Agrobiodiversity and climate change

– A complex relationship

Ficus carica, which grows wild, is well adapted to conditions in the Peruvian highlands. In view of the increasing aridisation of the country, it has great potential for use. Photo: CIP

Planet Earth is rich. It has many millions of species – plants, animals and micro-organisms. But biological diversity is being eroded, and species are becoming extinct at an alarming rate. The loss of biological diversity jeopardises the whole of mankind. This is especially true of the decline in agrobiodiversity, which is the resource base for our food.

Climate change – a threat to food security

The implications of climate change for agriculture have opened a new window in the discussion of agrobiodiversity. Environmental change is one of many factors reducing the diversity of crops and livestock. Five climate change-related factors can be identified: the rise in temperatures, changes in precipitation patterns, the rise of sea levels, higher incidence of extreme weather events and the increase of greenhouse gases – especially carbon dioxide – in the atmosphere.

The rise in temperature – commonly known as global warming – is probably the most obvious phenomenon of climate change. In the past 150 years the global mean annual temperature has increased by 0.6°C as atmospheric carbon dioxide concentrations have risen by 32 percent. This is likely to double in the next 40 to 100 years. Scientific estimates suggest that mean annual temperatures will rise by a further 1 - 5.8°C, although this will vary from region to region. It is expected that the increases will be highest in the tropics and subtropics, and the anticipated consequences there will be large-scale extinction of species, lower agricultural yields and a major change in cropping systems. Indirect temperature effects will also be significant, including the increased evaporation of water from the soil, the accelerated decomposition of organic matter, and the increased incidence of pests and diseases affecting both animals and plants.

The global water supply will also be seriously affected by climate change. In the last century, for example, subtropi-

Pastoralists' innovative responses to drought

Southern Ethiopia suffered a severe lack of rainfall between 1997 and 2000 and as a result experienced a major drought. Most of the livestock – the source of livelihood for most of the people of this region – died and the vegetation withered. Many people in the Horn of Africa lived for months on the verge of starvation.

In 2000 the Oxfam partner, Action for Development, purchased 120 camels, which are more drought-resistant than cattle because they only need water every ten days or so. As beasts of burden they can also be used for transporting water. Adde Lokko Aao describes what this means for the women: "The camels bring enough water for a number of households at a time. We women no longer have to carry water on our backs". The women used to walk for 6-10 hours to bring back as much water as they could carry. Now that the camels do this work, the women can spend their time on other tasks. They can now care for their families and return to a variety of income-earning activities. Moreover, the camels can also be used for ploughing if enough rain falls for seed to be planted. Looking after the camels is a man's task. "Our men have started getting involved in the work of fetching water, which is normally the responsibility of women. We are pleased to witness that our camels have shared our burden," says the mother of six children.

Source: Oxfam (2002): Drought Relief in Southern Ethiopia. www.oxfamamerica.org

giz Sustainable management of resources in agriculture

On behalf of Federal Ministry for Economic Cooperation and Development

Camels are particularly well adapted to the climatic conditions of Ethiopia. Photo: Wolfgang Bayer

cal regions most likely received around 3 percent less precipitation and suffered more frequently from drought than in the preceding centuries. By contrast, the northern hemisphere experienced 5 - 10 percent higher rainfall.

At the same time, increasing seasonal and regional rainfall irregularity has been observed, and scientific research suggests that this trend will become more pronounced. In many tropical areas there is already increased cultivation of drought-tolerant plant varieties. Similar trends can be observed in animal husbandry. For instance, camels are replacing cattle and goats in very drought-prone areas of Ethiopia.

Carbon dioxide is not the only greenhouse gas to give cause for concern. Chlorofluorocarbons (CFCs), for instance, have severely reduced the atmosphere's protective ozone layer, increasing the amount of ultraviolet radiation which reaches the earth. Scientists believe that the destruction of the ozone layer is reducing crop yields, and have, for example, studied this effect in the particularly sensitive soybean. Additional expected consequences are increased rates of pests and diseases in plants and animals and a rise in cases of sunburn in animals.

In summary, dramatic implications are expected for agriculture and food supply, although with large regional differences. It is predicted that the 40 poorest countries, located predominantly in tropical Africa and Latin America, may lose 10 - 20 percent of their grain-growing capacity due to drought by 2080. It is also argued that many rain-fed crops in some areas are already near their maximum temperature tolerance, and their yield may fall sharply with a further temperature rise. By contrast, yield increases are expected in temperate regions; a country like China could experience a 25 percent rise in production. Tragically, these changes are likely to hit the world's poorest people hardest.

Combating such changes requires a two-pronged strategy of mitigation and adaptation. On the one hand all possible efforts must be made to reduce greenhouse gas emissions and to slow climate change. On the other, fast and appropriate action is needed to enhance capacity to adapt to irreversible changes already inherent in the system but not yet fully visible.

Agrobiodiversity – an indispensable part of the solution

In the light of this recognition, the subject of agrobiodiversity and its insidious decline acquires new significance. Agricultural genetic resources are not only a victim of climate change; they are of fundamental importance for adaptation to this change and are crucial to coping with the problems it poses.

Plants and animals which have until now had no economic value but which can cope with the changing climatic situation will become more important. One question immediately arises: how much agrobiodiversity should we conserve for our future? Can our present cost/benefit calculations, based on tight budgets, provide the right answer, or must we conserve all we have because the future needs for human survival are unknown?

In scientific circles, the idea of conserving every species is regarded as utopian. Nevertheless, attempts should be made to maximise agrobiodiversity while keeping costs as low as possible. This requires an approach that goes far beyond the conservation strategies most widely used today. The *ex situ* conservation of seeds, involving storage in refrigerated banks or botanical gardens, is essential but does not go nearly far enough. What is needed are broader and better integrated conservation schemes that rely primarily on *in situ* concepts – the conservation and breeding of genetic resources by farmers and farming communities on their farms and in their villages. Farmers have been doing this for thousands of years. Gene banks can complement their work but cannot replace it.

In situ schemes enable the use and conservation of genetic resources to be closely linked. True to the slogan "use it or lose it", plant species or animal breeds should be used whenever and wherever possible; they should contribute to securing rural livelihoods and form a part of rural culture. The inherent value of seemingly uneconomic crops or farming systems needs to be recognised and harnessed. Thus wild plants may be used for medicinal purposes, organically grown wheat landraces may fetch a higher price, or regions that maintain their diversity may profit from agro-tourism, and so on. Of course it will not be possible to find a market for everything that should be conserved. But plants and animals deserve to be protected not only on account of their immediate "usefulness"; there are also social and cultural justifications for conservation, and it is therefore right that the public should pay for the service provided by farming communities.

In India there are many varieties of millet that have high yields even in very difficult climatic conditions. Photo: Detlev Franz

Agricultural diversity furthers adaptation to climate change

However, climate change requires not only that genetic resources should be conserved, but also that they should adapt to climate change. Plants, animals and ecosystems have the capacity to adjust to changes in factors such as heat, drought or salinity, and this enables us to cope with the consequences of changing environments. This capacity is an outcome of genetic diversity.

Adaptation is a dynamic process brought about through an organism's interaction with its environment. It is not a matter of, for example, deep-freezing a drought-resistant strain of millet for many decades in a gene bank, but rather of continuing to grow and breed the seeds in the fields where they are exposed to a wide range of agricultural and ecological conditions. The resistance of plants to environmental stress (e.g. drought tolerance) is a multi-genetic characteristic. It is difficult to achieve through genetic engineering and best developed through classical breeding under *in situ* conditions.

The social dimension of these adaptive processes is no less important. The poor sectors of the population, in particular, must be enabled to adapt to changing environmental conditions; traditional knowledge and social organisation must be strengthened and developed. Women play an important part in this process. In farming communities throughout the world, they are and always have been the seed keepers and the preservers of genetic resources.

Such a strategy as outlined above addresses regional and local agro-ecological variations and offers site-specific solutions. This contrasts with the large seed companies, which operate on the principle of mass production and aim to distribute a standardised variety or a whole cropping system technology as widely as possible.

Agrobiodiversity is an integral part of rural development

Despite the fundamental importance of agrobiodiversity for future food security, the subject has received little attention in the international debate on adaptation to climate change. Adaptation to climate change in agriculture – if discussed at all within the various international development initiatives – is driven by the increased frequency of drought and flooding, and focuses mainly on improved water management.

Agrobiodiversity – although a fundamental resource for adaptation – is almost forgotten.

The conservation and sustainable management of agrobiodiversity is one of our greatest environmental challenges. An agrobiodiversity strategy needs to take account of the following:

Minor millets save the poor from starvation

Sankappa is a small farmer owning three hectares of dry land in Vittalpura village of Bellary district in Northern Karnataka, India. This village is situated on the semi-arid Deccan Plateau and receives annual rainfall of 500 mm over a three-month period, which allows just one crop between July and October. Like his forefathers and other farmers of the village, Sankappa grows foxtail millet (*Setaria italica*). The amount of rainfall in this part of the country has dropped continuously over the last four years. It was below 300 mm in 2003. "All other crops failed due to extreme drought, and my family and livestock were saved from starvation only by the harvest of foxtail millet," says Sankappa. The varieties grown and conserved by the farmers of Vittalpura have excellent drought resistance.

Source: Bala Ravi (2004): Neglected millets that save the poor from starvation. LEISA India, Vol. 6, Issue 1. 34-36.

- Stronger coordination is needed between the key global programmes such as the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).
- Agrobiodiversity conservation should form a basic component of the adaptation strategies and plans for adapting to climate change called for by UNFCCC.
- Programmes for the management of agricultural genetic resources require their strategies to be reoriented. Formal institutional systems based on gene banks (*ex situ* conservation) must be broadened to an integrated management system that includes farmers and their agricultural systems (*in situ* conservation).
- *In situ* conservation of agricultural biodiversity must be made an integral part of agricultural development and be supplemented by *ex situ* conservation.

Individual states and the international community of nations must take the lead in implementing such a comprehensive approach. National laws and intergovernmental agreements will have to provide the necessary legal frame so that genetic resources remain largely a public domain with well-balanced benefit-sharing concepts among the various stakeholders. Civil society organisations as well as the corporate sector are more than ever required to fill this frame with development reality on the ground. Climate change-induced environmental stress may in fact exceed the adaptive capacity of animals and plants to cope with it. Nevertheless, the *in situ* approach offers a genuine chance to shape a future worth living.

Protecting biological diversity by means of gene banks enables Chinese agrobiodiversity to be conserved and later used.
Photo: Guenay Ulutunçok

The Issue Paper series "People, Food and Biodiversity" aims to:

- stimulate an interest in the conservation and sustainable use of biological diversity,
- present quickly and clearly concrete actions and experiences,
- explain new concepts and issues relating to the topic of biological diversity,
- encourage and stimulate the mainstreaming of this topic within development cooperation projects and programmes.

We look forward to your suggestions and experiences so as to enable us to improve this series.

References:

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