Citation: Koohafkan, P and M.A Altieri. 2010 Toward to Dynamic Conservation of Our World’s Agricultural Heritage. Food and Agriculture Organization of the United Nations, Rome.

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Acknowledgments: The authors are thankful to Ms. Mary Jane de la Cruz, FAO technical officer, for her assistance in assembling information and revision and editing of this publication. The authors are also grateful to Ana Cecilia Galvis for her work in the layout and editing of this publication and to Alejandro Henao for the graphics.
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Introduction

Agriculture and society have co-evolved for millennia. At the beginning, the first collectors of wild foods depended on knowledge about nature, that knowledge fed them and formed the base on which agricultural knowledge was built, and was handed down through thousands of generations until today. Whether recognized or not by the scientific community, this ancestral knowledge constitutes the foundation for actual and future agricultural innovations and technologies. This cultural, ecological and agricultural diversity is still evident in many parts of the world, maintained as unique systems of agriculture which through a remarkable process of coevolution emerged over centuries of cultural and biological synergy representing accumulated experiences of farmers and pastoralists interacting with the environment. Many of these remarkable landscapes, too heterogeneous for intensive agriculture, are managed by an estimated 1.4 billion people, mostly peasants and indigenous farmers, who conserve ancestral and local varieties of plants and animal races, and without access to external inputs, capital, or modern agricultural technologies produce between 30-50% of the domestic food consumed in the developing world, thus contributing substantially to food security.
at local, regional and national levels. Despite the fact that market penetration, migration, population growth, political reform, introduction of new technology and other factors have accelerated the pace of change in rural areas, many of these traditional systems have stood the test of time documenting a successful and resilient indigenous agricultural strategy, representing models of sustainability as they promote biodiversity, thrive without agrochemicals, and sustain year-round yields in the midst of socio-economic upheavals and environmental variability. In fact many scientists acknowledge that traditional agroecosystems have the potential to bring solutions to many uncertainties facing humanity in an era of climate change, energy and financial crisis.

As poverty alleviation and food security remain elusive for nearly a billion of the world’s population and with climate change threatening major disruptions with particularly strong effects on the poorest and most marginalised, it is clear that the new models of agriculture that humanity will need in the immediate future should include forms of farming that are more biodiverse, local, resilient, sustainable, and socially just. Necessarily modern farming will have to be rooted in the ecological rationale of traditional farming systems as the future of the world’s population will undoubtedly depend on key components of biodiversity and ecosystem services still found in these cradles of agricultural diversity.

Promising agricultural pathways, modeled after traditional farming systems can help in increasing on-farm food production and improve rural livelihoods thus substantially contribute to the Millennium Development Goals of combating hunger and poverty, now at the heart of the global development agenda.

The GIAHS initiative

Traditional systems of agriculture comprise a Neolithic legacy of considerable importance, yet modern agriculture constantly threatens the sustainability of this inheritance. Because of their ecological and cultural significance and the wealth and breadth of accumulated knowledge and experience in the management and use of resources that these systems represent, it is imperative that they be considered globally significant resources to be protected and conserved as well as allowed to dynamically evolve. In order to prevent further erosion of this legacy and to promote its dynamic conservation, the Global Environmental Facility (GEF) defines GIAHS as “Remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development”. A major goal of the GIAHS project is to launch a process of dynamic conservation for the maintenance of unique and culturally rich agroenvironments, source of ecologically relevant ancient systems and technologies that have proven to be resilient and sustainable through the centuries, and that therefore can serve as the basis of future agricultural systems capable of adapting to new planetary conditions imposed by climate change and other environmental and economic changes.
in partnership with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Development Program (UNDP) joined forces to raise world-wide recognition of the importance of these ingenious systems for local/global biodiversity conservation and ensuring of food security. The Globally Ingenious Agricultural Heritage Systems (GIAHS) initiative aims to establish the basis for international recognition, dynamic conservation and adaptive management of remarkable agricultural landscapes sill found throughout the planet along with their associated agricultural biodiversity, culture and knowledge systems. The GIAHS initiative has two major goals: (i) gaining systemic understanding and disseminating awareness and knowledge about these remarkable land use systems and landscapes, and (ii) mobilizing support of interested national and international partners and civil society actors for a long-term program to safeguard, support and restore such agricultural heritage systems.

Inherent to the concept of GIAHS is an acknowledgement that indigenous knowledge has intrinsic merit, and holds development potential. Fortunately in many parts of the developing world there still exists a diversity of local and traditional practices of ecosystem management, including systems of biodiversity management and soil and water conservation. There are many rural populations that are inventively self-reliant, where resource-poor farmers, continuously experiment, adapt and innovate. It could boldly be premised that rural peoples in GIAHS sites hold many of the potential answers to the production and natural resource conservation challenges affecting today’s rural landscapes. The GIAHS process acknowledges that there are real possibilities of building on local traditions and indigenous environmental knowledge to solve hunger and poverty in rural areas, instead of relying on often inappropriate technologies from outside.
Remarkable characteristics and emerging properties and services of GIAHS

By fostering an ongoing dynamic conservation of a selected group of sites around the world that contain unique agricultural landscapes, a process can emerge which offers tangible global services, while simultaneously benefiting local rural communities via food security, biodiversity conservation and maintenance of cultural identity. The unique traditional farming systems prevalent at the GIAHS sites represent systems that simultaneously exhibit seven remarkable features of global and local significance:

1. High levels of biodiversity that play key roles in regulating ecosystem functioning and also in providing ecosystem services of local and global significance.

GIAHS systems often reflect rich and globally unique agricultural biodiversity displayed at the field and also at the landscape level forming the basis for food production systems. A salient feature of GIAHS is their high degree of plant diversity in the form of rotations polycultures and/or agroforestry patterns. This strategy of minimizing risk by planting several species and varieties of crops stabilizes yields over the long term, promotes diet diversity and maximizes returns even with low levels of technology and limited resources. Genetic diversity provides security to farmers against diseases, pests, droughts and other stresses, heightens stability of the cropping systems and enables farmers to exploit different soil types and microclimates and to derive multiple nutritional benefits and other uses from the genetic variation among the species. At the landscape scale, diversification occurs by integrating multiple production systems forming mosaics of cropping systems with livestock, fallow fields and forests to create a highly diverse piece of agricultural land. Such heterogeneity confers stability and resiliency to the systems.

2. Agroecosystems nurtured by traditional knowledge systems and farmers innovations and technologies

Indigenous peoples that live in GIAHS sites often possess a broad knowledge base of the intricacies of local complex ecological systems. This knowledge about plants, animals, soils and the general environment has accumulated through a long series of observations transmitted from generation to generation. Indigenous farmers are aware that biological diversity is a crucial factor in generating ecological services, and preserving the resource base and foods on which they depend. Women, in particular, are holders of much traditional knowledge and thus play a critical role in the conservation and utilization of biodiversity.

3. Ingenious systems and technologies of biodiversity, land and water resource management and conservation that can be used to improve management of modern agroecosystems.

By studying traditional systems found in GIAHS sites, modern scientists can learn more about the dynamics of complex systems, especially about the links between agrobiodiversity and ecosystem function, thus enriching ecological theory, but more importantly deriving principles for practical application in the design of modern sustainable farming systems. For example, by deciphering how by interplanting, farmers take advantage of
the ability of cropping systems to reuse their own stored nutrients, information can be gleaned to improve the ways in which modern farmers manage soil fertility. Similarly, by determining which biological mechanisms are at play within the complex structure of traditional agroecosystems which minimize crop losses due to insect pests, diseases and weeds, much progress can be made in pest management.

Observations of agricultural performance after extreme climatic events in the last two decades have revealed that resiliency to climate disasters is closely linked to levels of farm biodiversity. Many indigenous management practices that buffer agroecosystems from climate variation include incorporation of wild and local varieties into the agricultural system and increasing the temporal and spatial diversity of crops both at the field and landscape level. This points to the need to re-evaluate indigenous technology as a key source of information on adaptive capacity centred on the selective, experimental and resilient capabilities of traditional farmers in dealing with climate and other external changes.

Most small farming systems are productive despite their low use of chemical inputs. Generally, small farms which produce grains, fruits, vegetables, fodder, and animal products in the same field are more productive than large farms if total output is considered rather than yield from a single crop. Yield advantages of diversified farming systems can range from 20 percent to 60 percent higher than monocultures, because polycultures usually reduce losses due to weeds, insects, and diseases and make more efficient use of the available resources of water, light, and nutrients. Traditional multiple cropping systems provide as much as 20-40 percent of the world’s food supply.

The maintenance of high biodiversity levels at GIAHS sites contributes to agricultural productivity and sustainability through the ecosystem services that biodiversity provides. Agroecosystem function is optimized via complementary interactions that emerge from added species in an agroecosystem, i.e. by mixing specific genotypes of crops for disease resistance, including a legume species that increases nitrogen inputs and cycling or by intercropping to support more insect enemies with specific roles in controlling pests. In many GIAHS sites agroforestry systems are part of a multifunctional working landscape, offering a number of ecosystem services and environmental benefits such as carbon sequestration, biodiversity conservation, soil

Diversified agricultural systems that contribute to local and national food and livelihood security.

Farming systems that exhibit resiliency and robustness to cope with disturbance and change (human and climatic-environmental) minimizing risk in the midst of variability.

Systems that provide local, regional and global ecosystem services.
enrichment, etc. In many regions, the management of diverse agriculture within landscapes provides critical watershed functions, such as maintaining water quality, regulating water flow, recharging underground aquifers, mitigating flood risks, moderating sediment flows, and sustaining freshwater species and ecosystems.

The stability and capacity of ecological systems to provision goods and services depends critically upon rural communities displaying various forms of social organisation (kinship, territoriality, settlement, group membership and identity, gender relations, leadership and political organisation), culture (worldviews, language, values, rights, knowledge, aesthetics), modes of production, labour allocation, technologies and practices, thus conforming complex social-ecological systems.

**GIAHS pilot systems around the world**

The project Globally Important Ingenious Agricultural Heritage Systems (GIAHS) has selected various pilot sites located in several countries of the developing world. The values of such sites not only resides on the fact that they offer outstanding aesthetic beauty, are key in the maintenance of globally significant agricultural biodiversity, include resilient ecosystems that harbor valuable cultural inheritance, but also have sustainably provisioned multiple goods and services, food and livelihood security and quality of life for millions of people. Despite the fact that in most parts of the world, modernity has been characterized by a process of cultural and economic homogenization, in many rural areas, specific cultural groups remain linked to a given geographical and social context in which particular forms of traditional agriculture and gastronomic traditions thrive. It is precisely this persistence that gives these areas and its rural communities a particular condition as a GIAHS site. The dynamic conservation of such sites and its cultural forms conforms the basis of a strategy of territorial development with cultural identity, recognizing that in order to overcome poverty it is not necessary to resign to the cultural richness existing in the territory. On the contrary, regional development should be founded upon the existing natural and agro biodiversity and the socio-cultural context that nurtures it.
Native potatoes of Chiloé island, Chile

The Archipelago of Chiloé, a group of islands in southern Chile, is a rich land in mythology, with native forms of agriculture practiced for hundreds of years based on the cultivation of numerous local varieties of potatoes. Traditionally the indigenous communities and farmers of Chiloé cultivated about 800-1,000 native varieties of potatoes before the onset of agricultural modernization. The varieties that still exist at present are the result of a long domestication process, selection and conservation made by ancient Chilotes. The preservation of such rich genetic diversity provides a major social-economic service to the Chilotan people by not only improving their nutrition but by improving their welfare and resiliency, as many varieties exhibit varied patterns of resistance to introduced pathogens and droughts which increasingly are affecting the region. These native varieties are highly adapted to the range of ecological conditions found in the region and are of key importance for subsistence production. With more than 60% of the population living still in rural areas, Chilotan small farmers located in inland valleys as well as coastal valleys grow potatoes (native and introduced), a giant variety of garlic, cereals such as wheat, barley and rye. Several old apple varieties in small orchards with a
cover of native vegetation grazed by local races of sheep. In addition many farmers preserve native forest fragments from where they derive wood and a number of non-timber products. Others harvest from the wild or grow a variety of medicinal plants. Most of these products are for subsistence use, but a small surplus is sold in local markets in nearby towns or cities. Potatoes, sheep meat, and marine resources are the backbone of the food security of the Chilotan population. Rural women have traditionally carried out the agrobiodiversity conservation activities in the small plots of their family vegetable gardens comprising a key source of knowledge about on-farm seed conservation, cultivation and potato based gastronomy in their respective communities.

**The Cuzco-Puno corridor, Peru**

The Andes are a range of mountains including valleys, Puna and Páramos, is considered as one of the most heterogeneous ecological environments in the planet. Andean people domesticated a suite of crops and animals. Of particular importance are the numerous tubers, of which the potato is the most prominent. Several hundreds of varieties have been domesticated by generations of Aymara and Quechua in the valleys of Cusco and Puno, of which more than 400 varieties are still grown
Conserving Our World’s Agricultural Heritage

on these terraces are native tubers, such as potatoes, oca, and ulluco. The 350 km long transect selected as a site pilot under the GIAHS project captures such environmental verticality and heterogeneity as it extends from the southern area of the Peruvian Andes and includes the environment around the sacred city of the Incas, Machu Picchu, (1900 m.), including the whole Vilcanota river watershed up to the divortium aquarium in the Raya (4,300 m), crossing to the northern part of the peruvian high plateau to reach Lake Titicaca at 3,800 m. In this transect more than 300 native communities maintain most of the ancient traditional agricultural technologies, in spite of strong outside economic influences which are eroding many of the old traditions. A long list of cultural and agriculture treasures from the Inca civilization can be found in the GIAHS transect and have been carefully preserved and improved over centuries to guarantee living conditions from 1,000 to 4000 meters above today. The maintenance of this wide genetic base is adaptive since it reduces the threat of crop loss due to pests and pathogens specific to particular strains of the crop. Other tubers include oca, mashua, ulluco, arracacha, maca, achira and yacon, but farmers also grow some fruit trees, corn and chenopods. Ascending the Andes includes a transect of different climates and plant communities, and a human landscape composed of terraces, irrigation works, patchworks of crop fields and settlements. The impact of the complex Andean environment on the human economy has resulted in vertical arrangements of settlements and agricultural systems. The pattern of verticality derives from climatic and biotic differences related to altitude and geographical location. The evolution of agrarian technology in the Central Andes has produced extensive knowledge about using the environment. This knowledge affected the division of the Andean environment into altitudinally arranged agroclimatic belts, each characterized by specific field and crop rotation practices, terraces and irrigation systems, and the selection of many animals, crops, and crop varieties. The most important cultural adaptation to these environmental constraints has been the development of farming systems and technologies designed to yield an adequate diet with local resources while avoiding soil erosion. The highlands of Peru contain more than 600,000 hectares of terraces, most constructed in prehistoric times. These staircase farms, built up steep mountain slopes with stone retaining walls, contributed vast amounts of food to the Incas. They provided tillable land, controlled erosion, and protected crops during freezing nights. Many were irrigated with water carried long distances through stone canals. Today, as in the distant past, the chief crops
sea level. One of the most amazing features of this heritage is the terracing system used to control land degradation. Terraces allow cultivation in steep slopes and different altitudes. Andean peasants manage a diversity of crops and crop varieties which have been adapted to different altitudes and are grown in up to 20 plots in different ecological zones to spread risk along the mountain environment. A plot is seldom dominated by a single crop, and even a potato field has up to 10 different varieties. Crops are combined for different purposes. As protection against certain diseases, mashua and potato are grown together. To prevent cattle damage, tarhui (lupine) is planted on the edge of maize fields. Maize, beans and pumpkin complement each other in fertility and growing space.

In the high plateau, around Lake Titicaca, farmers dug trenches (called “sukakollos” or “waru-warus”) around their raised fields. These trenches were filled with water, modifying the microclimate and allowing for crop production in the midst of frosts. These ingenious platforms of soil surrounded by ditches filled with water, were able to produce bumper crops, despite floods, droughts, and the killing frost common at altitudes of nearly 4000 m. The revival of this ingenious system of raised fields that evolved on the high plains of the Peruvian Andes about 3,000 yr ago. According to archaeologi-
Cal evidence these Waru-Warus platforms of soil surrounded by ditches filled with water, were able to produce bumper crops, despite floods, droughts, and the killing frost common at altitudes of nearly 4000 m. The combination of raised beds and canals has proven to have important temperature moderation effects, extending the growing season and leading to higher productivity on the Waru-Warus compared to chemically fertilized normal pampa soils. In the Huatta district, reconstructed raised fields produced impressive harvest, exhibiting a sustained potato yield of 8-14 tonnes/ha/yr. These figures contrast favourably with the average puno potato yields of 1-4 tonnes/ha/yr. In Camjata the potato fields reached 13 tonnes/ha/yr in Waru-Warus. It is estimated that the initial construction, rebuilding every 10 years, and annual planting, weeding, harvest and maintenance of raised fields planted requires 270 persons-days/ha/yr.

Andean plant genetic resources are an essential component for the livelihoods of thousands of peoples inhabiting the rural areas but are also key for providing genetic traits to breed new productive and resilient varieties. More than three-quarters of the increased potato productivity of the past 30 years is the result of plant breeding using native genetic materials. Clearly the world will continue to
depend upon plant germplasm that still exists in the Andes, to cope with future demands. In addition to their agronomic features, Andean crops are also valued due to their nutritional value. When compared with other staple root and tuber crops eaten around the world many Andean crops fare well in terms of protein content in such comparisons. Andean grains also tolerate insect pests, diseases, drought, frost and salinity and therefore perform very well in marginal lands. Quinoa and kañihua in particular are reported to be very tolerant of salinity, frost and drought. There are reports of acceptable production in areas with less than 100 mm rainfall per year. Growing Andean grains could therefore become a limited risk agricultural activity for farmers in many marginal areas of the world.

**Ifugao Rice Terraces, Philippines**

The ancient Ifugao Rice Terraces (IRT) are the country’s only remaining highland mountain ecosystem (about 68,000 hectares) featuring ingenuity of the Ifugaos which created a remarkable agricultural farming system which has retained the viability of a 2000 year-old organic paddy farming. The continued existence and viability of the rice terraces is a manifestation of strong culture-nature connections, marvelous engineering systems, innovativeness and determined spirit of the Ifugaos to maximise use of the mountainous lands for food production. In 1995, five terrace clusters in the Ifugao province were declared UNESCO World Heritage Sites honoring the spectacular landscapes reflecting the harmony between rural society and the environment.

The rice terraces are supported by indigenous knowledge management of muyong, a private forest that cap each terrace cluster. The muyong is managed through a collective effort and under traditional tribal practices. The communally managed forestry area on top of the terraces mostly contains about 264 indigenous plant species, mostly endemic to the region. The terraces form unique clusters of micro-watersheds and are part of the whole mountain ecology. They serve as a rainwater filtration system and are saturated with irrigation water all year round. A biorhythm technology, in which cultural activities are harmonized with the rhythm of climate and hydrology management, has enabled farmers to grow rice at over 1000 meters. The IRT paddy farming contain traditional rice varieties of high quality for rice wine production. Several species of mudfish, snails, shrimps, and frogs (many of them endemic) are associated with the paddie. The muyong surrounding many rice paddies, serve as biodiversity reservoirs of 171 tree species (112 species are used), 10 varieties of climbing
rattan, 45 medicinal plant species, and 20 plant species which are used as ethno-pesticides. About 41 bird species, 6 indigenous mammal species, including beneficial species of rats, and 2 endemic species of reptiles, are associated to the agro-ecosystem.

**Hani Rice Terraces System (China)**

Hani Rice Terraces are located in the southeast part of Yunnan Province. People of various races, with Hani being the main minority group which has lived in this remarkable landscape for over 1300 years, built the magnificent Hani Terrace System. The terraces are distributed along the south part of the Honghe Ailao Mountain covering an area of about 70,000 ha. Hani villages are usually located on the mountainsides, above the villages are the flourishing forests with the terraces just below the villages, thus the forest, village, terrace and river compose the typical ecological landscape of the Hani Rice Terraces.

The Hani Rice Terraces are rich in agricultural biodiversity and associated biodiversity. Rice planted in Hani terraced fields is extremely diverse although subjected to genetic erosion; of the original 195 local rice varieties today there are about 48. Common varieties of rice include Hongjiaogu, Shuihongjiaogu, Dabaigu, Maxiangu, Mazhagu, Pizagu, Changmaogu,
Rice-Fish Agriculture, China
In Asia fish farming in wet rice fields has a long history. Over time in these traditional rice-fish agricultural systems an ecological symbiosis has emerged: fish provides fertilizer to rice, regulates micro-climatic conditions, softens the soil, disturbs the water, and eats larvae and weeds in the flooded fields; rice provides shade and food for fish. Furthermore, multiple products and ecological services from the rice ecosystems benefit local farmers and the environment. The high quality food of fish and rice are helpful to maintain farmers’ nutrient and living standard: the reduced cost and labour increases the productive efficiency, and, especially by reducing the use of chemical fertilizers, pesticides and herbicides for insect and weed control, helps in agro-biological conservation and field environmental protection. The rice-fish system in Longxian village of Zhejiang province demonstrates an ingenious approach to generating ecological, economic and social benefits through encouraging integrated systems that perform essential ecological functions.

About 20 native rice varieties (many threatened) grow in the rice paddies, interwoven in the landscape with home gardens, livestock / poultry; trees and field hedges; and small plots featuring numerous native vegetables and fruits including lotus roots, beans, taro, eggplant, Chinese plum (Prunus simoni), mulberry; 6 native breeds of carp. 5 species of fish, several amphibians and snails can also be found in the paddies; 7 species of wild vegetables are commonly collected in borders of fields; where about 62 forest species thrive (21 of them used as food) as well as 53 medicinal plants species.

Shangu, Xianggu, Shuihuangnuo, Damaonuo, etc. One way in which Hani conserve rice diversity is through exchanges with surrounding villages.

In addition to the diversity of rice in Hani terraced fields, other common types of plants and animals include a large variety of natural aquatic animals like fish, snail, eel, loach, shrimp, stone mussels, crab, etc, as well as duckweed, lotus and other aquatic plants. Wild herbs like water celery, plantain, Houttuynia grow in the ridge of the terraced fields. Hani raise ducks and culture a variety of fishes including carp, silver carp, crucian...
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carp, etc within the terraces and also plant soybeans in the ridges between fields.

The well preserved evergreen broad-leaved forest above the villages are rich in biological diversity, including a variety of wild woody plants: Handonggua, Xishu, Nansuanzao, Baicangshu, Hongmuhe, Maochuhajiao, Xiangyeshu, Rangjiaomu, Lingmu, Xinmujiangzi, Danbingcha, Wafan, Shancha, Duancikao, Shaluoshu, Keleimu, Duomaidongqin, Bayberry, Golden bamboo, Cherry, Huahui, Mutong, Mao chestnut, etc. Also common are several wild herbs such as Yunnan baizhu, Maojuecai, Chaotianjue, Zijingzilan, Youcifengweijue, Wanjue, Xiangqing, Jincão, Riceball, Biandaxiuqiu, Baimiu, Tuerlan, Xiatic, Hanqin, Shuiqin, Yuxingcao, Yemoyu, Huanghuacai, Tumoyu, etc. Wild fungi include several species of mushrooms, white fungus, black fungus, white ginseng, green headed fungus, Ganbajun, etc and various insect species.

The vertical distribution of the Forest-Village-Terrace-River ecological landscape conforms a unique system of energy and material flows. Natural rainfall falls on the ground to form the surface runoff and percolate into the underground water system; surface runoff and springs flow through the forests, villages and terraces along the slope. The flowing water carries nutrients from the forest litters, the village sewage and
In the absence of a dedicated global support structure, many of these heritage systems and associated communities are threatened with virtual extinction. With the rapid advances in globalization, liberalization of trade and commerce, technological change and revolution in communications, these traditional systems are increasingly being challenged by factors such as:

(a) agricultural transformation and loss of traditional agricultural know-how and techniques
(b) lack of payment for non-market goods and services,
(c) out migration of farmers due to economic crisis or opportunities elsewhere,
(d) loss of biodiversity and
(e) cultural erosion.

The immediate threat of extinction of cultures, habitats, and human-created ecosystems are particularly serious from the perspective of the need to preserve and safeguard the unique characteristics of the agricultural heritage systems -- the importance of these for human resilience, conservation of biodiversity, the cultural, spiritual, and agro-ecological assets reflected in the goods and services provided by traditional systems in their diverse local contexts. GIAHS main goal is to design policy strategies conceived in a global context to meet the threats that undermine the sustainability and agroecology of traditional agricultural landscapes.

GIAHS systems represent a continuation of the historic tradition of an evolving civilization over the centuries of cultures, settlements, landscapes and habitats, most of which have been obliterated in the wake of industrial and agricultural revolutions and advances of science, technology, commerce and communications in the 19th and 20th centuries. The few that still survive as flag bearers of the earlier tradition are worth safeguarding as a part of the protection of the world cultural and natural heritage. Agricultural heritage landscapes not only represent important landmarks of historical value but also living and evolving agricultural communities, institutions and ecological and cultural heritage which provide a number of benefits and services at the local, national and global levels.
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The extent of traditional agriculture in the developing world.

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Farmers</th>
<th>Area (hectares or %)</th>
<th>Contribution to food security</th>
</tr>
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| Latin America. | a. 160 million peasant units  
               b. 50 million indigenous people.                                 | 38% of total land devoted to agriculture, about 60.5 million hectares.                  | 41% of food consumed domestically.                                                              |
| Africa     | a. 60-80% labor force involved in agriculture.  
               b. 70% of population living in rural areas (about 375 million of Sub-Saharan Africa). | 100-150 million hectares                                                              | 80% cereals  
               95% meat                                                                                   |
| Asia       | 200 million small scale rice farmers.                                            | a. 7.3 million hectares of upland rice.  
               b. 20.5 million hectares of rainfed rice.                                         | 200 million people supported by upland shifting cultivation.                                |

Terraced fields. Nutrients are ploughed into the substrate to provide long-lasting basic fertility. The second type of fertilization, uses the rain in June or July which washes dung and humus on the mountain into the ditch and diverted then into terraced fields of rice to provide fertilizers for the flowering rice. These traditional methods of soil fertilization not only save energy and labor in the fertilization process but also make full use of the “garbage” in the village and the nutrients carried by water runoff and natural soil erosion. Management of the ditches plays a very important role in terraced field irrigation. The water coming down from the hills has to go through the ditch to reach the whole terrace. The purpose of digging the ditches is to catch flows from mountain forests and spring water seeping from mountains to irrigate terraces. In addition, the ditches also can deposit sediments before entering the terrace to avoid continuously elevating the terrace surface due to sediment deposition and declining water-retention capacity. To enable every household reasonable access to the water, Hani invented a unique water allocation method with “Water dividing wood”, “Water dividing stone” and “watershed distribution”. A wood or stone bar is placed at the junction of water diversion to lower ditches. The wood or stone is carved with different sizes of water outlets to divide and allocate certain volume of water flow to lower ditches. The size of water outlet for each lower ditch is decided according to the irrigation area of the ditch, the water flow in the upper ditch, and the historical order of irrigation priority. This water distribution method not only enables water conservation, but also ensures irrigation of lower hill paddy, and has set the precedent example for irrigation of mountainous regions.

Wannian traditional rice culture system (China)

Wannian County is located in the northeast of Jiangxi Province and the lower reaches of
Lean River. It is under the jurisdiction of Shangrao City in Jiangxi. Wannian has a long history and splendid ancient civilization and is believed to be one of the regions of origin of rice cultivation, whose ancestor is the wild rice in the neighbouring Dongxiang County. Wannian traditional rice was formerly called “Wuyuanzao” and is now commonly known as “Manggu” cultivated in Heqiao Village since the North and South Dynasty. Wannian rice cannot grow in other places except Heqiao Village as it requires cold spring water and special soil conditions and climate, found only on the Heqiao Village. Wannian traditional rice is of high nutritional value as it contains more protein than ordinary hybrid rice and is rich in micronutrients and vitamins. The paddy rice and surrounding forests form a biodiversity-rich agro-forestry systems, where trees play a crucial role in soil and water conservation. The surrounding forests conserve spring water for irrigation as well as clean drinking water. Moreover forests on the hills around the paddy fields prevent soil erosion and landslides, serving as a watershed to store excessive water and reduce the risk of floods. The rice culture is closely related to the local people’s daily life, expressed in their customs, food, language, and form part of their cultural diversity. After the long-term of rice cultivation practice,
Wannian people have developed a set of experiences in rice seedling preparation and transplanting, field management, harvesting, storage and processing. Traditional rice is resistant to insects and adapted to poor soils, hence farmers do not need to use chemical fertilizers and pesticides, which contributes to environmental quality and biodiversity conservation.

**Oases of the Maghreb, Algeria and Tunisia**

The oases of the Maghreb region are green islands flourishing in a constraining and harsh environment. They are home to a diversified and highly intensive and productive system, which has been developed over millennia. Sophisticated irrigation architectures, supported through traditional local resource-management institutions which ensure a fair water distribution, constitute a crucial element of the oasis systems. Dominated by the date palm, intertwined with trees and crops, these ancient systems produce a surprising variety of fruits (pomegranates, figs, olives, apricots, peaches, apples, grapes, citrus) and vegetables, cereals, forages, medicinal and aromatic plants. In Algeria there are about 100 date varieties and 50 can be found in Tunisia. The palm groves offer shade and lower the ambient temperature, making it the best place to live in the Sahara and an
Agricultural products from the oasis provide an important source of nutrition and income for its inhabitants and for many it is their primary or secondary source of livelihood. Most of the agricultural products derived from the oasis are for self-consumption and guarantee food security that is high in quality and quantity.

The systems of production and irrigation and the culture of the oases vary between the different locations in correspondence to their environment. There are oases in continental, mountainous, as well as in littoral areas. With their rich diversity these oases systems constitute an agricultural and cultural heritage.

In Algeria, social institutions such as the Aoumma represent the local community and are charged with the oversight, control, and maintenance of oasis resource systems. This institution derives its legitimacy and authority from customary law and is dependent upon the council of local religious dignitaries the Halqa of Azzabas which is also the focus of social life and norms. Agricultural products from the oasis provide an important source of nutrition and income for its inhabitants and for many it is their primary or secondary source of livelihood. Most of the agricultural products derived from the oasis are for self-consumption and guarantee food security that is high in quality and quantity.

The traditional social water management system has been largely replaced by the association of farmers for water management (Groupement d’Intérêt Collectif: GIC for water), 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. Also, due to the increased demand for drinking water for the city of Gafsa, the irrigation systems for the Gafsa oases are under increased stress.

The Maasai pastoral system, Tanzania

Maasai pastoral system in Tanzania occupies the northern parts of the county bordering Kenya (from Loliondo to West Kilimanjaro) extending southward as far as parts of Manyara (Kiteto to Simanjiro), along the Great Rift Valley on semi-arid and arid lands including parts of the Ngorongoro National park and Serengeti Plains.

Maasai live in polygamous households and manage livestock herds to increase herd size (sheep and goats for market slaughter, and camels and cattle for wedding, rituals and insurance), produce milk (for young children), wool (sheep), hide (goats).

It is an old pastoral system and culture of over 1000 year and continues to demonstrate how it’s able to strike a social environmental bal-
ance in its fragile environment. The Maasai community is thriving to maintain its unique identity through maintenance of its socio cultural institutions, which are critical in regulating natural resource uses, maintaining grazing cycles and promoting conservation values. The Maasai practices of rotational grazing and other natural resource management practices co-created the typical East African rangeland landscapes that provide such critical habitat for wildlife. In areas where traditional Maasai pastoralism is practiced, the synergies between their natural resource management practices and the prevalence of wildlife continues to exist. However, this traditional pastoral system is under pressure, threatened by several factors including; the recent policy reforms, increase in human and livestock population, socio-economic changes, and climatic changes. The livestock resources (pasture and water) are diminishing due to shrinkage of grazing areas, successive droughts years and prolonged dry seasons and probably increasing stocks.

Engaresero village on the Western shores of Lake Natron has been chosen by the government of Tanzania to represent the Maasai pastoral system for its uniqueness, integrity, high diversity of habitats and biodiversity. The site also has major additional significance, because of the presence of Lake Natron and the volcano Oldonyo L’Engai, which have immense ecological, geological and cultural value. Its community on the other hand has demonstrated a strong resilience to threats to their systems, maintained associated social and cultural institutions, which ensure its sustainable functioning and resilience under its environmental conditions.

In summary the major drivers of biodiversity losses are land use changes, crop improvement programmes, over exploitation of wild resources, over fishing, high food consumptive societies, trade liberalization and agricultural subsidies. The consequences of these losses disrupt the lifestyles mostly of the poor who depend upon local eco-systems for their livelihoods especially in terms of food security. Clearly, drivers may be complex, but very often major drivers (positive and negative) can be readily identified and largely understood through the combina-
 Rewarding traditional farmers as providers of ecological and cultural services

As mentioned, through their use practices, many traditional farmers provide environmental services such as watershed conservation, biodiversity protection and carbon storage, which mostly benefit external stakeholders. GIAHS intends to build momentum and public interest in rewards for environmental services and to develop ways to offer incentives to poor farmers who protect ecosystems of local and global significance. Farmers organizations and/or NGOs, working with the funds of external donors, could play an important role in developing and maintaining programs to utilize and conserve agrobiodiversity, e.g., bridging between farmers and agencies who pay for environmental services, or facilitating the production of ‘added value’ products that come from GIAHS farming systems that utilize and conserve unique agrobiodiversity. Also, stakeholders outside agriculture, e.g., ecotourists may be induced to pay for conservation measures that offset the loss of biodiversity in agricultural landscapes that reduces farmers income and livelihood security. As GIAHS sites conform heritage landscapes of global significance, recognition and/or rewards for environmental services from beneficiaries within countries and even from distant countries can generate finances and incentives for GIAHS environmental service providers to maintain biodiversity-rich agricultural landscapes.

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Final reflections: Opportunities for promoting heritage conservation

It is imperative that agricultural patrimony of the GIAHS sites is recognized at the national and international level and values these landscapes as a cultural and ecological heritage that satisfies the expectations and demands for food, tradition, culture, health, recreation of thousands of people in specific countries but that also provide global benefits. Such recognition can open a new opportunity for the GIAHS sites for the generation of employment and income via what may be called the “cultural economy” (ecotourism, cultural identity products, local gastronomy, etc).

Since in many of the GIAHS areas the ecosystem patrimony is associated with “poor people”, the public recognition of their knowledge and skills can also aid in enhancing the rural poor’s self esteem and sense of citizenship. Their cultural resources may also be considered economic resources thus the challenge is to search for new ways of valuing such resources, in order to arrive at a strategy of territorial development based on products

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of cultural identity. By obtaining economic benefits from their “products with cultural identity”, local farmers can live and maintain their traditions without abandoning the rural space, and thus continue their role as stewards of GIAHS. Identifying and promoting crop varieties and other products with cultural identity present at GIAHS sites can lead to the creation of market processes tailored to consumers (local and tourists) that prefer products differentiated by origin and cultural quality. In the case of GIAHS located in biodiverse areas of global importance, linking cultural capital with natural resources, can provide the foundation of a territorial development strategy directly involving the native people and their knowledge systems. Farmers at GIAHS sites maintain in-situ crop genetic diversity and are in effect net-subsidizers of modern agriculture and food consumers worldwide. These custodians of such genetic portfolios are left uncompensated for the potential global benefits that they provide. Clearly rewarding such ecological and social service providers so that they continue engaged in biodiversity conservation is a major goal of the GIAHS initiative.

In many regions, the preservation of the eco-cultural patrimony is still threatened by the low value given to traditional products and skills. As mentioned above, markets need to be developed and improved, although other non-market mechanisms may be available and preferable to enhance income and well-being. Also the tourist industry must be directed to become more aware of the significance of the patrimony and support it by consuming local foods, practicing ecotourism of natural areas and traditional farms, donate to local projects that support community projects, etc. When ecotourism is managed by local people or local businesses committed to the GIAHS concept, a result should be lower visitor impact and greater biodiversity conservation generating beneficial socio-economic outcomes for local populations to help reduce poverty.

Major drivers of traditional agrobiodiversity loss include land use changes, introduction of new crop varieties, over exploitation of wild resources, over fishing, high food consumptive societies, trade liberalization and agricultural subsidies. The consequences of these losses disrupt the lifestyles of poor farmers who depend upon local ecosystems for their livelihoods especially in terms of food security. Therefore policies are needed to cushion GIAHS from negative external drivers of change. It is also important to protect the natural and cultural assets of GIAHS sites from industrial development that can extract labour and also distort markets. Special care should be paid to the introduction of modern agricultural varieties and inputs to avoid upsetting the balance of traditional agroecosystems.

In addition to just preserving local production systems and compensating farmers for their services, one of the goals of GIAHS is to enter into a process of scaling up of agroecologically based innovations which incorporate elements of both traditional knowledge and modern agricultural science. The analysis of hundreds of farmer-centered projects around the developing world show convincingly that in agroecological systems yields for crops that the poor rely on most can be increased by several-fold, relying on labor and know-how more than on expensive purchased inputs, and capitalizing on processes of intensification and synergy. Scaling up
such approaches at GIAHS sites can have a positive impact on the livelihoods of small farming communities in dozens of countries. Success will depend on the use of a variety of agroecological improvements that in addition to farm diversification favouring a better use of local resources, also emphasize human capital enhancement and community empowerment through training and participatory methods as well as higher access to equitable markets, credit and income generating activities, all supported by conducive policies.