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Causes of Desertification

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Abstract: In many drylands, recent changes to land tenure systems have had widespread effects on traditional resources utilization mechanisms. Rural household economies often rely directly on the local or regional availability of natural resources. Any qualitative or quantitative changes to the natural resources will have a direct impact on the stability of these households. Overgrazing in many rangelands of Africa has for instance led to the decline in perennial plants. This has increased the seasonal fluctuations in available biomass, hence aggravating for instance the risk for animal husbandry. Research into identifying and assessing indicators for desertification is thus not a purely academic issue. Extensive transboundary and participatory research into the causes and effects of desertification is required in order to delineate concepts for sustainable management, restoration mechanisms and effective environmental monitoring, hence, supporting measures for mitigating or even preventing desertification-induced poverty and migration.

Key words: Land use, drought, climate change, degradation indicators, sustainable management.

Desertification, a Global Issue

Worldwide, the aggressive exploitation of natural resources endangers water sources, biodiversity and soil quality. Already more than 1.2 billion people in over 110 countries are affected by the social and environmental effects of land degradation in drylands. Socio-economic impacts of desertification are most pronounced in Africa. The transformation of drylands into agricultural lands with intensive production systems has triggered extensive land degradation also in the steppes of Central Asia (major parts of Kazakhstan) as well as in the prairies of the Midwest of the USA.

In drylands, rainfall is restricted to a few months. Unpredictable and irregular drought events accelerate the process of human-induced land degradation. Mobility and flexibility were determinative traits of traditional land use systems in drylands, and are undoubtedly the consequence of an optimal ecological adjustment to rainfall-induced inter-annual and seasonal fluctuations in the availability of natural resources. However, in many drylands, the degeneration of traditional land tenure systems and the introduction of vaguely defined modern land use rights have led to alarming vacuums in the control and the sustainable management of natural resources. Technical innovations in the agricultural field as well as the inappropriate management of modern agricultural activities in drylands have led to maximum utilization of the vegetation, soil and water resources. A decline in rangeland quality emerging from the loss of or change in biodiversity as well as declining crop yields are alarming indicators of land degradation due to overgrazing, excessive woodcutting, over-cultivation and mismanaged irrigation in arid, semi-arid and dry sub-humid regions.

Dryland degradation and irregular drought events enhance the risk of poverty by destabilizing vital sources of income that are based on the natural capital of a region. This effectively counteracts the millennium development goal of reducing poverty. Simultaneously, the decline in natural resources triggers or enhances conflicts between individuals and user groups. The degradation of productive land exacerbates national food security measures and triggers internal and eventually also transboundary migration.

In case countermeasures to combat desertification are not developed, the socio-economic situation of many dryland countries will be further strained. Many dryland countries are confronted with the precarious situation in how to adequately safeguard their (remaining) natural resources, secure the requirements of their uninterruptedly growing population and cope with the effects of an increasing number of displaced people.

In Asia and the Pacific, the situation is aggravated by the fact that over half the world's total population live in this region. It is estimated that 35% of the productive lands in Asia are already desertified. The UNEP/ISRIC source of 1990, as quoted in the UNEP Global State of the Environment Report (1997a), estimates the contribution of human activities to land degradation in the region as follows:

- Removal of vegetation cover: 37%
- Overgrazing by livestock: 33%
- Unsustainable agricultural practices: 25%
- Overexploitation through construction of infrastructure: 5%

The emergence of barren land surfaces has increased the occurrences as well as the severity of sand and dust storms. Sand encroachment and dune movements lead to damages to the infrastructure, thus further aggravating economic losses due to land degradation and desertification.

In the 1970s, desertification was recognized by the international community as a major economic, social and ecological problem. In 1977, the United Nations Conference on Desertification (UNCOD) adopted a Plan of Action to Combat Desertification (PACD). Despite some local success stories and extensive research on dryland related issues the United Nations Environment Programme (UNEP) declared in 1991 that dryland degradation and desertification processes had intensified.

Hence, the identification of effective measures to combat desertification was still an important issue at the United Nations Conference on Environment and Development (UNCED), which was held in Rio de Janeiro in 1992. The conference supported a more holistic approach to tackle the problem and stressed that sustainable development should be based on a participatory approach that must start at the community level. It called on the United Nations General Assembly to establish an Intergovernmental Negotiating Committee (INCD) to prepare, by June 1994, a

Convention to Combat Desertification. In December 1992, the General Assembly agreed and adopted resolution 47/188. The Convention was adopted in Paris in 1994 and entered into force in 1996. The UNCCD secretariat is now located in Bonn, Germany.

Desertification or Desertation?

Often, the far too general application of the term desertification led to controversies on whether the human exploitation of the natural dryland resources is capable of producing desert-like features in dryland ecosystems (Helldén, 1994). In fact, prolonged dry phases with sub-optimal rainfall during the 1970s, 1980s and 1990s in the Sahel backed the idea that the decline in biomass production, loss of phytodiversity as well as soil erosion is entirely rainfall-induced. The term desertification on the other hand emphasizes that the deterioration of productive land is primarily the result of aggressive human exploitation of the natural dryland resources. Desertification must, however, not be seen as the inevitable and ultimate consequence of human activities in drylands. It is principally the lack of clearly defined management regulation that inhibits the sufficient regeneration of the utilized natural resources, thus leading to land degradation.

Desertation on the other hand, is the natural, climate-induced transformation of an extensive area into a desert. However, high rainfall variability is a typical feature of dryland climates that leads to recurring and unpredictable drought events. The general lack of long-term instrumental records on rainfall makes it difficult to assess whether a dryland is experiencing desertation (climate aridisation) or just another drought phase.

Years with sub-optimal rainfall can temporarily retard or even completely hinder the natural rejuvenation, especially of frequently exploited resources. According to Koohafkan (1996), the complex interaction between human and drought effects leads to the extensive loss of plant cover due to overexploitation and contributes to climate change. Thus, desertation can be the consequence of extensive desertification, and the desertation process can also trigger and intensify the ecological effects of the severe resources exploitation, thus accelerating the process of desertification. Although desertification and desertation processes produce similar regressive features in the landscape, distinctions could be possible to some degree, and are necessary to deal with the question whether a human-induced overexploitation is occurring or not (Table 1).

Efforts undertaken to identify the prime cause of the decline in natural resources in a region is not a purely academic issue. Rather, it is fundamental for restoring, maintaining or developing reliable and cost-effective food production systems in drylands.

The worldwide accelerated pace of land degradation and desertification in drylands also puts an increasing focus on the combined effects of unsustainable land use practices and changing climate impacts. Since the beginning of the 1970s, an increase in drought events has been recorded in the Sahel. These have worsened the ecological and socio-economic effects of human-induced land degradation.

Table 1. Some indicators of desertification and desertation

Desertification indicator	Desertation indicator
Degradation intensity is correlated to the accessibility and the spatial as well as temporal availability of water (cf. desertification rings, mosaic of neighboring areas showing different stages of degradation).	Indicators of a decline in the natural resources show a more homogeneous distribution characteristic. Variations principally reflect the abiotic conditions in the different geomorphic units.
Selective grazing and browsing transforms the vegetation composition due to increasers (low grazing value or noxious plant species) and decreasers (palatable), especially in the low growing life-forms. Wood cutting further impedes a sufficient rejuvenation. Barren lands can emerge.	The condition of the vegetation cover reflects the drought resistance of the different plant species. Drought tolerant species have a competitive advantage.
The infiltration rates of rainfall can decline in severely degraded areas, leading to enhanced surface run-off and increasing soil erosion. This leads to a decline in the recharge of the regional groundwater.	Overall decline in surface water and groundwater. Although exceptional rainfall can induce severe soil erosion, principally aeolian morphodynamic processes will prevail in the landscape.

Rainfall data from the meteorological station of Khartoum (Republic of Sudan) in eastern Sahel show that during the seventies, eighties and nineties, the deviations (especially negative) from the long-term mean (1899 to 1998) have increased (Fig. 1). However, during this time of declining rainfall, and the decrease in the number of days that experience precipitation, Gerstengarbe and Werner (Akhtar-Schuster *et al*., 2000) recorded a minimal prolongation of the rainy season (14.3 days in El Fasher, mean duration = 85.0 days; 3.3 days in Kassala, mean duration = 100.2 days). In case this trend continues, it would mean that the rainy season is becoming drier. Simultaneously, this region has experienced the unilateral promotion of cultivation (rainfed and irrigated agriculture) whose production system is closely linked to more regular rainfall. In case the tendency towards further climatic aridisation continues in the eastern Sahel, a further destabilization of the food security has to be anticipated in the region.

Although recently precipitation in the north-eastern Republic of the Sudan has improved slightly, the question still remains whether the increase in the striking climatic anomalies during the recent past signals the beginning of the desertation of the partly severely overexploited ecosystems in the eastern Sahel.

The internationally negotiated definition of desertification, adopted by the United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, Brazil, in June 1992, is "land degradation in arid, semi-arid dry sub-humid areas resulting from various factors, including climatic variations and human activities".

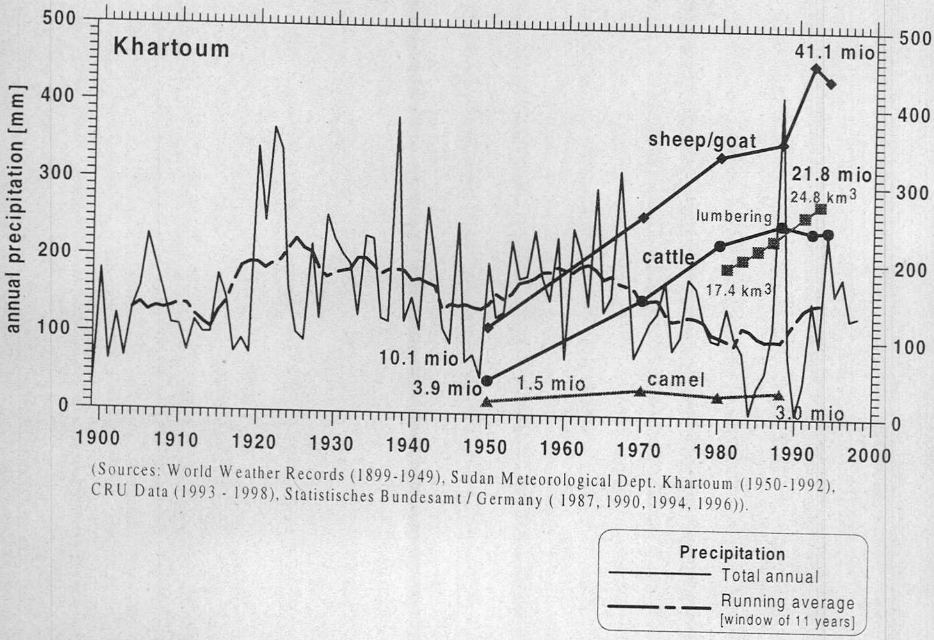

Fig. 1. Long-term rainfall structure in eastern Sahel (example: Khartoum), with regard to livestock and woodcutting development in the Republic of Sudan

Untangling the human and climate impacts under long-term field investigations show that currently, human activities are the principal agents of declining resources, hence desertification. Recurrent lean years have aggravated the situation. Long-term field surveys from drylands in northern and southern Africa show that the marginalisation of mobile land use systems, the abolition of traditional resources control mechanisms and the introduction of vaguely defined new regulation mechanisms have triggered or reinforced the intensity and the spatial dimensions of land degradation and desertification in Africa. Hence, it should be considered whether the term "... resulting from human activities and aggravated by climatic variations" should be used in the definition.

Indicators and Effects of Plant Cover Degradation

The identification of prime and successive degradation indicators supports the documentation of different stages of land degradation that often start with a decline in plant species richness, especially within the low growing life-forms that are easily accessible to domestic animal herds (Fig. 2). Browsing on the other hand is indicated by stripped off barks, and bitten off twigs. Heavy browsing leads to a decline in the rejuvenation rate, and an increasingly unbalanced age structure within the trees and shrub layer. Finally, the overexploited system can end in the emergence of barren, i.e., desertified, lands.

The over-exploitation of the plant cover does not inevitably have to end in the

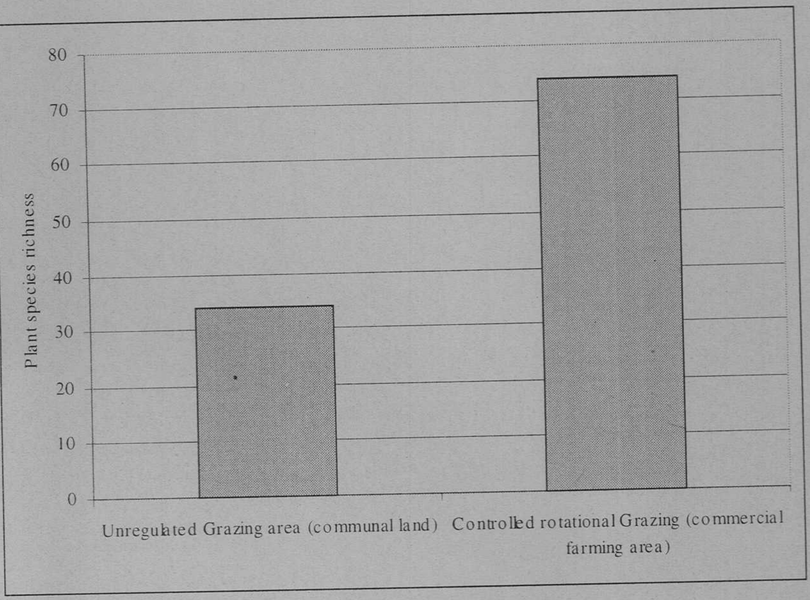

Fig. 2. Example of the reduction of plant species richness due to unregulated grazing in southern Namibia (field survey was carried out in the rainy season of 2001).

emergence of desertified lands. In heavily grazed areas, selective grazing can lead to a plant cover that is dominated by low quality or even unpalatable plant species. Their low utilization rates often support the emergence of secondary, quite stable floristic compositions so that desert-like features do not emerge. The bush encroachment phenomenon is another indicator of a continuous removal of the grass layer due to heavy grazing, and as a result, also of a reduced frequency of fire (Hoffman and Ashwell, 2001). The spread of indigenous shrubs and trees into former grasslands was observed in the overgrazed drylands of southern Africa. The economic impact is disastrous, as bush encroachment ultimately reduces the grazing capacity for cattle and sheep farming.

Hence, even in severely degraded drylands, a high amount of biomass can be produced in years with average or above-average rainfall. Due to the decline in palatable plants the grazing lands, however, experience a qualitative deterioration. A classification of this ecosystem as intact that would purely be based on the parameters of sufficient soil coverage and high biomass production, would convey a totally distorted impression of the actual condition of the grazing lands.

The immigration also of drought-resistant plants into a severely exploited area signals the aridification of a dryland ecosystem. This process indicates that the affected dryland ecosystem is drifting into a desertified stage. Simultaneously, the sizes of intact dryland habitats shrink, slowing down, or even preventing any natural restoration. Although the process of dryland degradation up to the final stage of desertification is gradual, it can have an immense impact on the socio-economic stability of the affected region due to loss of the biological output and the ensuing irreversible ecological damages.

In drylands, the concentration of relevant precipitation that fall only in a few months distinctly subdivides the year into a time with possible rainfall and a dry season. Mobility and flexibility of traditional land use systems enabled a dynamic adaptation to the annual and seasonal rainfall-induced variations in the biomass production. In the eastern Sahel for instance, mobile and flexible land use systems until recently counteracted a regular exploitation of the Sahelian rangelands. The regeneration capacity of the utilized pastures generally remained widely intact.

However, vast and open dryland areas and a strictly regulated access to the natural resources are indispensable for a mobile animal husbandry system to function. In the Republic of the Sudan, recent changes to the land tenure and the introduction of the Open Access System (Kirk, 1996) as well as the marginalisation or complete abolition of traditional resource management systems have led to an aggressive and uncontrolled exploitation of the natural Sahelian rangelands.

Up to the late 1950s, *Blepharis edulis* (Acanthaceae) was an important perennial dry season grazing plant in the dryland pastures of the Butana region (Republic of the Sudan) (El Hassan, 1981; Harrison, 1955). Today, *Blepharis edulis* is restricted to areas where scarce water supply hinders the regular exploitation (Akhtar-Schuster, 1995). Due to the decline in perennial species, annual, summer rainfall grasslands (e.g., *Schoenefeldia gracilis* or *Aristida* spp.) have emerged in the heavily exploited areas. However, these grasses wither away during the dry season so that the qualitative and quantitative grazing potential of the dryland rangelands deteriorates rapidly.

Gradually the uncontrolled heavy grazing in the degrading rangelands also impacts the annual grasses and herbs. Grasses and herbs with low palatability start spreading. In case such annual species also show a high drought resistance, then they quickly increase in heavily grazed areas, especially during years with sub-optimal rainfall. The annual grass *Urochloa trichopus* has these competitive advantages and has emerged extensively in those areas of the Sahelian Butana region that are most heavily grazed and cultivated.

The chronology of land degradation in the semi-arid Butana region shows that degrading drylands are often in the beginning transformed into areas with abundant annual growth during the wet season and with little or no grazing potential during the dry season. Hence, due to the aggressive utilisation, the natural seasonal variations in feed supply are intensified, resulting in the destabilisation of the entire grazing system. Simultaneously, the disappearance of perennial vegetation leads to enhanced soil erosion in the scorched landscape. This can have a negative impact on the soil seed reserves, thus further hampering the natural regeneration potential of the degraded vegetation.

Ecological indicators of inadequate resources exploitation were also frequently

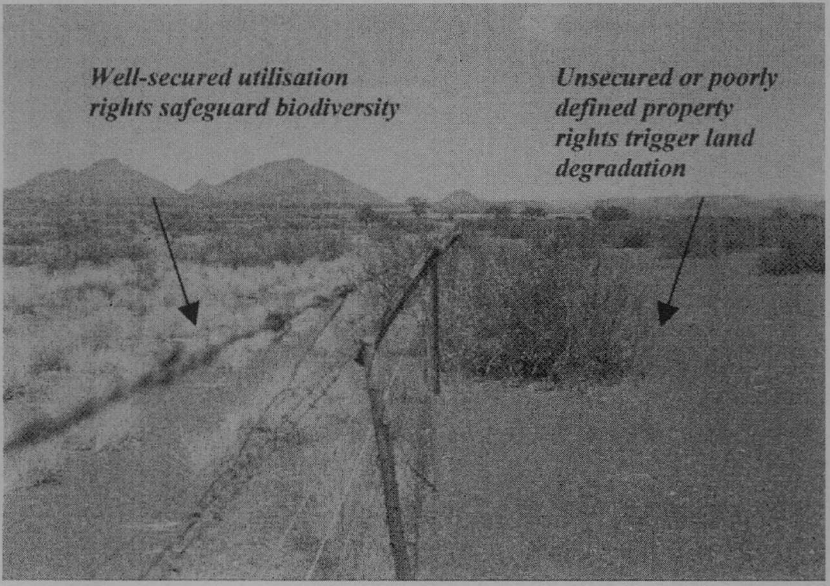

Fig. 3. Grazing-induced fence-line contrast in southern Namibia.

observed in Namibian and South African rangelands. In the semi-arid Nama Karoo (southern Namibia) for instance, varying land use intensities produced typical fence-line contrasts between the historically very intensively used communal farming areas, and the commercial farming lands with their regulated grazing systems (Fig. 3).

The direct ecological effects of plant cover degradation are manifold. For instance, the capture-mark-release investigations to monitor the diversity and the density of small mammals showed a markedly higher species diversity and density of small mammals in the intact grazing land compared to the excessively grazed and browsed land (Zeller *et al.*, 2001). The denser plant cover and the higher plant variety on the intact grazing site offer both protection from predators and solar radiation, as well as provide more microhabitats and additional food.

Communal livestock owners in southern Namibia clearly perceive the deterioration of their grazing lands as human-induced, and point out that the decline in biodiversity and biomass production is not the outcome of rainfall deficiency. But, in Namibia, the transfer of rights and governance away from local users to government authorities has led to a situation where practised communal resource management is not capable of rehabilitating degraded rangelands (Akhtar-Schuster *et al.*, 2003).

Communal land users stressed the fact that if they had better access to financial services, they would want to introduce a rotational grazing system for their animals by creating different camps. Many livestock owners also stated that they would also invest in their herds, especially by buying sheep. The latter statement clearly indicates that poverty reduction strategy programmes that are currently being propagated by development agencies as an efficient tool to combat dryland degradation, and to promote sustainable development, have to be supported by other coherent strategies (e.g., environmental awareness programmes).

Besides heavy browsing, the woody vegetation is additionally exposed to continuous and uncontrolled as well as mostly unlawful wood cutting. This free resource does not only cover the daily fuel requirements of the collectors, but in many drylands it is also another source of income for rural households. Due to human-induced decline in the availability of shrubs and trees in the proximity of settlements, people have to invest more time for collecting wood in an ever-expanding radius. In some drylands as in the case of Namibia, fuel demands could also be covered by gas. However, due to the fact that this energy source is not free of charge, it is used reluctantly. This again stresses the intense pressure that lies upon the woody vegetation as a freely accessible and exploitable natural resource.

The decline in the self-generating natural capital increases the risk for farming and destabilizes rural households. Additional sources of income have to be found. Currently, the out-migration of family members, especially of the young rural working force, is regarded as one strategy of communal households to cope with land degradation in Namibia (Blackie and Tarr, 1999).

In degraded drylands, research on land degradation also needs to identify ecological thresholds for reversible and irreversible processes. Irreversibility usually implies that if at all, the loss of natural resources (biodiversity, soil, water) with their manifold ecological and economic values, functions and benefits usually cannot be restored within the time horizon of a human lifespan. In drylands, long-term monitoring is indispensable for differentiating between entirely rainfall-induced changes to plant cover and the long-term, human-induced effects that can finally lead to desertification. Long-term ecological results supply relevant information for the development of sustainable land use systems and also cost-effective rehabilitation measures for degraded lands.

Indicators of Soil Degradation

The aggressive exploitation of the natural resources also affects the soils in drylands as well as the arid-morphodynamic system (Table 2). It should always be borne in mind that erosion and sedimentation are natural processes. These processes can, however, be accelerated by resource mismanagement. The susceptibility towards erosion is also controlled by the relief conditions (valley, slope, plane), the frequency of heavy rainfall, vegetation and soil properties (e.g., grain size distribution).

Fluvial processes can be exceptionally formative in the landscapes of drylands. On 4th August 1988 for instance, the meteorological station at Khartoum (Republic of Sudan) recorded 200.5 mm rainfall. The long-term (1899 to 1993) rainfall average in this semi-arid region amounts to 151.3 mm. Such singular heavy rainfall events are an essential part of the morphodynamic system in drylands and lead to extensive inundation of land and to

Table 2. Major soils of dryland regions (after UNEP 1997b, verified by the author)

USDA soil order	FAO major soil group	Description
Entisols	Aernosols Lithisols Fluvisols	Recently formed sandy to loamy soils, underdeveloped. Formed from wind blown sands mostly on plains. Easily eroded (deflation).
Aridisols	Xerosols Yermosols	Medium to fine textured soils, often with high contents of soluble salts, calcium carbonate or gypsum that can form surface or subsurface crusts. Easily erodible by wind and water.
Mollisols	Chernozems Kastanozems Phaeonems RendzinasLuvisols	Semiarid steppe soils, often porous with high organic matter contents. Less erodible.
Alfisols	Luvisols	Soils with well defined clayey horizons, commonly found in flat or gently sloping land. Highly susceptible to water erosion.
Vertisols	Vertisols	Clayey soils with markedly low infiltration rates. High susceptibility to surface runoff.

extreme natural erosion and accumulation (Mensching *et al.*, 1970). Erosion and accumulation processes can be altered by human-induced changes to the surface cover. However, it is often difficult to assess, whether gradually emerging higher erosion or accumulation rates are the outcome of land use or whether they merely reflect rainfall extremes. Also, the promotion of extensive land cultivation in drylands is more susceptible to the natural erosion processes than are mobile land use systems. For instance, measures to curb sand movement by wind into cultivated areas must not automatically be seen as systems that were introduced in order to combat land degradation. In fact, techniques to curb sand drift are often applied in order to control the natural morphodynamic processes for the benefit of agricultural activities in drylands.

Extensive loss of the natural regeneration ability of the plant cover enhances the mechanic dynamics within the substratum. Wind and water erosion of the unprotected soils increases leads to the (accelerated) development of extensive sand drifts and dunes or even badlands. The mobilisation of sand out of degraded lands and their re-deposition in other regions can impose a direct threat to agriculturally still intact areas. Declining infiltration rates in the degraded and barren soils reduce the seasonal availability and quantity of the indispensable water resources. Recurrent droughts reinforce this process of environmental aridification.

Salt-damaged soils are the result of mismanaged irrigation in drylands and can lead to the extensive loss of formerly productive lands. Irrigation water contains essential nutrients for plant. However, high evaporation rates in drylands lead to an

Table 3. Important indicators of soil degradation in drylands (after UNEP, 1997b, verified by the author)

Degradation type	Description
Soil displacement	Soil displacement
WATER EROSION	WATER EROSION
Loss of topsoil	surface wash and sheet erosion (exposure of roots)
Terrain deformation	irregular displacement, mass movement development of rills, gullies, piping, development of badlands
Sedimentation	e.g., of run-off channels, harbors, lakes, reservoirs
Flooding	
WIND EROSION	WIND EROSION
Loss of topsoil	displacement by deflation (reptation, suspension, saltation)uneven displacement leads to deflation hollows, hummock, shifting sands and/or dunes
Terrain deformation	
Internal soil deterioration	Internal soil deterioration
CHEMICAL DETERIORATION	CHEMICAL DETERIORATION
Loss of nutrients	e.g., decline in crop production
Salt-accumulation	decline in crop production in irrigated land
Discontinuation of flood-induced fertility	(e.g., due to flood control measures)
PHYSICAL DETERIORATION	PHYSICAL DETERIORATION
Sealing and crusting of topsoil	
Compaction	heavy machinery or trampling
Deterioration of soil structure	due to dispersion of soil material (e.g., trampling)
Aridification	human-induced change of the soil moisture (e.g., by lowering of local groundwater level)

accumulation of salts in the fields. In many countries progressing salt-damages to soils have triggered a crisis in dryland irrigated agriculture. Although salt-affected soils can be restored in many cases (Abrol *et al.*, 1988), the technical measures are by no means cost-effective.

As quoted in the UNEP World Atlas of Desertification (1997b), GLASOD (Global Assessment of Human-induced Soil Degradation) categorizes soil degradation in drylands as follows (Table 3).

In many degraded drylands, various soil degradation indicators can be observed side by side.

Conclusion and Perspectives

The environmental characteristics of intact landscapes are characterized by the sustained utilization of landscapes, rich species pool, moderate soil losses that are in equilibrium with weathering processes of parent rocks, biomass and nutrient equilibrium, and intact water resources. Degraded landscapes are prone to a loss and/or change of biodiversity, increased losses in soil and water-storage capacity, segmentation of water cycles and loss of nutrients. Desertification leads to the depletion of major biogenic resources (e.g., forage species, medicinal plants, timber).

Land degradation can induce or increase salt-damages. Thus, desertification triggers or enhances socio-economic conflicts at the national and gradually the international level.

Already the deterioration of natural resources has reduced the size of productive lands, proving to be disastrous for establishing or maintaining food security in many countries. Hence, understanding the mechanism for the downward spiral of natural resource availability is not a purely academic issue. In fact, its comprehension is of utmost priority for the development of feasible and innovative land use and resource policies in drylands.

How can the aggressive exploitation of natural resources, hence desertification be stopped? The economic, the social and the ecological stability are interwoven. Desertification breaches this interdependent network. The sustainable management of natural resources needs detailed insight into the prevailing social, economic and ecological frameworks as well as their complex path dependencies. Socio-economic activities that curb the sustainable management of natural resources have to be identified at the local and national level. Coordinated actions by individuals and diverse national and international communities are required immediately in order to address and combat the alarming and omnipresent desertification issue.

Given the scarcity of natural resources and the increasing demand for natural capital in countries with drylands, the big challenge is how to adequately address, integrate and mobilize stakeholders at all levels in order to support structures for the sustainable management and maintenance of natural resources and simultaneously rehabilitate the degraded lands. It is of utmost importance to disseminate strategic information on sustainable environmental management, i.e., transmit relevant information on the causes and effects of desertification into communities. Today, integrated and practical educational and training partnerships are required for combating desertification which consider local realities and are built on the participation and commitment of stakeholders.

A key concern of multidisciplinary research on desertification is also to develop appropriate and standardized tools for detecting bio-physical and socio-economic indicators of dryland degradation (Jürgens *et al.*, 2001). Worldwide, efforts have to be undertaken to introduce rehabilitation, program for degraded lands.

Multidisciplinary work has to be carried out in order to identify degraded areas that should be rehabilitated to the extent that they can be reintegrated into the local production systems, or even be restored to the natural conditions that prevailed prior to the onset of land use. In many desertified areas, restoration and rehabilitation costs exceed the costs for preventing desertification in the first place, which makes it fundamentally important to develop a network of environmental monitoring systems for drylands.

Also, the establishment of permanent biodiversity conservation areas in still intact lands should be considered. The exclusion of human activities in well defined no-go areas could effectively safeguard the gene-pool of dryland biodiversity for future generations.

In areas where irreversible human-induced environmental changes are obvious, taking up restoration programs could be very challenging and often useless. Since the 1960s for instance, the Aral Sea, once the fourth largest inland lake on earth, with a surface area of about 68,000 km^2, has deteriorated into disconnected smaller water surfaces. In just a few decades, 85% of the water body of the Aral Sea has disappeared due to the promotion of extensive irrigation in Central Asia (Breckle, 2001; Desertnet, 2003). This human-induced environmental catastrophe bears immense ecological and socio-economic problems. The formation of a new salt desert (the Aralkum-Desert) and regular salt and sand storms are having a serious impact on the human health and the agriculture in the entire Aral basin. Simultaneously, there are severe changes and losses to biodiversity that have to be dealt with. However, new plant communities and soils are forming. It is quite clear that innovative measures have to be developed which support land use practices that are adjusted to the new environmental conditions.

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