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3.2.2 Biodiversity and desertification

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SUMMARY: *Recent changes to land tenure rights in drylands have not only provided new opportunities for increasing agricultural production. Changed access to the natural capital is in many cases also seriously affecting the ability of the utilised natural resources to regenerate naturally. In many drylands, the overexploitation of biodiversity, of soils and the of groundwater resources has led to their deterioration to the extent that these ecological damages will often not be reparable within the time horizon of a human lifespan. Desertification is an alarm signal for socio-ecological dysfunctions.*

The problem

Approximately 41% of the land surface experience highly variable rainfall, high temperatures and recurrent droughts. These areas are characterised as drylands. More than 2 billion people, and thus, 1/3 of the human population lives in drylands (MILLENNIUM ECOSYSTEM ASSESSMENT Desertification Synthesis Report, 2005). Despite these environmental constraints for land use, significant cultural, economic and political developments derive from these hyper-arid, arid, semi-arid and dry sub-humid areas. Dryland biodiversity was the backbone for agricultural innovation. It contributed considerably to the development of human culture. Numerous cereals, legumes, cotton but also farm animals originate from drylands. Thus, biodiversity is not only essential for the functioning of natural ecosystems, it directly offers numerous economic and non-economic values, services and benefits to society, such as food, medicine, fibres, forage, fuel and building materials. In many drylands, livelihoods completely rely on the local and regional natural capital. Therefore, any qualitative or quantitative changes to the biodiversity can directly impact on means to earn and sustain a living. Increasingly, humans are changing biodiversity to meet their demands or due to land mismanagement. Prime indicators of dryland mismanagement can be very unspectacular. The decline of a palatable species due to intensive grazing will often not give rise to much concern as the process is gradual and biomass production usually does not change dramatically. Usually, desertification has reached an advanced stage before policy and society react. Often, the affected countries have other more urgent issues to solve so that actions to halt and combat desertification are even further delayed.

The MILLENNIUM ECOSYSTEM ASSESSMENT Desertification Synthesis Report (2005) estimates that about 10 to 20% of formerly productive drylands are presently degraded. Africa and Asia are very seriously affected by desertification. This report estimates that approximately 1 to 6% of the dryland people live in already desertified areas and underscores that desertification is one of the greatest environmental challenges. Governments in affected regions are forced to develop measures for food security and simultaneously delineate plans for safeguarding their biodiversity. Social disruptions, rural poverty and population displacement are the ultimate outcome of these socio-ecological disorders. This is especially true for rural households, whose economic stability directly depends on the condition and on the availability of local or regional natural resources, and whose access to other sources of income generation are limited or non-existent.

Causes and effects of biodiversity loss and desertification

In many drylands, biodiversity is currently undergoing dramatic changes which can ultimately lead to desertification (JÜRGENS 2005, 2006a). It can be assumed that losses of species richness, the declining functionality of ecosystems, the invasion of new species, as well as changes to biomass production will continue and might accelerate in future. These changes are primarily associated to human activities.

This is due to continuing demographic developments, alternating social norms and values, economic and industrial dynamics, urbanisation, poverty, past and prevailing land tenure systems, lacking land reforms, and the implementation of new agricultural technologies which are not adapted to the dryland ecosystems. A progressive narrowing of the genetic potential has to be anticipated for many species in drylands, resulting in reduced adaptability towards changing conditions. Thus, the ongoing changes to biodiversity foreshadow a dramatic loss of the potential that is embedded in the organisms. Replacement of locally adapted plant strategy types by plantations or spontaneously spreading stands of invasive alien species has a severe impact on ecosystem function and the sustainability of natural resources such as soil and water in particular. In South Africa, for instance, about 10 million hectare, i.e. 8% of the land surface area of the country, are infested by invasive alien plants which use about 7% more water than native vegetation. In the national-wide poverty-relief-fund project »working for water« the South African Departments for Water Affairs and Forestry, of Environmental Affairs and Tourism, and of Agriculture, employed 21,000 previously unemployed individuals for clearing of aliens and ecosystem rehabilitation (WORKING FOR WATER 2003). Other components include the conservation of biological diversity,

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and the building and empowerment of local communities through job creation and management initiatives.

The continuing fragmentation of ecologically intact regions in drylands will reduce the capacity for natural restoration processes. In many cases, the functionality of biodiversity will not be restored within the time horizon of a human lifespan. These developments will hamper regional and local measures for maintaining food security. The stability of rural, low-income households which depend on the condition of the local biodiversity will be at a greater risk (KUIPER & MEADOWS 2002). Poverty will increase. Conflicts will rage over the use of the remaining pastures, the declining arable lands and over diminishing water resources. Transboundary migrations and urbanisation will increase.

The growing number of environmental refugees who have been forced to leave their lands due to the effects of the over-exploitation of the natural resources highlights the global extent of the socio-economic destabilisation process that arises out of the local loss of biodiversity and desertification.

In the arid rangelands of southern Africa, marked fence-line contrasts visualise the degradation process of biodiversity due to intense and uncontrolled grazing by domestic livestock (SCHMIEDEL et al. 2003). *Fig. 3.2.2-1* (left side of the fence) clearly shows the impact of severe grazing on the vegetation cover. Investigations carried out by Bock (AKHTAR-SCHUSTER et al. 2005) underscore that natural resources in the communal land of Tiervlei (southern Namibia) ensure the mere survival of households. Domestic livestock still covers many essential functions in the area, i.e. insurance, social status, and investment. Bock formulates that incomplete tenure rights, as a result of apartheid policy, have a negative affect on today's users' sense of responsibility for the natural resources in the communal lands of Namibia.

The right side of the photo (*Fig. 3.2.2-1*) shows, how the establishment of rotational grazing and the regular monitoring of indicator plants of the rangelands of a research station in southern Namibia are successful strategies to maintain the perennial grasslands which are dominated by the palatable Stipagrostis uniplumis. Species with low palatability or which are entirely unpalatable start dominating heavily utilised pastures.

In the Tiervlei communal area, the decline in plant cover has also had a severe impact on the diversity and abundance of most insects and mice. This can be traced back to fewer dietary resources, to disruptions in the food chains and to less structural diversity within the degraded plant cover. Cover and shelter are lost and the risk of predation is increased (HOFFMANN & ZELLER 2006; VOHLAND et al. 2005). However, although reduced abundance and diversity in the beetle species were observed on the degraded site, an increase in the biomass of beetles (Coleoptera) could be documented on the degraded communal land. Seemingly, the decline in the beetles' numbers is compensated by the occurrence of larger species (VOHLAND et al. 2005). Investigations by Petersen (in AKHTAR-SCHUSTER et al. 2005) show that the deterioration of grass cover in the Tiervlei communal area as well as heavy trampling have also increased soil disturbances and soil erosion.

The over-exploitation of biodiversity can also lead to dramatically reverse effects in dryland ecosystems (JÜRGENS 2006b). Grazers such as cattle and sheep can lead to bush and tree encroachment. Intensively grazed grasslands are gradually converted into dense and partly impenetrable bush lands. A »green desert« emerges which again has an adverse affect on farm production (HOFFMAN & ASHWELL 2001).

In order to solve the pressing issues on the causes and effects of aggressive biodiversity exploitation in drylands, socio-economic activities and constraints which counteract the sustainable use of biodiversity have to be identified. Instruments and indicators for documenting the ecological effects of improper resources use, for maintaining the ecological resilience and for supporting the natural regeneration capacity of heavily used areas have to be discussed. Participatory- and scientifically-based, however, economically affordable, and socially acceptable restoration, protection and sustainable management proposals for safeguarding biodiversity have to play a key role in the national policy action plans for regional development in drylands.

Already in 1977, at the United Nations Conference on Desertification (UNCOD) in Nairobi, Kenya, a plan of action to combat desertification was formulated which comprised 26 recommendations that discuss the various and complex issues of desertification (MENSCHING 1977). Three decades later, desertification has continued to spread, and has destabilised the economic situation of rural households.

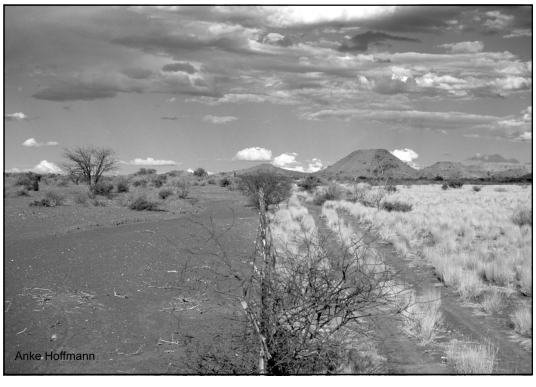

Abb. 3.2.2-1: In the Tiervlei communal land (left side of photo), severe grazing has changed the vegetation's species composition in arid rangelands in southern Namibia. On the right side controlled grazing maintains biodiversity. Photo Courtesy: Anke Hoffmann

Has science until now failed to convey deliverables to safeguard environment and support sustainable development in drylands?

What can be done?

Science has to develop methods to measure the problem. Integrated research techniques are necessary for documenting, monitoring and evaluating the past and present degradation of biodiversity within the context of desertification (JÜRGENS 2006). It is necessary to understand the drivers and the consequences of change of biodiversity from the ecological as well as from the socio-economic point of view. The step from diagnosing the problem to developing remedial action and prevention plans is the point, where science concretely has to address the policy level as well as the local stakeholders. Incentives for stimulating and introducing sustainable land use practices have to be discussed with policy makers in affected regions. Information is required to develop cost-efficient measures to improve existing management and governance structures for the protection of indigenous biodiversity. Scientifically-led information communication networks can support the exchange of knowledge on best practices for safeguarding biodiversity and combating desertification at the national and international level.

Participation

The lack of integration of affected local land users in research projects on sustainable development is a crucial setback for combating desertification. Several decades of applied rangeland science have revealed that the development of sustainable rangeland management practices requires both, sound scientific information about ecological processes as well as knowledge of local land users on the ecological, social, cultural and economic conditions governing their environment. A participatory approach in research on sustainable development is indispensable in order to translate research on sustainable development into action. Science and policy are increasingly aware of the necessity of winning local land users for maintaining the productivity of drylands. Also, traditional environmental knowledge is invaluable for the understanding of dryland ecosystems, and local land users can clearly name weak points in existing tenure systems which trigger the maximum exploitation of biodiversity. A clearly formulated legislation for sustainable resources utilisation, the development of decentralised and locally led resources management systems as well as land tenure security improve incentives among rural land users to manage their land in a sustainable manner.

Adaptable, user-friendly tools for the local monitoring of rainfall, fodder availability, livestock and rangeland condition have to be designed for farmers and the extension staff. These measures will improve the basis on which farmers will make decisions on their land use practices. Self-help systems have to be developed to locally monitor the condition of the utilised biodiversity. Therefore, in several applied biodiversity research projects, land-user communities have been integrated in the planning and conduction of research activities and transformation of project results in user-friendly management tools. In the interdisciplinary biodiversity monitoring and research initiative BIOTA AFRICA, members of local land-user communities are employed full-time and trained as para-ecologists (Fig. 3.2.2-2). By training and actively integrating para-ecologists in the research process, BIOTA AFRICA empowers them to take over substantial parts of the biodiversity monitoring tasks which were previously carried out by academic scientists and to facilitate research results for implementation in the land user communities (KRUG et al., in review).

Fig. 3.2.2-2: Members of local land user communities are trained and full-time employed by a biodiversity research initiative as para-ecologists in order to strengthen the links between science and local land users and to support the development of sustainable rangeland management tools. Photo: Ute Schmiedel.

Conclusions

Human-induced changes to biodiversity are important indicators of land mismanagement. Developing scientific standards and a classification system for degradation indicators are invaluable for the assessment of the condition of biodiversity. Continuous monitoring of biodiversity can assess the condition of biodiversity and deliver information for immediate remedial action before costly restoration is necessary or irreversible damages emerge. Collaboration with local communities in Namibia and South Africa underscores that the acceptance of measures to safeguard biodiversity and to combat and prevent desertification strongly depends on whether local users' interests have been considered and whether they perceive direct positive effects for their livelihoods♦