ET MECANISMES ETABLIS PAR LE SECRETARIAT DE LA CCD

Les réseaux établis par le secrétariat de la CCD se structurent autour de thématiques transversales qui renvoient à des défis environnementaux communs. Dans le cas particulier de l'Afrique, il s'agit principalement du réseau pour la gestion intégrée des bassins fluviaux, lacustres et hydrogéologiques, du réseau des énergies renouvelables et des éco-technologies et du réseau pour le développement de systèmes de production agricole durable.

Chacun de ces réseaux, dans le domaine spécifique d'intervention qui est le sien, cherche à favoriser le développement de la coopération et des échanges entre les institutions des pays Parties en vue de promouvoir des programmes conjoints.

Le réseau pour la gestion intégrée des bassins fluviaux, lacustres et hydrogéologiques se fixe pour objectif de promouvoir l'exploitation rationnelle et la gestion intégrée des ressources partagées des grands bassins fluviaux, lacustres et hydrogéologiques du continent. La démarche adoptée par le réseau s'appuie sur l'échange d'informations et d'expériences, ainsi que sur l'harmonisation des méthodes d'intervention en matière d'exploitation et de gestion des ressources en eau.

Le réseau des énergies renouvelables et des éco-technologies constitue un cadre de liaison entre diverses institutions et organismes publics et privés destiné à promouvoir la concertation et la coordination des politiques et des stratégies d'intervention. Il se fixe aussi pour objectif de procéder à l'identification des potentialités et des capacités africaines (locales et régionales) en matière d'acquis techniques et de savoir-faire.

Le réseau pour le développement des systèmes de production agricole durable établis se structure autour de trois objectifs essentiels :

- inventorier les connaissances et les acquis de la recherche dans le domaine concerné;
- identifier les axes de recherches prioritaires en relation avec les exigences de la mise en œuvre de la convention ;
- procéder à une revue des systèmes de coopération régionale et définir des stratégies d'amélioration des systèmes de production agricole.

En ce qui concerne l'Asie, la réunion du groupe international des experts sur la préparation du programme d'action régional avait recommandé la mise en place de plusieurs réseaux thématiques qui portent principalement sur :

- le suivi et l'évaluation de la désertification ;
- l'agroforesterie et la conservation des sols ;
- la gestion des ressources en eau pour le développement de l'agriculture ;
- la gestion des terres de parcours incluant la fixation des dunes de sable.

Pour atteindre les objectifs assignés, les trois premiers réseaux se réfèrent principalement aux connaissances et aux technologies modernes, alors que le dernier met un accent particulier sur l'exploitation des connaissances traditionnelles pour une meilleure maîtrise des techniques de fixation des dunes de sable et de gestion des terres de parcours.

Box 5 : Indigenous knowledge of rangeland managment

Objective

To study and assess - in a participatory way - indigenous knowledge and technologies existing in the region for rangeland management and to diffuse the acquired knowledge among concerned network partners in the region.

Activities

- use participatory assessment techniques such as participatory action research including RAP in the study of traditional rangeland management issues;
- use interdisciplinary approaches for the study and understanding of indigenous watershed management and water haversting techniques;
- study and document traditional techniques and approaches for the rehabilitation of rangelands;
- document medicinal and industrial uses of rangeland species of plants and animals (e.g., gum production or plant vegetable dyes, herbal medicines);
- carry out comparatvies study of indigenous technobotany with modern systematics/taxonomy (for example, knowledge of species and their classification, nomenclature, etc.);
- study techniques of sustainable use of natural resources;
- document indigenous and traditional methods in nomadic pastoral societies, especially among traditional community elders, for rangeland carrying capacity assessment and its rlionshi to migratory patterns, population density, flock composition, etc.;
- document traditional systems of rangeland protection and management such as hema, mahjar, mahmiyya, qoroq, etc.;
- study the impact of migratory routes and systems on rangeland protection and sustainable use, including the interdependance of different use systems on each other (pastoral nomadic, transhumant, settled grazing, farming);
- estimation of seasonal rainfall and agricultural/livestock productivity and their use in new classification schemes; and
- document traditional and indigenous coping strategies against drought and desertification in rangelands and watershed basins.

Si l'on excepte le réseau sur la gestion des terres de parcours, toutes les expériences évoquées révèlent des limites liées au fait que les réseaux n'ont pas su établir une intégration efficiente entre les connaissances traditionnelles d'un partet les acquis scientifiques et technologiques d'autre part. Sur un autre plan, ils n'ont pas réussi à initier une véritable politique de promotion et de diffusion des approches concluantes en matière de lutte contre la désertification.

La recherche méthodologique pour promouvoir des canaux et des supports appropriés d'information et de communication sur les connaissances traditionnelles fait défaut. Par ailleurs, l'existence des réseaux ne se traduit pas par une amélioration significative du système de collecte et d'inventaire des connaissances qui reste encore largement cloisonné.

6. ELEMENTS DE REFLEXION SUR LA VALORISATION DU SAVOIR LOCAL POUR OPTIMISER LES POSSIBILITES DE LUTTE CONTRE LA DESERTIFICATION

En attendant que des enquêtes systématiques soient conduites auprès des différents acteurs concernés, les contraintes déjà identifiées permettent de formuler un certain nombre de recommandations visant à améliorer la prise en compte des savoirs locaux par les programmes d'action et les réseaux régionaux.
Ces recommandations concernent principalement :

- l'amélioration du système de collecte et d'inventaire des connaissances locales et la mise en réseau des institutions intervenant dans ce domaine pour créer les conditions d'une synergie des efforts et d'une utilisation optimale des acquis disponibles ;
- la promotion de canaux et de supports de diffusion, notamment en recourant à la fois aux moyens de communication traditionnels et aux médias modernes d'information et de communication ;
- l'élaboration de méthodologies et de procédures d'intégration des savoirs traditionnels et des acquis scientifiques et techniques pour apporter des réponses plus opérationnelles aux défis environnementaux actuels ;
- le renforcement des capacités des organisations communautaires de base en vue de susciter l'émergence de structures et de formes d'organisation aptes à prendre en charge les impératifs de la lutte contre la désertification et de créer les conditions d'une synergie fécondante entre les initiatives endogènes des collectivités locales et les innovations proposées par la recherche scientifique et technique ;
- le développement du partenariat et des échanges entre les différents acteurs pour promouvoir un partage des connaissances et optimiser les possibilités de lutte contre la désertification.

Références

1. DPCSD/CCD/97/2 (1997) - Convention des Nations Unies sur la Lutte contre la Désertification. Texte avec Annexes.
2. TOE, E. (1998) - „Connaissances techniques et pratiques traditionnelles en matière de lutte contre la désertification en Afrique de l'Ouest : Burkina, Niger, Cap Vert.
3. UNCCD/ESCA (1998) - International experts group meeting on the preparation of the Regional Action Program (RAP) for Combating Desertification and Drought in Asia, Bangkok, 10 - 13 November 1998. Report
4. ICCD/COP(3)/CST/2 (1998) – Trational Knowledge: Synthesis on important and widely applied Traditional Knowledge on a Subregional and Regional Basis and on a National Scale.
5. ICCD/COP(3)/CST/3 (1998) – Traditional Knowledge: Report of the ad hoc panel.
6. ICCD/COP(3)/CST/3/Add.1 (1998) – Traditional Knowledge: Building linkages between Environmental Conventions and Initiatives.
7. ICCD/COP(3)/CST/3/Add.2 (1998) – Traditional Knowledge: Synthesis on Traditional Knowledge in Dryland Ecosystems.
8. ICCD/COP(3)/CST/4 (1998) - Survey and Evaluation of existing Networks, Institutions, Agencies and Bodies.
9. CEDEAO/CCD/CILSS (1997) - Le programme d'action sous-régional (PASR) de lutte contre la sécheresse et la désertification pour l'Afrique de l'Ouest : cadre d'orientation
10. CEDEAO/CCD/CILSS (1997) - Le programme d'action sous-régional (PASR) de lutte contre la sécheresse et la désertification pour l'Afrique de l'Ouest. Actes du Forum de Niamey, Niger, 21 - 23 Juillet 1997.
11. CEDEAO/CILSS (1998) - Le programme d'action sous-régional (PASR) de lutte contre la sécheresse et la désertification pour l'Afrique de l'Ouest.
12. CONAGESE (1999) - Programme d'Action National de Lutte contre la Désertification (PAN/LCD) du Burkina.
13. République du Sénégal (1998) - Programme d'Action National de Lutte contre la Désertification (PAN/LCD) du Sénégal.
14. République du Bénin (1999) - Programme d'Action National de Lutte contre la Désertification (PAN/LCD) du Bénin.
15. RADP (1999) - Programme d'Action National de Lutte contre la Désertification (PAN/LCD) de l'Algérie.
16. Jamahiriya Arabe Libyenne (1999) - Programme d'Action National de Lutte contre la Désertification (PAN/LCD) de la Libye.
17. STP/CIGQE (1999) - Programme d'Action National de Lutte contre la Désertification (PAN/LCD) du Mali.
18. République de Tunisie (1999) - Programme d'Action National de Lutte contre la Désertification (PAN/LCD) de la Tunisie.
19. UMA (1999) - Le programme d'action sous-régional (PASR) de lutte contre la sécheresse et la désertification pour l'Union du Maghreb Arab.
20. Plant, M. (1999) - Education pour le développement durable: une approche unifiée à l'éducation pour l'environnement. In „Dialogues pour l'Education à l'Environnement", n0 11 Décembre 1999.
21. PRSCS, Mali (1996) - Répertoire de Connaissances et de Pratiques Traditionnelles en matière de Lutte contre la Désertification.
22. Sarr, S., Lo, M., Thomas, J.P., Sokona, Y. (1998) - Promotion d'un réseau sur les énergies nou velles et éco-technologies.
23. Castini, S., Djalo, T., Wane, M.A. (1998) - Document introductif à l'atelier régional sur la Gestion intégrée des Bassins Fluviaux, Lacustre et Hydrogéologiques dans le contexte du Programme d'Action Régional de Lutte contre la Désertification en Afrique.
24. Akle, M. (1998) - Note introductive à l'atelier régional sur la Gestion rationnelle des Ressources en Eau des Grands Bassins Fluviaux, Lacustres et Hydrogéologiques dans le contexte du Programme d'Action Régional de Lutte contre la Désertification en Afrique.
25. Bulletin des Négociation de la Terre" vol. 4, n0 127 CdP-2.
26. Bulletin des Négociation de la Terre" vol. 4, n0 138 CdP-3.
27. IGAD (1999) - Status of the implementation of the IGAD Subregional Action Programme (IGAD/SRAP) in the context of the United Nations Convention to Combat Desertification Bejing Ministerial Conference on Regional Cooperation to Implement the CCD in Asia (13 - 15 May 1997)
28. CRDI (1994) - Compte rendu de l'atelier sur les savoirs locaux et ladésertification en Afrique (Le Caire 3 - 5 janvier 1994).
29. Toulmin C. et al. 1994. Réflexion sur l'expérience passée des stratégies environnementales. Enseignements pour la mise en œuvre de la Convention de lutte contre la désertification
30. Winter M. (1998) - La gestion décentralisée des ressources naturelles au Sahel: vue globale et analyse
31. Sites WEB du PNUE : **www.undp.org**

2.4 Report on the Measurement of the Reciprocity Between Traditional and Modern Knowledge and their Promotion

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China. Shelterbelt to protect farmland. **Photo: UNCCD.**

SUMMARY

Based on previous work on traditional knowledge to combat desertification, the author has prepared this framework paper on the reciprocity between traditional and modern knowledge for combating desertification in different regions affected by desertification and land degradation. It is stressed that there are many existing knowledge, know-how and modern techniques that are acceptable to both the developing and the developed country parties. A few constraints have been discussed, and comments on monitoring and evaluation, resources requirement and voluntary work have been contributed in the paper. Desertification is a global issue. International cooperation and wide efforts in the field of combating desertification is one of the initial steps to obtain success.

INTRODUCTION

Drylands are classified as arid, semi-arid and dry sub-humid areas, and include some of the world's well-known land types, such as the marginal area (transitional zones of dry-farming and animal grazing) in China, the Gobi landscape in Mongolia and western China, the Eurasian Steppe, rangeland in Australia, and savanna in Africa.

Desertification is land degradation in the drylands caused by the factors of climatic variations and human activities. In summarizing global experiences, it can be concluded that human factors which cause desertification include the growth of intensive farming, over-cultivation, poor irrigation practices, deforestation, over-grazing and anthropogenic technical development efforts. These unsustainable resource management practices are often induced by disruption of social systems, the under-valuation of traditional knowledge and know-how, inappropriate policies, weak administration management, increasing population pressure and poverty. It is not just in Asia and Africa or other developing countries, that the effects of human activity have accelerated the effects of drought. In the 1930s, the "Dust Bowl" in USA blew the topsoil of the drought-parched plains. In the 1990's, several dust storms swept across the three northern regions and even some parts of southern and eastern China. As towns and farms were buried in these dust storms, those villages that were not afflicted were forced to resettle in new regions where they had tremendous difficulties in starting a new life.

Drylands account for almost 40 per cent of all the Earth's land areas. Worldwide about two billion people, some 37 per cent of the world population, are living in drylands. In Asia, 1.5 billion people, or 43 per cent of the total population of the region, are living in dryland areas, which cover about 38 per cent of the land area of the region. In Africa, 43 % of its land mass is dryland and 41 per cent of its population live therein (UNSO/UNDP 1998). Some of the world's largest cities lie within arid zones. International metropolises such as Beijing, Cairo, and Lima all suffer from an acute lack of rainfall, and many of Africa's capitals, from Dakar to Khartoum, lie within the drylands (UNSO/UNDP 1998). All these large cities are facing the issue of desertification.
UNDP's data show that:

- 25 per cent of the Earth's surface is affected by desertification with an increasing trend;
- One fifth of the world population is under the threat of desertification and 135 million people are facing the lose of their productive land in the near future; and
- Approximately 800 million people, who survive, produce and live on dryland, are short of food.

The arid, semi-arid and dry sub-humid areas of the world are mainly located on the land surface between latitudes 72°N. and 57°S., especially in Asia and Africa, where vast land areas have been interrupted through human activities and most of aboriginal biotic resources have been consumed and destroyed. Fragile ecosystems of dryland are extensively used, particularly in the areas with complex topographic, edaphic and climatic conditions. As a consequence, agricultural production is limited to some areas with favourable conditions where animal husbandry is regarded as the main economic activity. Both physical and human factors play important roles in causing drought and desertification in these regions, characterized by great precipitation insufficiency, wind frequency, rich source of sand composition, lack of technology and backward education. Drought and high evapo-transpiration are frequent phenomena causing an arduous environment in the arid, semi-arid and dry sub-humid areas of the world.

The aboriginal vegetation in dryland varies from savanna to desert steppe. Human development activity, particularly in the underdeveloped regions with a high density of population, concentrates on economic growth and biomass production, without paying attention to sustainable development of the limited existing resources.

1. CONTENT

The United Nations Convention to Combat Desertification (UNCCD) places a great emphasis on the value of traditional and local technology, knowledge, know-how and practices in combating desertification. Certain initiatives on traditional knowledge, know-how and practices for combating desertification have been taken by the Conference of the Parties of UNCCD (COP) in light of recommendations of the Committee on Science and Technology (CST) during COP.1 (Rome, 1997). In response to its decision 14/COP.2, an ad hoc panel composed of ten experts was entrusted with the following terms of reference:

(a) To draw upon a synthesis report (ICCD/COP(3)/CST/2) prepared by the secretariat on the most important and widely applied traditional knowledge on a regional basis and on a national scale, where appropriate, to identify successful experiences relating to:

(i) Threats and other constraints, including socio-economic impacts, confronting such traditional knowledge and practice;

(ii) Strategies for integrating traditional and local knowledge, know-how and practices with modern knowledge based on specific case histories; and

(b) To report accordingly to the Conference of the Parties at its third session.

The ad hoc panel was subsequently convened in Matera, Italy from 15 to 18 July 1999 and the panel reviewed the background documents of ICCD/COP (2)/14/Add.1 (decision 14/COP.2) and ICCD/COP (2)/CST/5, which included a variety of useful and interesting techniques and practices to combat desertification and reflected on the value residing in the diversity of traditional knowledge. The panel developed a common understanding of the term "traditional knowledge" and its systemic and dynamic characteristics.

2. TRADITIONAL AND LOCAL KNOWLEDGE

It is understood that, from the compilation of the most important and widely used traditional knowledge on a national, sub-regional and regional basis, the term traditional knowledge embraces the characteristics of cultural diversity.

A tenet of both the National Action Programmes (NAP) and the UNCCD is that "desertification is a global problem with local solutions". From its inception, the NAP strategy was to build upon traditional technology, know-how and practices with the aim of increasing the ability of both government and stakeholders to control agricultural risk by improving techniques and restoring the degraded lands. It took the view, which subsequently became a principle of the UNCCD, that the people who bear the brunt of desertification, and who best understand the fragile environments in which they live, must be the starting point for efforts to rehabilitate desertification and combat land degradation.

2.1 COMMON UNDERSTANDING OF DIMENTIONS OF TRADITIONAL KNOWLEDGE

The first ad hoc panel meeting on traditional knowledge (Matera, 1999), dwelt extensively on this subject (see section 1.4 of this document).

2.2 DEFINITION OF TRADITIONAL KNOWLEDGE

Many physical and social scientists have been engaged in the study of management of dryland ecosystems and development of natural resources during the past two decades and they have the experiences to fight against desertification and control land degradation. Working with local people, they accumulated a reservoir of knowledge that is applicable in guiding how to survive in harsh environment. Traditional knowledge is often alternated with different names by many different groups of scientists, such as indigenous knowledge, local technology, and native know-how and farmers' practices. Traditional knowledge and local technology is part of a complex system and it is far more than a simple list of technical solutions. Its applications vary according to the results to be obtained. Each traditional practice is not an expedient to solve a single problem, but it is an elaborated and often a multipurpose system that is part of an integral approach which is strictly linked to an idea of the world based on the careful management of local resources.

In view of desertification processes, traditional knowledge comprises a wide range of accumulated experience to manage natural resources in farming, grazing, land greening, ecology restoring and other relevant sectors, institutional and organizational arrangements, as well as beliefs and values. Some experts also concluded that traditional knowledge is an accumulated cognitive and perceptive experience of interaction between a group of people, their physical and biological environments, and the productive systems. The quality and quantity of traditional knowledge vary among communities, societies and group of people, depending on age, gender, social status, education background, occupation and productive capability. Language, religion and socio-cultural aspects are also important differentiating factors.

It is reported that traditional knowledge may be considered a systematic body of knowledge acquired by local people through the accumulation of experience, informal experiments, and an intimate understanding of their environment in a given culture. Local people, including farmers, landless labourers, women, pastoralists and cattle keepers are the custodians of traditional systems. These people are well informed about their own situations, their resources, what works and what does not work. They are also aware of the possible impact of a change in one factor on the other parts of the production system. Some scientists have described traditional knowledge as:

- Adaptive skills of local people, usually derived from experience and acquired through family members over generations;
- Time-tested natural resources management practices;
- Strategies and techniques developed by local people to cope with socio-cultural and environmental changes;
- Practices that are accumulated by farmers due to traditional experimentation and innovation;
- Trial and error problem-solving approaches by groups of people to meet the challenges they face in their local environment; and
- Decision-making skills of local people to draw upon their resources.

2.3 TRADITIONAL TECHNOLOGY

2.3.1 Practical techniques for stabilizing mobile dune and fixing shifting sands

Artificial plantations of trees, shrubs and grasses are the most effective measures to stabilize mobile dunes and fix shifting sands in arid, semi-arid regions where the annual precipitation varies from 200 to 400 mm. Both seedling and seeding methods are available. The methods used in plantations for fixing sands include:

(1) Plantations of trees, shrubs and grasses in the inter-dune and low-lying lands;

(2) Shrubs that have a high resistance to wind erosion are planted on the front or middle part of the windward slopes of dune;

(3) Cuttings of species that are drought-resistant to sandy soil, such as Salix spp., Artemisia spp., Caligunuim spp. are planted in the leeward slopes of sand dunes to fix the sand surface of dunes. This plantation is characterized by non-irrigation, quick growth with production of fodder for livestock.

There is also a great deal of experience in managing sand dunes along both sides of transport lines of railway and highway so as to protect railroad beds from wind erosion and sand accumulation. This action guarantees the safe operation of transportation systems. The following are some successful techniques developed in China during its 40 years of efforts to fix dunes and transform desert land.

2.3.2 Traditional knowledge for establishing farmland protective shelterbelts systems in arid, semi-arid deserts and loess areas

This is an integrated approach which consists of species introduction, nursery management, maintaining of planted networks, and design of shelterbelts. The species for establishing farmland protective networks include: Platyclados orientalis, Populus alba, P. bolleana, P. nigra var. Thevestina x simonii, P. euphratica, Fraxinus sogdiana, F. America, Ulmus pumila, Amorpha fruticosa, Tamarix spp., Eleagunus angustifolia, Hippophae rhamnoides.

2.3.3 Techniques for mulching sand surface with straw checkerboard, clay and pebble to slow down movement of dunes, to reduce blowout and to accelerate sand accumulation

The techniques for mulching sand surface are popularly used in arid regions in China and Turkmenistan. The straw checkerboards are widely adapted to control shifting sands along desert expressway and railway lines in the mentioned countries.

2.3.4 Tassas

This is a special country programme in Niger aided by IFAD for improving traditional techniques. Planting pits, known as tassas, revived land that previously had little or no agricultural value. Under the first phase of the programme, 5800 ha of previously uncultivable, degraded land were recovered and farmers were able to introduce millet as a new crop. Originally used on barren, pavement-like soil known as faka, the use of tassas spread to other areas.

Building planting pits is simple and well within the capacity of the small holders during the dry season when the workload is usually low. The only innovation required is a 'pick-tool' that does not usually form part of the farmer's tool kit. A hole, 20 to 30 centimetres in diameter and 15 to 20 centimetres deep, is dug, and the dirt from it placed around the edge to form a ridge. The bottom of the hole is covered with manure. This layer provides organic matter and encourages termite activity, which helps to break up the underlying soil. When it rains, the holes fill up with water and the farmer then plants millet or sorghum in them.

Very often farmers use stones recovered from the pits to build bunds. Depending on how much stone is available, the bunds provide boundaries to the fields or crisscross them, slowing down the runoff of water. This increases water infiltration into the soil and protects the ridge of the tassas from being washed away. The tassas usually last two to three years as they gradually fill up and become covered over.

2.3.5 Traditional knowledge of biogas, solar energy-powered greenhouse

Biogas and solar energy are regarded as environmentally sound alternative sources of energy for cooking, lighting and heating. Biogas is popular in Asia, especially in China, while solar energy is initially used in a narrow scale in some regions where citizens have higher incomes, like herdsmen in Tibet and Inner Mongolia.

Traditional knowledge for building greenhouses is very popular in northern China in order to make full use of the solar energy and to improve land productivity. Solar energy devices are used to reduce the plunder-like destruction of vegetation in circumstance of shortage of fuel wood, especially in the desertified land areas where the human population pressure causes heavier loss of vegetative coverage. The clay and mud greenhouses are normally curtained with a straw matrix. All inside walls are painted black to absorb more solar heat, and outside walls are protected with a plantation of some evergreen trees and shrubs.

2.3.6 Optimizing techniques for controlling soil and water loss

The optimizing techniques for controlling soil and water loss can be divided into two components, one is the biomechanical slope system and the other the biomechanical gully system.

2.3.7 Water-saving irrigation techniques

This technique includes the extension of infiltration-proof along the canal; the application of modern irrigation facilities, such as dripping irrigation methods, sprinkler and injection irrigation.

2.4 KNOWLEDGE

2.4.1 Development of wind mill & wind energy

Wind energy and windmills are used to generate electricity for villagers and herdsmen in rangeland areas in northern China, South America and parts of Africa, especially in rural and mountain areas. Small windmills can be constructed around the settlements to meet the daily needs for pumping water, operating TV sets and generating electricity. In the arid Xinjiang Region of China, because of lack of coal and water resources, power and hydraulic electricity are limited. Therefore wind and solar energy are considered to be the main potentials to be developed for cultivating land, pumping wates, heating houses and cooking food.

2.4.2 Approaches for fencing over-grazed steppe in desert and transitional regions

In consideration of the effectiveness to protect pastures, steppe and rangeland from over-grazing, a wire-fencing system is widely adopted in densely populated steppe and transitional zones in northern China. Both shed-feed and, semi-shed-feed are wisely popularized at the transitional and marginal areas. But rotation-grazing system is carefully used in the steppe and desert steppe zones. Herdsmen and pastoralists are experienced to protect the over-grazed steppe and rangeland through artificial approaches and optimum management.

2.5 KNOW-HOW

2.5.1 Know-how to transform alkalized/salinized soils by planting salt-resistant species

The techniques for transforming alkalized/salinized soils include:
(1) Selection and introduction of salt-resistant species as the pioneer varieties for improving unfertilized soils;
(2) Preparation of trenches as parts of a drainage system to reduce the salt concentration on the soil surface; tree and shrub species that can grow in alkalized/salinized soils, such as Populus Euphratica, Calligonum klementzii, Tamarix spp., Haloxylon spp., Salix spp., Elaeagunus spp. have been widely tested and are suitable for planting.

2.5.2 Machobane Farming System in Lesotho

This is typical local know-how developed by Dr. James Jacob Machobane, a Lesotho agronomist in the 1920s. Although only a small part of this multidisciplinary programme promoting the Machobane farming system illustrates how poor farmers can identify agricultural production without imported inputs even when the soil fertility is low, Machobane's approach is unusual because it begins by ensuring that farmers are motivated and convinced that they can increase crop production. Farmers receive training in their own fields and must promise to help neighbours adopt the system.

This farming system is based on sound environmental principles: inter-cropping and replay cropping ensure optimum plant cover and extend the farming season; manure and wood ash from domestic fires sustain soil fertility and enhance water retention; pests are controlled by traditional methods, including the use of natural predators; and crop, including a cash crop, potatoes, are rotated between rows in the same fields.

2.5.3 Plastic mulching for developing crop cultivation,

preventing desertified land from both evapotranspiration and strengthening soil sterilization
Plastic mulching is used in desert and mountain/upland regions to develop crop cultivation in greenhouses in winter and spring and to increase farm produce; to prevent the moisture from evapotranspiration. It can also be used for runoff harvesting in arid and semi-arid regions to make full use of runoff. In the loess plateau area or terraced cultivation field, even some chemical materials and milky asphalt have been sprayed upon the cultivated soil surface for it to absorb and infiltrate more rainfall. Plastic mulching does not only prevent cultivated soil from evapotranspiration and holding moisture potential in soil, but also strengthens soil sterilization through increasing the humidity and temperature of surface soil. It is estimated that the growth season of plants has been lengthened by 20 to 30 days. The disadvantage of plastic mulching is that people have to collect the

waste plastic material after each harvest, otherwise, "white pollution" will harm arable soil.

2.5.4 Establishment of range reserves, fuel energy and fodder farms

Settled herdsmen communities have long adopted a simple method of allowing a piece of grazing land to rest for one or two seasons and graze it in rotation in order to improve the range condition and avoid excessive degradation. This know-how of using communal rangeland on a rotational basis has been practiced by some tribes in the Sahel, eastern and southern Africa and by villagers in some regions of Pakistan for a long period of time.
Additionally, the grazing land for the dry season is kept closed during the rainy season for the purpose of vegetation recovery. It is strictly forbidden to use these areas for grazing. This system does not only lie fallow the fragile rangeland, but also produces seeds of palatable species that are likely to be selectively depleted in the open areas. In Lesotho, grazing in wet depression areas during summer season is strictly limited and villagers are encouraged to graze their livestock in high mountain "cattle post" areas during the summer months instead of grazing animals near their villages.

2.5.5 Integrated approaches for establishing desert oasis

In China, due to the existence of mountains and river valleys and wide distribution of snow, most desert and sandy lands are rich in underground water. In order to prevent the oasis and villages from sand movement and spread, sandbreaks, windbreaks and farmland protective shelterbelts are established in close combination with the three protective systems. Inside oasis, narrow tree belts are designed to form a reticular pattern, and the structure of the tree belts is moderately penetrable by wind which increases the protective effects and prevents sands from being deposited around the tree belts to form a trough. The main tree belts are set perpendicular to the direction of the prevailing winds. The distances between two tree belts is 120-200 or 200-300 metres, namely, about 15-25 times the height of the tree belts. The distance between the accessory tree belts is 300-600 (or 800) metres, twice as long as the distance between the framework tree belts. The tree belts are often combined with the construction of road and irrigation canals. These tree belts not only protect oasis, villages, farmland, and crop field and improve the microclimate, but also provide timber, fuel wood, fodder and shade to animals in the hot and dry season.

2.5.6 Know-how for runoff-harvesting in arid area

Rain-fed farming, tree plantation with irrigation and nomadic grazing in arid areas, even in some dry sub-humid regions, as well as drinking water depend on rainfall and runoff. Therefore, for the people who live in arid areas, water harvesting and runoff catching/storage techniques have evolved on the basis of long-term experiences.

2.6 PRACTICES

2.6.1 Agroforestry practices to control damages and to improve farming activities

Agroforestry has been practiced for nearly a hundred years in Asia. The following types of agroforestry practices have been adopted in most countries with a long history of its use:
1) Tree-crop inter-plantation,
2) Farmland protective shelterbelts,
3) Social forests, and
4) Fast-growing and high yield plantation.
Agroforestry is characterized by the following functions: microclimate modification, increase of the capacity against natural calamities, wind velocity reduction; precipitation and humidity increase; fertility of degraded soil; high production of biomass and fuel wood energy sources.

2.6.2 Plantation of psymophyte to fix drifting sands with floods

Under the impact of natural vegetation destruction and the over-reclamation of desert land, local settlements and cultivated lands around desert oasis have been buried by drifting sands. The oasis have been invaded by megadunes. The practice of establishing plantations of psymophyte is relatively inexpensive, and easily operable in affected areas with adequate flood and runoff and cheap labour resources. The key point of this practice is the full awareness of local resources and

the consciousness of the local people about the importance of social participation to fight desertification. Meanwhile, local residents' interests and benefits must be regarded as the major components of any project for combating desertification.

2.6.3 Techniques for building crop and fruit terrace fields in mountainous areas

In order to catch, harvest and store more surface runoff to secure the survival and growth of crops and fruit trees in an optimum fashion on the one hand, and to control the occurrence of flood and soil losses during thunderstorms. On the other hand, sloping fields must be flattened according to the principle of water balance and water stress volume in terraced fields. The growth of crops and trees and their harvest are determined by the limited natural precipitation. Precipitation, which is often in the form of thunderstorms, falls in a short period of time and often exceeds the infiltration capacity of the soil.
The result of the cropping and fruit tree planting terrace fields in arid areas shows that the runoff collection surface on slope above the terraces has to be treated with special materials to avoid infiltration and to meet the higher water needs for plantations.

2.6.4 Minimum tillage, scarifying and staggered furrows

The minimum tillage, scarifying and staggered furrows refer to the minimal human ploughing activities and cropping productivity on the land during the planting, harvesting and fallow seasons. These land management measures are widely used in marginal, loess, wind eroded gully areas and the Gobi area in northern China. The minimum tillage and scarifying system is characterized by:
(1) Harvesting runoff and avoiding soil erosion. Dry farming or runoff cropping is popular in dryland regions. The scarifying system will store at the bottom the runoff as a catchment under the ploughing layer. It has been shown that soil moisture in the topsoil is 3-5% and that in the scarifying layer it reaches 8-13%. This system can save 60-70% more water than irrigated farmland;
(2) Increasing soil fertility. This system can collect, catch and store atmospheric precipitation and snow. It can also keep crop residues in the soil as green manure and humus. It is observed that the humus left in the soil is equivalent to applying fertilizer or manure to the crop;
(3) Improving soil texture. This system does not disturb topsoil resulting in the loss of soil fertility and destroying surface vegetation;
(4) Creating the conditions to conserve moisture and organic matter in the topsoil that was covered by dry crop residues and root systems.
Like the minimum tillage system, the staggered furrow is a successful method used on slopes where water is available and pits are ineffective after several heavy rains. This soil reclamation technique effectively reduces water and wind erosion, thereby increasing soil moisture and forage production.

2.6.5 Practice for carrying out the optimum rotation grazing

In order to increase rangeland or steppe productivity, the optimum rotation grazing system can be used in steppe and dry rangeland regions. For marginal areas of grazing land and rain-fed farming regions a wire-fence can be applied to prevent the degraded rangeland from further degradation and over-grazing. Herb and grasses are seeded through air-seeding or manual spraying and the fenced vegetation acts as the reserve. This measure is aimed to revegetate the fenced degraded rangeland for future developments of steppe/pasture and animal husbandry by establishing artificial forage or fodder farms. In the upland or plateau regions, summer grazing lands must be chosen and the optimum carrying capacity must be determined. The over-reclamation of steppe is also one of the key root causes of desertification.

2.6.6 Practices to develop runoff afforestation on upland of the Loess Plateau

The Loess Plateau is a major region where severe soil and water loss has led to serious ecological and environmental problems due to lack of vegetation in China. In order to revegetate this region, runoff afforestation measures (water harvesting techniques) have been used in the Loess Plateau to control soil erosion and water loss. The measures include:
(1) To classify the slope into different segments according to their slope degree and build small terraces or dig furrow to harvest more runoff;
(2) To flatten the slope and compact the soil surface in the small catchment to slow-down the infiltration

of runoff, to increase the depth of moisture in soil and mulch plastic film or thin asphalt layer on the flattened and compacted soil surface to harvest runoff; to spray infiltration-preventing chemical materials such as petroleum waste and asphalt on the soil surface to harvest runoff; to establish and protect soil/biological crusts to reduce rainfall infiltration, so that more runoff can be harvested;
(3) To plant pioneer species in the small terrace or furrow to keep the flattened soil in stable condition with rich root systems.

3. MODERN TECHNIQUES

According to international literature and patent records, thousands of modern technological design, techniques and advanced measures have been developed in the world. Only several widely used techniques that have been developed in China, USA, Belgium and Israel will be cited in the following pages.

3.1 BIOLOGICAL TECHNIQUES
3.1.1 ABT Rooting Powder

'ABT Rooting Powder' is a series of compound plant growth regulators developed by Prof. Wang Tao of the Chinese Academy of Forestry. It strengthens, adjusts and controls the content of endogenous hormone and the activity of important enzymes. ABT promotes the formation of large biological molecules, induces adventitious roots or buds, and enhances the intensity of metabolism. As a result, the vitality of forest seedlings and plants, and the quality and drought-resistance of crops are improved. This advanced biological technique is a highly efficient, compound conditioner for plant growth. ABT promotes the molecular compound of biology through intensifying and equalizing the contents of internal hormone and important active enzymes. ABT is aimed at raising seedling survival rates and increasing productivity, quality and resistance of crop. ABT is now widely applied in the fields of crop production, reforestation, vegetable produce, fruit gardening, medicine nursery and cash crop cultivation. The ABT R & D Centre has sponsored 80,000-demonstration/extension sites.

ABT can improve the survival rate and increase production of crops, vegetables, fruit trees, medical and special cash plants. ABT has been applied to farming on an area of 15.3 million hectares in China, resulting in an 8.37 billion kilograms increase in terms of crop output. ABT has been applied to the production of 6.77 billion seedlings of trees, representing over one billion US dollars in economic profits.
The research and development of ABT Rooting Powder Series was awarded the special prize of the National Scientific and Technological Advancement in 1996. ABT has also been awarded 13 other important national prizes and 12 international prizes.

3.1.2 TC SOIL CONDITIONER

TC soil conditioner, its full name being Terra Cotthem, is a soil conditioner that was developed and invented by Mr.Van Cotthem, Professor of Ghent University and President of TC Dialogue Foundation during his ten year effort in addressing water scarcity problems and improving ecology in the West Africa and Sahelian region since the early 1980s. TC plays an increasing role in revegetating degraded land surfaces in arid, semi-arid and dryland areas. Worldwide, TC is used in landscape gardening, ecology restoration and environmental protection.

Previously, the combination of water-holding polymers with sodium (polypropylene sodium) had brought a negative impact to horticulture. In addition to this, some polymers lost their water-holding capability while irrigating soil with blackish water, and could not filter out sodium and chlorine and could not absorb the useful elements. Water-holding polymers in TC are not sodium-based. Biological screening and field tests proved that the polymers in TC can decrease the negative impact of blackish water and salinized soil on plants, and could play an important role in storing water even in salinized/alkalized soils.

3.2 MECHANICAL MEASURES
3.2.1 Water saving techniques

Concurrent improvement in cultivation techniques has helped to optimize water utilization. As a result, water applications have been reduced and crop yields increased. Proper and controlled use of water has minimized the need for drainage and reduced salinity hazards and leaching

requirements, even if the land is arid or semi-arid and the quality of water often poor owing to its high mineral contents.

a) Drip irrigation

Drip irrigation has revolutionized arid zone agriculture with sweeping economic and ecological effects. Drip irrigation is now recognized as one of the most important agricultural developments of the 20th century. Drip irrigation involves the lateral spread of water on the surface to be irrigated by conducting the water under pressure to a relatively closely spaced grid of outlets, and discharging the water through these outlets at virtually zero pressure. When properly used, the system has many advantages, especially in arid areas characterized by shortage of water, poor and saline soil, saline irrigation water, and high evapotranspiration rates. It applies water to the roots of the plant. The quantity used can be regulated. Economically, the cost of drip irrigation is a limiting factor, particularly in rural areas where poverty and lack of access to financial resources and technical help are primary issues.

b) Sprinkler irrigation

This kind of irrigation is comparatively an effective method and has been popularized in the farmland areas in China's Hexi Corridor where water resource is rich and economic conditions are superior. When analyzing the statistics of agricultural production, the usage of the sprinkler irrigation technique indicates a water-saving of 40-60 percent. This irrigation system is widely adopted in crop fields in most plain areas. The cost of installation of a sprinkler system is high, but the benefit arising from saving water is also remarkable, particularly in areas with limited water resources. Sprinkler irrigation simulates rainfall in all respects, with the significant exception that both duration and intensity of fall can be controlled. Sprinkler irrigation has thus been quite successful in most countries applying the system, under the adverse conditions of poor-quality water, soils of restricted capability, and novice farmer. Compared to earlier methods it represents a tremendous step forward.

3.2.2 Air-seeding techniques for revegetation and pasture improvement

Air seeding is one of the effective methods for stabilizing sand in sandy desert in China and it has been popularly applied as a pilot technique since the late 1950s. It is used mainly in regions where precipitation exceeds 400 mm/yr. Successful experiences have been shown in the fixation of semi-fixed dunes in rangeland areas and in the stabilization of vast mobile dunes.

3.3 SPACE-BASED TECHNOLOGY

3.3.1 Technology for investigating and assessing watershed management

GIS, GPS and remote sensing technology are used to investigate the natural and socio-economic situation of the watershed which includes geological, geographic, geometric characteristics, soil and water losses, natural resources, population, productive structure, management level of production, income and consumption level, etc. The setting up of watershed management information systems is aimed at analyzing and diagnosing watershed environment conditions, resource utilization possibilities, soil and water loss control, policy, marketing demands, productive structure, etc. The actual productive potential model, index system, statistics analysis and mathematic methods used to evaluate the land capability, land stability and land economics. System dynamics, mathematical programming, random decision-making, and systems theory methods have been used for optimizing the productive structure of watersheds, analyzing watershed system stability and the environmental carrying capacity. Evaluation maps, reports and multi-media data are some of the outputs of watershed management information systems.

4. RECIPROCITY BETWEEN TRADITIONAL AND MODERN KNOWLEDGE THROUGH ADAPTATION, TRANSFER AND EXTENSION

Worldwide, successful experiences are generally characterized by a close combination of theory and practice, research and production and scientists and farmers. A series of practical techniques for combating desertification, for rehabilitating rangeland degradation, alleviating poverty, and controlling soil and water losses have been developed on the basis of long-term practice of traditional knowledge and adoption of modern techniques.

The issues and consequences of desertification and land degradation are very diverse in different climatic zones from the north to south and east to west. The process of desertification is normally caused by pressures of human population growth, over-reclamation of arable land, over-grazing, wind and soil erosions, irrational utilization of land resources and mining of underground resources, destruction of natural vegetation and wild collection of fuel wood and medicine herbs, mis-management of water resources, salinization and alkalization, activation of vegetated dunes and sand movements, deterioration of fragile ecosystem of oasis and drought hazards.

Traditional knowledge, local techniques, know-how and practice, often collectively referred to as traditional technologies, represent accumulated cognitive and perceptive experiences of interactions between a group of people, their physical and biological environments, and the productive systems. The quality and quantity of traditional knowledge varies among community members, depending on gender, age, social status, intellectual capability and occupation or trade. Language, religion, biophysical imperatives, and socio-cultural aspects, and environmental traits, are important driving forces in shaping these practices.

4.1 ADAPTATION

Traditional technologies are dynamic and have built-in mechanisms for innovation and growth of new dimensions according to changing challenges and circumstances. In practice, communities continue to learn from one another, through interactions between neighbours, cross-border marriages, and adaptation of a given culture to a new environment following conquest and subsequent domination. Many cultures have also borrowed from modern technology and scientific advancement. In general, traditional knowledge and local technology have been ignored by modern development and scientific research institutions since the dawn of industrial society. Indeed, a marked erosion of traditional knowledge and local technology occurred during colonial times and more recently, during the influence of research-driven global promotion of the green revolution in the 1960s and 1970s. It is only in the past decade that this knowledge has been recognized by the Western scientific community as a valuable source of information. Today, a growing body of literature attests not only to the presence of a vast reservoir of information regarding plant and animal behavior, nutrition and medicinal potentials of natural products, but also to the existence of effective indigenous strategies for ensuring the sustainable use of natural resources. Consequently, many scientists, community-based organizations and non-governmental organizations working with farmers and herdsmen have compiled a large body of traditional knowledge and local technologies associated with different production systems and agrarian typology. But vast quantities of information remain undocumented, while very little validation and appraisal of efficacy and sustainability has been done.

4.2 TRANSFER

The successful experiences in Africa, Asia, Latin America and the Mediterranean are all characterized by the close combinations of theory with practice, research with production and scientists with farmers. A series of practical techniques for combating desertification and rehabilitating degraded land have been developed on the basis of traditional knowledge and modern techniques in the above mentioned regions. The phenomena and consequences of desertification vary considerably in different climatic zones from West Africa to East Asia.

For better implementation of UNCCD and NAP, the following aspects are recommended to combat desertification at national, sub-regional and regional levels.

4.2.1 Technology transfer at national and sub-regional levels

(1) Transfer of techniques for establishing narrow shelterbelt systems developed in arid Xinjiang and Gansu Provinces, which play a large role in protecting farmland from wind hazards and sand disasters, should be carried out in the semi-arid regions and dry sub-humid areas in the regions where similar physical conditions prevail;

(2) Introduction of practices of straw checkerboards, clay/pebble/chemicals mulching for fixing drifting sands should be conducted in the watershed areas of loess, hilly areas for revegetating eroded landscapes where prevailing wind is frequent, sand source is rich and soil and water loss is serious;

(3) Extension of technologies for establishing bio-farms in steppe or rangeland areas, should be initiated to preserve the over-grazed rangeland in semi-arid and dry sub-humid areas. These should be conducted in desert steppe regions where there is a risk of a desertification process.
(4) Application of soil conservation practices, runoff harvest and terrace tillage systems, which occur in the watershed areas on loess and hilly regions facing creeping sands, should be promoted in areas affected by problems of rangeland degradation and soil erosion;
(5) Adaptation of windmill and solar energy should be encouraged in the regions facing a lack of fuel wood, coal and gas. Wire-fence protection should be undertaken in biodiversity reserves located in regions with dense animal population;
(6) Air-seeding techniques for fixing shifting sands and revegetating gully loess hills should be widely adopted in the over-grazed steppe areas for creating fodder-farms, shed-fed animal breeding and restoring the interrupted ecosystem in countries characterized by problems of mobile dunes and shifting sands;
(7) Agroforestry, which was successfully practiced in China's North Central Plain regions for fertilizing soil and improving farmland, and the agrofertiler approach in Brazil should be ope rated on a trial basis in the newly developed arable land in oasis or along the periphery of deserts where annual rainfall varies from 350-500 mm;
(8) Practice for further harvesting runoff on piedmont or in foothills should be introduced to the loess areas for managing watershed, seasonal river and depression areas with runoff afforestation.

The suitability and feasibility of traditional knowledge and practical techniques are adaptable, and great achievements have been made in specific fields to combat desertification. However, in consideration of poverty alleviation, rational utilization of resources, development of dryland and protection of arable land, improvement of rangeland, rehabilitation of desertification and ecology restoration, sustainable social, economic and environmental development, the following modern technologies should be introduced to the regions where people and government are ready to implement the National Action Programmes of the UNCCD, particularly those countries that have established international and regional cooperation programmes with the advanced countries:

(1) Water saving techniques, such as sprinkler irrigation, drip irrigation, micro-drop irrigation and fertilization systems;
(2) Greenhouse cultivation, introduction and silviculture of pioneer plants;
(3) Solar energy development, biogas farms and gases exploitation for avoiding the plunder collection of fuel wood and innovative cooking/heating facilities;
(4) Mechanization of afforestation and grazing land fodder harvest;
(5) New artificial materials for fertilizing soil and holding moisture in sandy soil;
(6) Introduction of TC soil conditioner to those regions with limited precipitation, particularly the arid and hyper arid areas in Northwest China, Sahelian states, West Asia and Middle East regions;
(7) Continue to popularize the application of the ABT Root Generating Powder to increase the quality of seedlings, widen the scale of revegetation and raise cultivation on a traditional farming basis.

4.2.2 Scholar exchange

Both research institutions and productive units in Asia, Africa, the Mediterranean, East and Central European and Latin America and the Caribbean regions have extensive international relations between the developed and developing country Parties. Scientific and technological exchange programmes, projects and demonstrations have been implemented at national, sub-regional and regional levels since the 1950s. After UNCED (1992), close contacts and exchange programmes have been arranged among various partner countries through international donors and UN organizations. As one of the international efforts to transfer traditional knowledge and modern techniques for combating desertification, the following exchanges should be stressed as the first step:

(1) Qualified personnel exchange programmes which include professors and postgraduates in fields relating to desertification combating, state laws and policies, new technology development and pioneer species innovation;
(2) Technician and decision-maker exchange programme in specialized fields at national, sub-regional and regional levels through international efforts and inter-regional initiatives on retraining and education;
(3) Student exchange programmes, including university study and awareness education and public awareness-raising at senior/junior schools;
(4) Demonstration and extension service exchange programmes, including technical training, study tours and ground observation, and grass-roots technical demonstration.

4.2.3 Information exchange and information-sharing

Information exchange and information sharing are important elements in establishing international linkages and communication between the affected developing and developed countries. The lack of information will certainly limit social progress and technical advancement. The following activities should be encouraged between the interested parties of UNCCD.

(1) Establishment of regional and inter-regional integrated information networks, such as databases, desertification monitoring and assessment network should be carried out;
(2) Information collection, analysis and exchange between state departments, institutions and even private sectors, and the promotion of the exchange of information on remote sensing and mapping services in the affected countries should be undertaken and strengthened;
(3) Free contribution and dissemination of technical information kits and multimedia materials should be arranged for nationwide, regional and global publicity. These materials should be made available on relevant occasions such as the World Day to Combat Desertification and Drought and the World Environment Day;
(4) Establishment of an informal network, such as e-mail, listserver, and Internet fora should be supported among the focal points of the affected countries;
(5) Sub-regional, regional, inter-regional and global coordination on combating desertification should be set up in different continents through the Regional Coordination Unit of the UNCCD;
(6) Facilitation of exchange and use of information on appropriate technology, knowledge, know-how and practice among the affected countries should be conducted and the involvement of relevant partners including international institutions, NGOs and other civil societies, community-based organizations in this exercise, should be fostered through the Global Mechanism, UNEP, UNDP/UNSO, WB, GEF, UNESCO, FAO, WMO, and other UN bodies;
(7) Periodic exchange of knowledge of the methodologies for developing benchmarks and indicators for the implementation of CCD, impact indicators of desertification and experiences in desertification monitoring and assessment should be made through every communication means particularly between national departments, sub-regional and regional institutions.

4.2.4 Bilateral/multilateral partnership cooperation

Desertification combating is a strategically significant task facing the whole of mankind. The governments of all the affected countries are actively encouraged to further implement the UNCCD, its regional implementation Annex and NAPs through concrete activities within the framework of the UNCCD. In accordance with the framework of UNCCD and with the support of relevant organizations, UN institutions and international donors, the affected country Parties are ready to conduct wide-ranging cooperation through bilateral and multilateral cooperation in the spirit of a Regional Cooperation Framework, particularly in the aspects of science and technology, information exchange, implementation of NAPs, promotion of public awareness, personnel training, and capacity/institution building so as to make a contribution to combating desertification worldwide. The following recommendations should be considered:

(1) At the international level, bilateral cooperation arrangement between universities, research institutions and training organizations involving private and public sectors of the affected countries should be initiated. The possibility for developing common curricula and, in particular, the inclusion of courses on desertification issues is worth exploiting;
(2) At the sub-regional level, necessary inter-governmental organizations should be designed to cope with natural disasters and undertake rehabilitation of the affected lands and development on a sub-regional basis. Bilateral cooperation would involve the exchange of experiences in the areas of legislation, institutional building and management of natural resources. Specifically, they could take the form of exchange of joint studies.

(3) At the regional level, triangular cooperation should be formulated in areas where projects and programmes initiated by two or more countries are financed by a third party in a spirit of partnership. An agency or any country with the capacity to do so, can also play the role of a third party. The triangular cooperation requires mutual understanding and trust among the participants. The financing supplied by the third party has to be provided on a predictable basis and should preferably be united. Projects or programmes should be initiated and formulated by the participating countries in association with the funding partner;
(4) An inter-regional Research, Development and Training Centre for Combating Desertification is proposed to be established in a selected country. It is necessary to recall the decision adopted in Item 40 of the Beijing Framework for Action on Asia-Africa Cooperation on Combating Desertification and/or Mitigating the Effects of Drought;
(5) On an experimental basis, a possibility should be explored to formulate a demonstration project for integrated management with an area of 2,000 ha, involving possibly two countries (one in Asia and one in Africa) where traditional knowledge and advanced technology for combating desertification are widely applied. In this context, the establishment of a network of research, demonstration and training centres for transferring and adapting available know-how and practical techniques should be encouraged by the affected countries with financial support from the interested developed countries Parties and international donors;
(6) The ordinary session of the Conference of the Parties (COP) and its Committee on Science and Technology should provide excellent opportunities to review, at the inter-regional level, the effectiveness of multilateral cooperation;
(7) The permanent Secretariat of UNCCD should be encouraged, in due time, to review the results achieved by the multilateral cooperation as an appropriate process for genuine partnership and commitment for cooperation on combating desertification.

4.2.5 Sub-regional training

It is sometimes very difficult to sponsor regional or international training activities, especially in the affected developing countries, due to the lack of financial resources, training and transport facilities and language barriers. According to Chinese and Iranian experiences in organizing sub-regional training activities and study tours during the past decades, these were found to be easier from both the administrative and cost-effective points of view. The following arrangement is suggested for adoption, in light of training effects and financial sources.

(1) Long distance education through TV Programmes;
(2) Classroom lectures on wheel and study tour on specific issues;
(3) Technical show and on-site visit;
(4) Periodic courses and exchange of visiting scholars; and
(5) Volunteer activities.

4.2.6 Regional or inter-regional linkage and academic exchange

Desertification is a global issue and international and inter-regional cooperation are thus becoming more and more necessary. Joint efforts, especially in combating desertification, at the inter-regional level are very urgent. In addition to international cooperation in productive activities and practical efforts, a certain technical linkage and academic exchange should be sponsored and organized at regional, inter-regional or global levels. (1) Technical seminars on introduction, adaptation and extension of high-technology to the affected developing countries, such as solar energy, cash crops breeding and nursery cultivation and so on; (2) International training courses at the junior level and forum/symposium at senior level for those engaged in research and development of advanced technology and thematic topics; (3) Workshop on coordination of policy and programme development for decision makers, project officials and administrators at state department levels; (4) Study tour on landuse and resources management and economic development in the affected areas.

4.3 EXTENSION

4.3.1 Extension of techniques

There are many advanced techniques, traditional knowledge, know-how and practices for combating desertification from the community to international levels. There are clearly problems and difficulties in transferring these techniques from the laboratory to the field environment. More effective solutions for solving these problems should be found through close integration of research results with concrete productive efforts. At the same time, great importance from various levels should be attached to this issue and practical mechanisms should be devised through the promotion of extension services and institution building at working levels. The following efforts should be made:

(1) An extension service system should be set up at the grass-roots level to help the local residents apply the techniques suitable to local conditions so as to improve people's quality of living;
(2) Technical consultation should be financed to support local governments to deal with desertification rehabilitation and ecology restoration at the community and county levels, expert missions should be organized to work in a bottom-up manner and technical assistance and strategic advise be provided to villagers and decision makers;
(3) Demonstration or pilot projects should be created in the affected areas to develop acceptable techniques and supervise local people in dealing with problems of introduction, adaptation and extension of new technology;
(4) Researchers should be encouraged to transfer their know-how from the laboratory to the field through installation of experiments from "closed territory" to the farmers' field under the protection of legal contracts. Community-based organizations and local governments are urged to provide necessary assistance to such efforts including financial support and preferential policy in landuse aspects;
(5) At the national level, a state fund for combating desertification should be established and the national institution concerned should be authorized to be in charge of this fund which aims to reward advanced personnel, both scientists/technicians and grass-roots cooperators. A special national prize of desertification combating should be formulated and pioneer workers in the field should be appreciated on the World Day to Combat Desertification;

4.4 MONITORING AND EVALUATION

In view of the principle that actions should preferably be thoughtful and modest, with realistic expectations and measurable outcomes, the focal points of authorized governmental agencies shall set up, in close collaboration with the Steering Committee, coordination members or international partners, a specific unit, similar to the Italian National Centre of Traditional Knowledge, to work on key issues. A scheme for the establishment of the specific unit shall be formulated by the Steering Committee members to ensure measurable progress on traditional knowledge, local techniques, know-how and practices for combating desertification, land degradation and ecology restoration. The Steering Committee or coordination members shall periodically review the progress and effectiveness of the adaptation, transfer and extension of the identified traditional technologies. Modern technology should be introduced by the international community, when the committee holds its regular meeting.

As a matter of policy, the coordination unit shall submit, on a regular basis, a consolidated Steering Committee Performance Evaluation Report (SCPER) which should reflect the progress and evaluation of traditional knowledge and transfer from the lab to the field and its popularization at grass-root levels. Specific monitoring and evaluation protocols may, however, be developed depending on the nature of the traditional technology, know-how, practice and if so required by both the domestic agency and international donor institutions supporting the adaptation, transfer and extension of traditional technology and introduction and popularization of modern techniques.

4.5 RESOURCE REQUIREMENT

Of the many elements that have bearing on the success of the wide use of traditional knowledge, local technology, native know-how and acceptable practice, involvement of various stakeholders and employment of affordable technologies are, perhaps, the most essential ones. To be effective, all relevant governmental agencies and Steering Committee members are expected to work with a sustained level of enthusiasm on the part of the participating members and commitments of the concerned departments and the country Parties in the spirit of partnership. While it is absolutely essential that the members of both the coordination unit and the Steering Committee share the benefits of traditional knowledge and know-how and make funds available from their own resources to the extent possible, external funding will have to be mobilized for undertaking the various

activities related to the use of traditional knowledge and local technology and introduction and extension of modern techniques at national, sub-regional and regional levels.

Placing priority by the government agencies or international donor community on the use of traditional knowledge and local technology or popularization of modern techniques will prove to be a cost-effective way for implementing both the NAP and the UNCCD in that the coordination unit is an acting body linking stakeholders with communities, institutions with government agencies, and country Parties with the international community. Funding will be crucial at the initial stage of the use of traditional knowledge and local technology as financial support can make an important contribution to ensuring the broad initial extension of the local know-how. Specifically, financial assistance from donor countries and international agencies may be in the form of funding technology transfer, or alternatively, grass-root level projects. Collaboration between institutions in the developing country Parties and international donor institutions is encouraged whether it is in the form of formal partnership agreements or informal arrangements. Donors will be assured that a structure and process will be set up for planning and administering the finances to facilitate practicing traditional technologies or modern techniques, from domestic and international sources.

4.6 VOLUNTARY WORK

Given the broad scope of the desertification problem and the vast expanses of the world, resources will likely be scarce in practicing traditional knowledge and local technology. The international donor community is expected to step forward in recognition of the significance of a full role of the know-how for combating desertification at national, sub-regional, regional and global levels, particularly for the affected areas in the country Parties. All the affected country Parties, both the developed and developing country Parties will be urged to contribute voluntary work, under the principle of UNCCD and spirit of partnership, that may take a variety of forms. The opportunity to afford voluntary work will expose the use of traditional knowledge and local technology to wider global connections by means of involving more people, especially women and stakeholders in rural regions, who will certainly bring with them different perspectives and valuable local knowledge and experiences. Voluntary work will also enable the forging of links between traditional knowledge and modern technology amongst the affected developing countries and the affected developed partners.

Specifically, internship opportunities open to college graduates, younger scientists and school students will be beneficial to the wide application and extension of traditional knowledge and local technology, modern techniques, especially in the aspect of training local technicians, farmers, herdsmen and stakeholders. Similarly, expert consultation aimed at enhancing technical popularization and human capacity for improving the process and progress of traditional knowledge and local technology will be profitable to the local citizens, local communities and the affected country Parties concerned as well as to the global efforts to rehabilitate desertification and improve ecology at large-scale. With the aid of international linkage and regional exchange, voluntary work in terms of governmental contribution, NGO consultation and institutional assistance will be effective and fruitful. Detailed provisions guiding specific arrangements for voluntary contributions will need to be worked out among the country Parties and affected communities when agreement between partners gets approved on the basis of mutual understanding.

4.7 CONSTRAINTS

In the interests of sound adaptation and popularization of traditional knowledge and local technology, a national steering committee or coordination unit will become fully operational. It must be recognized that the traditional know-how for combating desertification and controlling land degradation will be subjected to a variety of constraints. In particular, resource constraints will dictate the speed and adequacy of the efforts to use the mentioned know-how and technology. Hence, some activities or programmes for technology and know-how transfer need to take place in phases. Speedy progress and quality performance of the transfer of technology will also depend on the level of skills and educational background among the local stakeholders and the efficacy of the cooperation between the partners, donors, other stakeholders and the international institutions such as UNDP, UNEP, GEF, FAO, World Bank, the Global Mechanism of UNCCD and other financing donors. There is a growing realization that, in spite of a strong requirement towards adapting the traditional knowledge and

local technology, the use of traditional know-how must be framed with clearly defined models that link the biophysical and socio-economic dimensions of the problem. Desertification processes in arid and semi-arid areas are inseparable from social and economic processes in the neighbouring as well as local areas. Recognizing that human activities as well as climatic variations contribute to the process of desertification, human impacts on the surface characteristics and atmospheric composition of various arid, semi-arid and dry sub-humid areas should be identified and evaluated when planning the efforts and activities to transfer the traditional and modern technologies, especially in the development of benchmarks and indicators for the focal point at national level. It is clear that new strategies and approaches to eliminate the above constraints should be proposed quickly, on the basis of establishing demonstration and pilot experiments of traditional knowledge and modern technology from one state or region to another. The real constraints limiting the use of traditional knowledge and modern technology for combating desertification and land degradation on different continents should be carefully considered.

BENCHMARKS AND INDICATORS

5.1 Reciprocity between traditional and modern knowledge and or promote it

In consideration of a successful combination of traditional knowledge and modern techniques for implementing the UNCCD and NAP and the resultant effects, some of the following measures should be emphasized as the main benchmarks and indicators to assess the implementation of the UNCCD and the NAP at the national level.

Support at state government level

1) Incorporation of traditional and modern knowledge for combating desertification, mitigating effects of drought, alleviating poverty, rehabilitating rangeland degradation and controlling soil and water losses, into State Science and Technology Plan;
2) Formulation of state policies, legal guarantees and regulations to support adoption of traditional and modern knowledge to combat desertification, to mitigate drought effects and to rehabilitate rangeland degradation at the national level;
3) Establishment of extension systems of traditional and modern knowledge;
4) Institution building of research and development units for popularizing traditional and modern knowledge at national level, in different sectors or through close inter-ministerial cooperation;
5) Creation of reward and prize systems which should be annually used to encourage those who made significant contributions in the field of traditional knowledge and in development of modern techniques for combating desertification, mitigating the effect of drought, alleviating poverty, rehabilitating and controlling soil and water losses;
6) Mobilization of financial resources through international cooperation and social participation.

Support at local government level

1) Incorporation of traditional and modern knowledge for combating desertification, mitigating effect of drought, alleviating poverty, rehabilitating rangeland degradation and controlling soil and water losses, into provincial science and technology plan;
2) Formulation of preferential policies, legal knowledge and regulations to support demonstration and extension of traditional and modern knowledge in the relevant fields at provincial level;
3) Creation of extension service and demo/pilot experiments at the local level;
4) Set up of expert groups working on assessment and evaluation of the feasibility of traditional and modern knowledge as requested by users of traditional and modern knowledge;
5) Reward and prize systems for workers dealing with adoption and extension of traditional and modern knowledge;
6) Set up a grant system for supporting the initiatives to combat desertification with traditional knowledge and modern techniques, from domestic laboratories or international institutions.

5.1.3 Research, education, extension and dissemination systems of traditional and modern knowledge

1) Encouragement of scientific research, laboratory analysis and station experiment and demo/pilot projects;
2) Promotion of education and capacity building to popularize traditional and modern knowledge, at both national and local levels;

3) Expand the extension and dissemination of traditional and modern knowledge, particularly at grass root level through close combination of technicians with farmers/herdsmen.

5.1.4 Nationwide concerns and social participation for introducing, adopting and extending traditional and modern knowledge through efforts of the following stakeholders at different levels or through various channels

1) State-owned technical company and collective research and development incorporation;
2) NGOs and COBs dealing with the development of technology to combat desertification;
3) Enterprises or private sectors working for long periods in accumulating field experiences in the control of land degradation and desertification rehabilitation;
4) Volunteers who have strong interests in combating desertification and mitigating the effect of drought; and
5) International cooperation at community or national levels. This is an effective approach, particularly for the neighbouring states facing the same issue of desertification, sand disaster and drought, to tackle the problem threatening the regional environment. Without mutual support and international donors' assistance, one or two countries can do very little on the successful implementation of the UNCCD and the rehabilitation of desertification. This item should be regarded as one of the main indicators to implement the UNCCD.

5.1.5 Media and public awareness

Nationally or regionally, the acceleration of desertification processes is difficult to be controlled. In consideration of a case study in China, desertification has been rehabilitated at some particular sites, and the processes have been expanded to the whole country. The main reasons are the lack and weakness of the public awareness to combat desertification. Desertification rehabilitation has not been inter-linked with the local economic development and poverty alleviation. Special attention should be given to the prevention and rehabilitation of those lands without risk of desertification and degradation or those lands that have become slightly degraded or desertified. It is suggested that the following media means should be used to increase the awareness in combating against desertification, particularly on special occasions, like the World Day to Combat Desertification, World Environment Day, World Water Day, the World Earth Day and so on.

1) TV programmes and radio;
2) Newspapers and journals;
3) Information kits and mailings; and
4) School classes and grass root training.

5.1.6 Enhancement of the effect to combat desertification by applying advanced science and technology and training professionals

Science and technology are the primary preventative forces. Desertification rehabilitation represents a multi-disciplinary, integrated, systematic engineering system. The advancement of science and technology should be applied for carrying out the national efforts to control the desertification issue. All the achievements, experiences and lessons in the past decades show that the goals and targets to combat desertification can be obtained by increasing scientific and technological knowledge and by strengthening the capacity of extension in science and technology. The following points should be determined in order to develop practical techniques to combat desertification at the national level:

1) To strengthen the improvement of capacity in extension in science and technology;
2) To continuously carry out studies about new techniques and practical skills;
3) To accelerate the popularization and dissemination of research and experimental results;
4) To improve traditional knowledge and modern techniques at the local level;
5) To organize technical training and enrich the scientific and technical background of technicians at local level;
6) To combine closely the research with productive practice through the transfer of technology from the laboratory to the field;
7) To actively encourage the inter-national, sub-regional, regional and inter-regional exchange programme and cooperation for learning advanced techniques and experiences between the affected country parties;
8) To set up priority areas and thematic networks with the help from the UNCCD secretariat and the Global Mechanism. The launching of networks should be completed at the earliest date to comprehend and analyze the dynamic information of impacts of desertification and rehabilitation of desertification and to provide reliable scientific references and evidence for developing and determining national, sub-regional and regional strategies against different patterns of desertification and for making macro-scope policy arrangements to control the issues.

5.1.7 Preparation of preferential policies and increase the funding level

The integrated development of desertification affected areas represents an inter-ministerial, inter-regional and often a 'trans-valley' approach to resource management. More concrete support in policy aspects should be stressed, such as the following:

1) Investment planning;
2) Advancement of science and technology policies;
4) Price and taxation policies;
5) Crop farming and animal husbandry policies; and
6) Environmental protection and sustainable development planning.

5.2 Assessment of networks and mechanisms created by the secretariat (regional networks, regional coordinating bodies, national focal points) for incorporating traditional and local knowledge in their work programmes

With guidance from the provisions of the United Nations Convention to Combat Desertification, regional conferences have been sponsored in Africa, Asia, Latin America and the Mediterranean regions. During these regional conferences, the Regional Action Plans (RAP) have been developed, formulated and substantiated by the establishment of six thematic programmes. Recommended actions have been developed and given below.

5.2.1 Building up Regional Cooperation

1) Building on existing knowledge and experience: Regional cooperation should take stock of traditional land use methods, indigenous knowledge systems and available local data so as to enhance the effectiveness of measures proposed in the various RAP elements;
2) Building up a coalition for the implementation process: National efforts and cooperation amongst the affected countries within the framework of the UNCCD are essential to prevent further land degradation and to rehabilitate already degraded areas. Awareness raising activities remain a priority to harness international cooperation, in order for the RAP to gain support from the scientific community and ensure, at the national level, the involvement of local authorities and communities in governmental programmes. In this respect, NGOs have a key role within the civil society to play in building up a coalition to combat desertification and mitigate the effects of drought.

5.2.2 Firming up of the Regional Thematic Programme Network

Several draft proposals have been prepared by the Regional Conferences of Africa, Asia, Latin America and the Mediterranean. In consideration of their feasibility and possibility, it has been decided that the first stage of the implementation of the RAP for Asia should include the development of the three specific TPNs along the following lines:

1) Regional Thematic Network of Desertification Monitoring and Assessment (TPN1)
2) Regional Thematic Network of Agroforestry and Soil/Water Conservation (TPN2)
3) Regional Thematic Network of Rangeland Management and Dune Fixation (TPN3) As a second step, the following three specific TPNs are suggested to be launched in due time, on the basis of accumulation of successful experiences of the smooth operation of the previous three networks.
4) Regional Thematic Network of Water Resource Management (TPN4).
5) Regional Thematic Network for Strengthening Capacities for Drought Impact Mitigating and Desertification Combating (TPN5).
6) Regional Thematic Network of Assistance for Integrated Local Area Development programmes (LADPs) Initiatives (TPN6).

5.3 Assessment of the socio-economic and ecological benefits of traditional knowledge in the light of environmental changes

5.3.1 Social benefit

1) Social participation to combat desertification and mitigate the effects of drought;
2) Progress and advancement of science and technology at grass root level;
3) Close combination of research with practice and acceleration of the step to transfer technology from labs to field;
4) Promotion of the understanding that scientific and technological forces represent the dynamic potential to combat desertification;
5) Strengthening cooperation between technical sectors and productive units through transfer, adoption, extension and information-sharing.

5.3.2 Economic benefit

1) Poverty alleviation in the affected areas;
2) Making arable fields from desert and affected areas;
3) Preservation of oases impacted by desertification and relevant issues;
4) Saving water resources, particularly in arid and semi-arid zones;
5) Development of solar and other alternative energies;
6) Windmill, greenhouse; and
7) Improvement of living environment quality, particularly in the affected areas.

5.3.3 Ecological benefit

1) Artificial plantation of sand barriers, straw checkerboards;
2) Air-seeding for revegetating dunes and stabilizing sands;
3) Introduction of pioneer varieties;
4) Re-afforestation in arid zone;
5) Windbreaks and sandbreaks;
6) Forage-farm protective shelterbelts;
7) Pebble-mulching field to avoid transpiration;
8) Watershed management and soil and water conservation;
9) Agroforestry system;
10) Grass kulun (fodder farm);
11) Control of salinization/alkalization.

5.4 Participation of NGOs and COBs

5.4.1 Civil societies (Academic level):

1) State Society for Desert Development and Desertification Rehabilitation;
2) State Soil and Water Conservation;
3) State Rangeland Society;
4) State Environment Society;
5) State Forestry Society.

5.4.2 CBOs (Technical level):

1) Desert Reclamation and Desertification Rehabilitation Engineering Association;
2) Engineer and Technician Association;
3) Community Demonstration Station.

5.4.3 NGOS (Productive level):

1) County Desert Reclamation Association;
2) County Foresters Association;
3) County Soil and Water Conservation;
4) County Land Management Association.

5.4.4 Private systems (Grass root level):

1) Farmers Association;
2) Village Groups;

6. CONCLUSION

Deserts and desertified areas cut across international boundaries. It is important to recognize that combating desertification is a massive task which no individual organization, institution, agency or country can take up alone. Being one of the world's most pressing environmental problems, desertification is widespread in more than 100 countries in Africa, Asia, Latin America and the Caribbean, the Mediterranean and the East and Central European regions and varies in magnitude, intensity and form. To increase understanding of the bio-physical and socio-economic elements contributing to desertification and finding solutions to this dire problem, resources may be put to optimum use in achieving cost effective results if traditional technologies and local know-how from across the world can be applied. The encouragement of the use of traditional knowledge and local technology demonstrates the willingness and commitment on the part of the countries affected by the problems of desertification and drought in the mentioned continents and the various agencies and organizations worldwide to pool together talent and resources in countering the common problem of desertification. Monitoring and assessment of the effects of the use of traditional knowledge and local technology for combating desertification will accelerate the accumulation of successful experiences and methods to fight against the desertification problem at national and regional levels and, therefore, establish a scientifically justified perspective for technology transfer and policy making at the global level. In view of UNCCD's insistence on partnership, future efforts and programmes on transfer of traditional knowledge and local technology will need to be flexible and responsive to the diversity of the above mentioned five continents or regions to allow the affected country Parties and partners to benefit equally from a regional and global sharing of traditional knowledge. Recognizing that technology transfer at the national, sub-regional, regional and international levels is an urgent imperative, and all the affected country Parties have every right to place high hopes on the use of traditional knowledge and local technology for it to succeed as an effective sub-regional and regional effort thanks to fruitful relationships among the various key players in the field of desertification combating and ecological restoration.

References

1. ICCD/COP(3)/CST/1, Recife, 16-18 November 1999;
2. ICCD/COP(3)/CST/2, Recife, 16-18 November 1999;
3. ICCD/COP(3)/CST/3, Recife, 16-18 November 1999;
4. ICCD/COP(3)/CST/3/Add.1, Recife, 16-18 November 1999;
5. ICCD/COP(3)/CST/3/Add.2, Recife, 16-18 November 1999;
6. ICCD/COP(3)/CST/MISC.1, Recife, 16-18 November 1999;
7. ICCD/COP(3)/L.3, Recife, 15-26 November 1999;
8. UNSO/UNDP: Programme Activity Report 1995-1998;
9. UNCCD, Proceedings of the Second Asia-Africa Forum on Combating Desertification, Niamey, Niger, 2-5 September 1997;
10. MASHAV, Ministry of Foreign Affairs, Israel, Combating Desertification: The Israeli Experience, 1997;
11. Soil Conservation Service, Iceland, Soil Conservation in Iceland, 1997;
12. Agroforestry Systems in China, Editors: Zhu Zhaohua, Cai Mantang, Wang Shiji and Jiang Youxu, Published jointly by Chinese Academy of forestry, PRC and International Development Research Centre, Canada. ISBN-T-5038-0857-8/S.0441, Singapore, 1991;
13. Agroforestry--Research and Practice, edited by Wenyue Hsiung, and Paul F. Chandler, ISBN 7-5038-1753-4/S.1009, China Forestry Publishing House, Beijing, 1996;
14. Beijing Ministerial Conference on Regional Cooperation to Implement the CCD in Asia, 13-15 May 1997, Beijing;
15. China Country Paper to Combat Desertification, Secretariat of CCICCD, Forestry Publishing House, March 1997, Beijing;

16. China National Action Programme to Combat Desertification, Secretariat of CCICCD, Jan. 1995, Beijing;
17. Ci Longjun, Ecological Landscape Effects of Windbreak System in Desert Zone of Western China, The Journal of Chinese Geography, Vol. 7, No. 2, 1997, P13-22.
18. Combating Desertification in China, edited by Wang Lixian, China forestry Publishing House, ISBN 7-5038-1685-6/S.0968, Beijing, 1996.
19. Desertification and Its Combating, Training Textbook of the Awareness Seminar on CCD, prepared by CCICCD, National Bureau to Combat Desertification of MoF and National Training Centre for combating Desertification, Beijing, 1996;
20. Desertification and Its Combating, Training Textbook of the Awareness Seminar on CCD, prepared by CCICCD, National Bureau to Combat Desertification of MoF and National Training Centre for combating Desertification, Beijing, 1997;
21. Desertification through Wind Erosion and Its Control in Asia and the Pacific, ESCAP/UNDP, New York, 1991;
22. Directory of the Existing Institutions Dealing with Desertification and Its Combating in Asia and Africa Countries, Secretariat of CCICCD, Beijing, May 1997;
23. Down to Earth, A simplified guide to the Convention to Combat Desertification, why it is necessary and what is important and different about it, June 1995, Secretariat of CCD;
24. Euphrates Poplar Forest, by Wang Shiji, Chen Binghao, Li Huqun, China Environmental Science Press, ISBN 7-80093-890-5/x.1012, Beijing 1996;
25. Handbook on Desertification Control, Investigating Committee on Comprehensive Measures for Desertification Control, Japan, December 1996;
26. Integrated Local Area Development programme in the Implementation of the Convention to Combat Desertification in China, IFAD-CCD International Forum, Rome, 5-7 June 1996, prepared by the Secretariat of CCICCD, Beijing, May 1996;
27. Proceeding of Annual Symposium of China Desert Reclamation and Desertification Combating Society, Beijing, 1995;
28. Proceedings of Afforestation in Semi-arid Regions, International Symposium in the People's Republic of China--Findings and Perspectives, Datong/Jinshatan, June 1-6, 1997;
29. Proceedings of Asia-Africa Forum on Combating Desertification, Beijing, 5-11 Aug. 1996, printed in Dec. 1996;
30. Range Management in Arid Zones, Proceedings of the Second International Conference on Range Management in the Arabian Gulf, Samira, etc., published by KPI and KISR;
31. Research on Forest Energy, Gao Shangwu and Ma Wenyuan, ISBN 7-5046-0589-1/s.80, December 1991, Beijing;
32. Revegetation in Chifeng, Inner Mongolia Forestry Department, Chifeng, 1997;
33. Runoff afforestation on the Loess Plateau, Research Paper on Optimal Techniques, Project chief: Wang Binrui, Beijing Forestry University, and November 1997.
34. Sand Dune Stabilization in China, A Case Study, ESCAP/UNDP, New York, 1991;
35. The Desertification Control in China, Gao Shangwu and Zhou Shiwei, Beijing Science and Technology Press, June 1993;
36. The Rebuilding of the Green, Shaanxi provincial Forestry Department, Xi'an, 1997;
37. Training Package of International Training Course on Desertification Control, Lanzhou, Jan. 30th 1988, International Centre for Education and Research on Desertification Control, Lanzhou China;
38. UN Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, 1994, Secretariat of CCD.
39. Israel and her Wilderness, Reprint from: SCOPUS-Magazine of the Hebrew university of Jerusalem, p. 32-39.
40. Synergy, The Newsletter of the Terracottem Soil Conditioner Companies, Edition V-Sept.1999.
Section 3. COP Decisions and the Matera Proposal

Section 3.

COP Decisions and the Matera Proposal

3.1 Decision 12/COP.4 Traditional knowledge

The Conference of the Parties,

Recalling its decisions 14/COP.2 and 12/COP.3 on traditional knowledge,
Taking note of the report of the Ad Hoc Panel on Traditional Knowledge and the recommendations of the Bureau of the Committee on Science and Technology on the subject,
Taking note also of the world network of UNESCO's Man and the Biosphere Reserves which can be an important site based tool to make inventories, validate and apply traditional knowledge,
Taking note also that the Italian authorities are in the process of establishing an international research centre on traditional knowledge at Matera, Italy,

1. Invites the Italian authorities to continue the work undertaken in collaboration with the other interested institutions and to present a proposal for the realization of a pilot project of a network of institutions, bodies and experts on traditional knowledge. The proposal should include scientific representatives of all interested Parties, a description of the role of interested members of the network, a detailed programme of work and the expected cost for its implementation;

2. Requests the Bureau of the Committee on Science and Technology, at its inter-sessional meeting to review the project, forward it to the regional groups and present it for consideration at the fifth session of the Conference of the Parties in order to share results and expand opportunities for partnerships.

12th Plenary 22 December 2000

3.2 Decision 12/COP.5 Traditional knowledge

The Conference of the Parties,

Considering the reports1 and recommendations of the two ad hoc panels on traditional knowledge,
Recalling its decision 12/COP.4 on traditional knowledge,
Taking note that the Italian Government is in the process of establishing an international research centre on traditional knowledge at Matera, Italy,
Also taking note with appreciation of the proposal2 presented by the Italian Government on its work on traditional knowledge,

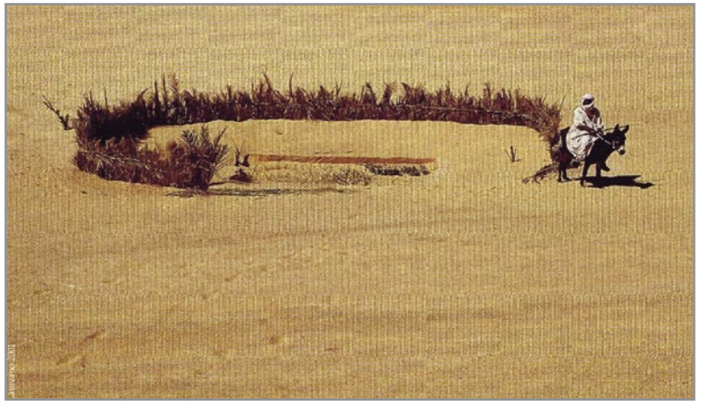
1. Encourages the Italian Government to revise its proposal, taking into account the comments and observations presented by the members of the Committee on Science and Technology (CST) at the fifth session of the CST;

2. Invites the Italian Government to continue its work on traditional knowledge undertaken in collaboration with the other interested institutions;

3. Requests the Parties, international organizations and institutions dealing with traditional knowledge, and the Global Mechanism, to explore a partnership agreement to establish a network on traditional knowledge as proposed by the Government of Italy.

11th plenary meeting 12 October 2001

3.3 Traditional Knowledge (Proposal by the Government of Italy) ICCD/COP(6)/CST/4



The birth of an oasis. A slight depression collects humidity; the palm tree flourishes and provides shade and biological material which attract the other organisms; the humus produced gives rise to further cultivations.
Photo: P. Laureano.

By its decision 12/COP.5, the Conference of the Parties noted that the Government of Italy was in the process of establishing an international research centre on traditional knowledge in Matera, Italy, and also of setting up, as a pilot project, a network of institutions dealing with traditional knowledge. It invited the Government of Italy to revise its proposal for the realization of the pilot project, taking into account the comments and observations made by the Committee on Science and Technology (CST) on this matter at its fifth session. The Government of Italy has revised the proposal, taking account of the comments and the observations made by the CST. The report, prepared by the Government of Italy, is contained herein and is transmitted by the secretariat for consideration by the CST without formal editing.

I. BACKGROUND INFORMATION

The subject of traditional knowledge has been object of discussion since the beginning of the UNCCD process. This new revised project proposal intends to take advantage of the long and fruitful debate on the subject and in particular of the output of the fifth session of the CST. At the same time, it intends also to obey to the necessity of finding out useful tools in the fighting against drought and desertification, optimizing efforts, adopting, wherever possible, a synergistic approach with other United Nations global conventions, in order to comply with public opinion's urges for more concrete action. In fact, the UNCCD process is progressively entering its implementation phase, also thanks to the establishment of land degradation (desertification and deforestation) as a new focal area of the Global Environment Facility. For these reasons, it is opportune to focus expressly on traditional knowledge and practices which have a clear and evident value in combating desertification. This project is intended as a proposal for the establishment of network on traditional knowledge within the regional (and, in some cases, also subregional) action programmes as a thematic programme network (TPN). The regional approach with the participation, where appropriate, of interested institutions external to the region seems to be the most viable approach for setting up of a network on traditional knowledge.

II. GENERAL GOALS

The project aims at setting up a network of institutions, bodies and experts on traditional knowledge (TK), hereinafter referred to as ITKnet (Innovative Traditional Knowledge Network). Such a global network will be implemented in successive steps. The goal will be reached by accomplishing pilot projects.
In the establishment of the ITKnet, the TPN on traditional knowledge shall identify:

- Procedures for the effective participation of local communities and linkage to local organizations;
- Linkage between organizations that handle the data and local societies that own the traditional knowledge;
- Ownership and rights over the TK;
- Connection of TK to biodiversity and genetic resources;
- Linkage with existing networks and ongoing initiatives;
- Appropriate methodologies to take into account oral traditions;
- Procedures of verification and validation of information collected;
- Selected areas to implement TK and its linkages with modern technologies;
- Methods to ensure the effective participation of local communities and linkage to local organizations in relation to local conditions and priorities.

III. PURPOSES OF THE PROJECT

Project proposal aims at both cognitive purposes and operative actions. Cognitive purposes are:

1. To draw up an inventory on TK of pilot countries and their innovative use;
2. To study the possibilities to disseminate TK;
3. To study the parameters and the indicators to evaluate the effectiveness of TK and practices in combating drought and desertification. Linkages to biodiversity and genetic resources and, more generally, a synergistic approach with other United Nations global conventions (on biodiversity and climate change) will be also considered;
4. To select successful practices and to evaluate a system of incentives to implement and dis seminate TK and innovative technology (hereinafter referred to as TKIT) within the framework of traditional know-how;
5. To examine any methods for the protection of rights on TK that can be implemented by subjects, local communities, disseminators and innovators of traditional techniques;
6. To evaluate the promotion of traditional technologies by the focal points of each country and give guidance to adopt nation-wide safeguard and dissemination strategies;
7. To explore linkages between organizations that handle available data and local communities that own the traditional knowledge and practices and to find out appropriate procedures for the effective participation of local communities and linkage to local organization.

Operative actions include:

1. Setting up of a pilot network in order to encourage and actively support partnership building in addition to the documentation and dissemination of traditional and local knowledge, know-how and practices;
2. Establishment of the conditions for the implementation of a network of experts and institutions between the Parties to the Convention which will draw up the inventory on TKIT, adopt and disseminate them;
3. Sharing of methodologies of research, study and classification of TKIT; training of the person nel of different countries to collect inventories, to disseminate the TKIT, and their innovative use for the combat against desertification;
4. Implementation of Internet stations wherever necessary in order to facilitate communication and to strengthen networking and exchanges among various organizations and regions;
5. Creation of a public multilingual internet database and accompanying CD ROM entitled ' Traditional Knowledge and its Innovative Use', to be distributed among experts from countries affected by drought and/or desertification, thus encouraging the transfer of appropriate and environmentally sound technologies and know-how while promoting the exchange of experiences;
6. Setting up of eligibility criteria for network members as well as their rights and duties. Setting up of criteria for establishing any operative structure;
7. Setting up of the implementation phases of the global network.

IV. CHARACTERISTICS AND WORK OF THE NETWORK

The network will be made up of institutions, research centres, bodies, focal points of affected countries. Consequently, all organizations, institutions and experts will be able to collaborate, to exchange information and interact in a synergistic way. A Web-based multimedia database will enable the network to disseminate and share information, thus taking a bottom-up approach to the study of TK. Dedicated levels of access for institutions, research centres, experts, focal points and users will be available. Multilingual information will be completed with explanatory graphs. According to the different access levels new information and remarks could be entered and automatically forwarded to experts, discussion forums, bodies, focal points as well as to the

interested countries. Some research centres will focus on several topics by filtering, processing and validating the information. The number and the entity of these research centres could change according to the needs and proposals. The database does not depend on a single centralized pole but on a series of nodes that will apply for each topic.The research centres that have already been involved in the initiative in a preliminary phase are the following:

- Arid Regions Institute (Institut des Regions Arides) - Medenine, Tunisia
- Centro de Investigación, Formación y Esperimentación sobre Arquitectura de
- Tierra, Energías Renovables, Desarrollo Sostenible y Tranferencia Tecnológica a Paises en
- Via de Desarrollo - Madrid, Spain
- Institute of Water Resources Management - Karlsruhe University, Germany
- IPOGEA, Traditional Knowledge Centre - Matera, Italy
- Minia University, Egypt
- United Nations agencies: Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organizations (UNESCO) In the preliminary phase, the focal points of the Parties will select other research centres and will facilitate the involvement of experts from the UNCCD roster of independent experts.

The information technology system supporting ITKnet shall:

1. Be accessible on the Internet by means of common Web browsers.
2. Deal with multilingual information. The documents will be translated outside the system but, after choosing the language, the interface of the user and the documents will share the same language.
3. Be updated on-line by privileged accesses (editors) controlled by the username and the password. The user can choose not to make the changes immediately available since they could be subject to the check and validation by authorized users and nodes (gatekeepers) guaranteeing the quality of data in the relative specialization fields.
4. Provide community services such as seminars, mailing lists and subscriptions to specific areas of the system to foster the collaboration and the synergy between the users and the bodies involved.
5. Notify via email one or more users (supervisors) and the nodes monitoring the system evolution on the changes saved.
6. Handle multimedia information supporting and completing the main information on local and traditional knowledge such as glossaries, pictures, bibliographies etc. Editors and gatekeepers will be able to link such information in order to complete the main information forms using a simple grammar to be consulted upon request by means of hypertexts.
7. Manage the on-line drawing up of presentations (slide shows) by means of pictures and other resources of the system.
8. Enable the distribution of the documents extracted from the system on multiplatform CD ROM (Macintosh and Windows).
9. Handle the collection of profiles (curricula vitae and description of the specialization fields) regarding experts, research centres, bodies, institutions according to the topics dealt with by ITKnet so that the users interested can set up a collaboration relationship with them.
10. Keep the graphs (banners) and customized references of the information received by each individual or body.
11. Easily fit the needs of ITKnet that could change according to the evolution of the activity. The system could be localized anywhere on the Internet in compliance with cost optimization and access speed. Therefore, it shall be possible to remotely administrate the server from all the qualified nodes of the network. To this end, such nodes will be equipped with a quick Internet access, at least with an ISDN line, preferably with an ADSL or higher, according to the availability of these lines within the area.

V. WORK PROGRAMME

First year

Goals

Cognitive goal: to continue the drawing up of the inventory on TK and their innovative use.
Operative goal: to highlight the physical network of the centres involved.

Activities

1. Census-taking of the main bodies, research centres and institutions dealing with TK.
2. Collaboration with bodies, research centres and institutions dealing with TK.
3. Organization of a workshop on the pilot project involving the countries where the workshop is organized, focal points, a representative of each regional group, annexes, bodies, research centres and institutions leading a key role in the initiative.
   The workshop will focus on two topics of the project:

a) Analysis of the progress made on cognitive purposes
b) Operative actions to set up the organization structure
   As for the former, the following issues will be dealt with:

- Drawing up of an inventory on TK of pilot countries and their innovative use;
- Study of the parameters and indicators on the loss of TK and the analysis of the possible ways to avoid such a loss.
  Therefore, a form to draw up an inventory on TK will be approved.
  As far as the latter is concerned, the following issues will be dealt with:
- The evaluation of the eligibility criteria of the network members, of their rights and duties as well as the evaluation of the opportunity to set up a body that could take part in the network;
- The evaluation of the needs of each country (training, technical equipment etc.);
- The evaluation of the further phases to implement the global network.
  Therefore, the information on the needs of each country to implement the capabilities of participation in the network will be collected.

4. Organization of a stage, training courses and thematic workshops in the countries needing to implement their own capabilities.
5. Implementation of nodes of a dedicated network on TKIT at the institutions implementing the project.
6. Creation of Internet stations wherever necessary and formulation of a first hypothesis of qualification of database nodes.

Second year

Goals

Cognitive purpose: Database dissemination
Organizational purpose: Network implementation

Activities

1. Questionnaire administration
2. Data collection and processing
3. Realization of graphs on TK and their innovative use
4. Organization of the information to create the database on the basis of the results of the survey
5. Development of the database software and organization of the server
6. Organization of an e-mail conference to evaluate the working of the database
7. Organization of a workshop focusing on:
   Cognitive purpose: Work programme for the successive phases aiming to:

- study the parameters and the indicators on the loss of TK and to analyse the ways to fight against such a loss;
- choose the successful practices and to assess a system of incentives to adopt and disseminate the TKIT within the framework of traditional know-how;
- examine any methods for the protection of rights on TK that subjects, communities,
- disseminators and innovators of traditional techniques can implement;
- evaluate the promotion of traditional technologies by the focal points of each country and
- give indications to carry out nation-wide safeguard and dissemination strategies.

Operative actions:
To assign competences and roles to the network;
To set out the further phases concerning the widening of the process for the implementation of the global network.

VI. COSTS
Since every regional action programme relies on different financial instruments for its implementation, this proposal aims to present, as an example, an assessment of the activities and of the associated costs for the implementation of a TPN on traditional knowledge in the Northern Mediterranean region, also including the participation of experts and institutions from other regions. The opportunity of involving international organizations and United Nations agencies in TPN should be assessed on a case-by-case basis. The costs are contained in document ICCD/COP(5)/CST/2.

Annex Techniques of traditional knowledge

In its decision 20/COP.1, adopted at its first session, the Conference of Parties, noting the report of the Permanent Secretariat of the Convention contained in ICCD/COP(1)/CST/5 on inventories of research and traditional knowledge, encouraged Parties and observers to collate information in respect of the use of traditional and local technology, knowledge, know-how and practices, and to provide reports to the Secretariat. The Secretariat received reports from 12 Parties and 5 observers. These reports concerned a wide range of traditional and local knowledge stemming in many instances from experience handed down from generation to generation and responsive to social and cultural change and the local environment. The Committee on Science and Technology (CST) reviewed the reports in depth and noted the use of a variety of techniques which could be classified by topic as follows: control of wind or water erosion; water conservation; improvement of soil fertility; plant protection; forestry; social structure; and housing architecture.

Control of wind or water erosion
(a) Windbreaks: creation around plots of barriers comprising trees or, in some instances, non-living material;
(b) Erection at right angles to the prevailing wind of obstacles (walls, banks, fences) made of stone, earth or vegetable matter (tree branches or palm fronds). These structures, the height of which is periodically increased, cause sand to accumulate; the sand can then be stabilized by covering it with branches or earth. The operation can be continued by planting species with an extensive root system or by biological fixing of the dunes;
(c) Erection of obstacles at an angle to the wind so as to force it to change direction: this leads to deviation of the sand, which therefore ceases to accumulate;
(d) Placing of large stones on the tops of dunes: this accelerates the wind around the stones, so increasing the lifting force on the sand, which is then carried further away;
(e) Spreading of water on land after ploughing: this stabilizes the fertile components of the soil by increasing soil cohesion;
(f) Building cultivated terraces separated from each other by low stone walls running along the contour lines. The distance between the walls depends on local conditions (rainfall amount, distribution and rate, geology, soil, crop types, etc.). Associated with the terraces are ditches to channel the excess water to gullies serving as natural outlets for it;
(g) In gullies: fixing in place of flat dry stones together with logs and large branches. A simple planting scheme will help to reduce the water velocity;
(h) Use of vegetation to control erosion: the species used are chosen for their rapid growth, high density and well-developed root system.

Water conservation projects
(a) Construction of ponds, pools and lagoons to collect water during the rainy season for irrigating crops and watering livestock. The structures are made using local materials;
(b) Construction of impoundments on small water courses;
(c) Controlled flooding: a very old technique for conserving water and the soil which is well-suited to desert environments. During the heavy rains, part of the precipitation is absorbed by the ground and some (the proportion varies with the intensity of the precipitation and the characteristics of the soil) runs over the ground surface towards lower-lying areas. This runoff can be directed onto walled plots where its impoundment between the walls promotes infiltration. The land can then be cropped, with good yields. The critical question with this technique is whether the degree of infiltration is adequate for the intended crops;
(d) Cultivation of large areas in order to reduce soil evaporation;
(e) Greenhouse farming with water management;
(f) Construction of watertight clay or tile drains and irrigation channels in order to reduce evaporation;

(g) Construction of "qanats", underground dykes and tunnels for the transfer of subsurface water to the surface by gravity (for agriculture or consumption);
(h) Construction of multi-level "qanats": channels at various depths;
(i) Construction of impoundments for artificial recharge of "qanats";
(j) Use of clay jars for irrigation;
(k) Use of textiles to keep garden soil moist;
(l) Irrigation of hillside terraces by means of channels built by the farmers along the inner edge of each terrace. The water runs along these contour-line channels from the highest to the lowest terrace;
(m) Collection of water on house tops, etc. (installation of tanks) for consumption in the desert or other areas with an inadequate water supply;
(n) Rice-growing based on the use of surface water in the rainy season: berms some 1.5 m high are built to prevent flooding and retain the water.

Improvement of soil fertility

(a) Use of natural fertilizer: animal or human excrement and decayed plant waste;
(b) In situ manuring: livestock is brought directly onto fields to graze and deposit dung there;
(c) Production and use of compost from plant and household waste. The composting process can be speeded up by the addition of microorganisms;
(d) Production and use of a mixture of animal dung, urine, forest litter and household and agricultural waste, including ash from cooking fires;
(e) Maintenance of soil fertility by green manuring, the manure coming either from natural vegetation or from crops intended for ploughing in;
(f) Use of nitrogen-fixing plants;
(g) Mixing of forest litter directly into the soil;
(h) Mixing of animal carcasses into the soil;
(i) Spreading on the ground, in order to increase soil permeability, of sugar cane ash obtained from sugar refineries;
(j) Spreading of liquid sugar-industry waste. This is suitable for any soil capable of growing sugar cane, but it is also very effective on compacted, saline or eroded soils. It increases both the content of organic matter, especially nitrogen and carbon (a humic substance), thereby improving soil stability, and the bacterial biomass;
(k) Liming to prevent soil erosion and reduce evaporation;
(l) Application of clay (loam) as a mulch to protect the ground surface;
(m) Use of gravel to reduce the risk of soil erosion;
(n) Improvement of the texture of heavy soils by adding sand;
(o) Crop rotation to ensure better management of soil fertility and moisture;
(p) Fallowing in order to maintain soil fertility;
(q) Careful choice of soil-preparation techniques;
(r) Use of multi-bottom ploughs and animal draught power to minimize tillage (for soil preparation and to facilitate crop-growing without inverting soil profiles);
(s) Appropriate soil management: the best example is considered to be the method used by the Jyapu, a Newar community in the Kathmandu valley. Jyapu farmers rarely use livestock, preferring to till the soil with hand tools such as hoes. As manure they use black shale, compost and human nightsoil;
(t) Soil conservation: the traditional "zai" technique employed in Burkina Faso is an intensive technique involving manure management and water-saving. It consists in digging holes in the ground and filling them with manure during the dry season. This attracts termites, which digest the manure; the latter is then more easily taken up by roots and increases soil porosity. Seeds are sown in the holes. This highly efficient technique enables communities with very limited resources to regenerate even badly degraded soil. When not being used for growing, the holes can provide water storage space.

Plant protection

(a) Preservation of the natural vegetation: choosing of species to suit micro-climatic conditions; growing of drought- and heat-resistant species; growing of salt-resistant species;
(b) Prohibition of grazing: preservation and protection of areas of rangeland, especially in depressions rich in alluvial deposits and forage plants;
(c) Harvesting of spontaneous fodder and burning of land to promote re-growth;
(d) Irrigation of crops in winter to control frost;
(e) Use of birds (e.g., starlings) to control insects (e.g. crickets);
(f) Harvesting outside full-moon periods in order to minimize insect infestation;
(g) Application of ash to plants;
(h) Application of dilute urine to plants and seeds in order to clean them and give them some protection against disease and insects;
(i) Use of common, usually stronger species of plant.

Forestry

(a) Creation of forests using local species of trees and bushes and planting of fodder trees and bushes;
(b) Creation of nurseries for reforestation and desert pastureland; development of orchards and reforestation in the desert;
(c) Simultaneous planting of sorghum or millet seeds and saplings. The cereals are cut to a height of 50 cm or more so as to protect the saplings, which then benefit from the soil moisture and manure. The high cutting also promotes natural regeneration of all sorts of species, ensuring considerable genetic diversity;
(d) Growing of coffee together with forest species known for providing beneficial shade. Use of the same system to grow cocoa;
(e) Use of clearings for small-plot growing of a variety of vegetables in forests.

Social structures

(a) There are three types of lifestyle: nomadic, semi-nomadic and sedentary. The distances covered by the population groups who practise them vary widely, entailing differences in management and type of livestock farming and, in the case of semi-nomads and nomads, the presence or otherwise of irrigated agriculture on rivers or lakes. Nomadic herders use their pastureland in a seasonal pattern (transhumance), moving their animals from one zone to another depending on the availability of water and grass. This provides protection against weather risks and prevents the degradation of vegetation;
(b) "Motselo" (in Botswana, a form of cooperative and bank involving 5-15 not-necessarily-related people (men and women)). Membership of such a group is voluntary and lasts until the end of the loan and borrowing cycle. Each person puts in an agreed sum of money or quantity of seeds or an equivalent amount of work, all of which is then used as well as possible in the light of local knowledge in order to increase the group's monetary wealth. The types of activities supported may include cooking or the brewing and sale of local beer. The cash contributions are used to purchase requisites such as sugar or cooking or brewing equipment, etc. Labour expended in production or marketing is also considered as a capital contribution. All the income is allotted in turn to the members of the "motselo", who then use the money to develop their farms by purchasing equipment or to meet social needs (family celebrations, burial ceremonies, etc.). The advantages are: the structure is simple; the funds are turned over rapidly; investment is simple and free from conditions, so everyone can afford it; the funds and profits go directly to the members; and very poor people can take part by contributing labour;
(c) Water resources management by local communities or farmers' committees. Their skills and knowledge are passed on from one generation to the next, ensuring that water resources are soundly managed;
(d) Pastureland protection and access control by a community organization that defines rights and roles and enforces sanctions (in connection with pasture management). Knowledge, however, varies from group to group and region to region and depends on local conditions, the

responses to particular problems and the given group's geographical or social isolation. In Nepal, pastureland is managed in accordance with religious beliefs;
(e) Management and control by the local population of access to forest resources;
(f) Development through agriculture of unused floodplains: this can, as in the case of Niger, stabilize the population by increasing food availability. It also introduces a new form of agri culture: the partial replacement of millet, the staple foodstuff, by rice can help to reduce excessive cultivation of millet and prevent desertification;
(g) Use of waste products - from coffee-farming, sugar-refining or sunflower-oil production - as animal feed;
(h) Promotion of Vigna (several varieties) for human and animal consumption: high protein value. The residual matter can be used as green manure;
(i) Storage of cereals and seeds in kitchens, where the carbon monoxide and carbon dioxide prevents their becoming infested with insects.

Architecture and energies
(a) Protection of structures (houses, equipment sheds, stables, etc.) by siting them outside natural-disaster (flood, storm, etc.) hazard zones;
(b) Building of chimneys in houses to improve ventilation and thereby reduce summer temperatures;
(c) Inclusion in buildings of arches, domes and high ceilings to keep down temperatures;
(d) Insulation of walls with clay or straw to keep out heat or cold;
(e) Construction of basements for their cooling and food-conservation capabilities;
(f) Construction of ice pits in mountainous areas and around towns so as to be able to build up stocks of ice for the summer;
(g) Making of hinged doors and windows and wooden venetian blinds to shield against solar radiation;
(h) Building of dovecotes with a view to using the birds' droppings as a manure supplement;
(i) Building in villages of artificial drainage systems so as to retain some moisture in dry areas;
(j) Use of windmills and water mills; use of solar energy;
(k) Use of briquetted sugar-industry waste as a household energy source (residual crop matter is dried and briquetted);
(l) Use of rice straw as fuel;
(m) Construction using maize or millet stalks, wheat straw, weeds and other waste. This contributes towards keeping villages clean and limiting numbers of rodents and insects.