

GIAHS pilot systems around the world

The GIAHS initiative has selected pilot systems located in several countries of the developing world. The values of such systems not only reside in the fact that they offer outstanding aesthetic beauty, are key in the maintenance of globally significant agricultural biodiversity, and include resilient ecosystems that harbour valuable cultural inheritance, but also have sustainably provisioned multiple goods and services, food and livelihood security for millions of poor and small farmers, local community members and indigenous peoples, well beyond their borders.

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 makes for the selection of these areas and their rural communities a GIAHS site.

The dynamic conservation of such sites and their cultural organization is the basis for a strategy of territorial development and socio-cultural revival. Overcoming poverty is not equivalent to resignation to loss of the cultural richness of rural communities.

On the contrary, the foundation of regional development should be the existing natural and agro-biodiversity and the socio-cultural context that nurtures it.

CHILOE AGRICULTURE SYSTEM

Chiloé island, Chile

The Archipelago of Chiloé, a group of islands in southern Chile, is a land rich 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 conserva-

tion made by ancient Chilotes.

The conservation of such rich genetic diversity provides a major social-economic service to the Chilotan people by improving their nutrition, welfare and resiliency, as many varieties are resistant to introduced pathogens and droughts which are increasingly affecting the region. 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 still



living in rural areas, Chilotan small farmers located in inland as well as coastal valleys are cultivating native and exotic potatoes, giant garlic, wheat, barley and rye. Old apple varieties in small orchards with native vegetation are utilized to feed local races of sheep. In addition many farmers preserve native forest areas from which they derive wood and other non-timber products. Others gather from the wild or grow a variety of medicinal plants. Most harvest for

subsistence family use but 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 agrobiodiversity conservation activities in small plots on family vegetable gardens, comprising a key source of knowledge about on-farm seed conservation, cultivation and potato-based gastronomy in their respective communities.



ANDEAN AGRICULTURE SYSTEM

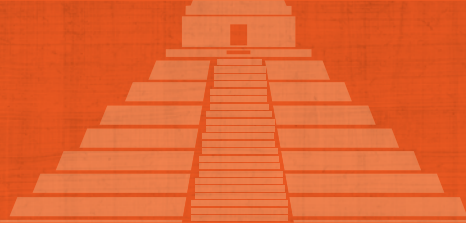
The Cuzco-Puno corridor, Peru

The Andes are a range of mountains including valleys, Puna and Páramos. These valleys are considered as one of the most heterogeneous ecological environments in the planet. Andean people have 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 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 grown include oca, mashua, ullucu, arracacha, maca, achira and yacón. Farmers also grow some fruit trees, corn and chenopods.

Ascending the Andes range of mountains, a transect of different climates and plant communities, and a human landscape composed of terraces, irrigation works, patchworks of crop fields and settlements can be found. The impact of the complex Andean environment on 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 a 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, mostly constructed during prehistoric times. These staircase farms, built up in steep mountain slopes with stonewalls, 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 at long distances through stone canals. Today, as in the distant past, the major crops grown on these terraces are native tubers, such as potatoes, oca and ullucu.



The 350 kilometre transect of the GIAHS pilot site 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**, (1 900 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** (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. A long list of

cultural and agriculture treasures from the Inca civilization can be found in this GIAHS transect, and has been carefully conserved and improved over centuries to live in high altitudes (from 1 000 to 4 000 meters above sea level).

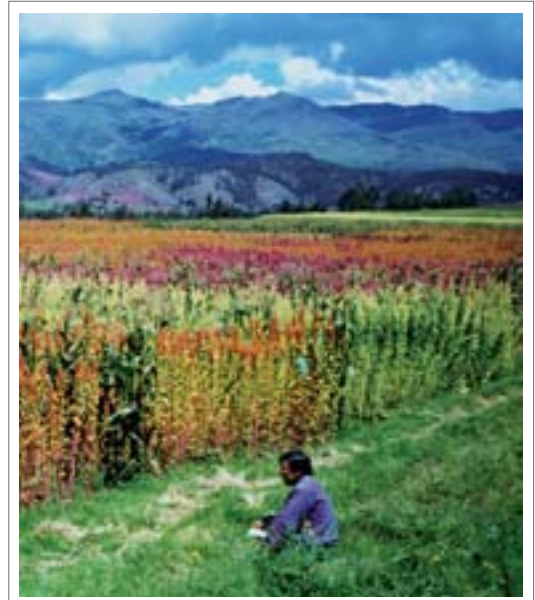
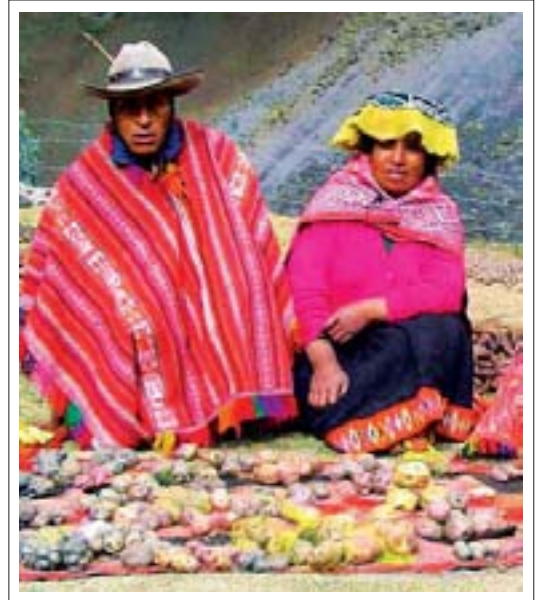
One of the most amazing features of this agriculture heritage is the terracing system used to control land degradation. Terraces allow cultivation in steep slopes and at different altitudes. Andean peasants manage a diversity of crops and crop varieties which have been adapted to different altitudes and are grown in up to 20 plots in different ecological zones to spread risk across 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. Mashua and potato are grown together as protection against certain diseases. To prevent cattle damage, tarhui (lupine) is planted on the edge of maize fields. Maize, beans and pumpkin complement each other in maintaining soil fertility and growing space.

In the high plateaus around Lake Titicaca, farmers used to dig trenches (called “sukakollos” or “waru-waru”) around their raised fields. These trenches were filled with water, modifying or regulating the microclimate and allowing for crop production in the midst of frosts. These ingenious platforms of soil surrounded by ditches filled with water are able to produce bumper crops, despite floods, droughts, and the killing frost common at altitudes of nearly 4 000 m. The revival of this ingenious system in the form of raised fields emerged on the high plains of the Peruvian Andes about 3 000 years ago.

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 fertilize normal pampa soils. In the Huatta district, reconstructed raised fields produced impressive harvest, exhibiting a sustained potato yield of 8 to 14 tons per hectare per year (t/ha/yr). In Camjata, with the waru-waru system, the potato yields can reach up to 13 tons per hectare per year.





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 has created a remarkable agricultural farming system and has retained the viability of a 2 000 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 mountainous lands for food production. In 1995, five terrace clusters in the Ifugao province were declared UNESCO World Heritage Sites honouring 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 caps 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 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 1 000 meters.

IRT paddy farming favours planting traditional rice varieties of high quality for food and rice wine production. Varieties of mudfish, snails, shrimps, and frogs (many of them endemic) are associated with the rice paddies. The *muyong* associated with the rice terrace paddies serve as biodiversity reservoirs (171 tree species, 10 varieties of climbing rattan, 45 medicinal plant species, and 20 plant species used as ethno-pesticides, about 41 bird species, 6 indigenous mammal species, including beneficial species of rats, and 2 endemic species of reptiles) and are fundamental to the agro-ecosystem.



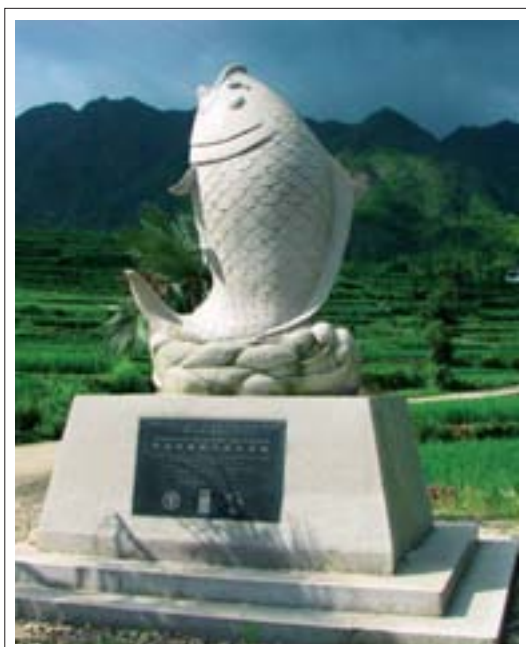
RICE-FISH CULTURE

Qingtian county, China

In Asia fish farming in wet rice fields has a long history. Over time an ecological symbiosis has emerged in these traditional rice-fish agricultural systems. Fish provide fertilizer to rice, regulate micro-climatic conditions, softens the soil, displace water, and eat 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. Fish and rice provide high quality nutrients and an enhanced living standard for farmers. The rice-fish association reduces cost and labor, increases productive efficiency and reduces use of chemical fertilizers, pesticides and herbicides for insect and weed control through agro-biological conservation and on field environmental protection. In the Longxian village of the Zhejiang province this system demonstrates an ingenious approach to generating ecological, economic and social benefits through 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, field hedges; small plots featuring numerous native vegetables and fruits including lotus root, beans, taro, eggplant, Chinese plum (*Prunus simoni*) and mulberry; 6 native breeds of carp; 5 other species of fish, several amphibians and snails can also be found in the paddies. Seven species of wild vegetables are commonly collected along field borders where 62 forest species thrive with 21 species used as food as well as 53 species for medicinal and herbal purposes.





HANI RICE TERRACES

China

Hani Rice Terraces are located in the Southeast part of the Yunnan Province. The Hani are the main minority group and have lived in the region for over 1 300 years. Their rice terraces are distributed along the South slopes of the Ailao Mountains covering an area of about 70 000 hectares. Hani villages are usually located on the mountainsides in a landscape with flourishing forests above and the Honghe River below. Hani Rice Terraces are rich in agricultural biodiversity and associated biodiversity. Rice planted in Hani terraced fields is extremely diverse even though it has been subjected to genetic erosion. Of the original 195 local rice varieties, today there are still about 48 varieties. Local varieties of rice include Hongjiaogu, Shuihongjiaogu, Dabaigu, Maxiang, Mazhagu, Pizagu, Changmaogu, Shangu, Xianggu, Shuihuangnuo, Damaonuo, etc. To conserve rice diversity, Hani people are exchanging seed varieties 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 local aquatic flora and fauna such as fish, snail, eel, loach, shrimp, stone mussels, crab, as well as duckweed, lotus and other aquatic plants. Wild herbs like water celery, plantain, Houttuynia

are grown on the ridges of terraced fields. Hani communities also raise ducks and culture a variety of fishes including common carp, silver carp, crucian carp, and other fish species within the rice terraces and also plant soybeans in the ridges between fields.

The vertical distribution along the mountain slopes of the Forest – Village – Terrace – River landscapes constitutes a unique system of energy and material flows. Part of surface rainfall runoff percolates into the underground water system, while the balance of the runoff and springs flow through the forests, villages and terraces. The flowing water carries nutrients from the forest litter, village sewage and waste, and soil into the layers of horizontal terraced fields. These nutrients and sediment are trapped and filtered in the fields, hence improving soil fertility of the terrace fields. The spatial distribution of the different components of the Hani terrace system performs multiple ecological functions, including soil and water conservation, control of soil erosion, maintenance of system stability and water-purification.

The Hani people also invented two traditional methods of “fertilization of rice fields with hydropower”. The first fertilization method



requires each village to dig a communal manure pond, in which livestock manure is gathered. During spring ploughing, water is released from the large pond and nutrient-rich water washes into the terraced fields. Nutrients are ploughed into the subsoil to provide long-lasting basic fertility.

The second type of fertilization method uses June or July rains, which wash dung and humus from the mountain into ditches and diverts them into terraced fields to fertilize the flowering rice. These traditional methods of soil

fertilization not only save energy and labour in the fertilization process but also make full use of the organic “garbage” in the village and the nutrients carried by water runoff and natural soil erosion. Management of ditches plays a very important role in terraced field irrigation. Water coming down from the hills has to go through ditches to reach the whole terrace. The purpose of digging, cleaning and maintaining ditches is to catch flows from mountain forests and spring water seeping from mountains to irrigate terraces. In addition, the ditches also

In the absence of a dedicated global support structure, many of these heritage systems and associated communities are threatened with virtual extinction. With 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 disappearance of cultures, habitats, and human-created ecosystems is a serious and immediate threat. There is need to protect and safeguard the unique characteristics of agricultural heritage systems: from the perspective of the need to protect and safeguard the unique characteristics of agricultural heritage systems: their importance for human resilience, conservation of biodiversity, cultural, spiritual, and agro-ecological assets in the light of the goods and services provided by traditional systems, in 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.

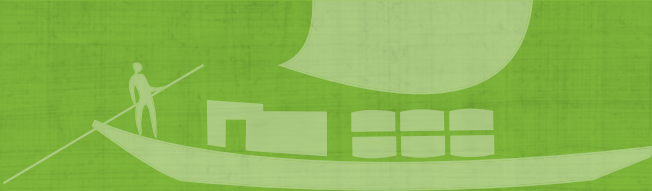
deposit sediments before entering the terrace to avoid continuously elevating the terrace surface due to sediment deposition resulting in declining water-retention capacity. To enable every household reasonable access to water, the Hani invented a unique water allocation method with “water dividing wood”, “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 a specific volume of water flow to lower ditches. The size of the 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 conserves water but also ensures irrigation of lower hill paddy, and has set a precedent for irrigation of mountainous regions.

▼ **Table 1. The extent of traditional agriculture in the developing world.**

REGION	NUMBER OF FARMERS	AREA (HECTARES OR %)	CONTRIBUTION TO FOOD SECURITY
<i>Latin America.</i>	a. 160 million peasants. b. 50 million indigenous people.	38% of total land devoted to agriculture, about 60.5 million hectares.	41% of food consumed domestically.
<i>Africa</i>	a. 60-80% labor force involved in agriculture. a. 70% of population living in rural areas (about 375 million of Sub-Saharan Africa.	100-150 million hectares	80% cereals 95% meat
<i>Asia</i>	200 million small scale rice farmers.	a. 7.3 million hectares of upland rice. a. 20.5 million hectares of rainfed rice.	200 million people supported by upland shifting cultivation.

Source: Organic agriculture, environment and food security (FAO 2002).



Small farms and family farming have been and will remain a key component of our efforts to reduce global food insecurity, alleviating poverty and achieving the Millennium Development Goals (MDGs). In the context of increased global urgency for economically viable, socially responsible and environmentally sound solutions, GIAHS can serve as benchmark systems for international and national strategies for sustainable agriculture and rural development. They address the increasing food and livelihood needs of the poor and the sustainability of natural resources in an era of climate change.

WANNIAN TRADITIONAL RICE CULTURE

China

The Wannian County is located in the Northeast of the Jiangxi Province and the lower reaches of the Lean River. It is under the jurisdiction of Shangrao City in Jiangxi. The Wannian has a long history, a splendid ancient civilization and is believed to be at the regions of origin of rice cultivation. Its wild rice ancestor is found in the neighbouring Dongxiang County.

Wannian traditional rice was formerly called “Wuyuanzao” and is now commonly known as “Manggu”, cultivated in the Heqiao Village since the North and South Dynasty. Wannian varieties are unique traditional rice varieties as they only thrive in the Heqiao Village. The varieties require cold spring water

and special soil conditions and climate that can be found in this Village. The traditional rice is of high nutritional value as it contains more protein than ordinary hybrid rice and is rich in micronutrients and vitamins.

Rice culture is intimately related to local people’s daily life, expressed in their customs, food and language. As ancient but dynamic tradition, 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. This contributes to environmental quality and biodiversity conservation.

OASES OF THE MAGHREB

El Oued, Algeria and Gafsa, 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 infrastructure constitute a crucial element of the oasis systems, supported through traditional local resource management institutions which ensure a fair water distribution.

Dominated by the date palm, intertwined with trees and crops, these long-standing 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 Gafsa, Tunisia. The palm groves offer shade and lower the ambient temperature, making it the best place to live in the Sahara and an important place for recreation.

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. The systems of production and irrigation and the culture of the oases vary between the different locations in

relation to their environment. There are oases in the plains and mountains, as well as in littoral areas. With their rich diversity these oasis 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. The Aoumma derives its legitimacy and authority from customary law and is dependant upon the council of local religious dignitaries- the Halqa of Azzabas- which is also the focus of social life and local norms. Agricultural products from the oasis provide an important source of nutrition and income for its inhabitants and for many it is their source of livelihood. Most of the agricultural products derived from the oasis are for family



consumption and guarantee food security that is high in quality and quantity.

In Tunisia, the oasis dwellers are descendents of indigenous Berbers and people from numerous civilizations that have invaded, migrated to and assimilated into the population over millennia. Since the beginning of the extraction of phosphate (at the end of the 19th century) there has been a significant influx of workers and families looking for work in phosphate mines from Libya and Algeria. The backbone of Oasis livelihood is the irrigated date palm culture with integration of other crops and livestock. In recent times other economic activities such as tourism and remittances from emigrated community emigrants have provided for other sources of income and investment.

The traditional social water management system has been largely replaced by: an association of farmers for water management (Groupement d'Intéret Collectif: GIC for water), a co-operative of agricultural services, Omda (responsible for the smallest administrative unit), agricultural engineering services, and local farmer unions. As there is no integrated collaborative community approach to water management, access to the principal natural water sources and disputes between water users are beginning to be a problem. Also, due to the increased demand for drinking water of the city of Gafsa, the irrigation systems of the Gafsa oases are under increased stress.

THE MAASAI PASTORAL SYSTEM

Kenya and Tanzania

The Maasai pastoral system in Tanzania occupies Northern areas bordering Kenya (from Loliondo to West Kilimanjaro) and extends 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 the Serengeti Plains. The Maasai live in extended 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), for wool (sheep) and for hide (goats). It is an old pastoral system and culture of over 1 000 years and it continues to strike a social and environmental balance in a fragile environment. The Maasai are trying to maintain their unique identity through the maintenance of socio cultural institutions, which are critical in regulating natural resource uses, maintaining grazing cycles and promoting conservation values. Maasai practices of rotational grazing and other natural resource management practices have contributed to creating 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 continue. However, this traditional pastoral system is under



pressure, threatened by several factors including recent policy reforms, an increase in human and livestock population, socio-economic changes, and climatic changes. The livestock pasture and water are diminishing due to shrinkage of grazing areas, successive years of droughts, prolonged dry seasons and increasing stocks. The Engaresero village on the Western shores of Lake Natron has been chosen by the government of Tanzania to exemplify the Maasai pastoral system given its singularity, 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. The community has demonstrated a strong resilience in facing threats to their systems, and has maintained associated social and cultural institutions, which ensure its sustainability under prevailing environmental conditions.

