Local Knowledge Systems and the Management of Dryland Agro-ecosystems: Some Principles for an Approach

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Introduction

Local agricultural[3] knowledge in dry-land land-use systems is centred on the conservation, use and optimisation of soil moisture and soil organic matter. Additionally, biodiversity is carefully managed and nurtured to interface with hydrological and nutrient cycling to provide for ecosystem resilience, food security and diversity, and risk minimisation. Examples of such traditional livelihood systems are the water harvesting systems on alluvial fans (Zuni, USA), Oasis systems in North Africa, Chacras Hundidas (sunken fields) in Peru, and Qanat subsoil irrigation systems throughout Central Asia. These systems are mainly crop based, with various degrees of livestock integration. Others types of traditional dryland livelihood systems are mobile animal-based systems, which optimise resource use and mitigate risk by moving with the dynamics of the availability of water and pasture resources. These are particularly adapted to highly variable ecosystems, especially with high climatic variability. Examples are herding strategies of pastoral peoples in East and North West Africa and the transhumant highland systems like the Yak based systems of Ladakh in India. Most such traditional landuse systems are intertwined with carefully adapted social institutions for access to common resources and ecosystems management, and a deep knowledge of the dynamics of the ecosystem over a large territory comprising of various ecological niches. Such often highly ingenious traditional management systems and cultures have co-evolved over centuries with the landscape and its components, including genetic resources. They are noteworthy for their contribution to biodiversity conservation, sustainable land, water and landscape

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[3] Each time the words *agriculture* or *agricultural* are used in this paper it is meant to include cropping, livestock forestry, fisheries, hunting-gathering livelihood systems or various combinations thereof.

management and the provision of food and livelihood security and quality of life. Many provide globally important goods and services well beyond their geographical limits.

There is little doubt that local knowledge systems are a valuable resource for the management of drylands, as they are in other types of ecosystems. However, in many places in world, local or traditional management strategies are eroding or loosing their relevance, due to rapid changes in their biophysical and socio-economic environments. These changes, some of which are driven by processes of globalisation, outrun their evolutionary adaptive capacity. The focus over recent decades on agricultural productivity, specialisation and global markets, and associated disregard of externalities and adaptive management strategies, has led to a relative and general neglect of research and development support for diversified, ingenious systems. Pressures are constraining farmer innovation and leading to the adoption of unsustainable practices, overexploitation of resources and declining productivity, as well as agricultural specialisation and adoption of exotic domesticated species. The result can be biodiversity loss, ecosystem degradation, poverty and loss of people's livelihoods. We are at risk of a severe erosion of the diverse base of agricultural systems and their associated biodiversity, knowledge systems and cultures that ensure human livelihoods and healthy and resilient environments.

Under these current circumstances and viewed from the perspective of the farmers and pastoralist communities it is not so relevant to dwell upon the limits of applicability of local knowledge systems versus scientific knowledge. What is more interesting and urgent is how to develop approaches that successfully integrate the comparative strengths of both types of knowledge systems. This paper sets out to find answers to three questions: 1. What are the different natures of local knowledge systems in drylands and modern or scientific knowledge systems? 2. What challenges, constraints and obstacles are there to strengthen traditional sustainable agricultural practices and their knowledge systems? 3. What are the principles for an approach to safeguard traditional management systems for the sustainable use of drylands?

First, two case studies of traditional agricultural systems in drylands will be briefly described. Second, this paper will analyse local knowledge and scientific knowledge systems and their social and institutional settings. Thirdly, it will propose some principles for an approach to strengthen traditional agricultural systems Finally, it will present an initiative by FAO, taken with UNESCO, UNDP, GEF, governments, NGOs and other partners for the global recognition, conservation and sustainable management of Globally-important Ingenious Agricultural Heritage Systems (GIAHS) that seeks to take on the challenges outlined.

The example of the Gafsa Oasis in Tunesia

Oases are complex agro-ecosystems characterized by agronomic, ecological, economic, social, cultural and political dimensions. The Gafsa Oases are exemplary models of agricultural biodiversity in a constraining and harsh environment. The oasis of Kasba covers approximately 700 ha and it stretches in a part of 2000 ha of the oases bordering at the town of Gafsa (Kasba, South-west and Ksar).

The endemic and non-endemic wild and cultivated plants that grow in Gafsa have high resilience in these adverse conditions. Varieties of cultivated species have been carefully selected from natural ecosystems over centuries of experimentation. For example, more than 300 named cultivars of date palm trees have been recorded across Tunisia and many of these cultivars have their origin in the Gafsa Oases. The Oases also contain a large number of varieties of fruit trees (pear, apple, plum, peach, mulberry, apricot, olive, citrus, etc.), vine, fruits (cucumber, melon, zucchini) vegetables (parsley, celery, spinach, and cabbage), roots and bulbs, pulses, aromatics, cereals, fodder and ornamental plants. Each variety is characterized by distinct and valuable quality traits selected according to local needs and culturally determined criteria. Furthermore, oasis agro-ecosystems provide habitat and resources for numerous wild species of fauna and flora.

Species and varieties are carefully chosen as to be adapted to local environmental constraints. For instance, there is a prevalence of the olive tree in the periphery of oases because of its drought resistance, and the Degla date palms are preferentially planted in South West Tunisia where climatic conditions are favourable for fructification, whereas common date palm varieties are more frequent in coastal areas. There is an intensive occupation of space for the optimum use of water resources and their functions in regulation of the oasis microclimate, for the maximization of harvest security by producing plants that provide for multiple products and through careful diversified production spacing and timing (cropping pattern and rotation). The latter is done using a three-tier canopy level system, which includes date palm (the highest tier), arboriculture (middle tier) and annual/pluri-annual crops at the lowest tier. Livestock raising in the strict oasis area is limited to a few individuals of sheep, goats, donkeys and/or camels. This is functional to the system by providing for food (meat, milk), transport (people, agricultural produce, etc.) and manure (soil amendment).The management practices and techniques reveal ingenuity of local population in using biodiversity, for instance in term of crop management (plantation, pollen transfer and thinning techniques, biological control of pests and diseases, etc.) and irrigation techniques (plant flexibility, water stock in soil, management of and adaptation to salt, sand and wind). The oasis inhabitants inherited important bodies of local knowledge in various fields such as systems of irrigation and management of seeds, palm and fruit trees. The local knowledge is also rich in techniques of conservation and storage of the agricultural harvests. In spite of the attempts at introduction of mechanization, the old working tools proved to be the most adapted to the oasis, some tools exist only in the Gafsa Oases.

The constraining environment and the opportunity and climatological requirement of irrigation lead to a necessary intensification and diversification. The growing of different crops in space and time allows oasis communities to meet the essential needs for home consumption: food, domestic (building, crafts, etc.), energetic and medicinal requirements. The surplus production is sold in the market and there is a trend to increasing cultivation of cash crops in order to generate income.

This diversity and its associated knowledge is a fundamental asset for the inhabitants of the Oases and which continue to ensure the inhabitants economic returns and a fair level of quality food security throughout most of the year. The various annual cultures allow a daily production though collection of arboreal fruit is spread out: apricots are collected in April and May, followed by the maturation and collection of figs, vine, dates, and finally, olives. Much of the agricultural production is for self-consumption and storage. The Oases are an important source of wood for the construction of residences, cattle sheds, for heating, and furniture making. The oasis is less vulnerable to the shocks and risks of the climate than the surrounding areas. In an arid environment of strong heat, the Oases' plant communities lower ambient temperatures and reduce evapo-transpiration. the harsh environment, thus explaining the antiquity and rich culture of the old town of Gafsa.

Threats and Challenges

Recent socio-economic developments have introduced modifications in these farming systems especially on the level of the annual crops. Today, people's livelihoods and their farming ecosystems in the oases are under heavy pressure. A number of inter-linked factors of ecological and socio-economic nature are affecting the delicate equilibrium of the Oases. Ecological factors include land degradation, genetic erosion of biodiversity, use of inappropriate agronomic practices, reduction of aquifers, frequent droughts, and the introduction of foreign species. Among the socio-economic factors which negatively affect farmers' livelihoods are the marginalization of indigenous communities (particularly fragile and silent groups, especially women) and cultural erosion related to traditional agricultural knowledge and practices. In particular the traditional social water management institutions have been largely replaced by the association of irrigation (GIC), the co-operative of agricultural services, Omda (responsible for the smallest administrative unit), the agricultural engineering services, and local farmer unions. As there is no integrated collaborative community approach towards water management, access to the principal natural water sources and disputes between water users are beginning to pose a problem which may lead to its unsustainable use. Oases are havens of agricultural biodiversity in a constraining environment, and their degradation is synonymous with high genetic erosion.

The example of Maasai Rangeland management

The history of Maasai pastoralism is closely intertwined with the evolution of the savannah and highland landscapes of southern Kenya and Northern Tanzania. These landscapes are world renound for their stunning views and rich wildlife. Tourist revenues from these areas benefit the national economies of the countries involved as well as private tourism companies all over the world. What is often overlooked, when policies and management interventions are designed and implemented in these areas, is that these landscapes and their wildlife habitats were shaped over centuries by the knowledge intensive and highly flexible nomadic pastoral strategy of the Maasai and other pastoral communities.

The ecological and human rationale of a well regulated opportunistic strategy

The pastoral strategy is highly adaptive to space temporal fluctuation of the environment. By moving around herds of cattle, resources (pasture, water, salt) are used where and when they are most available. All habitats are used and there is no functional distinction between wild and cultural lands. The Maasai have a complex strategy of customary arrangements to commonly manage and use these resources based on a rich and diversified knowledge of the savannah and highland ecosystem. Their settlement patterns and associated social organisation are built on the need to spread resource use over a large area to avoid concentration of livestock and consequent overgrazing. Their grazing strategies and burning techniques have turned bushland into pasture and controlled pests, thus creating a habitat and food source for large wild grazers and their predators. In many ways the abundance of wildlife in these systems is largely due to the pastoral strategy. The presence of cattle in the grazing sequence with wild grazer favours the growth of grasses that are preferred by these wild herbivores. Overgrazing is sometimes wilfully applied to open up bush invaded pasture again. The Maasai adjust their herd composition and size to the availability and carrying capacity of certain areas and availability of water (for example: dark cows get warmer in the sun and drink more!). There is a fine balance between competition over resources and interdependence between the human/domesticated components and the wild components of the ecosystem.

Maasai manage to cope with the great fluctuations of the environment (seasons, droughts), making the entire system more resilient and sustainable, while providing for their own food and livelihood needs. Their customary institutions for resource access ensure not only environmentally sustainable use of resources but also equitable access and benefitsharing, with high levels of reciprocity and social security for those who suffer misfortune, whilst being flexible to adjust to environmental circumstances. The many and complex exchanges of cattle taking place provide not only for a rich genetic diversity of cattle in each herd, but serve also as a social strategy to deal with hardship. The genetic heritage of cows is administrated through burning marks on cows, which also have many social, religious and artistic functions. Other users (ethnic groups, including agriculturist and hunter gatherer groups) are allowed to live and use resources on Maasai territory, which is beneficial for the exchange of goods and services between social groups and livelihood systems, but this is also a potential source of conflict in times of scarcity.

The knowledge base of pastoralism

Maasai have an intense practical experience and rich knowledge of their environment and the ecological relations between various areas, accrued by moving around over large areas and passed on over many generations. They have a vast knowledge of plants and their nutritional and medicinal purposes (human and animal), as well as of animal behaviour. This is borne from the necessity to be able to move their cattle safely through various areas and make use of the resources available in these areas, as they cannot be brought along whilst moving. This knowledge is safeguarded and passed on through many cultural institutions and expressions. One of the them is the considerable freedom of children to move around and discover their environment. Another crucial socio-cultural institution is the stage of warriorhood for young men, now in strong decline. This 3-7 year period combines intensive education by elders on livestock, ecology, social values, justice and leadership, with challenges, rituals and a "military service". The young warriors are expected to take care of them selves and to provide for their needs without the care of their mothers, challenging them to acquire knowledge of plants and their uses and building social networks with people outside their families. There are also many stories, jokes, sayings, riddles and other cultural expressions that convey knowledge of the environment and social values for the appropriate use thereof.

Threats and challenges

When British colonialists first arrived in the Rift Valley they perceived its' landscape as a wild habitat. The presence of people and cattle was considered as a constructive component, but as a threat to the landscape and its wildlife. Their background in a sedentary culture made them fail to see the interconnections and rationale of the nomadic strategy and its role in creating and maintaining the landscape. They also failed to see the resource use efficiency of the pastoral systems that integrates various ecological niches with varying productive capacities over time. One can only understand this rational when the system is viewed from a larger space-temporal scale than the agricultural zone for a single all-year-around use. Many of the old perceptions persist today. Wildlife conservationists and landuse planners who are trained in land zoning and planning for a single use, continue to have rigid perceptions of how land and resources should be managed in space and time, with a clear Cartesian separation of "natural" and "agricultural use" areas. This has consequences for policies, resource access legislation, institutional arrangements for land management and delivery of services, causing great disturbances to the pastoral-ecological dynamics, and the culture and social organisation that underpins the management of the system. These perceptions are materialised largely in land tenure legislation by creating restrictions to livestock movement, loss of access to key areas and resources, and subsequent and sometimes deliberate erosion of the culture of the Maasai. This in turn has negative effects on the capacity to deal with ecological risk, causing a decline in food and livelihood security, but also increasingly on land quality and wildlife abundance, through invasion of bush and pests on the shared habitats of livestock and wildlife. Many customary institutions for land management and access to resources have been deligitimised and/or replaced. Also, the open system of resource use is not sufficiently safeguarded against agricultural settlers (due to population pressures outside the system) and land grabbing through corruption, which are both threats of a growing magnitude. Population growth and changing lifestyles add to the pressures. HIV/AIDS is also an increasing problem, causing loss of leadership, parental care, labour force and knowledge.

<u>Key Characteristics of knowledge systems</u>

All knowledge and technology is generated, passed on and adapted in specific ecological, socio-economic and cultural context. They are the result of a human process of interaction with each other and the environment, which is organised through and guided by specific institutional settings, power relations, values and perceptions. Therefore "any analysis of technology must be situated within a social and economic understanding of the role of technology, the rationale and purpose of its design" (Scoones, Reij and Toulmin, 1996). If we would like to understand the different natures of various knowledge systems we should not only look at the content and forms of knowledge at technologies, but also at the processes through which it is generated and managed. Because of the interconnectedness of the social process and social and ecological context of knowledge generation in this paper the term *knowledge systems* is used rather than of *knowledge* to be able to grasp the full scope of the relevant processes.

Before we provide a typical description of the characteristics of local and modern knowledge systems, it is also important to acknowledge that the terms *traditional, indigenous* and or *local* and their juxtaposed *modern* and *scientific* are contested terms. In certain arenas the conceptual juxtaposition of traditional knowledge versus scientific or modern knowledge may be useful. In cases where people are establishing their historical ties to land and territory, like in the case of many indigenous peoples, when rights of natural resources and benefit sharing mechanisms have to be put in place, or when for cultural groups are going through a collective process of strengthening their cultural identities, the concept of traditional knowledge is one of the key tools. However, for the practical management of ecosystems and for the problems that farmers face in providing for their livelihood the distinction is often immaterial and in many cases counterproductive, particularly in cases where changes outrun the adaptive capacity of traditional knowledge systems and when there is no viable alternative. What counts for a farmer or pastoralist is that the technology or management intervention offers a good solution from his or her point of view, which is almost by definition the whole interdisciplinary context that the actor operates in. Whether a solution is traditional or scientific is irrelevant for the actor. The point is that it works. Additionally, in practice, it is very difficult to establish where one system begins and the other ends. Over history, all knowledge systems have incorporated elements of other knowledge systems, transformed the and given them new meaning. A successfully adopted modern technology can quickly become part of the local knowledge system. In the locality it will acquire new meaning and application and it will most certainly be adapted. Table 1. gives an overview of *typical* characteristics of local and scientific knowledge systems.

Local knowledge systems	**Scientific knowledge systems**
integrated and holistic	disciplinary and reductionist
humans and ecosystem considered as one	human and ecosystem approached separately
relatively low degree of specialisation	relatively high degree of specialisation
co-evolved with local ecosystems and cultures	derived under isolated, controlled and/or generalised circumstances
symbolically represented orally or visually in stories, rituals, arts, riddles, etc.	represented in writing
derived through rational conscious process plus experiential, intuitive and spiritual cognitive processes	derived and validated through rational conscious process only
includes knowledge, technologies, philosophies and concepts, skills, arts and practices, values and spirituality/religion	includes knowledge, technologies and concepts
On the spot problem solving, good validity in context	Slow problem solving with good validity and wide applicability of principles.
Learning by doing and experiencing	Learning through formal education

Table 1. Typical characteristics of local and scientific knowledge systems

A key characteristic of local knowledge systems is that they have co-evolved with the surrounding bio-physical environment from landscape level to the genetic resources and with other social, economic and cultural institutions. Thus the values, ethics and social relations of production are incorporated either implicitly or explicitly into the technologies and management practices. Additionally, they have also incorporated the specific relationships of people with and functioning of the ecosystem. These knowledge systems are by definition interdisciplinary as any farmer or pastoralist takes all factors of production, human and bio-physical, into account in his/her management decisions. Modern or scientific knowledge and technology are by contrast often defined outside the locality and are usually disciplinarily defined. This may carry unforeseen and unwelcome side effects as implicit values and relations of production can be introduced into culturally different contexts and when factors not considered in the scientific definition of the problem come into play in practice. “Particularly, when introduced technologies are imposed, and prospects for local adaptation are constrained, problems arise”. (Scoones, Reij and Toulmin, 1996)

Local knowledge is generated in specific practical relationships of different actors with the ecosystem and the land, water or biological resources that are contained therein. These relationships are legitimised, regulated and guided by rights of access to resources, which are codified in customary law or other regulatory frameworks. To safeguard the existing knowledge systems and their ongoing evolution one must safeguard the continuation of the specific relationships between people and their environment. Access to resources and resource rights, individual or collective, are therefore of crucial importance to the survival of local knowledge systems and the sustainable management of ecosystems. It deserves specific attention to look at the role of customary law and governance and its relationship to formal landtenure and other regulatory systems.

One of the important social dimensions of knowledge systems are the differential roles of men and women in the generation and management of knowledge and the specialisation of different social groups. This holds true for any knowledge system, modern or traditional, local or formal. However, unlike in science, in the case of local knowledge special attention should be given to the different relations men and women have to the ecosystem and natural resources, including aspects of access and rights. In many places in the world, women have a specific custodial role in maintaining local knowledge and biodiversity. Women also tend to operate in economic niches that depend highly on the ecosystem and are more subsistence oriented. Additionally, it is worthwhile to note that there is often a convergence of customary institutions for the management of natural resources, which hold most of its associated knowledge, and customary institutions with other social, economic and political functions. In most indigenous and local communities the local knowledge systems are the same as or closely intertwined with other such social institutions and practices.

On cognitive processes of knowledge systems

Another key characteristic of local knowledge systems is that they are broader in cognitive scope than scientific knowledge systems. In scientific knowledge every step is ideally achieved through conscious rational process, whether or not validated by field experimentation or observation. The advantage of this is the relative certainty of the validity of such knowledge under known circumstances and the possibility of deriving general principles that are widely applicable. By contrast the cognitive processes in local knowledge systems also include conscious rational process, but have a much broader "bandwidth". Local and indigenous peoples integrate previous experiences, sensory input, prior knowledge, social and spiritual values and relationships etc. on the spot without making all steps consciously. The involvement of this broad range of human faculties helps provide for quick decision making in complex interdisciplinary situations. One of its disadvantages can be its lack of rationalisation, which limits its wider application. In particular bodies of skills and experience can only be transferred by example and learning by doing. The different cognitive processes and contents of knowledge systems are also reflected in the way knowledge is codified and transferred. In Local knowledge systems learning by example, stories, riddles, rituals and other forms of art and symbolic representation are used while scientific knowledge is codified in written and numbered form and is transferred through formal education.

A note on the role of culture

Historically, culture and tradition have been treated as an obstacle to development and sustainable and/or efficient use of natural resources. At best it was viewed by administrators as a heritage in its own right. What many policymakers and scientists alike have failed to see is that the values, customary law systems for access to resources and local knowledge and their understanding and attribution of meaning to the landscape and its components is a key element in the sustainable management of ecosystems. Religious codes and taboos as well as rituals and ceremonies often have key functions in the sustainable management of ecosystems. The relationship between a cultural group and the landscape may be defined and acknowledged through such practices, which are also a way to convey the knowledge about the environment to next generations. In many cultures it is through the sacred that ecosystems are managed. (Eyzaguirre and Woods-Perez, 2004)

Challenges for strengthening traditional landuse practices and local knowledge systems

As observed in the introduction many traditional sustainable landuse practices and their associated local knowledge systems are under pressure. Without strengthening their evolutionary, adaptive capacity or mitigating the threats through policy intervention an invaluable resource in terms of knowledge and outstanding landscapes and ecosystems that provide for food security livelihood and ecosystem services may be lost for good.

One of the questions and challenges that arises is what the potential is for integrating different knowledge systems. There are already many examples of successful integration. For instance the introduction agro-ecological principles, community mapping with GPS and GIS tools, community media, conservation agriculture and integrated pest and plant management (IPPM) techniques into traditional agricultural systems have proven successful. Often their success was based not only on the quality and appropriateness of the technologies and management practices offered, but also on the processes by which they were introduced. In the case of IPPM and integrated land management Farmer Field Schools have been effective.
Apart from offering the right products through the right processes science can also help systemise and derive principles from local knowledge systems and experiences with their integration with modern technologies. Such principles can help development workers and policy makers alike.

The challenge of integration is two-fold. 1. How can we integrate local and scientific knowledge systems and technologies in order to strengthen sustainable land-livelihood systems? 2. How can we integrate different scientific disciplines and come up with an holistic approach to the management of dryland ecosystems in order to be able to respond to the reality and problems of farmers, herders and their communities?

When we recognise the social processes underlying knowledge systems it becomes clear that in order to integrate different knowledge systems and disciplines, we have to integrate *the processes* underlying knowledge and technology development and innovation. We need a participatory approach to knowledge and innovation. Participation is not only a politically correct or socially desirable goal, but a precondition for the necessary integration. In order to integrate different knowledge systems we need a *dialogue of wisdoms* (Altieri, 2002). This should be based on respect and tackle problems that are commonly defined and understood by different stakeholders. To integrate different scientific and policy making disciplines we need institutional innovation and partnerships to brake down barriers between sectors and disciplines and join efforts in working on common problems and fields of interest.

Currently, there are various constraints in the social organisation and institutional setting of drylands development. Technologies, innovations for sustainable drylands development are developed outside and with little consideration for the whole human-ecological context of the landuser communities. As long as institutions, ministries, sciences, international organisations are organised along disciplinary lines with a general and deep divide between the human and bio-physical disciplines we will keep reproducing the same dichotomies and contradictions in scientific, and conservation and development planning and practice. We need partnerships and new ways of organising our institutions as well as new interdisciplinary concepts and methodologies to frame interdisciplinary work and facilitate communication and common understanding of the problematics across disciplines and sectors. Additionally, problems are defined at higher levels of planning and research, but solutions are expected to be borne by farmers and herders. The power relationships between these groups are such that local people have little influence on technology development, planning or policy making. With many newly introduced technologies farmers loose some of their autonomous capacity to manage their livelihoods and environment sustainably.

Some principles for an approach:

By their very nature sustainable traditional agricultural systems and their associated knowledge systems can only be maintained and allowed to evolve *in situ*. The specific relationships of humans and the environment have to be sustained in order for local safeguard local knowledge systems. Most knowledge can not be extracted, recorded or transferred without changing its meaning. Modern technology can offer tools, but can never replace local knowledge systems. When introduced technologies are imposed, and prospects for local adaptation are constrained, problems arise. For a technology to be attuned to people's needs, local environmental conditions and economic factors, it must be flexible and adaptable. Rigid prescriptions and designs do not work". (Scoones, Reij and Toulmin, 1996)

A key step in the knowledge and innovation process is the way problems are defined. They need to be defined in a participatory way incorporating the complexities of the context of the main agents of landuse and management. A guiding principle can be derived from the ecosystems approach. Principle 2 of the ecosystems approach of the Convention on Biological Diversity reads: *management should be decentralised to the lowest appropriate level.* Following this principle we can identify the level of at which any technology, management intervention or innovation has to make sense. Therefore, problems and innovation challenges have to be defined at the lowest appropriate level at which these innovations will be used and applied. In the case of most human management and use of ecosystems, which is done largely by individuals, households and communities of farmers and herders, it means that the problems will have to be formulated largely by these actors and with consideration of their socio-economic and ecological context. Experts can participate in this process offering windows to other knowledge and options. This approach would have implications for the role of the expert, moving from a planner and decision maker to a nexus between scientific knowledge systems and farming/herder communities. Such an approach should be carried forward throughout the planning and innovation processes during testing, implementing, monitoring and evaluating. It requires changes in concepts and personal attitudes on behalf of the expert.

When we design participatory processes we need to ask who is participating. One should recognise that there are different roles and power relationships within communities and households, between men and women and different social classes or ethnic groups. Any participatory process that doesn't acknowledge this runs the risk of causing greater inequalities, providing options for some and excluding others. In this respect, we need to also be mindful of working with customary forms of consultation and governance. One does not want to create new institutions which overlap or compete with the structures and processes that are considered legitimate within a landuser group even if one wishes to promote social change. Doing this may cause more harm than good. Additionally, we need to also respect sacred and spiritual elements of local knowledge systems. Not only because of their value as perceived by local populations, but also because they often have key functions in the sustainable management of ecosystems.

There is a need and scope for the development of information systems that are designed along principles of knowledge participation. This means that different actors should be empowered to contribute information and perspectives in different forms to knowledge systems from their own perspectives rather than that an expert collects data and tells the stories of others. Such tools are emerging and they may greatly facilitate dialogue and support integrated knowledge systems between disciplines and between experts and farming and herding communities.

In sum, the conditions for success are multiple, combining a conducive policy environment, effective institutional setting, access to a range of participatory methods and approaches, and personal changes among researchers and development workers (Pretty and Chambers, 1994). The researcher must acquire new skills, new technologies and new behaviours (Chambers, 1993). Rather than planning directing and enforcing s/he must facilitate, convene, catalyse and negotiate. Rather than on technological outputs, the focus is on the process by which technologies arise, become adapted and spread. Rather than dividing responsibilities between researcher, extentionist and farmers, roles combine and joint activities are central. These are big changes to the conventional, linear model of technology development. But they are proving successful (Scoones, Reij and Toulmin, 1996)

Globally Important Ingenious Agricultural Heritage Systems (GIAHS)

In 2002 FAO with UNESCO, UNDP, GEF, governments, NGOs and other partners has started an initiative for the global recognition, conservation and sustainable management of Globally-important Ingenious Agricultural Heritage Systems (GIAHS). GIAHS have been defined by FAO as:

> *Remarkable land use systems and landscapes, which are rich in biological diversity evolving from the ingenious and dynamic adaptation of a rural community to its environment, in order to realise their socio-economical, cultural and livelihood needs and aspirations for sustainable development.*

GIAHS represented the diversity of agricultural system evolved over millennia, which are to be the worlds' basis for food security and sustainable management of the environment. Most regions, large parts of the world's population and much of the world's biological diversity will continue to depend on their continued functioning and sustainable management. This is a heritage that has to be conserved and its sustainable management and adaptive capacity strengthened for our common future.

The GIAHS project aims to establish the basis for international recognition, dynamic conservation and sustainable management of GIAHS and their associated landscapes, biodiversity, knowledge systems and cultures throughout the world. The overall project goal is to identify and safeguard GIAHS and mobile global recognition and support for such systems and enhancing global, national and local benefits derived through their dynamic conservation, sustainable management and enhanced viability. Ultimately the project will be catalytic in establishing a long term programme building on the experiences and lessons learnt in a 5-10 pilot systems. A new category of World Heritage sites is expected to be created with the support of interested governments and intergovernmental bodies of FAO, UNESCO, the World Heritage Commission (WHC), and UNDP.

The project will achieve this goal and purpose by developing, testing and implementing specific Pilot Frameworks and participatory methodologies and mechanisms in 5-10 pilot sites/systems. The project will 1) leverage global and national recognition of the importance of GIAHS and institutional support for their safguard, 2) build capacity of local farming communities and local and national institutions to conserve and manage GIAHS, generate income and add economic value to goods and services of such systems in a sustainable fashion; 3) promote enabling policy, regulatory and incentive environments to support their conservation, evolutionary adaptation and viability.

Most outstanding agricultural heritage systems have evolved under particular environmental or socio-economic constraints, such as low available moisture, high altitudes, population pressures or remoteness. Many GIAHS can therefore be found in dryland areas, but also in mountainous regions or areas with high population densities. Examples of such systems include:

- Ingenious irrigation and soil and water management systems in drylands with a high diversity of adapted species (crops and animals) for such environments such as: ancient underground water distribution systems (Qanat) allowing specialised and diverse cropping systems in Iran, Afghanistan and other central Asian countries with associated home-gardens and endemic blind fish species living in under-ground waterways; and integrated oases in deserts of North Africa and Sahara, traditional valley bottom and wetland management e.g. in Lake Chad, Niger river basin and interior delta (e.g. floating rice system) and other like ingenious systems in pays Bamileke (Cameroon), Dogon (Mali) and Diola (Senegal);

- Remarkable pastoral systems based on adaptive use of pasture, water, salt and forest resources through mobility and herd-composition in harsh non-equilibrium environments with high animal genetic diversity and outstanding cultural landscapes. These include highland, tropical and sub-tropical dry-land and arctic systems such as Yak based pastoral management in Ladakh, high Tibetan plateau, India, and parts of Mongolia; Cattle and mixed animal based pastoral systems such as of the Maasai in East Africa; and Reindeer based management of tundra and temperate forest areas in Siberia such as Saami and Nenets;
- Outstanding rice based systems. This type includes remarkable terraced systems with integrated forest use (swidden agriculture/agro-forestry and hinting/gathering), such as rice terraces and combined agro-forestry vanilla system in Pays Betsileo, Betafo and Mananara in Madagascar, and diverse rice-fish systems with numerous rice and fish varieties/genotypes and other integrated forest, land and water uses in East Asia and the Himalayas;
- Maize and root crop based agro-ecosystems developed by Aztecs (Chinampas in Mexico) and Incas in Andes (Waru-Waru) around lake Titicaca in Peru and Bolivia), with ingenious micro-climate and soil and water management, adaptive use of numerous varieties of crops to deal with climate variability, integrated agro-forestry and rich resources of indigenous knowledge and associated cultural heritage;
- Taro based systems with unique and endemic genetic resources in Papua New Guinea, Vanuatu, Solomon islands and other Pacific Small islands developing countries;
- Complex multi-layered home gardens, with wild and domesticated trees, shrubs and plants for multiple foods, medicines, ornamentals and other materials, possibly with integrated agro-forestry, swidden fields, hunting-gathering or livestock such as home garden systems in China, India, the Caribbean, the Amazon (Kayapó) and Indonesia (e.g. East Kalimantan and Butitingui);
- Hunting-gathering systems such as harvesting of wild rice in Chad; and honey gathering by forest dwelling peoples in Central and East Africa.

The approach will put participatory frameworks in place in pilot systems to strengthen the management and knowledge systems that underpin the functioning of the agricultural ecosystem and to enhance its viability. Parallel processes will be put in place at national and international level in order to provide support and develop ways to upscale the impact of the initiative by incorporating lessons learned into policy and incentive structures and by creating national and international mechanisms for safeguarding these systems. The initiative will develop participatory methodologies for the preservation of GIAHS, without fossilising them. It aims to support their continued evolution and adaptation while preserving their inherently sustainable characteristics and enhancing their socio-economic and ecosystem functions.

Other initiatives of FAO on local knowledge systems:

FAO has various activities and programmes ongoing that involve local knowledge systems and/or are focussed on drylands. A list of activities and publications is provided as in annex 1.

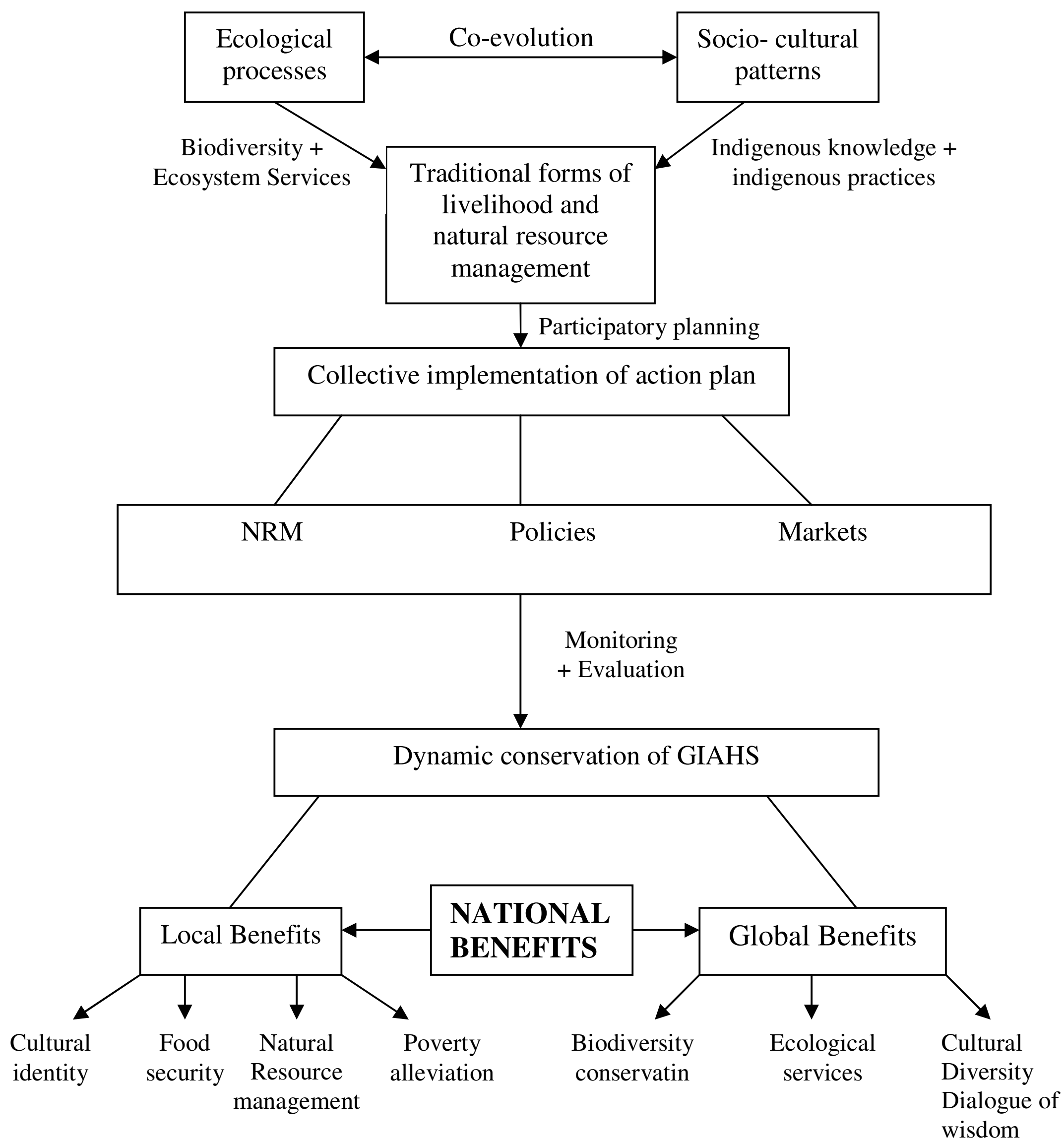

Figure 1 Framework for an approach to the dynamic conservation of GIAHS

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Food and Agriculture Organisation of the United Nations (FAO)
www.fao.org

Convention n Biological Diversity (CBD)
www.biodiv.org

Annex 1. FAO activities and publications on local knowledge systems and/or drylands

FAO Activities and programmes:

Commission on Genetic Resources for Food and Agriculture
www.fao.org/cgrfa

International Treaty on Plant genetic Resources for Food and Agriculture. This internationally binding instrument includes provisions on Farmers' Rights regarding farmer's genetic resources for food and agriculture and their associated knowledge.
www.fao.org/cgrfa

Interdepartmental Working Group on Biological Diversity
www.fao.org/biodiversity

The Globally-important Ingenious Agricultural Heritage Systems (GIAHS) initiative
www.fao.org/landandwater/giahs

Land Degradations Assessment in Drylands (LADA)
www.fao.org/ag/agl/agll/lada

Men and Womens Local and Indigenous Knowlede Systems (LINKS) Project
contact: Regina.Laub@fao.org

Traditional Early Warning Systems in Africa (on animal diseases)
www.fao.org/DOCREP/004/Y3649E/y3649e07.htm

Rangeland Rehabilitation and sustainable use wildlife reserve in Syria (Project)
contact: Catharina.Batello@fao.org

Promotion of Kreb and other Food and Medicinal Plants from natural dryland grasslands
contact: Catharina.Batello@fao.org

FAO Publications on local and indigenous knowledge:

FAO (2003*). From Indifference to Awarenes: Encountering Biodiversity in the Semi-arid Rangelands of the Syrian Arab Republic*

FAO (2003*). Kow to Move, Move to Know: Ecological Knowledge and Herd Movement among the Woodabe of South-Eastern Niger.*

FAO and UNEP (2001) *Savannah Lifestyles: Environmental Issues for Schools in East Africa*.

FAO (2003) *Understanding the indigenous knowledge and information systems of pastoralists in Eritrea*

FAO (2004) *The Future is an Ancient Lake: Traditional Knowledge, Biodiversity and genetic resources for food and agriculture in Lake Chad Basin ecosystems.*