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Agrobiodiversity in drylands

When it rains and drylands bloom, one realises the remarkable diversity of living organisms they harbour. Long overlooked, this diversity is crucial to the food security of a large share of the world's population.

Drylands cover about 41 % of the earth's land surface. More than two-thirds of their area lie in developing countries, where around 90% of the two billion dryland inhabitants live – about a quarter of the world's population.



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Drylands and dryland biodiversity

Drylands cover about 61 billion ha. About 16 % of this area is hyper-arid, 26 % arid, 37 % semi-arid and 21 % dry-subhumid. To date there are approximately 1.4 million or more named species in the world – plants, animals, fungi and microbes. How many percent of these are found in drylands is unknown as dryland diversity is still little documented. About 30 % of the cultivated plant species are endemic to drylands and at least a quarter of the world's documented 5600 (mammalian) livestock breeds has been developed in the drylands. Both wild and agricultural diversity are facing many threats. According to the Living Planet Index, the global population of (wild) species declined by about 30 % between 1970 – 2006. The downward trend was much more marked in tropical species populations which fell by almost 60 %. So far the percentages of livestock breeds reported at risk and extinct in drylands have – with the exception of Africa – been below the global levels. But data from drylands are rather incomplete and have to be treated with caution.

Drylands encompass savannah woodlands, grassland, deserts and other areas with inconsistent rainfall, often high temperatures, and great seasonal and spatial variations of the fauna and flora. Some drylands are too dry even for the most extensive pasturage. The bulk is rangeland and is used mainly for grazing. The remainder is cultivated with rain fed crops, and a small but growing percentage is under irrigation.

Many dryland inhabitants are poor and depend on local plants and animals for their survival, food and income. Their century-old food production and livelihood strategies optimise the sustainable use of available resources. The world's 120 million pastoralists have especially well adapted to dryland conditions. The breeds they have developed and their mobile herding strategies enable them to produce food in areas too dry for cropping.

Mobile herding of Borana pastoralists optimises resource use

Borana pastoralists in southern Ethiopia have a complex network of institutions and committees that regulate access to water and pasture, organize their herd movements, and coordinate movements with other pastoral groups in the area. Their mobile herding strategies and institutional set up have allowed them for centuries to exploit differing environments and to graze their animals throughout the year without depleting the resource base. But these mechanisms are breaking down due to a number of factors including population growth, settlement policies, the establishment of wells and other developments; as a result the sustainability of the dryland ecosystem is increasingly jeopardized.

Food crops from drylands

Numerous food crops of global importance originate from drylands. The list includes maize, beans, tomato and potatoes from Mexico, Peru, Bolivia and Chile; and wheat, rice, barley, millet, sorghum, lentils, chickpeas, and many fruit trees such as olives, dates, figs, pistachios, almonds and plums from North Africa, Central and West Asia and the Mediterranean. These are only a tiny part of the rich diversity found in drylands. The gene banks at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Center for Agricultural Research in the Dry Areas (ICARDA) have more than 119,000 and 131,000 accessions from about 144 countries – cereals, food and feed legumes and forages, including cultivated varieties landraces and wild relative species. Such gene bank holdings can be vital when diseases, conflicts and other disasters destroy the natural resource base.



Maize was originally cultivated in dryland areas and is one of the world's most important crops. © Martina Park



Maintaining diversity of potato species is a matter of vital importance for food security in the Andean region. © CIP

But land-use patterns are changing rapidly. Rising populations, new technologies, education, government policies, trade and other factors promote the intensification and expansion of cropping and livestock keeping. Overuse of resources and inappropriate land use lead to degraded soils, desertification and the loss of biodiversity. The impacts are felt especially in the 50 poorest countries of this world.

Climate change is expected to aggravate the situation and enhance the frequency and extent of extreme weathers, floods and droughts. This will threaten the existence of many of the poor whose livelihoods are closely intertwined with the diversity they have nurtured for centuries – and that holds many potential solutions for the adaptation to climate change.

Drylands: Stores of agrobiodiversity

Drylands are the original home of a long list of food crops and large numbers of adapted breeds of goats, sheep, cattle, equines, and camelids. Drylands also harbour numerous, but little-studied, soil bacteria, yeasts and other organisms involved in agriculture and food production.

The plants and animals in drylands are well adapted to drought, variable rainfall and harsh environments. A number of different mechanisms are at work. In plants, these include short growth cycles, long roots, water storage in roots and trunks, and dormancy during dry seasons. Livestock species and breeds have adapted by optimizing the use of scarce veg-

etation and water, minimizing their water loss, being able to walk long distances over rough terrain, and other characteristics. Camels are a case in point. They do not need to drink every day and can in extreme situations survive up to a fortnight without water. The adaptive traits of dryland organisms will be of growing importance for coping with the impacts of climate change.

This rich diversity has evolved over thousands of years, shaped by ecological factors and human activities. Summarized under the term “agrobiodiversity”, the plants, animals and micro-organisms relevant to food and agriculture cannot be separated from the people who have created them through the sustainable use of selected resources and the management of ecological and biological processes. Their practices continue to support biodiversity and reduce agricultural and ecological risks.

Management approaches are very diverse and encourage diversity. Because of their diversity, strategic use of local resources and limited external inputs, traditional systems are often more productive than “modern” alternatives: the productivity of pastoral systems in Africa is estimated to be 2–10 times higher per hectare than ranching.

Drylands still hold many landraces, local varieties and wild relatives – making them a crucial storage of genetic resources and a potential source of income for dryland people. Ensuring that communities adequately benefit from the use and commercialization of the resources they steward can provide important incentives for the conservation of these resources.

The value of dryland agrobiodiversity

The contribution of traditional dryland systems and their agrobiodiversity to food production and food security is enormous. Worldwide, about 800 million farmers in drylands depend on dryland cereals and legumes, together with vegetable and fruits for crops and basic food. During droughts and scarce food supply, traditional plant varieties are often life savers. In some areas, adapted livestock can be the only sustainable option for food production.

Economic figures mostly capture market values of single products or production strategies and therefore do not reflect the true value of the complex dryland agrobiodiversity. Nevertheless, they highlight that its economic contribution is substantial. In Sudan, Senegal and Niger, pastoralism contributes about 80% to the gross domestic product. In Ethiopia, pastoralists produce about 65% of the national milk output – not counting pastoralists' own consumption, which is estimated at 77% of the total production. In India, more than 45% of agricultural production and nearly 80% of coarse cereal outputs stem from drylands.

While the importance of dryland agrobiodiversity for food and the storage of genetic resources is increasingly recognized, its potential for climate change has yet to be fully understood. Modern, high-yielding varieties and breeds do not perform well in the uncertain, harsh and low-input environments of drylands, and will do even less so when the weather conditions get more erratic and extreme. That will make dryland production even more dependent on traditional species and varieties of crops, and on local breeds of livestock.

Threats to agrobiodiversity

Long dismissed as “fragile”, drylands are in fact remarkably resilient: for example, the natural vegetation can quickly recover from long periods of drought or from heavy grazing. Nevertheless, agrobiodiversity in drylands is subject to various threats:

- Rising human populations, resulting in increasing pressure on already scarce water, trees and cultivable land, and conflict over such resources
- Inappropriate farming techniques, resulting in falling water tables, monocultures, soil erosion, the formation of hard-

pans, rising soil salinity and pollution of groundwater and surface water

- Land-use change from grazing to cropping, afforestation with inappropriate species, fencing and land-grabbing or expropriation by powerful locals or outside investors, often illegally and in areas that cannot reliably support crops
- Attempts at conservation, including restrictions on the movement of pastoralists, and designation as wildlife reserves regardless of traditional uses and local peoples' rights
- The marginalization of traditional communities that manage dryland resources, and the loss of traditional management mechanisms and indigenous knowledge
- Climate change, reflected in rising temperatures, changed rainfall amounts and patterns, frequent drought and destructive floods.

Combating these threats and minimizing their impacts is urgent to avoid dryland communities – already among the poorest in this world – from bearing a disproportionate share of the costs.

Dryland people hold the key for agrobiodiversity conservation

Building on and strengthening peoples' sustainable use of natural and domesticated resources is one of the most promising routes to conserving dryland agrobiodiversity. Successful measures have included reviving traditional management systems, developing and marketing products, and ensuring that local people have access to genetic resources and benefit from them.

Reviving traditional crops, livestock and management practices. Where traditional crops and animals have been declining, their revival can further conservation. Possible measures include encouraging local people to raise traditional varieties or local breeds, helping them establish seed banks, multiplying seeds, holding seed fairs to exchange varieties, forming livestock breeding associations, and supporting mobile herding.

Developing and marketing specialty products. Local people will conserve plants and animals if they benefit from it. One way of doing this is to help farmers and livestock keepers to develop and market specialty products.



The “tree of life”

Berbers in Morocco call *argan* (*Argania spinosa*) the “tree of life”. They use oil from the seeds of this tree as an effective treatment for many diseases. Since 1995, German Development Cooperation has supported Berber communities to improve the production and marketing of argan oil and make more income from its sale. Government and private tree nurseries grow argan seedlings, and demand appears to be on the rise.

Similarly, local livestock species and breeds offer ample opportunities for the production and marketing of niche products such as wool and leather handicrafts, specialty meat products, and camel milk.

Equitable benefit sharing. A danger with developing a lucrative new product is that outsiders will reap the benefits, leaving local people with nothing – and with no incentive to conserve the resource. A way to avoid this is through “access and benefit-sharing” (ABS) – governed by the international Convention on Biological Diversity. The ABS Capacity Development Initiative for Africa helps communities and other stakeholders to use benefits from the use of genetic resources for biodiversity conservation and poverty alleviation.

Empowerment, capacity building and awareness raising. Many local people have come to believe that their local crop varieties and animal breeds are obsolete and backwards. “Biocultural community protocols” enable communities to document and showcase the role they play in the management of genetic resources and agro-ecosystems.

Biocultural community protocols

Biocultural community protocols are documents that record a community’s knowledge, resources and traditions. They state the community’s rights to the resources and the support they need to manage them. By drafting such a document, local people come to reflect on their resources, and their own role in maintaining them. They learn about their rights under national law and international treaties such as the Convention on Biological Diversity. They become more interested in conservation, and more active in claiming their rights.

Setting the stage for sustainable use and conservation

For such projects with local people to work, suitable conditions are necessary. Examples of approaches to ensuring this are developing conducive policy, legal and institutional conditions, promoting regional initiatives, and supporting research on agrobiodiversity.

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A conducive framework. It is vital that governments are convinced of the value of dryland conservation. It is equally important that dryland people participate in discussions and decisions on dryland use and management. The United Nations Convention to Combat Desertification (UNCCD) and other UN conventions provide the legal basis for participatory efforts to combat desertification and enrich diversity. Acting on behalf of the German Federal Ministry for Economic Cooperation and Development, the Convention Project to Combat Desertification supports partner countries in UNCCD implementation and mainstreaming sustainable land management in relevant policies and programmes.

Regional initiatives. As agrobiodiversity does not stop at borders, regional initiatives need to bring neighbouring countries together. An example is the Central Asian Countries Initiative for Land Management initiated by Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Goals are to control desertification, further sustainable land use and alleviate poverty in rural areas.

Research. GIZ’s Advisory Service on Agricultural Research for Development coordinates Germany’s involvement with the international agricultural research centres. Areas that support agrobiodiversity conservation include:

- Assessing the value of dryland resources and the services communities provide
- The cultivation and processing of dryland plants and animals
- The optimization of traditional resource use and management
- The interaction of the different agrobiodiversity components with each other, their environment and climate.

Healthy dryland ecosystems and agrobiodiversity are essential for dryland communities to overcome their poverty. A major challenge is how to facilitate agricultural growth without endangering the resource base.

Communities are the experts but need support and conducive conditions to continue their sustainable use and conservation of dryland agrobiodiversity and get out of poverty.



Diversity of potatoes
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Further information

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