German Competence Network for Research to Combat Desertification

Desert * Net

Impressum

Publisher:	German Competence Network for Research to Combat Desertification (DesertNet) secretariat@desertnet.de Biocentre Klein Flottbek and Botanical Garden University of Hamburg c/o Ohnhorststrasse 18 22609 Hamburg
Editorial Board:	M. Akhtar-Schuster & C. Martius
Text contributions:	M. Akhtar-Schuster, Convention Project to Combat Desertification (GTZ CCD Project), S.-W. Breckle, J. Hill, B. Hoersch, A. Hoffmann, M. Kirk, C. Martius, G. Miehlich, U. Schmiedel, M. Veste, K. Vohland & W. Wucherer. Introductory chapters were formulated by the DesertNet Board.
Text editors:	M. Akhtar-Schuster, P. E. Midgley & C. Davenport
Photos:	M. Akhtar-Schuster, S. Breckle, Convention Project to Combat Desertification (GTZ CCD Project), H. Culmsee, U. Deil, J. Doerffer, M. Finckh, J. Hill, B. Hoersch, A. Hoffmann, H. Koehler, C. Martius, C. Mayer, G. Miehlich, A. Petersen, F. Thomas, M. Veste & W. Wucherer
Layout:	H. Gruber
Print:	Rautenberg Media & Print Verlag KG, Troisdorf

The publication was funded by the Convention Project to Combat Desertification (GTZ CCD Project), Germany, the Biocentre Klein Flottbek and Botanical Garden, University of Hamburg, Germany, the Center for Development Research (ZEF), Germany, and ICDC, Philipps-University Marburg, Germany.

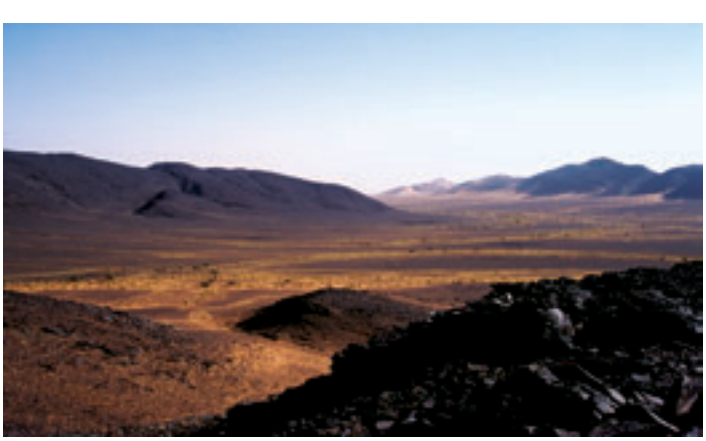


Photo: H. Culmsee

A typical distribution pattern of dryland vegetation.

Contents

1. Desertification – a Global Problem

The UN Convention to Combat Desertification defines desertification as: " land degradation in arid, semi-arid dry sub-humid areas resulting from various factors, including climatic variations and human activities".

Dryland ecosystems are very vulnerable to overexploitation, inappropriate land use practices and climatic changes. Land degradation leads to a drastic decrease in soil fertility, water availability, net primary production, plant cover and biodiversity changes.

Various aspects trigger and/or accelerate desertification:

- overgrazing
- deforestation/woodcutting
- land cultivation
- salinisation
- drought
- erosion, sand movement

Desertification is a problem of global dimensions. More than 250 million people in over 110 countries are directly affected by desertification, and about one billion people are at risk. Arid areas of all continents have extensive deserts. However, desert margins, the semi-deserts and steppes with their highly vulnerable natural resources are the major areas affected by desertification.

The socio-economic dimension of desertification is most pronounced in Africa where extensive areas bordering the Sahara are affected. The transformation of drylands into agricultural lands with intense 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. Unpredictable and irregularly recurring drought years accelerate the degradation process. Severe droughts hit the Midwest in the 1930s, creating massive dust storms that carried away millions of tons of fertile soil.

Photo: M. Finckh

Duststorm in the marginal Sahara.

Irrigation water contains essential plant nutrients. However, as the (potential) evaporation in drylands is higher than the water input by precipitation, salt begins to accumulate in the fields in situations where no additional channel systems for drainage water were built. This is the prime reason that in many dryland countries irrigation fields suffer from ever-increasing salinity problems. Salinisation leads to the decline in soil fertility and the intact physical soil structure is often irreversibly lost.

In many desertified areas, restoration costs (if at all possible) are by far higher than the costs of preventing desertification in the first place. Thus, research on the causes and ecological as well as socio-economic impacts of desertification is urgently required at a national and international level.

2. The German Competence Network for Research to Combat Desertification

The complexity of desertification requires an interdisciplinary approach to research. For this task the German Competence Network for Research to Combat Desertification (DesertNet) integrates a wide range of disciplines and scientific institutes with long-term experience from more than 40 countries. DesertNet was founded in order to form a binding link between science and public institutions. Thus, DesertNet, as a network of scientists and experts, provides rational data outputs, advises on scientific methods and projects and promotes co-operation between and with German institutions working in various fields of desertification research. There is a close co-operation with governmental bodies responsible for the application of new technologies and economic aid for combating desertification.

Photo: C. Mayer

Plenary discussion on the UN World Day to Combat Desertification (University of Hamburg, Germany, 17. June 2003) Starting from left: Dr J. Feichter (meteorologist, Max-Planck Institute Hamburg, Prof Dr G. Miehlich (soil scientist, University of Hamburg, Dr M. Akhtar-Schuster (geographer, University of Hamburg), Mr A. Diallo (Assistant Secretary General of the UN), Mr R. Jaura (journalist), Prof Dr N. Jürgens (botanist, University of Hamburg), Dr A. Muser (BMZ), Mr M. Dutschke (World Economic Archives of Hamburg).

DesertNet members have adopted the following declaration:

Declaration of the German Network for Research to Combat Desertification

Combating desertification and mitigating the effects of drought is a rising challenge whose importance has not been sufficiently recognised within the context of global environmental change. We, an interdisciplinary group of scientists in basic and applied research on desertification, intend to

- identify pressing problems with regard to desertification
- develop innovative research concepts and mobilise the necessary research which focuses on applicability and interdisciplinarity
- structure and facilitate the communication of knowledge
- raise public awareness of the alarming state of desertification
- strengthen and support research capacities with a view to promoting scientific co-operation with affected countries
- establish and intensify linkages with international research partners
- establish a mechanism for policy advice.

For this purpose we form a network open to those scientists sharing our vision. We support the UN Convention to Combat Desertification and for this purpose we want to strengthen our co-operation with its scientific body, the Committee on Science and Technology (CST).

Please also contact our website (www.desertnet.de) for information on latest publications.

3. The United Nations Convention to Combat Desertification and the Role of Science and Technology

The international community has recognised that desertification is an economic, social, and environmental problem of major concern to many countries worldwide. At the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, desertification was identified as a major concern. The Conference supported a new integrated approach to the problem. It also called on the United Nations General Assembly to initiate the Convention to Combat Desertification (UNCCD). In December 1992, the United Nations General Assembly adopted the UN Resolution 47/188. The Convention entered into force on 26 December 1996 and is now binding international law and should implement major development programmes. Currently, 191 countries are parties to the Convention.

The permanent secretariat of the UNCCD was established in Bonn (Germany) in January 1999 to coordinate activities and facilitates assistance to affected countries.

Science, technology as well as education are important to prevent and combat desertification. The Convention promotes the following scientific issues in Article 16-18.

- Information collection, analysis and knowledge transfer
- Research and development
- Transfer, acquisition, adaptation and development of technology

Besides the development of new technologies, traditional know-how should be considered and adapted to local needs.

The Committee for Science and Technology (CST) was established as an interdisciplinary body to supply the Conference of the Parties with scientific and technical background information. The first expert-meeting of the CST was organised together with DesertNet and was held in November 2002 in Hamburg.

Photo: C. Mayer

UN CCD Stall at the UN World Day to Combat Desertification (University of Hamburg, Germany, 17 June 2003).

4. The Convention Project to Combat Desertification (CCD Project) Implemented by Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) GmbH on Behalf of the German Ministry for Economic Cooperation and Development (BMZ)

4.1 Supporting Implementation of the Convention

As one of the 191 signatories to the international Convention to Combat Desertification (UNCCD), Germany has committed itself to supporting the process of implementing the Convention in developing countries and to raising awareness and mobilising people within Germany on issues relating to resource conservation in drylands.

The UNCCD tackles a problem of global dimensions. Implementation of the Convention principally takes place at national level, within the framework of National Action Programmes. In order to deal with cross-border manifestations of desertification, the Convention envisages Sub-Regional and Regional Action Programmes that foster co-operation among the countries concerned.

The UNCCD is a Convention that relates not only to the environment, but also to development since, alongside the sustainable use of resources, it also sets out goals such as reducing poverty and fostering economic and social development in the countries concerned by desertification. As the causes and effects of desertification and non-sustainable resource use are not only ecological, but also social, economic and political, all four dimensions must be given equal consideration in integrated programmes to combat desertification. Measures to combat desertification and manage resources in drylands must be interlinked at local, regional and national level; moreover, since resource conservation cannot stop at national borders, co-operation at international level is necessary too.

4.2 Tasks and Objectives of the CCD Project as Part of German Development Co-operation's Efforts to Combat Desertification

As a signatory state, Germany's activities in this area are guided by the principles of the UN Convention to Combat Desertification (UNCCD). The German Federal Ministry for Economic Cooperation and Development (BMZ) is the official German focal point to the UNCCD. Germany's bilateral development co-operation has already been focusing on desertification control since the mid-1980s. In order to supplement these efforts and to enhance support to the UNCCD implementation, BMZ set up the German CCD Project in 1999. The project is implemented by the GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit GmbH).

The key activities of the CCD Project include effective mainstreaming by tying the CCD process into other important elements of socio-economic development and into development initiatives (e.g. poverty reduction, water management, conflict prevention, decentralization, etc.). They also involve supporting the implementation of the CCD at sub-regional, national and local level. This takes place through the following activities:

- working to ensure that the principles of the CCD are enshrined in the instruments of German bilateral and multilateral co-operation and integrating

Photo: GTZ CCD Project

Turkmen women try to halt desertification by planting saxaul trees.

the CCD process into ongoing projects in partner countries (including activities financed through regional funds for Africa, Central America/Caribbean and Asia);

- advising partners on how to translate the CCD principles into coherent programmes and strategies to combat desertification at national and local level;
- supporting local initiatives to combat desertification that are proving promising in partner countries;
- supporting partner countries in forming strategic partnerships with important players in the field of combating desertification with national and international partners; this includes donor co-ordination and the support to the establishment of consultation facilities at the country level for all actors involved;
- promoting co-operation among scientists, the population and decision-makers in implementing the Convention;
- promoting the exchange of information and experience among the different players and at different levels in the field of desertification control, and implementing the CCD by means of networking;
- informing the German public about the problems and issues relating to desertification.

4.3 New Approaches to Combating Desertification in Central Asia

Since gaining independence, the Central Asian republics have been engaged in a major process of transition from centrally planned to market economies. Populations in these countries face the challenge of having to come to terms with these changes and deal with ever more threatening environmental problems largely on their own, especially at community level.

The German Government through its CCD Project promotes pilot projects to combat desertification in the five Central Asian republics of Kazakhstan, Uzbekistan, Kyrgyzstan, Turkmenistan and Tajikistan.

In the Soviet era, the National Institute of Deserts, Flora and Fauna (NIDFF), based in Ashgabat/Turkmenistan, was one of the most highly regarded institutes on questions relating to desertification control in Central Asia. Today, the institute not only provides research on the ecology of Central Asian drylands; it also offers approaches to solving the problems of desertification by strengthening the self-help capacity of local communities in the field of natural resources management through a pilot project financed by Germany. This pilot project running in Turkmenistan since 1999 under the auspices of the CCD Project and the NIDFF aims to implement measures to counteract desertification at local level with the participation of the people directly affected by it, and to pass on this experience of participatory resource management to other communities and projects in Central Asia.

4.4 Solving Cross-border Problems by Means of Regional Co-operation

The German Government through its CCD Project provides support for the five Central Asian coun-

tries to elaborate and implement a Sub-Regional Action Programme (SRAP) within the framework of the UNCCD. The SRAP was signed in 2003 and is an important framework agreement for solving or mitigating the effects cross-border desertification problems. The German side supports the Central Asian countries not only financially but also by providing consultancy services and training. Germany is also part of strategic partnerships aiming at the mobilisation of bilateral and multilateral donors for a joint support of the implementation of CCD. For example in Central Asia a Memorandum of Understanding that has been signed by the Asian Development Bank (ADB), the Global Mechanism (a subsidiary body of the UNCCD), the International Fund for Agricultural Development (IFAD), and by Switzerland, Canada and Germany. This strategic partnership agreement (SPA) aims at a joint and coherent support to combating desertification at the national and sub-regional level. In 2004 SPA and their Central Asian partner countries with additional support from the Global Environmental Fund (GEF) have embarked into an innovative program approach ("Central Asian Initiative on Land Management, CACILM") which will mobilise around 250 million US $ for resources management in the sub-region during the following 10 years.

Photo: GTZ CCD Project

Expert assessment of an aerial photograph for drawing up a village land use plan (Niger).

4.5 Monitoring and Evaluating the Effects of Combating Desertification

In order to evaluate the various approaches adopted by the different signatory states to implement the Convention, and to compare the results and derive useful insights regarding ways forward, criteria need to be developed as a basis for assessing the effectiveness of measures to counteract desertification.

With the aid of the German government and advised by the CCD Project, the African regional organisation Sahara and Sahel Observatory (OSS) has developed systems for monitoring the impacts of measures to combat desertification. These systems have now been evaluated by the Conference of the Parties to the UNCCD and have been recommended for use worldwide. The OSS with German support also runs training courses on impact monitoring in the field of desertification control measures.

4.6 Exchanging Knowledge and Experience

In 1994, a CCD information network was established within the German co-operation system. This is to foster the exchange of information among the various German actors intervening in the campaign to combat desertification worldwide. This network is organised by the CCD Project and links the project to the most important national and international organisations in the field of combating desertification; its members include among others the German Competence Network for Research to Combat Desertification (DesertNet).

The German Government through its CCD Project was involved in establishing DesertNet and maintains close contacts via this network with German academics and researchers engaged in dryland research. The CCD Project exchanges information with DesertNet on a regular basis, and uses the network as a platform for co-operation on regional or sectoral aspects involving several members. Specific forms of co-operation between both sides have evolved ever since. For example, the CCD Project is promoting components of the Aral Sea reforestation project implemented jointly by the University of Bielefeld and the Botanical Institute of Kazakhstan.

For further Information please contact

German UNCCD Focal Point
Dr. H.-Joachim de-Haas
Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung Federal/Ministry for Economic Cooperation and Development Referat / Division 314 (Ländliche Entwicklung /Rural Development)
Postfach/P.O. Box 12 03 22 53045 Bonn Germany
Tel.: +49 - 228 - 535-0
Fax: +49 - 228 - 535-3755
Email: Hans-Joachim.de-Haas@bmz.bund.de
Or visit BMZ's website at http://www.bmz.de/

or

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ GmbH)
CCD Project
Tulpenfeld 2
D-53113 Bonn, Germany
Tel: +49 228 98371-0
Fax: +49 228 98371-25
Email: project@gtzccd.de
Project coordinator: Dr. Anneke Trux
Or visit the Project's website at
http://www.gtz.de/desert/

Further information on this topic can also be acquired from The CD "Schwerpunkt Desertifikationsbekämpfung-Bessere Lebensbedingungen durch globales Handeln" (BMZ-Materialie 005) prepared by the Federal Ministry for Economic Cooperation and Development (BMZ) in cooperation with the CCD Project. The CD can be purchased from (www.bmz.de).

5. Interdisciplinary Research Co-operation and International Links to Support the Struggle Against Desertification

The complex processes and interactions leading to desertification require interdisciplinary research approaches and continuous dialogues between natural and human sciences. Interdisciplinary field research in drylands as well as the participatory-based formulation of strategies for sustainable land use and resource management should consider local realities and can significantly contribute to preventing or effectively combating desertification, hence securing and improving people´s livelihoods. Research of the member institutes of DesertNet is closely connected to international dryland research institutes and networks.

5.1 The Problem

Desertification leads to a gradual loss of the regeneration capacity of dryland natural resources in time and space. This human-induced over-exploitation ultimately leads to a drastic reduction of the plant cover and a decline in soil productivity. The overriding characteristic of desertified areas is the decrease in the interannual and seasonal availability of vital biomass resources. Worldwide, 70 % of the drylands and 1/6 of the world´s population (as quoted by the INCD Intergovernmental Negotiating Committee for the Elaboration of an International Convention to Combat Desertification International Network) are directly affected by the declining productivity of arable lands and natural pastures. The decrease in environmental quality triggers an upsurge of explosive socio-economic conflicts and uncontrolled migrations which convert the problem of desertification into a matter of global political and environmental concern at this stage at the latest.

5.2 Stages of Land Degradation / Desertification

Desertification is the ultimate outcome of degradation sequences. In the beginning, land degradation is not a visible ecological problem. This aggravates the implementation of appropriate steps to combat desertification in its initial stages.

The sustained utilisation of natural dryland resources preserves their ability to regenerate. However, frequent over-exploitation of usually freely accessible natural resources or vaguely defined allocation rights gradually exhausts the regenerative capacity of renewable natural resources.

The extensive loss of natural regeneration ability of the plant cover enhances the mechanical dynamics within the substratum. The erosion of unprotected soils increases, e.g. leading to the development of extensive sand sheets and dunes or even badlands. The mobilisation of sand out of degraded lands and its re-deposition in other regions can impose a direct and severe threat to agriculturally intact areas. Simultaneously, declining infiltration rates in the degraded and barren soils reduce the seasonal availability and quantity of indispensable water resources. Recurrent droughts reinforce this process of environmental ´aridification´.

The environmental characteristics of intact and degraded or desertified drylands can be summarised as follows:

- Intact landscapes: sustained utilisation of landscapes, rich species pool, moderate soil losses in equilibrium with weathering processes of parent rocks, biomass and nutrient equilibrium, functional water storage capacity and short water cycles.
- Degraded landscapes: Biodiversity loss, extinction of „functional plant groups" increased losses in soil and water-storage capacity, segmentation of water cycles, losses of nutrients. Desertification leads to the depletion of major biogenic resources (e.g. forage species, medicinal plants, timber). Land degradation can induce or increase salinity. Desertification leads to water shortage in quantity and quality, thus triggering or enhancing socio-economic conflicts at the national and international level.

5.3 Biodiversity and Desertification

During the past decades, the ecological, aesthetic and economic value of biodiversity has gained awareness at the levels of local land users, regional stakeholders, and among decision makers. The scientific community has investigated the productivity and thus improved resilience to disturbance of diverse ecosystems. The economic value of natural resources has been acknowledged worldwide, and has led to the establishment of the International Intellectual Property Law and respective organisations, which mainly deal with local knowledge about the applicability of natural resources. Land users in general, but especially rangeland farmers, rely on their natural environment as their prime or often even sole economic source. Thus, rural households increasingly require scientific, logistic and financial support to adapt

Photo: M. Akhtar-Schuster

Plant cover degradation in the eastern Sahel leads to severe soil degradation and to the development of bad lands.

management decisions towards a more sustainable land use. Due to their everyday work with and in their environment, they are aware how fragile and how limited dryland resources can be.

However, lack of experience and incentives for alternative management systems as well as economic limitations, social obligations, established traditions and political constraints force land users in many drylands to apply less sustainable management techniques. Overstocking, even for a comparatively short period, can have long-term effects on the vegetation cover, especially in years with sub-optimal rainfall events. Plant species compositions and soil conditions can deteriorate, thus leading to disastrous soil erosion and often irreversible landdegradation. It is especially the decline in perennial plants that has increased the seasonal fluctuation in available biomass in drylands, hence aggravating animal husbandry and making additional sources of income indispensable. The resulting decline in land productivity (land degradation) can finally lead to irreversible desertification and thus to a downward spiral of poverty. With regard to global climate change, many drylands in the near future could face a permanent decline in the total annual amount and an increase in the unpredictability of rainfall, thus further destabilising the economic situation of many rural households.

Photo: A. Hoffmann

Field surveys on the impact of land degradation on the population and diversity of small mammals in the semi-arid farmlands of southern Namibia.

5.4 The BIOTA AFRICA Project - Motivation, Aims and Scientific Strategies of an Interdisciplinary Research Initiative on Protecting Biodiversity and Sustainable Land Management

Losses of species richness, the declining vitality of species and ecosystems, the invasion of new species, and natural hybridisation processes as well as changes in biomass production will intensify in the future. In fact it can be assumed that the pace of change will accel-erate in the future. This is due to continuing demographic developments, alternating social norms and values as well as economic and industrial dynamics, urbanisation, poverty, changes in the land tenure situation, and technical innovations. A progressive narrowing of the existing genetic base must be anticipated.

Photo: M. Akhtar-Schuster

Overgrazing has led to a marked fence-line contrast in the semi-arid Nama Karoo, southern Namibia.

The ongoing loss in biodiversity thus foreshadows a dramatic reduction of the future potential (for coping with change) that is embedded in the variety of organisms. The continuing fragmentation of ecologically intact regions will reduce the capacity of natural restoration processes. In many cases, the vitality of the biodiversity will not be restored within the time frame of a human lifespan.

Protecting biodiversity successfully - thus also maintaining its social and economic value - however still faces a striking lack of knowledge on biodiversity and biodiversity-related issues on the local, regional, and global scale. As a project within the "Biodiversity and Global Change" programme (BIOLOG), which is funded by the German Federal Ministry of Education and Research (BMBF), the BIOTA AFRICA research initiative (www.biota-africa.org) aims at mobilising interdisciplinary resources for creating a network of standardised research techniques, which will continuously generate scientific data for stimulating national policies on safeguarding biodiversity. In a joint effort, scientists from the Ivory Coast, Benin, Burkina Faso, Germany, Kenya, Namibia, South Africa, Tanzania, Uganda, and Yemen have created multi-national research structures within the BIOTA AFRICA initiative which should support the efficient pooling of the existing knowledge on biodiversity in the research target areas.

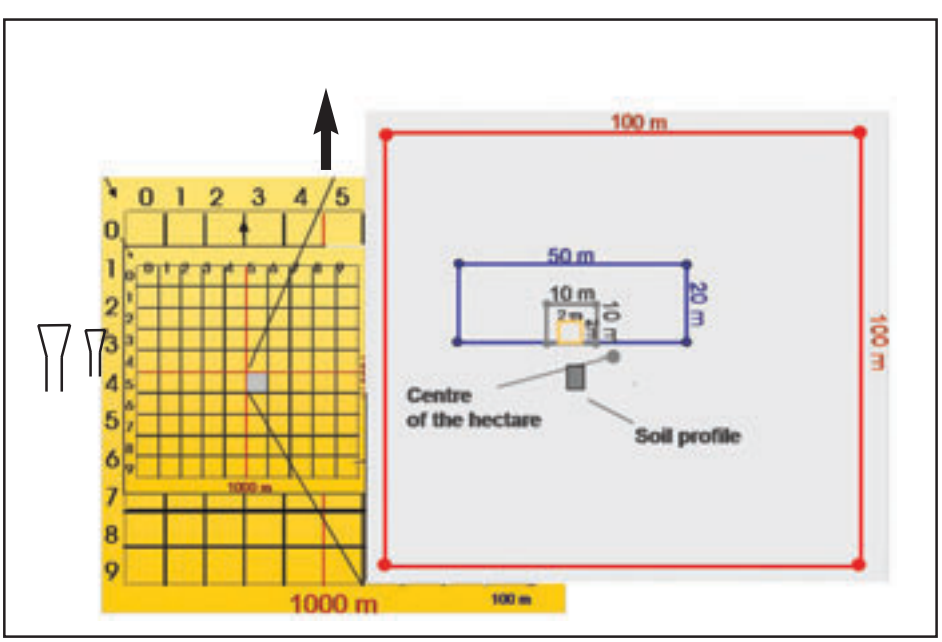
Within BIOTA AFRICA Biodiversity Observatories have been developed in order to acquire information on the regional biodiversity. A Biodiversity Observatory is a standardised research area where long-term research is carried out on the basis of standardised methodologies. Biodiversity Observatories have been established along all majors climate gradients and biomes in Africa:

(a) from the tropical rainforests up to the semi-arid savannahs of West Africa (Ivory Coast, Burkina Faso, Benin);

(b) from the dry forests of northern Namibia to the semi-arid savannahs and further towards the south, up to the winter rainfall zones in South Africa (Namibia and South Africa);

(c) along the complex altitudinal gradients of mountains in East Africa (Kenya, Tanzania and Uganda).

Biodiversity Observatories are the fundament where the 30 uni-disciplinary sub-projects of the BIOTA AFRICA research initiative interact and generate baseline information at all relevant temporal and spatial scales. The data provide maximum comparability, and can be extrapolated to larger areas. Long-term interdisciplinary scientific data series within BIOTA AFRICA will create the backbone for the development of locally adaptable biodiversity management and restoration measures.



The design of Biodiversity Observatories.

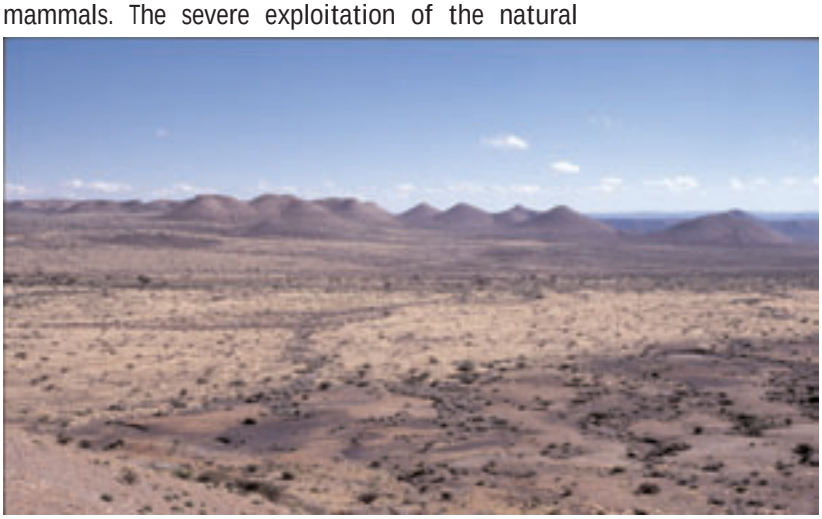
The three transects of the BIOTA AFRICA research initiative (BIOdiversity Monitoring Transect Analysis in Africa).

Biodiversity Observatories were often established in identical environments that were, however, exposed to different intensities of land use. This allows the analysis and the comparison of the impact of different land use types on the natural resources, thus enabling the differentiation between natural- and human-induced changes to biodiversity. Socio-economic and ecological thresholds that characterise adverse management can thus be identified.

To give an example of the research results, we cite the findings of the Biodiversity Observatories in semi-arid southern Namibia that showed the alarming effects of overgrazing on arthropods and small mammals. The severe exploitation of the natural vegetation has strongly reduced the diversity and abundance of most insects, spiders and mice. This can be traced back to fewer dietary resources and less structural diversity within the severely exploited plant cover on the degraded sites. All findings can be explained through the loss of the vegetation layer due to heavy grazing by domestic livestock. This leads to a reduced food and dew supply (for the arthropods) and small mammals, and a loss of habitat structures, cover and shelter in addition to a higher risk of predation. Lower diversity and abundance may impair the function of insects and spiders in the ecosystem (e.g. nutrient cycling, pollination, food resource for birds and small mammals).

At the Biodiversity Observatories scientists and land users collaborate in order to jointly identify research issues and share their understanding of the ecosystem. This very participatory research approach results in the development of realisable tools for sustainable management strategies.

The BIOTA AFRICA research initiative follows the guidelines of the international biodiversity task force of the UN and DIVERSITAS, hence, integrating its participatory-driven research on biodiversity restoration, protection, and maintenance into the global perspective. BIOTA AFRICA supports efforts that aim to establish a worldwide network of Biodiversity Observatories. BIOTA AFRICA thus aims to create a significant contribution to the UN Convention on Biological Diversity (UNCBD).



Overview of a marked grazing-induced fenceline contrast in the semi-arid dryland of southern Namibia. The yellow colour on the one side indicates an intact perennial grassland. The dark soil in the lower part of the picture shows the bare dark soil of the heavily grazed area.

Photo: M. Akhtar-Schuster

Photos: G. Miehlich

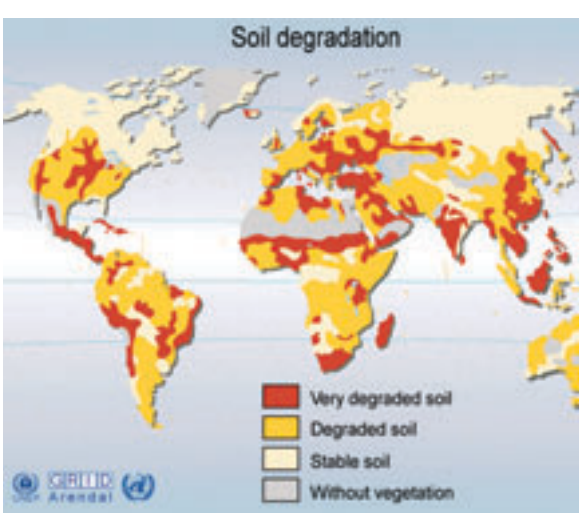
Severe land use induced soil erosion in the Highlands of Mexico (northern slope of the Pico de Orizaba) – The chronology of an environmental disaster. Photos were taken at the same spot.

5.5 Unheeded Soil Degradation Prevents Sustainable Development

Worldwide, soils are being damaged at an alarming speed, despite the generally well-known fact that soils are of fundamental importance for food production and healthy environments. Soil degradation leads to the severe and partly irreversible loss of soil functions. Currently, about 1/3 of the agricultural areas worldwide are affected by soil degradation. The substantial demands for natural goods and services of a steadily rising world population will aggravate the situation. Immediate actions for combating soil degradation are the basis for regional sustainable development, and the maintenance of food security and intact environments.

Drylands in particular experience severe soil degradation by water or wind erosion, over-fertilisation or soil exhaustion, inappropriate irrigation techniques, soil compaction and pollution. Soil degradation is caused by a complex and interwoven structure of ecosystem (biosphere, atmosphere, hydrosphere) and socio-economic (population, psycho-social situation, social organisation, science, technology, traffic and economy) factors. Thus, combating soil degradation successfully demands a very interdisciplinary approach. Unfortunately, this is rarely achieved.

Protecting the soils worldwide requires immediate attention. The development or (re-)adjustment of sustainable and applicable land use systems in vulnerable ecosystems helps prevent soil degradation and safeguards biodiversity. Techniques have to be developed that enhance the yields of fertile soils and simultaneously maintain soil quality. Also, the effects of excessive production demands originating from developed countries (e.g. import of foods, animal feed, and fibres that are produced in desertification prone areas) must be considered critically. An increased awareness of the economic value of soil, but just as importantly, the ethical responsibility towards maintaining a healthy environment for future generations has to be created in all parts of society. The co-ordination of scientific efforts on achieving these goals also requires the creation of an Intergovernmental Panel on Land and Soil, analogous to the Intergovernmental Panel on Climate Change. Unfortunately, although soil degradation is a very pressing issue whose relevance is discussed at an international level, until now, all efforts to create such an international board have not succeeded.



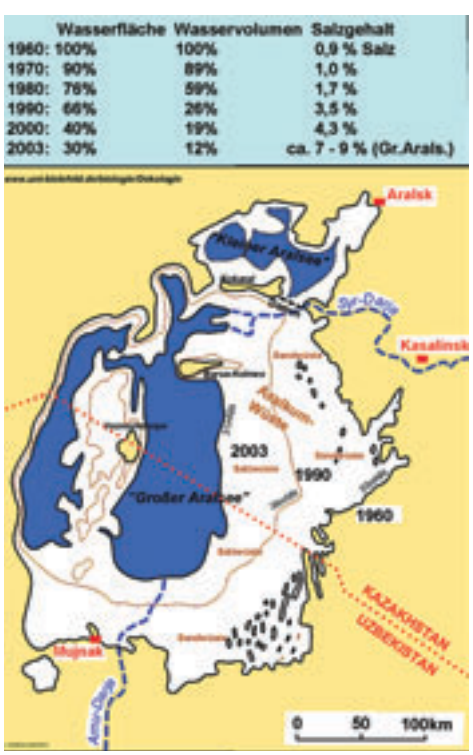
The extent of soil degradation worldwide (ed. UNEP).

6. Regional Research Findings on Desertification

6.1 The Aral Sea Syndrome

The Aral Sea region has probably experienced the largest human-induced environmental change in recent times. Huge irrigation projects in Central Asia which were developed during Soviet times are the main cause for the desiccation of the Aral Sea and the extensive desertification in the region. The transformation of the biodiversity relations, the worsening of the water-salt balance in the agricultural areas, the pollution of rivers and drinking water, salt dust and sandstorms but also the change in the regional climate outline the current anthropogenic environmental catastrophe in Central Asia.

The Aral Sea used to be the fourth largest inland lake on Earth, with a surface area of about 68 000 km^2. Since the 1960s, the surface area has decreased dramatically. More than 80% of the water body and more than 60% of the water surface have been lost. A separation into smaller water bodies has taken place: Great Aral Sea and Small Aral Sea. The sea level of the Aral Sea is still declining. The drying out



The disappearance of the Aral Sea 1960-2003 and the emergence of the Aralkum Desert.

of the Great Aral Sea causes the following environmental problems:

- the formation of a new salt desert between the island Vozrozhdenie and the eastern coast (the Aralkum Desert);
- salt dust and salt storms, threatening people and agriculture in the entire Aral basin;
- the aridification of the regional climate;
- the increase in salinity of the sea water and loss of the remnant fish fauna;
- the opening of the former military test site Vozrozhdenie to the mainland;
- growing threat to the existence of the nature reserve on the former island Barsa-Kelmes;

The dry sea floor of the former Aral Sea is a new terrestrial surface covering an area of about 44 000 km^2. In this new desert, called Aralkum, the formation of new plant communities and soils, new groundwater levels, and aquifers are developing. Currently, the dry sea floor is the largest area worldwide where a primary, large-scale succession is taking place. Most parts of the dry sea floor form huge salt flats and are the source of presumably millions of tons of (partly alkaline) salt and dust which are blown out each year, transported to distant areas and re-deposited on irrigated fields and settlements. There is an urgent need to minimise the salt dust output which leads to severe health problems in the region. Combating desertification in the region is the goal of a project carried out under the framework of the scientific cooperation between Kazakhstan and Germany under the leadership of the Department of Ecology at the University of Bielefeld (www.uni-bielefeld.de/biologie/Oekologie/index.html). The project is funded by the German Federal Ministry for Education and Research (BMBF). Additional support has been made available by the GTZ-CCD Project in Bonn on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ). Aims of the project are:

- combatting desertification through phytomelioration of the salt deserts
- development of a regional nature and biodiversity conservation strategy
- participatory resources management at the local level.

First plantings of suitable plants (Tamarix, Haloxylon,

Photo: W. Wucherer

Halophyte plant community in the Barsa-Kelmes nature reserve.

Photo: W. Wucherer

Group work (PRA-Seminar in the village of Karateren/ Kazakhstan).

Halocnemum) on the saline soils of the seafloor of the Aral Sea have been carried out. Conservation of the flora, plant community and landscape diversity under conditions of desertification is one of the major problems of the Aral environmental crisis. The steps hitherto undertaken in this direction have an arbitrary character, and are not based on theoretical positions established by the ecological sciences, so there is risk of failure. The island Barsa-Kelmes is one of the most precious nature reserves within Central Asia. It was established in 1939. Without special additional means of protection this former island will rapidly lose its role as one of the most important nature reserves. Barsa-Kelmes is a model site for the investigation of the biodiversity in the region.

In autumn 2002 a PRA-Seminar in the region took place, where the hard life and the main problems of the people in the region were discussed, as well as means for rehabilitation and new economic sources of the stakeholders. UNESCO developed an initiative "Virtual Laboratories for Drying lakes of Central Asia, Africa and the Middle East". The Department of Ecology at the University of Bielefeld proposed an information exchange on matters of the desertification in the region of the Aral Sea, especially with regard to the problems of the new Aralkum desert.

6.2 Land and Water Management in Central Asia: Building a Future for the Aral Sea Basin

Combating desertification in the Aral Sea Basin is the goal of a project carried out under the framework of the scientific co-operation between Uzbekistan and Germany and developed in close international co-operation under the lead of the Center for Development Research (ZEF) at the University of Bonn. During Soviet times, vast desert areas in the Aral Sea basin were transformed into artificially irrigated agricultural land in order to produce cotton, resulting in the withdrawal of large amounts of river water from the tributaries of the Aral Sea. The local agricultural production systems are characterised by large monocultures and heavy inputs of fertilisers, pesticides and water, the latter being delivered in extensive irrigation systems that are expensive to maintain and in which up to 70% of the water is lost. The state order on crops, which is imposed via strongly centralised government structures, still secures the predominance of cotton production and impedes a transition to a market economy, which further hampers progress. At present, the agricultural production is ecologically unsustainable, and soil degradation is rampant. It is also economically unstable, as for example the wages paid in agriculture are among the lowest in the region. The inhabitants of Karakalpakstan and Khorezm, two regions in the lower reaches of the Amu Darya River, the largest of the Aral Sea's tributaries, suffer most from the accumulated effects of low water availability, soil degradation and salinisation, and from the economic and administrative orientation towards soviet-style centralised structures.

In this setting, in March 2002 ZEF initiated a research program which is based on the presupposition that the complexity of the problems requires an integrated, interdisciplinary approach that takes into consideration not only natural resource management, but also economic viability and legal-administrative

compatibility. Only an activity-oriented scientific investigation programme will be able to provide applicable concepts for sustainable, efficient and effective land and water use. Furthermore, the programme is based on the premise that effective international co-operation can be built up only in equitable agreements and via a long-term commitment. Human capacity building, such as the education of young Uzbek scientists that will be tomorrow's decision-makers, must be part of the solution. Finally, the regional disparities in human capacity building must be counterbalanced, thus strengthening the marginal regions most affected by desertification.

The programme is being developed in close co-operation with a local education and research institution, the State University of Urgench. Urgench is the capital of the Khorezm Province in Uzbekistan, an area of 630,000 hectares of irrigated land. The project is funded by the German Ministry for Education and Research (BMBF), the State of North Rhine-Westphalia, and the German Academic Exchange Service (DAAD). Important scientific partners are the German Remote Sensing Data Center (Deutsches Fernerkundungsdatenzentrum DFD) of the German Aerospace Center (Deutsche Luft- und Raumfahrt DLR) and the Tashkent Institute for Irrigation and Agricultural Mechanisation Engineers (TIIAME). The project is supported by UNESCO, and in Uzbekistan, by the Ministry for Agriculture and Water Resources. This institutional set-up represents the backbone of the co-operation and ensures the co-operation of all partners on all relevant levels of decision-making in the programme.

Since the project's establishment in early 2002, an old workshop building at the University of Urgench has been extended and refurbished to host state-of-the-art lab facilities and offices for the research programme. To date, 14 Ph.D. and 10 Master students, in addition to numerous bachelors, have been accepted and represent the "first generation of young scientists". They participate in the programme by addressing in their field of research several key issues such as the establishment of farm water budgets, the determinants of soil salinity, alternatives for crop production, and economic as well as administrative aspects of agricultural production and water distribution. Most of the Ph.D. students are fellows of the International Ph.D. Programme at ZEF in Bonn.

Concurrently a GIS laboratory was installed as a service component for the programme and the region, with two goals: One is to integrate the data available in Uzbekistan and those data produced by the field work of the programme into one central computerised data base. The other goal is to make state-of-the-art remote sensing tools regionally available. The data base will provide the basis for the development of the concept for an effective and sustainable restructuring of the landscape in Khorezm Province, and to outline suggestions for the necessary administrative and legal-administrative re-organisation. During its first year of existence, the programme has received increasing attention from the Uzbek scientific community, among decision-makers and the public.

Whereas the first project phase was dedicated to establishing a sound scientific regional data base, the next project phase will be targeting the science-

Photo: C. Martius

Measuring soil salinity.

Photo: C. Martius

Phenological measurements.

based elaboration of a concept for landscape restructuring. This concept will be thoroughly tested in close co-operation with farmers and other stakeholders in a pilot farm scheme. This scheme, to be established after 2006, will also serve as a demonstration of "good practices", and help to create a decision support system which, at the end of the project, will be made available to farmers and decision makers. Indicators of the increase in ecological as well as economic efficiency and sustainability of land and water use in the region will allow the success of the project to be gauged, and to fine-tune the concept. By using this approach, ZEF hopes to be able to contribute to improving soil and water quality, ecological and economic sustainability, and the livelihoods of the local population. Successful measures can then be exported to areas and countries under similar conditions.

6.3 The Sahel Case

The Arabic term Sahel describes the southern fringe or ´coastal line´ of the Sahara desert. Intact Sahelian ecosystems show transitional features from the arid Sahara to the humid savannahs in the south. With a length of approximately 6 000 km, the Sahel extends from the Atlantic Ocean up to the Red Sea. Since the start of the second half of 20th century all Sahelian countries have been facing a dramatic increase in population, consecutive years of little or no rainfall, a severe decline in the availability of natural resources due to land degradation, structural economic problems and frequent exceptional food emergencies as a result of crop loss and civil strife.

Photo: H. Culmsee

Seasonal grazing lands in the Sahel.

Already in the late sixties, the catastrophic Sahelian drought of 1969 – 1973 drew the attention of the German community to the phenomena of desertification processes and their impacts on the socio-economy. At first, only large-scale relief assistance was given to these drought-stricken countries. However, concrete measures to combat desertification and rehabilitation programmes could not be initialised at this early stage as there were no long-term ecological and socio-economic field surveys on the complex causes and impacts of desertification.

Within the framework of the first UN Conference on Desertification (UNCOD) 1977 in Nairobi, the German Federal Ministry for Economic Cooperation and Development (BMZ) invited German scientists to discuss the desertification problem at an international level. This was the starting point for the formulation and the establishment of interdisciplinary German research projects on dryland ecosystem analyses and the ecological and socio-economic causes and effects of desertification in the Sahel. In the following years, numerous ´Sahel projects´ were launched at different research institutions throughout Germany. Within this context it has to be mentioned that the project ´Morphodynamic Processes and Desertification Project´ (1980–1993) at the Academy of Sciences in Göttingen played a key role in the research work on desertification in the eastern Sahel. At the same time, in co-operation with CILSS, more applied work was carried out by the long-term German Sahel programme (1980–1989) in the western Sahel. An interdisciplinary collaborative research centre (SFB 268) funded by the Deutsche Forschungsgemeinschaft (German Research Society) at the University of Frankfurt investigated the cultural, ecological and climatic changes in the West African savanna in Burkina Faso, Benin and Nigeria.

In subsequent years, ecological research on desertification in the entire Sahel naturally gravitated towards more applied aspects, such as the development of rehabilitation programmes for desertified areas and the formulation of land use systems which are adapted to the natural restrictions of dryland ecosystems. Sustainable land use systems and supporting programmes crucially depend on the participation and the incentives of the local population and other stakeholders involved in an emerging civil

society. Therefore, research in the Sahel more and more had to integrate the critical interface between socio-economic development, local culture and desertification processes. Interdisciplinary projects like „Animal Production in the Sahel - Recent Developments and Prospects in the Republic of Sudan" tried to identify through their extensive field work both the natural and anthropogenic impacts on desertification and its feedback on vegetation and resource use patterns. In this comprehensive approach, hydrology, ecology, agriculture (animal and plant production), veterinary medicine, social anthropology, agricultural and social economy were integrated and led to comprehensive findings and policy recommendations.

The sustainable development of extensive, mobile livestock systems as the main income source in semi-arid Sahelian areas together with mixed crop-livestock production as an often competing land use became a major research focus in the 1980s and 1990s. More than 80 million people live in these areas, and these people are among the poorest in the world with their livelihoods being subject to high environmental, tenurial, social, and political risks.

Applied research has, for example, shown that the ability of land and water to sustain ever larger numbers of livestock-owners without damaging the ecosystem will be determined, in part, by the way that users and other stakeholders can manage access and use of these vital resources. Population growth, expansion of cultivated lands, new risky management strategies, and market integration affect the sustainability of management regimes. An interdisciplinary research project on 'Property Rights, Risk and Livestock Development', (conducted by ILRI, IFPRI and the Universities of Marburg and Göttingen) has contributed to a better understanding of grazing management under different property rights regimes and with different environmental and production risks, and has identified the conditions under which different development pathways are followed and how policy and other external interventions, like drought relief, can assist communities to achieve sustainable resource use patterns.

What are major challenges for the future? Within the context of ongoing climate change, water shortages

Photos: M. Akhtar-Schuster

Animal husbandry and wood cutting in the Sahel have led to the degradation of natural resources in the Sahel.

and loss of biodiversity, Sahelian areas belong to the most endangered regions of the World. In which way will these changing conditions affect water availability in the region and create new ecological loads with direct and indirect effects on animal and crop production and human health? Can existing resource tenure systems cope with the challenge, what will be conflict potentials and what can be societal models to overcome them successfully, based on which institutional prerequisites?

In more recent years, these applied aspects have also led to a closer co-operation of the German scientific community with the German Federal Ministry for Economic Co-operation and Development (BMZ)/ GTZ (CCD Project). Scientists from different disciplines are firmly integrated into ongoing development co-operation projects to combat desertification in Mauritania, Mali, Niger, Chad, Burkina Faso, Senegal and also Ethiopia.

6.4 Microorganisms Stabilising Desert Sand Dunes

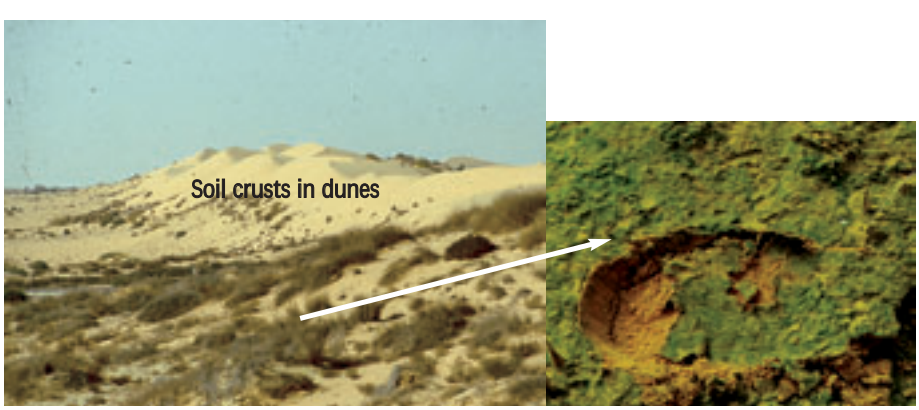
Soil erosion and shifting sands are major problems of desertification and land degradation in arid and semi-arid areas. Nearly 20% of the world's arid zones are covered by fine windblown sand. Such fragile ecosystems are very sensitive to land use practices. Grazing and trampling by livestock and agricultural use destroy the vegetation cover and enhance sand mobility, thus accelerating desertification processes. In most arid regions of the world, sand dune movement is a threat to irrigated farmlands, villages, railways, highways and other infrastructures.

The stabilisation of drifting sands is a major task within the framework of combating desertification. Worldwide, several experiments have been made regarding this problem. Planting methods are a traditional means of controlling drifting sands and are widely practised in the Middle East, Central Asia, China and North Africa. However, sand dune fixation by vegetation is only successful if wind speed is greatly reduced and sand movement is minimised.

In this context biological surface crusts provide the only natural protective cover on the soil surface. They are common cryptogamic communities in various arid and semi-arid regions. They have been reported from several deserts, for example from Australia, North America and from the sand dunes of the Negev, China and the South African Karoo. Usually sand surfaces are covered by crusts over wide areas. These biological crusts are built up by cyanobacteria, green algae, mosses, fungi, soil lichens and fine soil material.

These biological crusts enhance the aggregation of soil particles, and are thus a key feature for increasing surface stability.

After the mobile sand is stabilised by a physical raincrust, cyanobacteria are the first colonisers. Filaments of cyanobacteria which exude mucilaginous material and the rhizoids and protonemata of mosses stick the sand grains together and enhance topsoil stability. Surface stability is an important factor in deserts in order to prevent the surface from wind and water erosion as well as encouraging the establishment and increasing spatial distribution of higher vegetation.



Photos: M. Veste

Biological crusts stabilise the surface against erosion and can be vital for the rehabilitation of soils.

The biological soil crusts decrease infiltration rates and, thus, run-off could be observed even in a sandy area when covered by a biological crust.

In addition to its influence on the hydrological conditions, the biological crust also stabilises the topsoil and reduces soil erosion. Cyanobacteria are able to fix nitrogen and enhance the nitrogen pools in these nutrient poor ecosystems. Biological nitrogen fixation can contribute up to 60 to 80% to the soil nitrogen pool.

An intact and living biological crust prevents wind and water erosion, enhances soil fertilisation and is an important tool to combat desertification in arid, semi-arid and sub-humid regions.

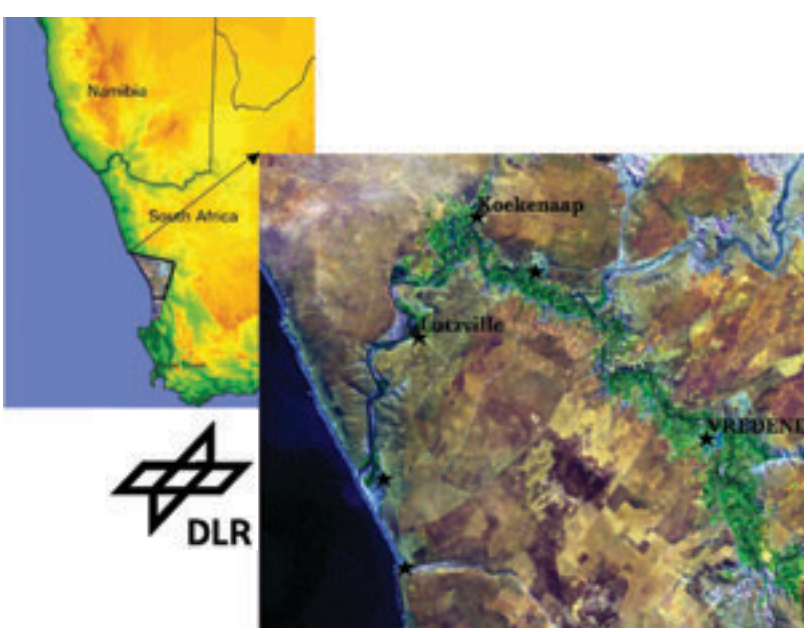
6.5 Modern Technology for Combating Desertification

Now that the United Nations Convention to Combat Desertification (UNCCD) has entered into force, the need to develop operational monitoring schemes to assess desertification and land degradation processes from the global to the local scale has arisen.

Standard methods of obtaining data for areas of desertification have been found to be expensive and time-consuming. By collecting information about the Earth's physical condition and social systems and the interactions between the two without physical contact, remote sensing systems can contribute to monitoring schemes. This is mainly achieved by sensor-based collection of absorption and reflection characteristics of the Earth's diverse surface, within the range of the visible towards the microwave parts of the electromagnetic spectrum. Remote sensing can be applied to environmental issues like desertification at various scales. At the local or regional scale airborne systems and aerial photography can be used for assessment. However, as desertification is a global issue, satellite systems such as METEOSAT/GEOS, NOAA-AVHRR, Landsat ETM, SPOT-HRV and SPOT-VEGETATION, TERRA-MODIS, ASTER or IKONOS to name only a few, are indispensable.

Remote sensing complements ground-based methods in various ways. The major advantages result from the fact that remote sensing can generate objective spatial data at full earth coverage with short repetition intervals synoptically without infringing national sovereignty. As mentioned above, a major benefit that remote sensing offers for the set-up of monitoring schemes is the availability of retrospectively comparable data, going back as far as several decades in time with varying spatial resolution for applications ranging from global to local scales.

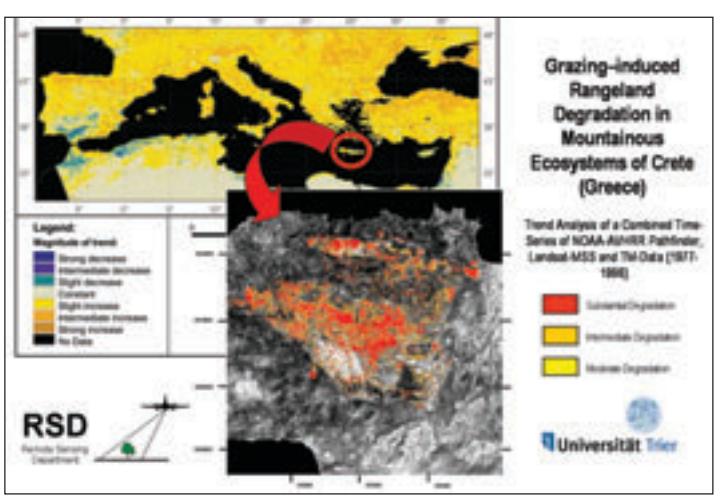
While remote sensing has primarily been used for resource mapping in the early years, the potential to monitor changes in the state of the Earth's surface and to assess human impacts on the natural system today makes Earth observation a strong tool for the implementation of environmental treaty objectives. There is growing interest in the application of remote sensing technology for international conventions such as the UNCCD, either from the side of contracting parties to these treaties or of convention secretariats, scientists, donors and environmental non-governmental organisations. This interest has been activated in part by the enormous growth in the suite of observational, ready-to-use operational data products that are now available and which can even be raised in value when integrated with all sorts of geo-data by the use of Geographic Information Systems (GIS), e.g. for predictive modelling of future scenarios.



The satellite images show a patchy mosaic of the land surface in South Africa, reflecting the different land use systems and intensities. Image processing: B. Hörsch, DLR.

As remotely sensed imagery can provide data over time that address environmental issues at national scales, it can provide these in consistent formats that complement national-level data collection efforts, which are often under-resourced especially in developing countries. For example, future protocols to the UNCCD could benefit from better data about the extent and characteristics of desertification patterns. Especially for contracting parties with limited capacity to address treaty-related concerns such as developing countries, remote sensing data may help to better target their resources. Such information can also be used for targeting donor assistance. In terms of implementation of such environmental treaties, remote sensing may be able to provide accurate data about implementation efforts and their environmental effects, as well as about environmental or socio-economic factors that interact with implementation efforts, such as land use changes or population growth.

Finally, image-based data may prove particularly useful to lay audiences and the public, thereby catalysing action. The visualisation of environmental changes and thus greater understanding of particular environmental problems can have great impact on public awareness, which is often one of the most critical factors for decision making and the effectiveness of counteraction.



Source: J. Hill

Application of remote sensing data for detecting land mismanagement.

6.6 Desertification Assessment, Monitoring and Early Warning with Indicators Derived from Remote Sensing Systems

The United Nations Convention to Combat Desertification (UNCCD) has raised worldwide attention for the discussion about desertification indicators, classification benchmarks and early warning systems, the importance of which has repeatedly been stressed by the Group of Experts of the CCD-CST in the past (e.g., Decision 14/COP.3 14/COP.4, 14/COP.5). The European Union responded to these objectives with a number of regulations, directives and programmes, and has promoted scientific investigations on desertification and degradation processes. In particular the 6th Framework Programme challenges the development of conceptual approaches for the "Assessment of the vulnerability to desertification and early warning options", and also the GMES Initiative (Global Monitoring for Environment and Security) aims at strengthening the European capacity for a global monitoring of environmental processes. Remote sensing data sets meet these conditions by providing unbiased and repeatable measurements on adequate spatial detail and coverage. The EU-supported research projects DeMon-II, GeoRange and LADAMER (all coordinated by the University of Trier; see also www.georange.org and www.ladamer.org) are oriented towards the assessment and monitoring of degradation and desertification on local to regional/global scales.

Retrospective monitoring of "vegetation cover" supported by long time series (> 20 years) from remote sensing data archives enables the identification of "hot spots" on regional scale (NOAA-AVHRR), which can then be further investigated on local level based on time series from Earth Observation Satellite (e.g., Landsat-TM).

Common to these projects is the utilisation of different spatial datasets together with field-based information to assess the environmental status of different regions, and propose ways for a sustainable use of their resources, or the mitigation of degradation processes. The ability to assess and monitor land resources and environmental change through remote sensing systems is based on their capacity to assess specific surface characteristics (i.e., vegeta-

tion cover and derived variables, such as biomass and net primary produc-tivity, parent material and soil properties related to infiltration and runoff dynamics, including mineral and microbiotic crusts).

In particular the availability of long time series (remote sensing data archives) enables the characterisation of trends in vegetation cover which has been identified as one of the most pressing objectives in effectively combating desertification (e.g., ICCD/COP(6)/CST/7). The analysis of land degradation/desertification processes and dynamics is thus depending on the avail-ability of suitable data archives. Although the 1-km-scale is preferred, the 8-km NOAA Pathfinder data set with its exceptionally long time span (1982-1999) is still considered an indispensable reference data set for analysing long-term trends in land surface properties and land use change dynamics. Its use is of particular importance for cross-pointing to multi-year time series at 1 km resolution (such as, for example, MEDOKADS available from the Free University of Berlin, or the SPOT VEGETATION decadal data at 1 km).

The pictorial example shown in this section emphasises how the connection of corresponding analysis steps executed on different scale levels (coarse scale analysis based on the LADAMER Project, local scale evaluation from DeMon-II) may unveil the existence of degradation "hot spots" in their spatial differentiation.

These approaches are not only considered vital for detecting land degradation and desertification "hot spots", but also to issue early warning signals identified by deviations from the long-term trends of biophysical variables (vegetation indices, cover proportions, NPP and others).

New global imaging systems (MODIS on EOS-1 and -2, MERIS on ENVISAT) enable us to compute even more differentiated indicator variables, which are compliant with the spectral resolution of existing high spatial resolution imagers, such as the Enhanced Thematic Mapper and ASTER, or ALI and Hyper-ion from the technical design platform Earth-Observing-1.

Photo: C. Mayer

Field experiments with potting and caging of plants, South Africa.

7. German Research Initiatives on Desertification and Related Issues

Biocentre Klein Flottbek & Botanical Garden, Hamburg

Photo: J. Doerffer

Community-based work on sustainable resources management in South Africa.

Photo: C. Mayer

Children from a nearby settlement in South Africa show much interest in the vegetation documentation carried out by a scientist from the Hamburg Biocentre.

Research topics and disciplines

Evolution and ecology of African dryland vegetation; biodiversity; vegetation ecology; Development of standardised environmental monitoring techniques

Regions/Countries

South Africa, Namibia, Morocco, Egypt, Sudan

Contact

Dr. M. Akhtar-Schuster
Phone: +49 (0)40-42816 533
Fax: +49 (0)40-42816 539
E-mail: makhtar-schuster@botanik.uni-hamburg.de

Dr. M. Finckh
Phone: +49 (0)40-42816 549
Fax: +49 (0)40-42816 539
E-mail: mfinckh@botanik.uni-hamburg.de

Prof. Dr. N. Juergens
Phone: +49 (0)40-42816 260
Fax: +49 (0)40-42816 261
E-mail: juergens@botanik.uni-hamburg.de

Dr. U. Schmiedel
Phone: +49 (0)40-42816 548
Fax: +49 (0)40-42816 539
E-mail: uschmiedel@botanik.uni-hamburg.de

Biocentre Klein Flottbek & Botanical Garden
Biozentrum klein Flottbek & Botanischer Garten
University of Hamburg
Ohnhorststrasse 18
22609 Hamburg, Germany

✦✦✦

Center for Development Research (ZEF) University of Bonn

Research topics and disciplines

Land and water use, hydrology, soil science, ecology, biodiversity, agriculture; agricultural and development economics, resource economics; social and political sciences, institutional analysis

Regions/Countries

West Africa (Ghana, Burkina Faso); Central Asia (Uzbekistan); South America (Brazilian North East and Amazon); Ethiopia

Contact

Prof. Dr. P. L.G. Vlek
E-mail: p.vlek@uni-bonn.de
PD Dr. C. Martius
E-mail: c.martius@uni-bonn.de

Center for Development Research (ZEF)
Zentrum für Entwicklungsforschung
Walter-Flex-Strasse 3
53113 Bonn, Germany
Phone: +49(0)228-731865
Fax: +49(0)228-731889

✦✦✦

Department on Ecological Modelling
UFZ Centre for Environmental Research
Leipzig-Halle GmbH

Research topics and disciplines
Modelling dynamics and spatial structure of plant communities in (semi-) arid ecosystems; driving forces; typical dynamics; essential processes and factors, influence of weather conditions, consequences of climatic change. Modelling of land use and its consequences for ecosystems: degradation, rehabilitation, grazing, sustainable land use. Ecological modelling, spatially explicit modelling, economic ecological modelling

Regions/Countries
South Africa, Namibia, Argentina, Australia, Near East

Contact
Prof. Dr. C. Wissel
Dep. of Ecological Modelling, UFZ-Umweltforschungszentrum
P.O. Box 500136
04301 Leipzig, Germany
Phone: +49(0)341-235 3245
Fax: +49(0)341-235 3500
E-mail: Wissel@oesa.ufz.de

✦✦✦

Freie Universitaet Berlin (FU Berlin)
Department of Geological Sciences
Geoinformatics

Research topics and disciplines
Monitoring of desertification dynamics and erosion control measures; analysis of vegetation dynamics; determination of desertification levels; Remote Sensing;Vegetation Sciences

Regions / Countries
Niger, Mali, Mauritania, Burkina Faso

Contact
Dr. H. Kusserow
c/o FR Geoinformatik
FU Berlin,
Malteserstr. 74-100
12249 Berlin, Germany
Phone: +49(0)30-83870575/ +49(0)30-7935777
Fax: +49(0)30-83870723
E-mail: h.kusserow@nexgo.de

✦✦✦

German Aerospace Center DLR - German Remote Sensing Data Center

Research topics and disciplines
Remote Sensing; Imaging Spectroscopy; Geographic Information Systems (GIS); vegetation dynamics; soil characterisation; change detection and degradation monitoring; ecological modelling; biodiversity; geodiversity

Regions/Countries
Alpine Regions; The Mediterranean, Africa (Ivory Coast, Namibia, South Africa); South America (Bolivia); China, Uzbekistan (Khorezm/Lake Aral)

Contact
Andreas Mueller
DLR-German Aerospace Center - German Remote Sensing Data Center
Environment and Geoinformation (DFD-UG)
Muenchnerstr. 20
D-82234 Wessling, Germany
Phone: +49(0) 8153-281533
Fax: +49(0) 8153-281458
E-mail: Andreas.Mueller@dlr.de

✦✦✦

Hamburger Umweltzentrum Karlshöhe /Freundeskreis CREFELD

Research topics and disciplines
Education for sustainable development; Trees against desertification

Regions/Countries
Chad

Contact
Freundeskreis CREFELD
Dieter Ohnesorge, Juergen Forkel-Schubert
c/o Hamburger Umweltzentrum, Karlshoehe 60 d
22175 Hamburg, Germany
Phone: +49 (0)40 6003860
Fax: +49 (0)40 60038620
E-mail: hamburger.umweltzentrum@bund.net

✦✦✦

Hohenheim University
Institute of Soil Science and Land Evaluation
Unit of General Soil Science and Petrography

Research topics and disciplines
Soil sciences, land evaluation and site ecology-matter, cycling: soil development and soil deteriotion, soil water management, soil fertility and salinisation, water and wind erosion, dust generation, transport and impact

Regions/Countries
Subsahara West Africa, Niger, Chad, Benin, South America, Northeast Brasil, South Argentina, Asia: China, North China Plain, Xingjian, Uzbekistan

Contact address
Prof. Dr. Karl Stahr, Dr. Ludger Herrmann, Dr. Thomas Gaiser
Emil-Wolff-Straße 27
70599 Stuttgart, Germany

Phone: +49 711 459 3980
Fax: +49 711 459 3117
E-mail: kstahr@uni-hohenheim.de

✦✦✦

Humboldt-Universität zu Berlin
Museum fuer Naturkunde
Institut fuer Systematische Zoologie

Research topics and disciplines
Biodiversity; zoology; biosystematics.

Regions/Countries
Namibia, South Africa

Contact
Prof. Dr. U. Zeller
Invalidenstr. 43
10099 Berlin, Germany
Phone: +49-(0)30-2093 8657
Fax: +49-(0)30-2093 8528
E-mail: ulrich.zeller@museum.hu-berlin.de

✦✦✦

Institut fuer Landschaftspflege und Naturschutz der Universitaet Hannover

Research topics and disciplines
Basic and applied plant ecology; vegetation science; landscape ecology; Influence of human land use on biodiversity in arid and semi-arid regions

Regions/Countries
Near East (Israel, Jordan Palestinian Autonomy), Southern Africa (Namibia)

Contact
Prof. Dr. Ruediger Prasse
Institut fuer Landschaftspflege und Naturschutz der Universitaet Hannover
Herrenhaeuser Strasse 2
30419 Hannover, Germany
Phone: +49(0)511-762-3619
Fax: +49(0)511-762-3791
E-mail: prasse@land.uni-hannover.de

✦✦✦

Max Planck Institute for Meteorology

Research topics and disciplines
Anthropogenic climate change; development of numerical climate simulation models; climate effect of aerosol particles; air pollution and the hydrological cycle

Regions/Countries
Global

Contact
Dr. J. Feichter
Bundesstr. 55
20146 Hamburg / Germany
Phone: +49(0)40-41173317
Fax: +49(0)40-41173298
E-mail: feichter@dkrz.de

✦✦✦

University of Bern
Institute of Geography
Centre for Development and Environment, National Centre of Competence in Research NCCR North-South

Research topics and disciplines
Syndrome mitigation; sustainable land management; soil and water conservation; regional development

Regions/Countries
East Africa: Kenya, Tanzania, Mozambique, Madagascar; Horn of Africa: Ethiopia, Eritrea; Central Asia: Kyrgyzstan, Tajikistan, Kazakhstan

Contact
CDE
NCCR North-South
Steigerhubelstrasse 3
3008 Bern, Switzerland
Phone: +41(0)31-631-8822
Fax: +41(0)31-631-8544
E-mail: hurni@giub.unibe.ch

✦✦✦

University of Bielefeld, Faculty of Biology, Department of Ecology

Photo: W. Wucherer

Salt desert between the former island Barsa-Kelmes and Kokaral on the dry sea floor of the Aral sea.

Research topics and disciplines
Global ecology (Biome); ecophysiological plant adaptation strategies to stress (salt, drought, light, temperature); vegetation dynamics (transect and population analysis; dispersal and establishment, community development)

Regions/Countries
Aral Sea Region, Aralkum Desert, Kazakhstan and Uzbekistan
Aral Sea Region, High Mountain Deserts in Pamir, Tajikistan

Contact
Prof. Dr. S.-W. Breckle, Dr. W. Wucherer
Department of Ecology, University of Bielefeld
PO Box 100131
33501 Bielefeld, Germany
Phone:+49(0)521-106-5537
Fax: +49(0)521-106-2963
E-mail: sbreckle@gmx.de, walter.wucherer@uni-bielefeld.de

Photo: W. Wucherer

Land degradation in the East Pamir.

✦✦✦

University of Bonn
Faculty of Agriculture

Research topics and disciplines
Agricultural Sciences and Resource Management in the Tropics and Subtropics (ARTS)

Regions/Countries
Countries to develop mainly in Asia, Africa and Latinamerica

Contact
Susanne Hermes
ARTS co-ordinator
University of Bonn
Faculty of Agriculture
Nussallee 1
53115 Bonn
Phone: +49(0)228-73-2924
Fax: +49(0)228-73-2619
E-mail: arts@uni-bonn.de

✦✦✦

University of Bremen
Center of Environmental Research and Env. Technology (UFT)

Research topics and disciplines
Soil ecology, pollination systems; water harvesting technology; Soil degradation; restoration; phytoremediation; Socio-economy: sustainability as a matter of governance

Regions/Countries
Mediterranean region; Cameroon, Namibia, South-Africa

Contact
Dr. H. Koehler
University of Bremen
Leobener Str.
28359 Bremen, Germany
Phone: +49(0)421-2184179
E-mail: a13r@uni-bremen.de

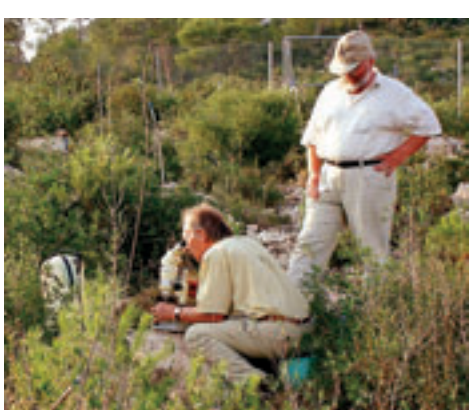
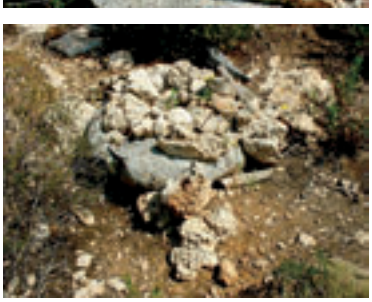


Photo: H. Koehler

Prof. W. Heyser (left) and Raimund Kesel examine the degree of mycorrhiza infectation on the oak trees at the MedOak experimental site near Calvia (Mallorca).



Photos: H. Koehler

Oak tree in a bumed forest area on ReviTEc Island (Mallorca). The stones are used to collect condensation of the dew.

✦✦✦

University of Freiburg
Institute of Biology II/Department of Geobotany

Photo: H. Culmsee

Grazing impact in Morocco.

Photo: U. Deil

Graveyards often safeguard biodiversity in highly exploited drylands.

Research topics and disciplines

Biodiversity and patterns in desert and semi-desert vegetation. The frontier between desert and semi-desert vegetation: indicating elements; Pastoral semi-desert and desert landscapes (impact of pasturing on the plant cover) Criteria for the evaluation of sustainable land use (versus degradation) in semi-arid ecosystems; Mediterranean landscapes in transition - the vegetation cover under self-sustaining and agroindustrial impact; Methodological approaches in vegetation science for working in semi-desert and desert areas; Holy forests in Morocco: their potential as nature conservation areas Temporary lakes (dayas): ecosystems sensitive to changes in the regional hydrological system; Vernal pool vegetation under the impact of trampling and grazing; Desert locust habitats

Regions/Countries

North-West Africa: Morocco, Mauritania, Algeria
The Arabian Peninsula: Yemen, Emirates

Contact

Prof. Dr. U. Deil, Dr. H. Culmsee
Institute of Biology II/Department of Geobotany
University of Freiburg
Schaenzlestr. 1
D-79104 Freiburg, Germany
Phone: +49(0)761-203-2695 (U. Deil)
+49(0)173-3285974 (H. Culmsee)
Fax: +49(0)761-203-2696
E-mails: ulrich.deil@biologie.uni-freiburg.de, heike@culmsee.de

✦✦✦

University of Giessen, Germany
Department of Agricultural Policy and Market Research

Research topics and disciplines

Environmental & Agricultural Economics; Bioeconomic Modelling of Natural Rangeland Management; Biodiversity Management

Regions/Countries

Southern Africa, Namibia

Contact

Prof. Dr. E.-A. Nuppenau
Professur für Agrar- und Umweltpolitik
Senckenbergstr.3
35390 Giessen, Germany
Phone: +49-(0)641-99-37022
Fax: +49-(0)641-99-37029
E-mail: ernst-august.nuppenau@agrar.uni-giessen.de

✦✦✦

Johann Wolfgang Goethe-University
Botanical Institute
Ecology and Geobotany

Research topics and disciplines
Plant ecology and vegetation science: analysis of vegetation patterns and dynamics, esp. influence of grazing, influence of human activities

Regions/Countries
West Africa (Burkina Faso, Benin), China (Autonomous Region Ningxia)

Contact
Prof. Dr. R. Wittig
Botanical Institute,
Ecology and Geobotany
Siesmayerstr. 70
D - 60323 Frankfurt am Main, Germany
Phone: +49(0)69-798-24747 or 24739
Fax: +49(0) 69-798-24702
E-mail: r.wittig@em.uni-frankfurt.de

✦✦✦

Justus Liebig University Giessen
Department of Livestock Ecology

Research topics and disciplines
Rangeland ecology; genetic resources; livestock production systems; common property and natural resource management; indigenous knowledge; Conflict management (farmers and herders); land use and biodiversity

Regions/Countries
Burkina Faso, Nigeria, Namibia, South Africa, Ethiopia, Syria, China

Contact
Prof. Dr. J. Steinbach
Dept. of Livestock Ecology
Ludwigstrasse 21
35390 Giessen, Germany
Phone: +49-(0)64-19937670
Fax: +49-(0)64-19937679
E-mail: Joerg.Steinbach@agrar.uni-giessen.de

✦✦✦

Philipps-University Marburg
Department of Business Administration and Economics
Institute for Co-operation in Developing Countries (ICDC)

Research topics and disciplines
Income generation, livelihood diversification, sustainable resources and desertification; Role of property rights and collective action to combat desertification; Land and resource tenure, land and resource policy in fragile lands of DCs and transition economies; Biodiversity management and desertification; Multi-level governance structures between centrality and decentrality in desertification-prone countries; Global public goods, international regimes and desertification; Development economics, agricultural economics, resource economics, co-operative sciences, law; inter- and

transdiciplinary work with development sociology, anthropology, law, and natural sciences such as physical geography, botany, and ecology

Regions/Countries
Africa South of the Sahara, South-East Asia, Central and Eastern Europe, FSU, Namibia, Rep. of South Africa, Mali, Cambodia, Ethiopia,

Contact
Prof. Dr. Michael Kirk
Philipps-University Marburg
Institute for Co-operation in Developing Countries
Am Plan 2
35037 Marburg, Germany
Phone: +49(0)6421-2823731
Fax: +49(0)6421-2828912
E-mail: kirk@wiwi.uni-marburg.de

✦✦✦

University of Goettingen
Goettingen Centre of Biodiversity and Ecology (Goettinger Zentrum fuer Biodiversitaetsforschung und Oekologie)

Research topics and disciplines
Water and nutrient relations of plants and soils; Water and nutrient budgets of ecosystems; Morphological and physiological reactions of plants to specific stress situations (deficiency and excess of nutrients, drought and waterlogging, acidic gases, frost, defoliation)

Regions/Countries
Central Asia (Xinjiang, NW China); Additional countries in Central Asia (planned); Algeria (proposal submitted)

Photo: F. Thomas

Risk of sand encroachment on the oases at the southern margin of the Central-Asian Taklamakan Desert (Xinjiang, NW China): sand dune at the border of Qira oasis.

Contact
Dr. F. Thomas
University of Goettingen
Goettingen Centre of Biodiversity and Ecology (Goettinger Zentrum fuer Biodiversitaetsforschung und Oekologie)
c/o Institute for Plant Sciences
Plant Ecology (Abt. Oekologie und Oekosystemforschung)
Untere Karspuele 2
37073 Goettingen, Germany
Phone: +49(0)551-3912404
Fax: +49(0)551-395701
E-mail: fthomas@gwdg.de

✦✦✦

University of Goettingen
Albrecht-von-Haller-Institute for Plant Sciences, Dept. of Ecology

Research topics and disciplines
Water relations, nutrient supply and productivity of plants under extremely arid conditions; Population biology and propagation of perennial plant species; Utilization effects and sustainable vegetation management

Regions/Countries
China, esp. Xinjiang

Contact
Prof. Dr. M. Runge
Untere Karspuele 2
37073 Goettingen, Germany
Phone: +49(0)551-395721
Fax: +49(0)551-395701
E-mail: mrunge@gwdg.de

✦✦✦

Research topics and disciplines
Pedodiversity and biodiversity in mutual dependency; Interrelation of plant-soil processes; water balance; erosion; influence of land use systems

Regions/Countries
Southern Africa (Namibia, South Africa)

Contact
Dr. Alexander Groengroeft
University of Hamburg Institute for Soil Science
Allende Platz 2
20146 Hamburg, Germany
Phone: +49(0)40-42838-4395
Fax: +49(0)40-42838-2024
E-mail: a.groengroeft@ifb.uni-hamburg.de

University of Hamburg Institute for Soil Science

Photo: A. Petersen

Soil investigations in the semi-arid drylands of Namibia.

✦✦✦

Research topics and disciplines
Plant nutrition aspects in dry climates, especially:
1. Salt tolerance of crops in the dry regions
2. Phosphorus efficiency of different crop species and varieties in the dry regions

Regions/Countries
Dry regions in Africa and Asia, especially: Algeria, Egypt, Sudan, Palestine, Ethiopia, Kenya, Myanmar

Contact
Prof. Dr. C. Richter
University of Kassel
Steinstrasse 19
37213 Witzenhausen, Germany
Phone: +49(0)5542 - 981263
Fax: +49(0)5542 - 981230
E-mail: chricht@wiz.uni-kassel.de

University of Kassel

✦✦✦

University of Potsdam
Institute for Biochemistry and Biology Plant Ecology and Nature Conservation

Research topics and disciplines
Vegetation dynamics; spatial modelling; population biology; species diversity dynamics; climate change effects; land use impacts; long-term dynamics; shrub encroachment

Regions/Countries
Southern Africa (current focus: southern Kalahari); Israel; Argentina; Australia

Contact
Prof. Dr. F. Jeltsch
University of Potsdam
Plant Ecology and Nature Conservation
Maulbeerallee 2
D-14469 Potsdam, Germany
Phone: +49(0)331-977-1954
Fax: +49(0)331-977-1948
E-mail: jeltsch@rz.uni-potsdam.de

✦✦✦

University of Tuebingen
Institute of Botany, Dept. of Plant Ecology

Research topics and disciplines
Plant Ecology, Population Ecology, Applied Ecology: Adaptations of plants to extreme environments, sustainable use of useful desert plants, effect of global change on vegetation in arid and semi-arid regions, land use effects on vegetation in arid and semi-arid regions

Regions/Countries
Main: Middle East (Israel, Jordan, Palestinian Autonomy); Others: Namibia, Southern Africa

Contact
Dr. K. Tielboerger
University of Tuebingen, Institute of Botany
Dept. of Plant Ecology
Auf der Morgenstelle 1
72076 Tuebingen
Phone: +49(0)7071-2972610
Fax: +49(0)7071-295344
Email: katja.tielborger@uni-tuebingen.de

✦✦✦

University of Trier, Faculty of Geography / Geosciences
Remote Sensing Department

Research topics and disciplines
Remote sensing and geomatics in desertification assessment and monitoring (regional to local scales), rangeland management, geo- and biophysical indicators of land degradation processes, time series analysis, spatial modelling, land use changes. Definition and development of a Satellite-based Desertification Assessment and Monitoring System for ACSAD, Damascus

Regions / Countries

Eastern and Western Mediterranean, Middle East

Contact
Prof. Dr. J. Hill, Dr. Th. Udelhoven
Remote Sensing Department, University of Trier
D-54286 Trier, Germany
Phone: +49(0)651-201-4592
Fax: +49(0)651-201-3815
E-mail: hillj@uni-trier.de, udelhove@uni-trier.de

✦✦✦

University of Wuerzburg
Geographic Institute

Research topics and disciplines
Dynamics of arid zone landscapes in time and space; climate change effects; human impact; vegetation history; traditional knowledge; methods of resource use

Regions/Countries
North- and West Africa, Southwest Africa, Arabian Peninsula, Iran

Contact
Dr. E. Schulz
Geographic Insitute
Am Hubland
97974 Wuerzburg, Germany
Phone: +49 (0)931-888 5546
Fax: +49 (0)931-888 5544
E-mail: erhard.schulz@mail.uni-wuerzburg.de

8. Co-operation with Other German Networks

Arbeitskreis Wuestenränder, or AKWue is an interdisciplinary geoscientific working group (mainly geographers, soil scientists, geologists and mineralogists) which arose in 1994 from the IGCP 349 and 413 (International Geological Correlation Programme). Each year the working group holds a two-day workshop that provides information on planned or running projects and other activities. The AKWue discusses German contributions to relevant international programmes (e.g. IGCP), also providing information for the participation at national and international conferences. An internet site is being prepared.

Contact (temporarily):
Prof. Dr. Ludwig Zoeller, University of Bayreuth, Germany
www.uni-bayreuth.de/departments/geomorph/)

ATSAF, Council for Tropical and Subtropical Agricultural Research, e.V. Scientific Association in the field of International Research on Agriculture, Food Security and Natural Resource Management, with individual membership.

Contact:
E-mail: atsaf@atsaf.de
www.atsaf.de

DFOR, **German Forum on Research for Development**. The National Forum under the European and the Global Forum on International Agricultural Research. Scientific Association in the field of International Research on Agriculture, Food Security and Natural Resource Management, with institutional membership only.

Contact:
E-mail: juergen.richter@inwent.org,
www.dfor.de

Contact:
Prof. Dr. Christian Wissel, UFZ Leipzig
E-mail: wissel@oesa.ufz.de
Maik Veste, University of Hamburg
E-mail: mveste@botanik.uni-hamburg.de

Gfoe, **Ecological Society of Germany, Austria and Switzerland**. Gfoe supports co-operation among scientists and institutions working within the field of ecology. Principal aims are to investigate the relationships between organisms and their environment and to promote ecology in schools and universities. Gfoe supports the application of ecological knowledge to improve the use of environmentally sound methods within the field of environmental planning. The working group “desert ecology” deals with basic and applied research topics in dry regions.

Contact:
Prof. Dr. S.-W. Breckle, University of Bielefeld
E-mail: sbreckle@uni-bielefeld.de or sbreckle@gmx.de

Gtoe, **Society for Tropical Ecology**. The Gtoe in Germany is a scientific association dealing with all aspects of tropical ecology. Tropical areas consti-tute not only humid, but also semi-arid and arid areas which are at high risk of desertification. The gtoe is committed to:

1. Supporting research in tropical ecology,
2. Disseminating the findings of research,
3. Contributing to the conservation of tropical plants, animals and habitats.