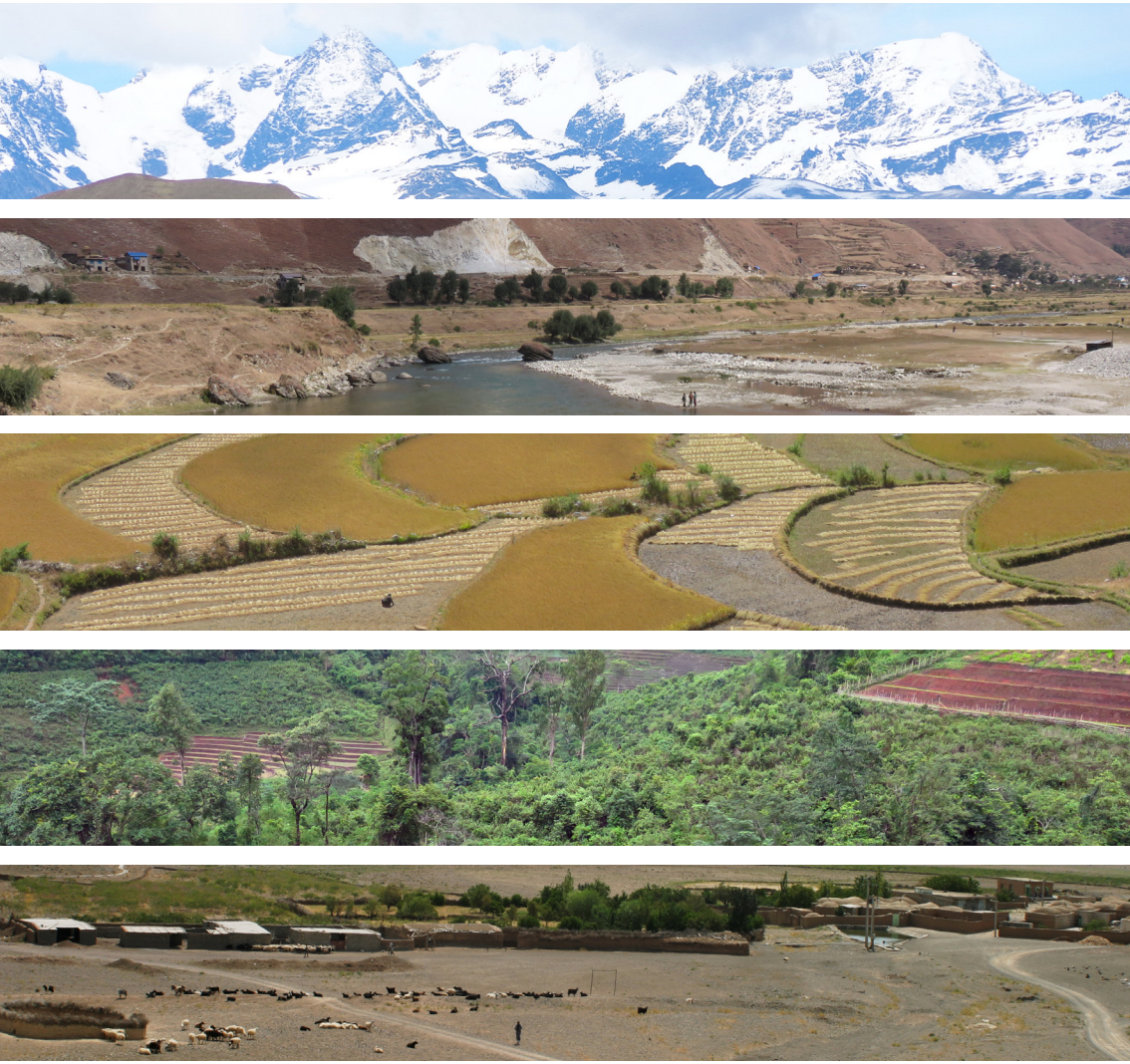
PAR
AGROBIODIVERSITY, LAND AND PEOPLE

# Landscapes for Agrobiodiversity

## Agrobiodiversity perspectives in land-use decisions



## CONSERVATION DEBATES OFTEN IGNORE AGROBIODIVERSITY

Agrobiodiversity is vital for human health, wellbeing and livelihoods. It has important cultural dimensions and makes a key contribution to food sovereignty. Agrobiodiversity includes the variety and variability of animals, plants and micro-organisms at the genetic, species and ecosystem levels, which sustain the functions, structure and processes of production systems. It also includes crop varieties, fodder and tree species, animal breeds, aquatic and marine species, soil biota, pollinators and the great diversity of non-domesticated (wild) species used by people.

Both wild and domesticated species in agricultural landscapes support production and provide essential ecosystem functions. Important wild species include soil micro-organisms, pollinators, aquatic organisms, and plant and animal pest predators. Pollination of crops by animals is estimated to contribute to approximately 35% of global food production. The quality of many provisioning, regulating and supporting ecosystem services depends on the diversity of wild species.

Agrobiodiversity is created and managed by farmers, pastoralists, forest dwellers and fishers, and remains essential to the lives of indigenous peoples and other small-scale food providers who produce and gather most of the world's food. Agrobiodiversity reflects the diversity of both human activities and natural processes. It forms an intrinsic link between people, their land and the environment.

**The importance of agrobiodiversity and its custodians has been ignored in both conservation and agricultural development, as reflected in the debate about whether land "sparing" or land "sharing" is better for biodiversity and meeting future food needs.[1] This debate has largely ignored the ways in which decisions on land use, cultivation practices, and crop and animal production choices affect the amount and distribution of agrobiodiversity in any production system and hence, ecosystem services, agro-ecosystem health and livelihoods.**

1 *There is an ongoing debate between those who argue for farming agricultural land intensively to maximize yields while conserving and protecting natural habitats (land sparing), and those who emphasize integrating biodiversity conservation with food production using wildlife-friendly farming methods (land sharing). See for example Fischer et al. 2014. Land Sparing Versus Land Sharing: Moving Forward. Conservation Letters 7(3), 149–157.*

2 *Tscharntke* et al. *2012. Global food security, biodiversity conservation and the future of agricultural intensification. Biological Conservation 151 (1), 51–59.*
*Bommarco* et al. *2013. Ecological intensification: harnessing ecosystem services for food security. Trends in Ecology and Evolution 28(4), 230–238.*
*Kremen C. 2015. Reframing the land-sparing/land-sharing debate for biodiversity conservation. Annals of the New York Academy of Sciences 1355, 52–76.*



## INCLUDING AGROBIODIVERSITY INTO LAND MANAGEMENT DECISIONS

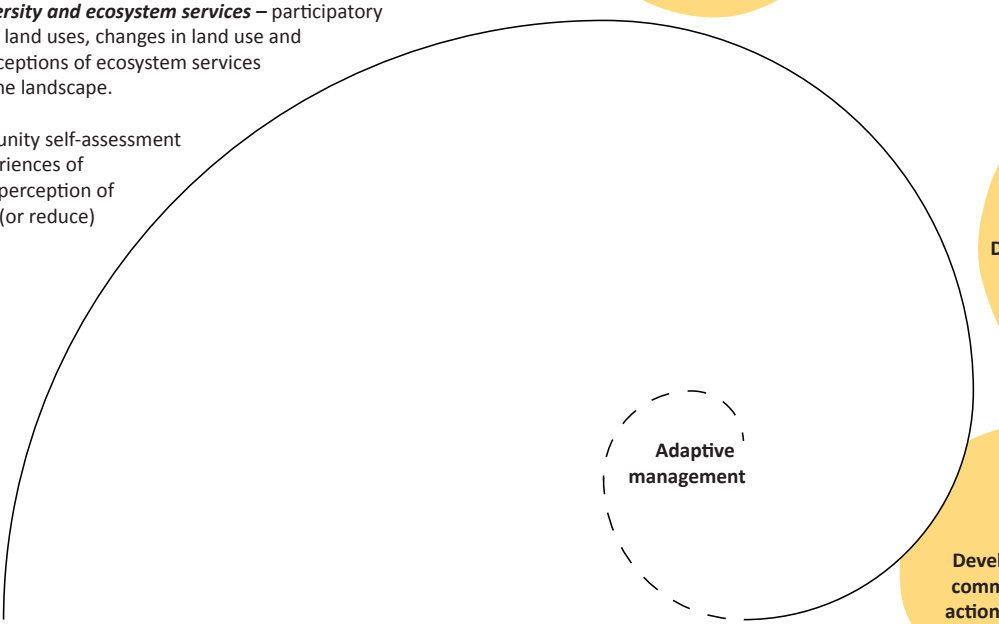
Landscapes around the world are undergoing simplification due to changing patterns of land use. Changing land-use practices can result in a reduction of agrobiodiversity —crop, livestock and aquatic diversity and the biodiversity associated with ecosystem functions, such as pollination and soil productivity. Land-use changes that take insufficient account of their consequences for agrobiodiversity may lead to the loss of landscapes' capacity to support sustainable production and rural livelihoods.[2] Land-use decisions that take into consideration the experiences of indigenous and rural communities and their management of agrobiodiversity are more likely to sustain delivery of ecosystem services, increase adaptation options and strengthen resilience to climate change.

**In this booklet, we present the results of an interdisciplinary research project in eight biocultural landscapes undertaken by the Platform for Agrobiodiversity Research (PAR) in collaboration with local partners and communities from around the world. The aim of the project was to illustrate the importance of including agrobiodiversity in land-use decisions. The project brought together young researchers with different backgrounds, including sociologists, biologists and geographers, with expertise in various areas that were of relevance to this study such as participatory mapping, animal and crop diversity, agroecology and resilience. The tables presented over the following pages describe the eight landscapes in which the project team worked and summarise the findings.**

# A FRAMEWORK FOR ASSESSING THE EFFECT OF LAND-USE CHANGE ON AGROBIODIVERSITY

As part of the project, a framework was developed to examine the effects of land-use change on agrobiodiversity. It employs participatory and transdisciplinary approaches to build collaborative relationships between the researchers and the community, and to capture local communities' needs and experiences. It transcends a single disciplinary view to include different components of agrobiodiversity (crops, animals and wild plants) as well as the different forms of knowledge that underpin this diversity.

The framework takes a landscape perspective, which allows a more complete reflection of agrobiodiversity characteristics and accounts for the many different features that provide ecosystem services and support resilience. It can be used in 1) areas rich in agrobiodiversity threatened by land-use change and 2) areas with low agrobiodiversity where it is necessary to increase diversity in order to support resilience to climate change and agroecological approaches to production.




**1 Building a partnership**

Creating an agreement with communities with respect to objectives, expectations and working practices; and the signature of ***Free Prior Informed Consent Agreements***, which should be based on a full and open discussion to develop a common understanding of all aspects of data collection and analysis, and their use and purpose.

**2 Data collection and organization on status, trends and changes with respect to agrobiodiversity, land use and resilience**

***Agrobiodiversity assessment*** – household surveys, focus group discussions (including four cell analysis), key informants and other methods including free-listing and transects walks to assess
**a) crop and varietal diversity**: the numbers (richness) and identities (names), evenness and divergence (the extent to which the uses of diversity differ between farmers and between communities); the uses and the reasons for any changes; and identification of rare and lost varieties
**b) wild plants** identity and characteristics, location (habitat), uses and associated local knowledge and trends with respect to uses and availability
**c) animal species and breed** identity and their population size; challenges and changes; social, cultural, ecological and production context

***Mapping land use, agrobiodiversity and ecosystem services*** – participatory mapping of landscape features, land uses, changes in land use and the assessment of farmers' perceptions of ecosystem services provided by different parts of the landscape.

***Resilience assessment*** – community self-assessment workshop to capture local experiences of environmental change and the perception of main factors that contribute to (or reduce) resilience.

**3 Data integration and analysis**

Understanding landscape dynamics and the effects of land-use change on agrobiodiversity and resilience, e.g. identifying landscape features of importance to the maintenance and use of agrobiodiversity and continued flow of ecosystem services.

**4 Data sharing and validation**

Sharing data and results with community members provides for better interpretation, and facilitates collective ownership of data.

**5 Developing community action plans**

The information gathered is used to develop strategies and action plans for improved adaptive management of agrobiodiversity at the landscape scale.

# Research sites

## IRAN Abolhassani

LANDSCAPE FEATURES

The Abolhassani Indigenous Nomadic Tribal Confederacy consists of 11 villages on the edge of the central desert of Iran. Abolhassani tribes are transhumant pastoralists. Every year, the flocks of sheep and goat repeat a cycle of migration between the summer and the winter pastures.

CONSERVATION MECHANISMS

The Abolhassani Confederacy is an *Indigenous Peoples' and Community Conserved Area (ICCA)*. It is inside Touran, one of the nine UNESCO Biosphere Reserves in Iran, home to the critically endangered Asiatic cheetah.

## BOLIVIA Cachilaya

The indigenous Aymara community of Cachilaya is located on the southeastern shore of Lake Titicaca in Bolivia. Cachilaya farmers derive their livelihoods from mixed crop and livestock farming, largely on communal lands. Traditional land use comprises a mosaic of sacred sites, communal lands and family-owned plots.

The area of Lake Titicaca is recognized as a *Micro-center of Biodiversity* for potato, quinoa, cañahua and other crops. The local government has acknowledged the importance of supporting custodian farmers who safeguard crop diversity.

## NEPAL Hanku

Hanku is a village in Jumla district in the Himalayan highlands in Western Nepal. Hanku extends from 2200 up to 4600 MASL and it is predominantly covered by forest and grasslands. Agriculture, livestock and forests are the main sources of livelihoods for the local communities.

Jumla district declared itself as an organic district in 2007. Efforts for conservation of local crops have been made by District Agriculture Development Office, the Nepal Agricultural Research Council and NGOs working in the area. Forests are used and managed by community-based groups. Highland lakes are considered sacred.

## INDIA Lyngngam

The Lyngngams are one of many distinct indigenous societies in northeast India. They practice rotational (*jhum*) cultivation and maintain a rich diversity of local crops. We worked with three Lyngngam communities in West Khasi Hills.

In Lyngngam, *community reserved forest* is a conservation mechanism that protects several forest patches, which were traditionally considered sacred.

## THAILAND Pgaz K' Nyau

Pgaz K' Nyau landscape in Chiang Mai province, Thailand, is managed by the Karen indigenous communities. Traditionally, the Karens cultivate hill rice on rotational fields in hilly forest areas and collect wild foods, medicinal plants and other resources in forests and fallow lands.

San Din Daeng is a part of Inthanon National Park. Local communities are members of a highland conservation network, and manage their resources according to community rules.

## CUBA Sierra del Rosario

Located in the Guaniguanico mountain range in Cuba, Sierra del Rosario is one of richest biodiversity areas in the Caribbean. The landscape comprises a mosaic of forests, home gardens and shaded coffee agroforestry systems. It hosts high levels of agricultural and wild biodiversity.

Sierra del Rosario was declared an UNESCO biosphere reserve in 1985. It covers an area of 26,686 hectares with about 800 plant species and high levels of flora diversity with 11% endemism.

## ZIMBABWE Tshongogwe

Tshongogwe in Lupane District, Zimbabwe, is a dryland savannah landscape predominantly inhabited by Ndebele communities that derive their livelihoods from mixed crop and animal smallholder farming and wild resources.

*Conservation forest*, grazing lands and other resources are managed by the communities according to their traditional rules. Certain species such as the marula tree are considered sacred. Crop fields are cultivated with minimum disturbance of the soil.

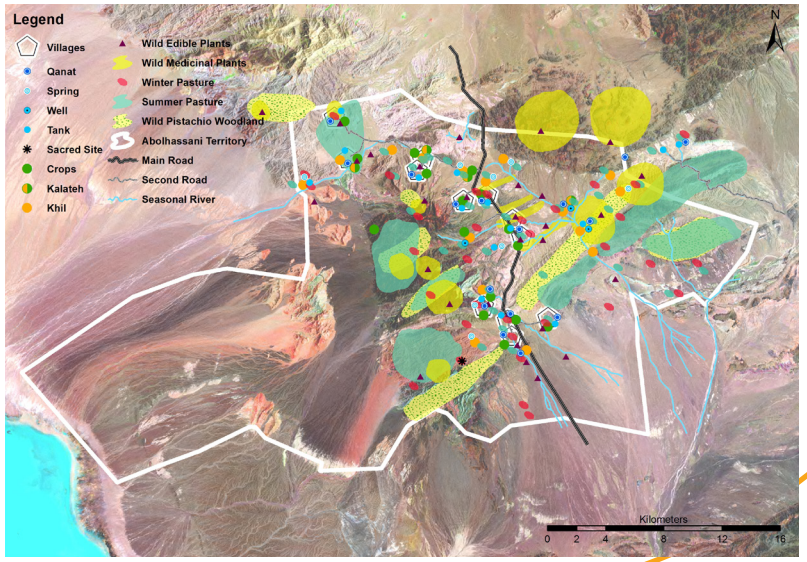
## SRI LANKA Udakumbura

Udakumbura in Kandy District in Sri Lanka is famous for its spice gardens. Forests are interspersed with black pepper gardens, paddy terraces, rotational (*chena*) fields and *patana* grasslands.

In Udakumbura, the forestry and wildlife departments of Sri Lanka manage the forests. In addition, some small forest patches are co-managed with the community.

## Agrobiodiversity

| | CROPS | WILD PLANTS | ANIMALS |
|---|---|---|---|
| **Abolhassani** | Several different varieties of figs, grapes, pistachio and pomegranate are cultivated in home gardens and fruit orchards. Barley and wheat have been recently introduced. | About 50 wild plants species, largely collected in the rangelands, are commonly used as food, medicine, forage and fodder. | Animal breeds include *Mahali* and Pakistani goat and Baluchi and *Afshari* sheep. *Mahali* goat and Baluchi sheep are local and well adapted to drought, cold and the limited availability of forage and feed. |
| **Cachilaya** | Lake Titicaca region is a centre of diversity for potato, quinoa and cañahua. Wild relatives of these crops are found throughout the landscape and used by local communities. About 100 potato varieties are conserved by a custodian farmer Viviana Herrera. | Wild plants are collected in all parts of the landscape, both mountains and wetlands. 33 medicinal plants and their uses have been documented. Some of the medicinal plants are cultivated, but most of them are collected from the wild. | Black, red, brown, bronze and *cheje* (stained) cattle, white, black and red sheep, and white, black, red and *cheje* pig are some of the animals present in the community. These animals are known as *creole* or local. |
| **Hanku** | Proso millet, foxtail millet and buckwheat are some of the traditional crops in Hanku. There are 6 varieties of cold tolerant rice, 4 varieties of amaranth, 2 varieties of barley, 3 varieties of buckwheat, 4 varieties of finger millet and 13 varieties of common bean. There is also a considerable apple production. | Diverse range of wild foods, fruits and vegetables are collected from forests and rangelands. An example is a wild plant called "*ghodamarcha*" – the leaves are commonly used to prepare tea considered to have medicinal properties. | Cow, ox and hen are among the major livestock raised by the majority of households in Hanku. Cows are mostly used for milk and manure whereas ox are used for draught power and manure. Some households also raise goats, sheep and horses. |
| **Lyngngam** | There are 13 varieties of rice, 13 varieties or taro and 4 varieties of cassava and 8 varieties of yam. Many other fruits and vegetables are cultivated, and they form an intrinsic part of the rotational cultivation system. | About 25 wild plants are commonly used as food and medicine. Bamboo is an important species with many different uses including basket weaving and house building. | Local breeds of chickens and pigs are kept, while goat rearing is becoming increasingly popular. Eri culture (raising of Eri silkworms) is popular but now used only for food and not for silk weaving. |
| **Pgaz K' Nyau** | In the past, there were 22 rice varieties, half of which are not cultivated any more. There are 15 varieties of yam, 6 varieties of taro, 8 varieties of cucumber, 7 varieties of eggplant, 6 varieties of gourd, 2 varieties of sesame and many other crops. | About 14 medicinal and 23 wild food plants are collected from fallow fields, gardens and forest. Food, medicine, building material, natural dyes and other material are collected locally and very few items are bought from external markets. | Local breeds of chicken, pig, and buffalo are kept. Some of the breeds such as black chicken and black pig are important for wedding and different ceremonies during which offerings are made to spirits. |
| **Sierra del Rosario** | Sierra del Rosario is recognized for its rich crop genetic resources with high levels of varietal diversity of coffee (3 varieties), maize (5 varieties), lima bean (8 varieties) and common bean (10 varieties), chilli (24 varieties) and *Musa* spp. | *Agroforestry* home gardens include up to 300 plant species most of which are ornamental and medicinal, followed by fruit and timber species. Several plants are considered sacred, including *Ceiba pentandra* and *Trichilia havanensis*. | Farmers have a mix of "*creole*" and improved commercial breeds of chickens, turkeys, pigs and cattle. *Creole* refers to local breeds, which have specific colours. |
| **Tshongogwe** | Crop varietal diversity included maize (3 varieties), sorghum (3 varieties), bambara groundnut (4 varieties), groundnut (3 varieties) and cowpeas (2 varieties). In addition many local vegetables and agroforestry species are used as food and other purposes. | Wild resources including forest fruits, wild vegetables, mushroom and insects are commonly used as food. Marula and other trees provide food, income, fodder, firewood and fencing for homesteads and crop fields. | Tshongogwe is rich in indigenous cattle and poultry breeds. There are four cattle breeds (*tuli*, *nkone*, *brahman*, *mashona*); poultry (*isikhova*, *insingizi*, *ithendele*, *imbila*, *indiya*); and goats (*matabele*, *mashona*). |
| **Udakumbura** | About 40 crops are cultivated: different spices, paddy rice, beans, finger millet, pepper, tomato and 22 leafy vegetable (cultivated and uncultivated). Traditional varieties have been lost, except for rice where about 8 varieties are still found in the community. | Many wild species are used for cooking, medicinal, religious and spiritual purposes. Production of jaggery from kithul trees (*Caryota urens*) and oil from seed of mee trees (*Madhuca longifolia*) is common. | Livestock diversity comprises local breeds of cattle, buffalo and chickens. Numbers of animals are dropping. Goats were introduced by the agricultural extension service in the 1990s but are no longer present. |

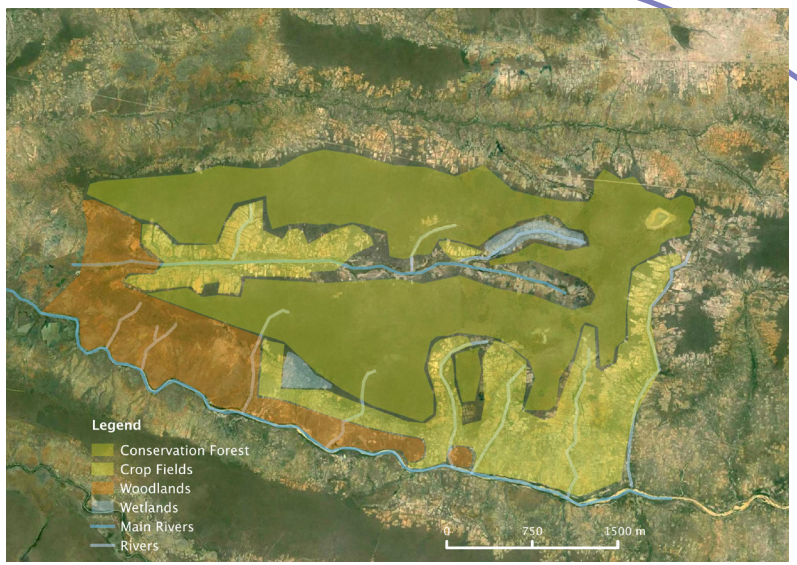



## Abolhassani, IRAN

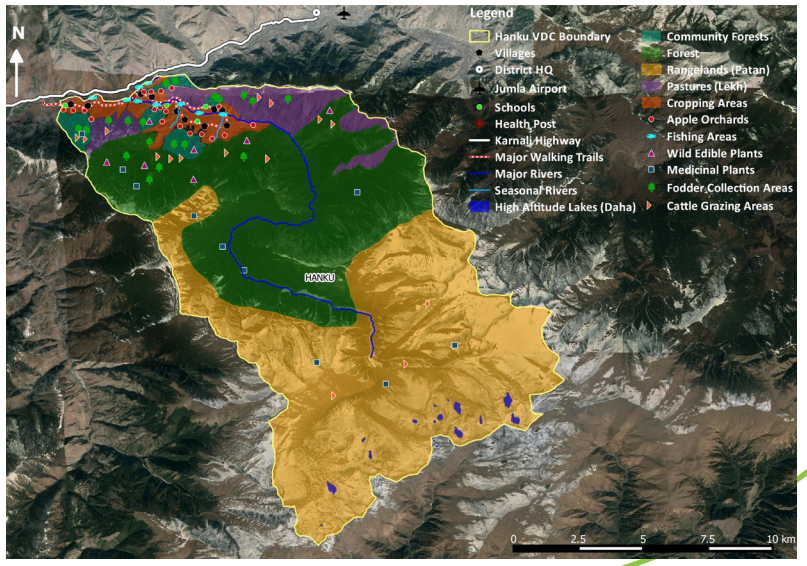


## Cachilaya, BOLIVIA

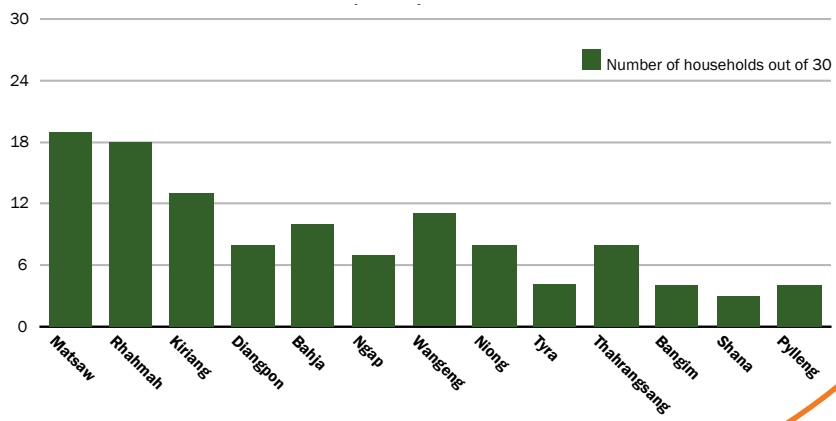
## Tshongogwe, ZIMBABWE




## Udakumbura, SRI LANKA




## Hanku, NEPAL

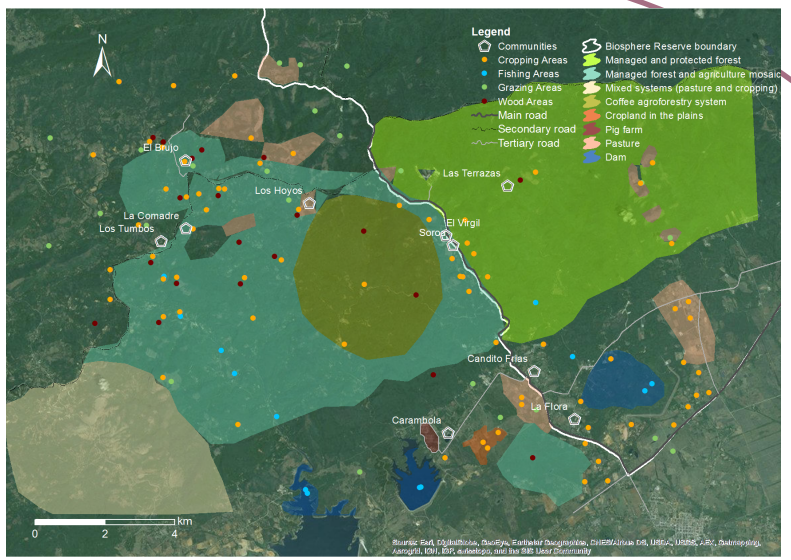



Richness and evenness of taro varieties

## Lyngngam, INDIA

## Pgaz K' Nyau, THAILAND

## Sierra del Rosario, CUBA




## Land use and Resilience

| | LAND-USE AND ENVIRONMENTAL CHANGE | RESILIENCE AND ADAPTATION STRATEGIES |
|---|---|---|
| **Abolhassani** | An increasing frequency and intensity of droughts has had a negative impact on livestock, water availability and pastures. Droughts have exacerbated the overgrazing problem. The shortage of food and water caused by droughts can lead to a reduction of the numbers of animals and loss of animal breed diversity. Only very hardy sheep and goat breeds can survive the harsh conditions in this area. | Local communities have diversified their activities through the crop-livestock integration. Instead of relying on pastures, they now cultivate barley, which is used as fodder. Barley cultivation has helped decrease pressure on pastures. Landscape-scale grazing plans devised by the communities are re-evaluated by elders every year to determine the number of livestock that can enter each pasture. “Weak” pastures are left to recover and are not grazed for a period of time. |
| **Cachilaya** | Environmental degradation is a major problem. The fish number is dwindling due to the pollution of Lake Titicaca. Soil degradation is exacerbated by increasingly unpredictable, shorter and more intense rains, which in combination with more pronounced frosts and droughts have a negative impact on crops. Another problem is diminishing size of *sayaña* lands as they get divided into progressively smaller plots generation after generation. Farmers who seek economic alternatives outside the community tend to cultivate improved varieties, which require the use of pesticides and fertilizers. | High number of crops and varieties help mitigate weather-related risks. Some of the local crops and varieties have valuable traits such frost- and drought-tolerance. The community's resilience is attributed to a dense fabric of social networks and a high level of self-organization reflected in the management of common land and crop diversity. Greater focus on land and ecosystem restoration will be needed to improve the resource base on which the local livelihoods depend on. |
| **Hanku** | The over-exploitation and shrinking of forest areas and overgrazing of pastures are some of the problem affecting the availability of medicinal plants, fodder, firewood and building material. In recent decades, commercial apple and bean cultivation has replaced some minor crops, such as proso millet. More than 60% and 90% households grow apples and beans respectively. Crops are affected by drought during the summer, and heavy rains and hail in September and October. | To ensure sustainable forest management, four community forests groups have been established: *Mahadev Gaira*, *Chaupat*, *Jalpa Devi*, and *Thala Chaur*. There is a great need to devise and implement sustainable management plans to address overgrazing. For climate change adaptation, it will be important to maintain local crop varieties that tolerate unpredictable rainfall, hail and disease. Some crops such as proso millet, foxtail millet and buckwheat show resistance to both cold and drought. |
| **Lyngngam** | Shrinking of the reserved forest areas and expansion of crop fields resulted in lower availability of wild plants, some of which are now available in remote areas. Shifting cultivation has intensified, with fallow period reducing from 7-8 years to less than 4-5 years. Millet diversity has been reduced to an extent that only a few farmers continue to grow these cereal crops. Hill rice diversity is still cultivated but several varieties are being grown by a few farmers and are at risk of loss. Irregular and erratic rainfall has caused negative impact on crop yield, while intense rains and floods cause damage to paddy fields. Water shortage during dry months is becoming more pronounced. | Traditionally, clearing of *jhum* fields was done in a way to support the regeneration of the vegetation after cultivation (i.e. some trees are always left in the fields). With land-use intensification, no trees are left in the fields leading to slower regeneration. There is an awareness of the need to maintain or plant trees in cleared fields to support soil rejuvenation during fallow period. Diversification through conversion of paddy fields to fish ponds improved both the income and water availability. Encouraged by a local NGO, the farmers have expressed a desire to revive millets and sorghum, which could be an adaptation to increasingly drier condition between the monsoons. |
| **Pgaz K’ Nyau** | Rotational farming and wild plants continue to have essential livelihood value, although the length of the rotation cycles shortened and individual land ownership are increasing. Paddy rice cultivation was introduced 20 years ago. Since the year 2000, the weather is more unpredictable, rainfall is erratic and seasonal patterns are changing. Crops and agricultural activities are affected both by droughts and floods, which occur one after another. | Forest and other natural resources are managed according to rules developed by the community and approved by the government. The conservation forest area is protected and used only for grazing but not for timber extract or agriculture. As a result, the forest cover has increased over the last decades. In addition to the conservation forest, areas for the conservation of aquatic organisms have been established. A community rice bank has been set up to mitigate the effects of droughts and harvest loss. |
| **Sierra del Rosario** | After large-scale deforestation in the 1960s, restoration activities promoted economic development through forestry. While high levels of wild and agricultural biodiversity have been maintained, main threats are related to climate change. Natural vegetation and crops are affected by the more frequent droughts and devastating hurricanes as well as the changes in rainfall patterns. | Farmers are adapting to increasingly unpredictable weather and drought by planting more perennial crop species and trees, as well as by adjusting and changing the timing of agricultural activities. Agricultural diversification is also promoted as a way to widen income opportunities in the face of extreme climatic impacts. |
| **Tshongogwe** | Conservation forest, although protected by customary law, is gradually converted to cropland resulting in the loss of wild fruits, wild honey and other important resources. The conversion is party driven by the low productivity of existing croplands, which is caused by low, uneven, erratic and unreliable rainfall. Increasing frequency of droughts result in poor yields and the loss of local crop varieties. Possible loss of diversity of crop and animal species. | The conservation forest is a source of resilience and food security. During droughts and crop failures, the conservation forest provides food as well as forage and fodder for livestock. In response climate change, livelihood activities are being diversified through gardening, agroforestry, fishing, carpentry, bee keeping and the sale of timber and non-timber forest products (e.g. marula oil). Grazing plans based on traditional community laws have been established to avoid overexploitation and depletion of pastures. Soil erosion and depletion is tackled through conservation agriculture techniques, which increase soil moisture. |
| **Udakumbura** | Traditionally, farmers practiced *chena*, (shifting cultivation) on forest lands. With the acquisition of forests by the government, *chena* cultivations has been minimized. With the abandonment of *chena* cultivation, many local crops and varieties have been lost. Nowadays, the main crop is black pepper, which require the use of agro-chemicals. Climate-related stresses include heavy rains and storms, which sometimes cause landslides. The major problem for the production of commercial vegetables is the reduction of second inter-monsoon rains. Crops also suffer from attacks by elephant, wild boar, giant squirrel and monkey, caused by deforestation in adjoining valleys. | Changing rainfall patterns have disrupted cultivation practices, in particular, the late coming of the second monsoon. The relatively large forest cover contributes to the mitigation of floods and droughts. However, improvements of current practices are needed to address periodical water shortage. The revival of stress-tolerant and nutritious local crops can contribute to adaptation to climate change. |

## LAND-USE CHANGE AND AGROBIODIVERSITY IN EIGHT SITES

Land-use patterns are changing under pressures coming from different sources, which range from climate change to urbanization and can even include the actions of conservation agencies. Our study revealed multiple drivers and causes of land conversion and agrobiodiversity loss: changes in land ownership, introduction of commercial crops, population growth and climate change. "Land sparing" scenarios, linked to change in ownership/tenure system, are likely to have a negative effect on agrobiodiversity, particularly crop diversity, as illustrated by the experiences of communities in Udakumbura (Sri Lanka) and Pgaz K'Nyau (Thailand).

In Pgaz K'Nyau, agriculture intensification was promoted as part of nature conservation efforts. After their land became part of Inthanon National Park, the indigenous Karen farmers were encouraged to cultivate paddy rice and other cash crops, and to use fertilizers and pesticides. Despite the pressure to "modernize", the Karens have maintained their traditional rotational farming practices in which they cultivated about twenty varieties of upland rice and many other species of vegetables. However, the area under commercial crops is gradually increasing. To demonstrate their commitment to conservation, the Karen have devised and implemented a resource-use plan to restore the forest cover.

In all eight landscapes, despite the changing land-use patterns, the diversity of crops, animals and wild plants continues to make a major contribution to resilience of local communities. Local crop varieties are used for their suitability to local environments and tolerance to climate-change related stresses. Several of our sites are in the centres of crop and animal diversity, e.g. Cachilaya (Bolivia) is located in the centre of origin of potato, quinoa and cañahua. By continuing to use local varieties and crop wild relatives, local communities allow the continuation of the processes of evolution embedded in specific land-use patterns.

Diversification of production systems through the introduction of cereals, leguminous plants and trees are some of the adaptation strategies in response to changing rainfall patterns, droughts and hurricanes. Furthermore, harsh environmental conditions are one of the reasons for the continued importance of local animal breeds, which are often hardy and disease-resistant. Wild plants continue to be an important source of food, medicine, forage, fodder, dyes and firewood. Particularly during periods of food shortage, wild plants are a critical source of nutrition and food security.

Wild ecosystems are perceived by the local communities to provide many of the ecosystem services assessed in this study, as shown in the table below. In addition to provisioning services, wild areas have an important role in buffering the effects of floods, droughts and other extreme weather events. Forests were perceived as a key source of ecosystem services, suggesting an awareness of the importance of wild areas within landscape mosaics. We also found great understanding of the interactions between land uses, although these interactions were not always taken into consideration in management decisions.

**A summary of farmers' perceptions of the sources of ecosystem services in eight sites**

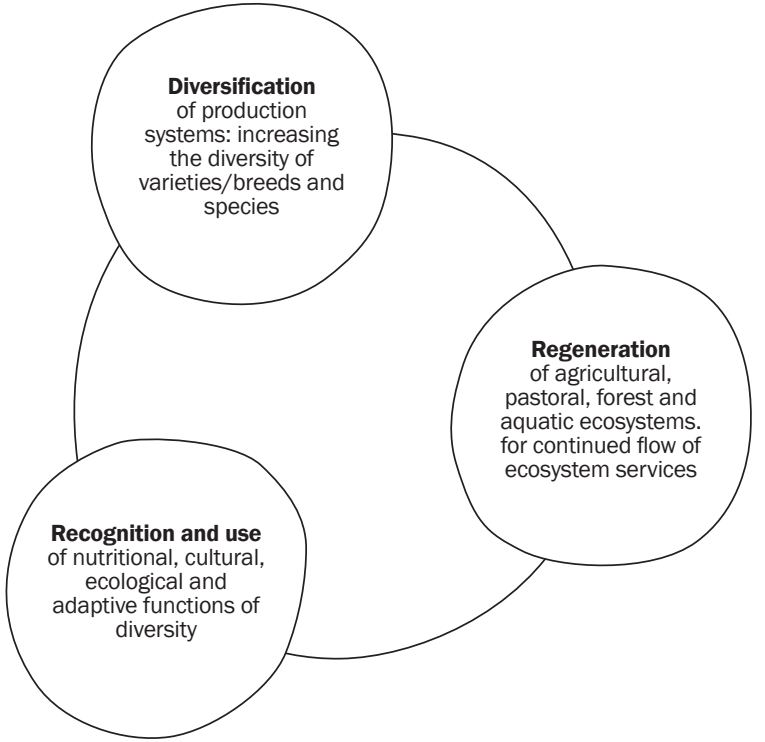
| | |
|---|---|
| Water for people, agriculture and animals | water sources*, forests°, woodlands |
| Soil fertility | cultivation systems including rotational fields, forests°, rangelands, pastures, woodlands |
| Pollination | cultivation systems including rotational fields, forests°, sacred sites, rangelands, pastures, woodlands, entire landscape |
| Wildlife habitat | forests°, rangelands, woodlands, pastures, cultivation systems, sacred sites, water sources |
| Cultural importance | sacred sites, forests°, cultivation systems including rotational fields |
| Drought mitigation | forests°, cultivation systems, water sources, rangelands, pastures |
| Flood mitigation | forests°, cultivation systems including rotational fields, pastures, rangelands, mountains |
| Pest and disease regulation | cultivation systems, rangelands, pastures, forests°, landscape |
| Soil erosion control | cultivation systems including rotational fields, rangelands, pastures, forests°, sacred sites |

* water sources: springs, wells, ponds, stream, rivers

° forests: conservation forest, used forest and other types of forests

Our study also shows that, in the absence of strict protection plans, the degradation and shrinking of ecosystems is a major threat to agrobiodiversity and ecosystem services: lake pollution in Cachilaya (Bolivia); shrinking of conservation and sacred forests in Tshongogwe (Zimbabwe), Lyngngam (India) and Hanku (Nepal); and the degradation of pastures in Abolhassani (Iran). In several sites, sacred forests are gradually being converted into cropland despite the customary laws that forbid tree cutting. This is related to the loss of cultural connection with the land and the disintegration of customary laws and traditional mechanisms of conservation.

**Linked land-use strategies carried out collectively through local institutions support and restore agrobiodiversity in landscape mosaics**




## SUPPORTING LANDSCAPES FOR AGROBIODIVERSITY

The assessment of the effects of land-use change on agrobiodiversity allows us to support local communities to harness synergies between conservation, diversification and ecosystem restoration at the landscape scale. These strategies in some cases arise from the aspirations of indigenous communities to protect their land and cultural heritage in the context of social and environmental change. They also provide ways of addressing some of the challenges related to food production, biodiversity conservation and resource scarcity raised by the land “sparing” versus land “sharing” debate.

Our case studies confirm others in showing that agrobiodiversity conservation, diversification and restoration depend on the collective engagement of community members through local institutions that facilitate adaptive management and equitable sharing of resources. Local institutions can take different forms, from specific management plans to shared sets of beliefs. The examples in this project included grazing plans in Abolhassani and Tshongogwe, forest use plans in Hanku and Pgaz K’Nyau, a community-seed bank in Cachilaya and sacred sites and plants in Sierra del Rosario, Tshongogwe, Hanku and Pgaz K’Nyau.

Local institutions embody traditional knowledge but at the same time provide a platform for innovation and adaptive management, which involves monitoring and continuous improvement of management practices in response to experiences and observations as illustrated by the grazing plans in Abolhassani. Ten pastoral communities have developed and implemented a plan for coping with, and adapting to, increasingly frequent drought. In collaboration with NGOs, they have diversified land use through integrated crop-animal production to ensure availability of animal feed during droughts. The pastures are closely monitored and re-evaluated every year, and “weak” pastures are not used for a certain period of time to ensure their recovery.

The involvement in strategic collective management plans reflects social cohesion and facilitates sharing of resources as illustrated by the community rice seed bank in San Din Daeng (in Pgaz K’Nyau), which was created after several years of drought. The rice seed bank is a collectively owned granary from which farmers who lose their harvest to unfavorable weather can borrow rice for food or seed.

Supporting community-based institutions for adaptive land-use and agrobiodiversity management can enhance their capacity to implement strategies for ecosystem regeneration, diversification of production systems and the maintenance of genetic resources. This can contribute to resilience by ensuring the flow of ecosystem services, supporting agroecological practice and enabling conservation and continued evolution of genetic resources.

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- Agrobiodiversity Conservation and Man and the Biosphere Reserves in Cuba: Bridging Managed and Natural Landscapes Project
- Mainstreaming agrobiodiversity conservation and use in Sri Lankan agro-ecosystems for livelihoods and adaptation to climate change (BACC)

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