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in Germany – a Balance**

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Abstracts der Vorträge

Abstracts of the talks

Contents

Session 1: Wissenschaftliche Vernetzung – Scientific Network Building	7
The relevance of integrated and participatory-based research for combating desertification – welcoming address to the Desert*Net	7
Biodiversity and desertification – networking in Africa.....	8
The Desertification, Drought, Poverty and Agriculture (DDPA) Consortium: Building a Global Research-for-Development Initiative in Support of the UNCCD	9
Restoring and conserving African farm- and rangelands – demand for adaptive research and networks in sub-Saharan Africa	10
Session 2: Mensch und Desertifikation im Konflikt – Man and Desertification in Conflict	12
Integration of Ecological Complexity into Economic Approaches: A Case Study on Semi-Arid Rangelands.....	12
Farmers' attitudes towards innovations for sustainable land management in Northern Ethiopia	13
Session 3: Bodendegradation, Landnutzung und technische Innovationen – Soil Degradation, Land Use and Technical Innovations.....	14
ReviTec® - an integrated ecological technology to combat degradation; first results from field experiments in Mallorca (Spain).....	14
Bodenversalzung der Drâa-Oasen in Südmarokko	15
Using Hydrus-1D to develop guidelines for improved irrigation management in the Aral Sea Basin (Uzbekistan)	16
Session 4: Die Nutzung der Biodiversität - Fragen zur Nachhaltigkeit – The Use of Biodiversity - Aspects of Sustainability	18
Land degradation in the East Pamir (Tajikistan)	18
Vegetation und Weidenutzung im Westlichen Hohen Atlas (Marokko). Eine Nachhaltigkeitsbewertung aus geobotanischer Sicht	19
Die Reaktion von Vegetation und Böden der Lößsteppen der autonomen Region Ningxia (China) auf Beweidung unterschiedlicher Intensität	20
How does land degradation effect small mammals?	21
Desertifikationsbekämpfung in der Region am Aralsee (Kasachstan)	22
Session 5: Klimaänderung und Wasserknappheit – Climate Change and Water Scarcity.....	24
Vorgeschichtliche Desertifikationserscheinungen oder natürliche mittelholozäne Klimaänderung? Das Beispiel Lanzarote	24
Impact of climate variability and land cover dynamics on desertification and natural resource management in West Africa (GLOWA Volta / BIOTA West Africa research network)	25
Drowning in water scarcity: Natural resource management in the Aral Sea Basin	26
Current and future water issues in the Jordan region and in other drylands.....	27

Session 6: Fernerkundung als Hilfsmittel zur Verhinderung und Bekämpfung der Desertifikation – Remote Sensing as Tool for Avoiding and Combating Desertification.....	29
Remote Sensing and Geomatics Applications for Desertification and Land Degradation Monitoring and Assessment	29
Application of Remotely Sensed Forest Inventory in Monitoring Desertification in Uzbekistan	30
New Hyperspectral Approaches for the Assessment of Dryland Degradation. Application Example: Ground Cover Estimates	32
Ist das Konzept der Desertifikation überholt? Ein Beitrag auf Basis eigener Forschungen im Sahel Westafrikas.....	33

Session 1: Wissenschaftliche Vernetzung – Scientific Network Building

The relevance of integrated and participatory-based research for combating desertification – welcoming address to the Desert*Net

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Abstract

In many drylands, the economic stability especially of rural households directly depends on the condition and the availability of local or regional natural resources. Access to other sources of income generation are usually limited or non-existent so that any qualitative or quantitative changes to the natural capital can directly impact on means to earn and sustain a living. Currently, in many drylands, the quality and the availability of natural resources are undergoing dramatic changes. These changes can often directly be associated to human activities.

Already, in many drylands, the alarming extent of land degradation up to the point of desertification converts rehabilitation measures into generation spanning undertakings. It can be assumed that the pace of changes will accelerate in the future, due to the prevailing demographic developments, the increasing demands for natural goods and services, technical developments, and unsuited or missing regulation mechanisms for the sustainable utilisation of the natural resources at the local or regional level. However, in an increasingly globalised economy, the causes and effects of desertification can be geographically detached. Production systems and consumer habits for instance in industrialised countries can and do influence production systems in drylands. This underlines the responsibility of the international (research) community to prevent and combat desertification.

The multifarious causes and effects of desertification show that solutions for combating or preventing the degradation of productive drylands are not possible solely on the basis of uni-disciplinary research. It is fundamental also to strengthen and support research capacities with regard to promoting scientific co-operation with the affected countries. On the medium and on the long run, science should deliver the basis for establishing a mechanism for policy advice. The ecological and socio-political issues linked to desertification require disciplinary interweavements and hybrid research structures which support the development of innovative research concepts that focus on the development of applicable (cost-effective) measures for rehabilitating degraded drylands and for promoting sustainable land use techniques which consider local realities. Participation and

capacity support for sustainable development in areas affected by or prone to desertification should be a major ambition of DesertNet.

For serving all these purposes scientific networking is indispensable. It is crucial to increasingly link science with other stakeholders. Developing successful communication and action mechanisms between all stakeholders requires the identification of incentives, hence win-win situations for all sides. This could guarantee the long-term commitment of all target groups that are required for preserving the productivity of drylands.

Biodiversity and desertification – networking in Africa

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Abstract

Over the past three years the scientific activities with respect to the context of BIODIVERSITY and DESERTIFICATION have been developed successfully on the African continent within a number of research projects, driven by various African institutions but also including German initiatives from BMBF, BMZ, BMU, DAAD, VolkswagenFoundation and the EU. These initiatives also gained high political visibility in various countries.

Progress in scientific methodology and good results of the research programmes can be reported with respect to several disciplines, to the integration of disciplinary work and to the transformation of results. Special emphasis is given to the development of long-term monitoring initiatives as e.g. within the BIOTA Africa network and to the role of soil fertility, degradation and restoration.

The Desertification, Drought, Poverty and Agriculture (DDPA) Consortium: Building a Global Research-for-Development Initiative in Support of the UNCCD

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Abstract

The Consultative Group on International Agricultural Research (CGIAR) created a 'Challenge Program' mechanism in 2001 as a major pillar of its reform process. Through Challenge Programs, the CGIAR encourages its fifteen international agricultural research Centers to 'elevate their game' by engaging in larger research programs addressing major international challenges through broader global partnerships. The DDPA originated in 2002 as a proposal to make research contributions to The United Nations Convention to Combat Desertification (UNCCD). DDPA partners, co-convened by ICARDA and ICRISAT, are pursuing their initiative as a Consortium while awaiting Challenge Program approval from the CGIAR. With supplementary funding from the International Fund for Agricultural Development (IFAD) and the Global Mechanism of the UNCCD (GM), a global consultation workshop was held in Aleppo, Syria in August 2002 to develop a coherent strategy and identify areas of research focus. An internet dialogue provided additional expert insights. These inputs have been consolidated into a draft position paper outlining the DDPA's rationale, research priorities and approaches, which are described in more detail at www.ddpa.net. The DDPA's core question is: "How can we help the poor to simultaneously build their agricultural livelihoods, and save their drylands?" Many past efforts have focused on either livelihoods at the expense of the environment, or vice-versa. The DDPA sees both as interdependent and therefore requiring an integrated approach. To achieve this, six main research thrusts deserve priority:

1. Understanding and coping with land degradation and drought risk
2. Integrated ecosystem approach for the sustainable provision of agricultural and ecological goods and services
3. Policy and institutional options for combating desertification and drought
4. Harnessing genetic resources to combat drought and desertification
5. Income-increasing agricultural diversification to improve livelihoods and foster more sustainable land use
6. Breaking technology and knowledge barriers: increasing impact with an "ICT for development" strategy

The DDPA aims to consolidate desertification-related work across the CGIAR Centers as well as initiate new research with outside partners. Three new studies on socioeconomic

issues are underway through GM funding: understanding farmer perceptions of drought (with the University of Wageningen and INERA-Burkina Faso), technology triggers that could lead to sustainable development pathways (with the International Food Policy Research Institute-IFPRI and INRAN-Niger), and profitability-market possibilities for diversifying into new crops and crop products (ICRISAT with INERA and INRAN). The DDPA would like to explore collaboration with DesertNet institutions that are interested in this research domain.

Restoring and conserving African farm- and rangelands – demand for adaptive research and networks in sub-Saharan Africa

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Abstract

Regional climate scenarios for sub-Saharan Africa are in accordance with the assumption that temperature will raise and variability in precipitation will increase with respect to duration and intensity. In semi-arid areas of Africa already now climatic conditions vary strongly, and local farmer and pastoralists developed adaptation mechanisms that aim to ensure water- and nutrient availability for biomass production. In future, further development of these traditional and improved techniques is expected and recommended, with a strong emphasis on rainwater harvesting techniques (RWH).

The applicability of these techniques and practices is restricted through natural as well as through socio-economic factors. Most practices have a high work load. Farmers only invest work and capital if adequate returns in terms of food and cash can be attained. Further, social structures as a high percentage of migratory workers complicate the adoption of improved practices. Alternative options like animal traction are hampered by lacking capital or know-how. Another frequently neglected term is the access to markets, the impact of prices on the world-market as well as land tenure and water use rights.

Further, under certain conditions some of the above mentioned techniques might have negative draw-backs. Conflicts concerning water rights might arise, erosion might be enhanced when RHW-structures are not maintained adequately, higher disease rates of e.g. malaria might occur, indigenous flora and fauna might change in the course of habitat change or introduction of exotic species. Measures often do not reach the poorest but reinforce social disequilibrium at community level.

On a recent workshop in Accra in August 2004, supported by Volkswagen-Stiftung, IWMI (International Water Management Institute), FAO and Humboldt University, participants and experts recommended therefore for future (research-) projects:

- Not only aim technical solutions but understand better socio-economic and cultural factors and dynamics on technology adoption, giving very high priority to tenure security and economic advantages but considering also factors like rural – urban migration and related loss of indigenous knowledge.
- Evaluate and improve, or build up regional networks for dissemination, and better link farmers/herdsmen, extension service, and researchers
- Put emphasis on options and incentives for conserving communal land

Session 2: Mensch und Desertifikation im Konflikt – Man and Desertification in Conflict

Integration of Ecological Complexity into Economic Approaches: A Case Study on Semi-Arid Rangelands

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Abstract

This contribution deals with the serious problem in interdisciplinary work to link economics and ecology more intensively. To mitigate environmental problems of degradation through resource extraction and unsuitable farming practices, a treatable interface has to be invented that serves the side of farm economics and ecology simultaneously. In particular, for a sustainable utilisation of fragile lands such as semi-deserts, semi-arid-lands, intensively farmed watersheds, etc. integrated approaches can provide important management tools. Previous studies in environmental economics and managements considered the ecological processes of degradation due to overuse of resources primarily with given coefficients as part in a foreseen dynamic change of the natural environment.

However, massive interferences in eco-systems can result in complex modification of the natural behaviour of eco-systems that go beyond simple delineation of productivity decrease as ecological studies have shown. Prevailing degradation problems rather involve an interaction of ecological and social processes which are characterised by feedback effects running in both directions. Therefore, usually anticipated fixed coefficients cannot reflect these dynamics sufficiently.

In this contribution we explore a recently developed ecological framework such as the state-and-transition model and integrate it into a dynamic resource use model for rangeland management. We show how ecological knowledge can be condensed into states that describe the environment in a non-continuous frame. Farmers control degradation by various measures and land shares which are degraded and depicted through resource use. Ecologists receive more detailed information on anticipated behaviour of farmers and the idea is to create a system exchange to iterate ecological and economic sub-systems.

Farmers' attitudes towards innovations for sustainable land management in Northern Ethiopia

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Abstract

Improving soil fertility of arable land especially in dryland areas is one of the major concern of policy makers, scientists and farmers themselves. In the following paper the successes and adoption rate of two different approaches in Tigray, Northern Ethiopia shall be compared: One is an extension package composed of improved seeds, chemical fertilizer and water harvesting technologies, the other one is a community development approach based on the improvement of existing ecologically based soil fertility management practices with a focus on composting. It could be shown that cultural and financial considerations are the predominant factors for the selection of farming practices by most of the farmers.

Indicators chosen for evaluation of the adoption and success rate are overall indicators of human well-being as defined by the Millennium Ecosystem Assessment, other indicators chosen are soil status and biomass.

Session 3: Bodendegradation, Landnutzung und technische Innovationen – Soil Degradation, Land Use and Technical Innovations

ReviTec® - an integrated ecological technology to combat degradation; first results from field experiments in Mallorca (Spain)

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Abstract

ReviTec is an integrated ecological 'soft' technology to initiate and accelerate natural succession on degraded sites. The technology has been developed for the ecological restoration of degraded landscapes, for the stabilization of erosion-prone sites and for the revitalization of undeveloped sediments. Due to its modular design, it can be adapted to specific site conditions. Based on scientific knowledge, including the self-organisation of ecosystems, it is implemented with participation of the stakeholders, increasing ecological understanding and giving incentives for local enterprises.

The modularity of ReviTec combines several scales, from erosion-safe 30 l bags of decomposable material (e.g. of Jute), over fertility islands in the scale of 1 to 2 m² (composed of a set of bags) to the landscape scale of a mosaic of fertility islands. Substrate and biota, which interact with ecosystem development in a complex way, are considered in detail. Additives, technological as well as from recycling processes, are applied to improve nutrient cycling and water conditions.

Within a large area destroyed by fire (1991 and 1993) at Na Burguesa mountain near Calvia /Majorca (Spain), an experimental site was established. ReviTec was applied to accelerate succession and improve *Quercus ilex* establishment. Soil biota and plants were added, with special emphasis on the role of mycorrhiza for plants. Artificial inoculation was tested with *Quercus ilex*. Results from 1997 to 2003 are presented and discussed.

As an outlook, the technology is discussed in a broader context, e.g., of water harvesting and arid sandy ecosystem stabilisation.

Bodenversalzung der Drâa-Oasen in Südmarokko

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Abstract

IMPETUS Westafrika (*Integrative Management-Projekt für einen Effizienten und Tragfähigen Umgang mit Süßwasser in Westafrika: Fallstudien für ausgewählte Flusseinzugsgebiete unterschiedlicher Klimazonen*) untersucht in Südmarokko das Naturraumpotential und die lokalen soziologischen Gegebenheiten im Wassereinzugsgebiet des Drâa.

Der Drâa gehört mit dem Guir und dem Zis zu den drei Hauptflüssen Marokkos, die den Hohen Atlas südwärts entwässern und - den Atlantik heute nicht mehr erreichend - in Salzpflanzen im Randgürtel der Sahara enden. Flussbegleitend bilden ihre weitgespannten Dattelhaine die Lebensadern Südmarokkos.

Die Böden im Drâa-Einzugsgebiet unterliegen einem starken Nutzungsdruck durch Beweidung und Bewässerungsfeldbau in den Oasen. Die klimatische Situation (semi-arid bis hyperarid), insbesondere der Wassermangel, bedingen marginale Standorte, die in traditioneller Nutzung die Subsistenz vermehrt nicht mehr sichern kann. Übernutzung hat weitflächig zu einer Degradation der Vegetations- und der Bodendecke geführt.

Seit 1970 regeln künstliche Fluten des mit 560 Mio m³ kalkulierten Stausees unzureichend die Bewässerung der sechs großen Drâa-Oasen. Der mittlere Abfluß des mittleren Drâa beträgt 13,4 m³/s. Die Salinität des Drâa-Wasser variiert stark zwischen 1,3 bis 10 g/l flussauf/-abwärts und auch vor und nach den Bewässerungsfloten. Bodenversalzung spielt neben den anderen vorhandenen, vielfältigen Desertifikationsproblemen eine entscheidende Rolle bei der Verschlechterung der Lebensgrundlage der Oasen. Sie ist u.a. auch in Zusammenhang mit der nach Süden zunehmend schlechteren Wasserqualität zu sehen.

In drei Oasen sowie an dem heutigen Endsee wurden Böden nach der World Reference Base for Soil Resources (ISSS-ISRC-FAO 2002) aufgenommen und ihre Salinität nach ABROL et al. (1988) und DRIESSEN et al. (2001) bewertet. Eine Entwicklung des Drâa flussabwärts nach Süden von ertragreichen Datteloasen bis zum Oasensterben kann nachvollzogen werden. In den von starker Versalzung betroffenen Gebieten weisen die Böden entsprechende diagnostische Horizonte auf: hypersalic, sodic, petrogypsic und calcaric.

Zu dieser anthropogenen sekundären Versalzung durch Bewässerung kommt eine natürliche Salzakkumulation durch Auswaschung saliner Mergel der umliegenden Schichtstufen hinzu.

Fragen zu einer nachhaltigen Oasennutzung müssen diese natürlichen Gegebenheiten berücksichtigen und auch die Frage der Funktionalität des Stausees zulassen, der die natürliche Salzauswaschung durch Hochfluten unterbindet. Dieser einstigen natürlichen Salzauswaschung kommt deshalb besonderes Gewicht zu, da es sich um bewässerte Oasen ohne Drainage handelt, wobei jeweils flussabwärts die salinen Abwässer abgeführt werden. Nur ein permanentes starkes Durchspülen kann eine Salzakkumulation der unteren Flussoasen unterbinden. Erschwerend kommt eine feinere Textur in den unteren Flussoasen hinzu, die größere Salz mengen akkumulieren und auch größere Spülwassermengen benötigen.

Using Hydrus-1D to develop guidelines for improved irrigation management in the Aral Sea Basin (Uzbekistan)

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Abstract

The Khorezm region, which is a part of the Aral Sea Basin located in northwest Uzbekistan, is characterized by low precipitation, high temperatures, low relative humidity, high radiation and wind velocity, and very irregular topography. Agriculture is completely dependent on irrigation water taken from the Amu Darya River. The observed high groundwater tables, which are caused by an inefficient drainage system, contribute to meet the crop water requirements, but on the other hand increase the secondary salinization of the rooting zone. In addition, the absence of efficient levelling of the cultivated fields results in low water application efficiency.

To develop guidelines for optimal water use for different crops during the hydrological cycle, the salt dynamics and the irrigation effectiveness of irrigated fields were analyzed. During the years 2002 and 2003, two fields with different soil texture were planted with cotton. Data on plant, soil and groundwater levels were collected. The soil water model HYDRUS-1D (U.S. Salinity Laboratory) was applied as a simulation tool to provide the basic information for irrigation operations at field level. The reference evapotranspiration (ET_0) and crop coefficients (K_c) were calculated with the standardized Penman-Monteith method (FAO 56).

The water and salt balance of the two fields computed by the model was highly sensitive to the main physical and chemical properties, the prevailing irrigation regime and to water extracted by the crop (which corresponds to crop yield). Analyzed data showed that at depths of 80 cm and 105 cm, soil moisture during the measured period was always above field capacity due to the strong influence of groundwater, which played a very important

role in the water regime. The results emphasize the need for site-specific irrigation as well as drainage management in order to make use of the scarce and highly variable water resources more efficiently.

Based on the increased understanding of the cause-effect relationships, field level recommendations of irrigation and drainage management for smallholders in the region will be developed. This not only contributes to the development of a highly needed sustainable irrigation strategy but also leads to an economic and ecological improvement of land and water use in the Aral Sea Basin.

Session 4: Die Nutzung der Biodiversität - Fragen zur Nachhaltigkeit – The Use of Biodiversity - Aspects of Sustainability

Land degradation in the East Pamir (Tajikistan)

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Abstract

The Pamir-Mountains are part of South-Eastern Tajikistan. Ranges are divided by the upper Amu Darya (there called Ab-e-Panj), the southern ranges belonging to Afghanistan (Eastern Hindu Kush), the northern ranges have a more humid and deeply dissected western part and a high plateau in the Eastern half. The northern Pamir is one of the highest mountains on earth with peaks high above 7000m asl. The Pamir knot is famous because its central location between other mountains in all directions.

The Eastern Pamir plateau, between 3500 and 4200m asl is characterized by a very dry climate, thus exhibiting a typical and very scarce mountain desert vegetation. Grazing and energy shortages has lead to a severe destruction of huge areas of the semidesertic and desertic vegetation types, mainly by digging out the dominant but very slow growing subshrub *Ceratoides papposa* (Chenopodiaceae). This subshrub is called teresken, and accordingly the severe problem there is the teresken-syndrome. It resembles a similar problem in the high andes (the Altiplano in Bolivia), the tola-syndrome, where the tola subshrubs mostly from the genus *Parastrephia* are widely used also for fuel as well as for grazing of domestic and wild animals.

The teresken-syndrome is not easy to solve since the coupling of grazing and of energy-supply is a strong basic need for the local people. But wind- and water-erosion are increasing and degradation of ranges is becoming very severe. By many small-scale local means the energy supply can be improved, by recultivation on proper stands a better wind-protection and a more diverse food-supply can be achieved. In many mountain slopes, villages and valleys measures against land slides and for improving range lands by proper afforestation are urgently needed, as well as planning and means for a better protection of the nature reserves and the Pamir National Park.

Vegetation und Weidenutzung im Westlichen Hohen Atlas (Marokko). Eine Nachhaltigkeitsbewertung aus geobotanischer Sicht

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Abstract

In den südmediterranen semi-ariden Randgebieten im Übergang zur Sahara ist die Produktivität der Ökosysteme gering. Die Regenerationsbedingungen für Schlüsselarten sind schwierig. Zu diesem Übergangsraum gehört auch das UNESCO Biosphärenreservat Arganeraie (SW-Marokko), in dem in den letzten Jahrzehnten sich verstärkende, durch menschliche Übernutzung bedingte Degradationserscheinungen beobachtet wurden. Beweidung ist dabei der wichtigste biotisch-anthropogene Standortfaktor. Die Degradationserscheinungen stehen im Gegensatz zu dem von der UNESCO postulierten Modellcharakter einer nachhaltigen Nutzung in Biosphärenreservaten. Die Arganeraie ist daher auch Zielgebiet des Nationalen Strategieplans Marokkos zur Bekämpfung der Desertifikation.

Am Beispiel des Westlichen Hohen Atlas (einem Teilgebiet der Arganeraie) wird der Frage nachgegangen, ob die Gehölzvegetation in diesem konkreten Raum unter dem ortsüblichen Nutzungsdruck der Ziegenbeweidung fortschreitend degradiert oder ob die dort praktizierten Formen der Weidenutzung als nachhaltig zu bewerten sind. Es wird ein System spezifischer, skalen-bezogener ökologischer Kriterien entwickelt, die sich von den generellen Prinzipien der Definitionen für nachhaltige Nutzung (CBD 1992) und Degradation (CCD 1994) ableiten. Als generelle Bewertungskriterien werden biologische Komplexität, Produktivität, langfristiger Fortbestand, Potentiale und Einfluss der Landnutzung herangezogen. Abgeleitete spezielle Kriterien sind die Ausbildung von Pflanzengesellschaften und Gesellschaftsmosaiken, Regenerations- und Etablierungsfähigkeit von Gehölzen sowie Veränderungen im Größenklassenspektrum ausgewählter Zwergsträucher unter Berücksichtigung von Beweidung und klimatischen Bedingungen. Diese werden auf jeweils geeigneten räumlichen Skalenebenen (Population, Bestand, Landschaft) untersucht.

Anhand von Fallbeispielen wird das Konzept der Nachhaltigkeitsbewertung der Weidenutzung in Hinsicht auf die verwendeten Kriterien, die Repräsentativität und seine Grenzen beurteilt. Es können geeignete vegetationskundliche Parameter identifiziert werden, anhand derer der Weideeinfluss auf die Gehölzvegetation herausgearbeitet wird. Dies wird vor allem durch die Vergleichsmöglichkeiten, die sich durch den großräumigen Versuchsaufbau ergeben, erreicht. Kritische Größe bei der Bewertung ist die Länge des Beobachtungszeitraumes. Es sollte beachtet werden, dass die Einbeziehung weiterer

Landnutzungsformen möglicherweise komplexere Zusammenhänge aufdeckt. Das methodische Vorgehen ermöglicht eine Grenzziehung zwischen aktuell fortschreitender Degradation und nachhaltiger Nutzung auf den Bestandes- und Populationsebenen. Auf der landschaftlichen Ebene wird die Kenntnis über solche Prozesse mit großräumigen Vegetationsmustern verknüpft und zusammenfassend interpretiert.

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Die Reaktion von Vegetation und Böden der Lößsteppen der autonomen Region Ningxia (China) auf Beweidung unterschiedlicher Intensität

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**Yinchuan

Abstract

In den Federgrassteppen der autonomen Region Ningxia (Nordchina) wurden die Auswirkungen unterschiedlicher Beweidungsintensität auf die Zusammensetzung der Vegetation sowie auf ausgewählte Bodenparameter untersucht. Hierbei wurden die folgenden Beweidungsintensitäten unterschieden: nicht beweidet (0), leicht beweidet (I), mäßig beweidet (II), intensiv beweidet (III) und überbeweidet (IV). Es zeigte sich eine deutliche Verschlechterung bestimmter Bodeneigenschaften mit zunehmender Beweidungsintensität, wobei diese Verschlechterung teils kontinuierlich von Stufe zu Stufe auftraten, teils erst ab Beweidungsstufe II mit deutlichem Anstieg zu III und IV. Im Hinblick auf das Thema der Tagung (Desertifikation) ist besonders von Interesse, dass die Vegetationsbedeckung in Stufe III deutlich reduziert ist. Beweidungsstufe II sollte daher auf keinen Fall überschritten werden. Die artenreichsten Steppen sind in Beweidungsstufe I zu finden. Aus Sicht der Biodiversität sollten Naturschutzgebiete also nicht von der Beweidung ausgeklammert, sondern leicht beweidet werden. Die dargelegten Ergebnisse sind für die beiden Haupttypen der Steppenvegetation des Untersuchungsgebietes, die *Stipa grandis*- und die *Stipa bungeana*-Steppe, nahezu identisch.

How does land degradation effect small mammals?

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Abstract

Information about the effect of land degradation on small mammals in Africa is scanty. Within the multidisciplinary biodiversity research project BIOTA (Biodiversity Monitoring Transect Analysis in Africa), our study focussed on aspects linked to the diversity of small mammals on two neighbouring sites with different forms of land use in Southern Namibia. The lack of livestock management in the communal area of Nabaos has resulted in serious overgrazing by goats. The governmental research station of Gellap-Ost, in contrast, has a controlled grazing regime for Dorper and Karakul sheep.

Population ecology data on small mammals were assessed during a 2-years capture-mark-recapture study, which was conducted for four trap-nights per season in either plot. 90 Sherman® folding live traps spaced at 15 m intervals were used on each of the 2 hectare plots.

As expected, the loss of habitat structures in Nabaos has led to a decrease in species diversity and abundance associated with a change in dominance structure. The most frequent gerbil of Gellap-Ost, *Tatera leucogaster*, which prefers a savanna environment, never occurred in the degraded land of Nabaos. There, *Gerbillurus vallinus*, a desert inhabitant, was the dominant species. The low species diversity along with all population ecology parameters and especially the high dominance of the desert species in the communal area indicates clearly, that the practised land use system has deteriorated the ecological conditions of the area. Therefore it is suggested that small mammals can be used as an indicator for assessing the degree of disturbance of an ecosystem.

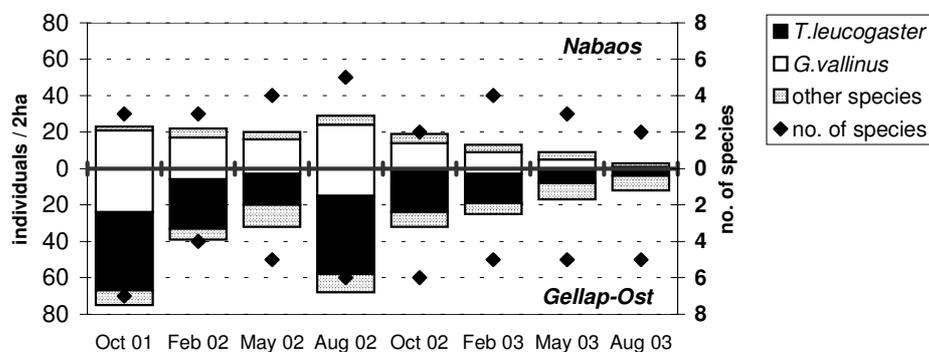


Figure 1: Abundance and species diversity at Nabaos and Gellap-Ost.

Desertifikationsbekämpfung in der Region am Aralsee (Kasachstan)

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Abstract

Der Aralsee und die umliegende Region gehören aus botanisch-geographischer Sicht zu den kasachisch-dsungarischen Wüsten der gemäßigten Zone Eurasiens. Die negativen Umweltveränderungen in der Region, die unter dem Stichwort „Aralsee-Syndrom“ bekannt sind, beeinträchtigen die wirtschaftliche Entwicklung, wie auch die Lebensbedingungen der Menschen sehr negativ. Nötige Gegenmaßnahmen zur Prävention und Bekämpfung der negativen Umweltveränderungen in der Region am Aralsee (im Sinne der UNCCD-Konvention) sind von dringlicher Bedeutung. Erhalt der Biodiversität, Naturschutzprogramme, Anpflanzungen und Stabilisierung der Salzböden sind von zunehmender Bedeutung für die Region. Die Bildung neuer Salzflächen in der Region am Aralsee ist dem räumlichen Ausmaß nach mit der Großen Iranischen Salzwüste oder der großen Salzwüste in Utah (USA) vergleichbar. Die Phytomelioration ist die einzige Maßnahme, die die verheerenden Folgen des Salzstaubaustrages vom trockengefallenen Seeboden vermindern kann. Die Anpflanzungen auf verschiedenen Bodentypen wurden durchgeführt. Die erprobten Technologien (Anlage von Furchen, mechanische Befestigung des Oberbodens, Wegnahme der Salzkruste, minicachment-Verfahren usw.) sollen auch für die Anpflanzung von Euhalophyten verwendet werden, jedoch unter Berücksichtigung der Spezifikation des Standortes und der biologischen Eigenschaften der Aufforstungsarten. Am Beispiel des Naturschutzgebiets *Barsa-Kelmes* sollen bestimmte Modelle für die Erhaltung der Biodiversität in der Region entwickelt werden. Im Zusammenhang mit der Erweiterung der Fläche des Naturschutzgebiets bis zur Ostküste des Aralsees entstehen neue Aufgaben in Bezug auf dieses Gebiet. Mit den Projektpartnern von Kasachstan (Institut für Botanik in Almaty, Institut für Forstwirtschaft in Kokschetau, Institut für Agrarökologie in Ksyl-Orda, Anpflanzungsbetrieb „Syrboi-Ormany“ in Ksyl-Orda, GIS-Terra in Almaty) wurde im Rahmen des Projektes eine erfolgreiche Kooperation entwickelt.

Die Prinzipien der CCD (partizipatives Vorgehen, Programmansatz, Mainstreaming, etc.) auf der dörflichen und regionalen Ebenen werden konsequent angewandt. Als Modellobjekte für die Zusammenarbeit in der Region sind die Dörfer Bogen und Karateren (Bezirk Aralsk, Distrikt Kzyl-Orda) ausgewählt worden. In den Dörfern wurde ein PRA-Seminar durchgeführt. Die Projektbeteiligten nahmen an den Seminaren und Workshops der DSE, des BfN, des GTZ-CCD-Projektes teil. Das Projekt wird als dynamischer Lehrvorgang für alle Projektbeteiligten und für die Zielgruppe betrachtet und entwickelt

werden. Das Forschungsprojekt wird vom BMBF (0330389) gefördert und vom GTZ-CCD-Projekt in Bonn unterstützt.

Session 5: Klimaänderung und Wasserknappheit – Climate Change and Water Scarcity

Vorgeschichtliche Desertifikationserscheinungen oder natürliche mittelholozäne Klimaänderung? Das Beispiel Lanzarote

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Abstract

Untersuchungen zu Sediment-Boden-Abfolgen in „Vegas“ (geschlossene Becken) auf der Kanareninsel Lanzarote zeigten auffälligen Sedimentationswechsel im Hangenden eines spätglazial-frühholozänen Paläobodens. Bis dahin ruhige „fluvio-äolische“ Sedimentation wandelt sich zu einer Wechsellagerung torrentieller mit (vorwiegend) äolischen Ablagerungen und lokalen Tephren. Funde von Ovicapriden-Knochen in den torrentiellen Sedimenten belegen die Anwesenheit von Menschen zur Zeit der Ablagerungen. Bisherige Lumineszenz-Datierungen mittels IRSL engen den Beginn dieser Sedimentation zwischen etwa 5 und 10 ka ein, deutlich früher als bisher bekannt gewordene archäologische Funde nahe legen.

Aus der Sahara und ihren Randgebieten ist von vielen Regionen bekannt, dass im fraglichen Zeitraum eine schubartige, von mehreren kürzeren Feuchtphasen unterbrochene Aridisierung einsetzte. Der Sedimentationswechsel auf Lanzarote könnte also einzig auf natürliche Morphodynamik zurückzuführen sein. Dagegen spricht aber, dass derartige Sedimente aus früheren Phasen mit nachweislichen hygrischen Schwankungen auf Lanzarote nicht in dieser Weise auftreten. Daher muss in Erwägung gezogen werden, dass eine frühe vermutlich präkeramische neolithische (oder epipaläolithische?) Kultur mit vorwiegend halbnomadischer Weidenwirtschaft das empfindliche semiaride Ökosystem derart stören konnte, dass desertifikationsartige Erscheinungen ausgelöst wurden. Diese könnten durchaus durch Aridisierung verstärkt worden sein. Da eine Siedlungskontinuität derzeit nicht belegt werden kann, erscheint momentan auch eine Siedlungslücke mit nachfolgender Wiederbesiedlung durch eine keramische aber prä-metallische Kultur denkbar.

Nach aktuellen Beobachtungen reichen Niederschläge von 40 mm in 48 h nicht aus, um derartige Erosions- und Akkumulationsereignisse auszulösen. Die heute weit verbreitete Trockenfeldbautechnik „enarenado artificial“ wirkt klar erosionshemmend, droht aber aufgrund des wirtschaftlichen Strukturwandels (touristischer Bauboom) vernachlässigt zu werden, wodurch die Desertifikationsgefahr wieder steigt.

Die Insel Lanzarote, die heute größtenteils durch ein ozeanisches Halbwüstenklima charakterisiert ist, birgt in ihren Vega-Sedimenten nicht nur ein für NW-Afrika einzigartiges Klimaarchiv, sondern bietet aufgrund ihrer weitgehenden Isolierung bis zur spanischen Kolonialzeit auch besonders gute Möglichkeiten zum Studium der geoökologischen Auswirkungen früher prä-metallischer Kulturen in desertifikationsgefährdeten Trockengebieten.

Impact of climate variability and land cover dynamics on desertification and natural resource management in West Africa (GLOWA Volta / BIOTA West Africa research network)

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Abstract

Especially in climate sensitive regions, where rainfed and irrigated agriculture is the main source of food security and income, concerns about the impact of environmental changes and the variability in rainfall, its temporal and spatial distribution, must be taken very seriously. This seems to be particularly true of West Africa where significant alterations in precipitation during the great Sahelian drought of the early 1970s and 1980s affected great parts of West Africa in terms of ecological, economic, and societal aspects. Analysing the complex reasons is still one of the major challenges for environmental scientific research.

In West Africa essential anthropogenically induced land cover changes took place during the past five decades. At the same time, great parts of the region suffered from a rainfall deficit at least for the last three decades. Results of this paper support the idea that regional variability in precipitation with regard to its temporal and spatial distribution is considerably linked to significant changes in vegetation cover. The environmental impact on socio-economy and natural biodiversity, however, remains ambiguous.

In frame of the GLOWA-Volta and BIOTA-West Africa scientific research networks funded by the Federal German Ministry for Science and Education (BMBF) a multi-scale monitoring concept was designed, combining most suitable and advantageous features of remote sensing and bioclimatic ground observations in order to examine the following focal points:

- a) monitoring of large scale vegetation, hydrologic and biogeophysical dynamics;
- b) change detection of vegetation and land surface characteristics (particularly human induced changes of different degradation intensity); and
- c) the importance of climate variability based on observations of biosphere – atmosphere interactions.

Drowning in water scarcity: Natural resource management in the Aral Sea Basin

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Abstract

Water management has become one of the most critical issues in the Aral Sea Basin. This region suffers from enormous problems related to irrigation and drinking water quality and safety, affecting not only the ecological sustainability, but also the economic viability of rural livelihoods. In view of the often precarious situation of water management infrastructure and land management approaches that oppose textbook solutions, problems seem easy to solve at first glance. However, the persistence of the status quo shows that quick fixes seem not to do the trick. More careful analysis of the situation in Uzbekistan – where the largest share of the agricultural population of the Aral Sea Basin lives - reveals that the intricacies of agricultural production under the state-commanded 'state order' system are at the heart of many of the problems perceived. A deeper look that takes into account the perspectives and perceptions of the local farmers and decision-makers is needed to fully understand the system and to be able to provide solutions to the point. Two examples are discussed here.

The fact that high groundwater table is seen throughout the region, which is associated with high soil salinity levels, leads to the obvious conclusion that farmers have to reduce water application to the fields in order to reduce salt loads in the fields. The farmers, in contrast, often block the drainage system because their larger concern is with water security, not soil quality. Crops will grow on bad soil, but no crops will grow without water. Recommendations based solely on irrigation water reduction without taking into account the farmer's needs of reliable water supply will not address the true underlying problem and fail to be implemented in the long run.

It is often recommended that a stronger privatization of the agricultural production system would free the farmers' from Soviet-style command hierarchies and leave it to a higher market-oriented system to solve many economic and at the same time environmental problems. However, again a careful complete analysis reveals that, farmers may be better off, in financial terms, with the partial and incomplete reforms currently implemented. The present system with its subsidies, purchase guaranty and possibilities to bypass has clear advantages. The anticipated privatization must address aspects such as compensation, marketing and processing which have not been considered thus far; otherwise it might become a difficult pathway to pursue.

These two examples reveal that much deeper understanding is needed for devising solutions for 'apparently obvious' development problem chains, if such solutions are intended to be sustainable. The long-term, science-based, and interdisciplinary approach

of the ZEF research program on 'Land and Water Management in Khorezm, Uzbekistan' is one avenue of addressing the problems and providing appropriate solutions that have a better chance of finding acceptance with local land users, farmers, and decision-makers.

Current and future water issues in the Jordan region and in other drylands

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Abstract

Increasing water scarcity is a threat to many dryland regions. Climate change, in combination with other drivers of change, is likely to decrease per-capita availability of "blue" water for irrigation, drinking and other human uses. Similarly, natural ecosystems and rainfed agriculture in semi-arid or arid regions are vulnerable to increasing "green" water scarcity and increasing climate variability.

Despite the uncertainties inherent to current climate models, a consistent spatial pattern of critical regions emerges, that will experience increasing water scarcity due to climate change. The eastern Mediterranean / Middle East is one of the hot-spots of further aridification.

The ability to cope with water scarcity varies strongly between countries and population groups, with the poorest generally being most vulnerable. Hence, specific combinations of mitigation and adaptation options, and of structural and non-structural measures are required, to reduce adverse effects to humans and ecosystems.

Since water scarcity is always caused by a mixture of internal and external drivers, sustainable solutions have to go beyond local responses and address also global "teleconnections".

Science plays an important role in providing system understanding, e.g. with respect to interactions and feedbacks between humans and environment, as well as the impacts of future changes.

The GLOWA initiative of the BMBF provides a framework for integrating disciplinary knowledge, and for bridging between science and water and land management.

The GLOWA Jordan River project is located in a region with one of the lowest per-capita water availabilities and high natural climate variability, compounded by strong drivers of change, such as very high rates of population growth, urbanization and other land use

changes. On the other hand the region also has a very long history of adaptation to water scarcity.

The GLOWA Jordan River Project is taking a scenario-based approach. Qualitative and quantitative scenarios are developed jointly between stakeholders and scientists. Hydro-ecological responses to these scenarios are simulated, and adaptation options in water and land management, in particular for agriculture, wastewater reuse and natural ecosystem management, are tested for these scenarios. A common framework for assessing costs and benefits will yield water productivities and tradeoffs between different options.

A central user interface integrates information from the different disciplines, and provides stakeholders with a tool to simulate the system responses of different (blue) water management and land (green water) management decisions, in order to optimise water allocations under global change.

Session 6: Fernerkundung als Hilfsmittel zur Verhinderung und Bekämpfung der Desertifikation – Remote Sensing as Tool for Avoiding and Combating Desertification

Remote Sensing and Geomatics Applications for Desertification and Land Degradation Monitoring and Assessment

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Abstract

One of the major fields of research at the Remote Sensing Department at the University of Trier is the development and application of methodologies to assess and monitor desertification and land degradation processes, especially in the European Mediterranean. While initial efforts were confined to the evaluation of potential spatial indicators of degradation and how these could be inferred from spatial data sources (e.g. Demon I and II, Lucifer), current approaches focus on methodological improvements, their multi-temporal application, and the development of remote sensing based environmental process models. In this context, an increasing integration with different disciplines is of utmost importance to proceed from purely descriptive approaches towards the definition of alternative management strategies to support the prevention or mitigation of land degradation.

In this context, the GeoRange project focused on the implementation of integrated assessment concepts for multifunctional Mediterranean rangelands. These are based on retrospective data sets, where long time series of medium resolution satellite images have been set up and quantitatively analysed with respect to proportional vegetation cover as the target indicator of rangeland condition. Trend analyses were then calculated to characterize the development of vegetation cover with time, and interpretation frameworks were defined to interpret the resulting statistical parameters with regard to different problem regimes, such as fires, grazing etc.

While the integration of remote sensing derived information into ecological process models has triggered widespread applications using medium and high resolution imagery, increasing emphasis is attributed to the synoptic, integrated assessment of larger spatial units, and the provision of dedicated information products for administrations and policy-makers. In the frame of the GMES initiative of the European Commission, the LADAMER initiative aims at the small-scale assessment of the degradation status of large areas, and the identification of degradation 'hot spots'. Using small scale multi-year observations from global monitoring satellites (SPOT VEGETATION, NOAA-AVHRR, MODIS), the decoupling of long-term trends and cyclic components of vegetation dynamics is among

the most prominent tasks. Due to the complexity of such approaches, mostly automatic classification or principal-component-related techniques have been employed to global coverage and high temporal resolution imagery for mapping either phenology types or seasonality effects. While these approaches allow identifying pixel clusters with similar temporal and radiometric behaviour, they fail to unveil long-term degradation trends as expressed by associated vegetation changes, whereas for example Fourier- or Wavelet-analyses may introduce significant advances towards identifying long-term trends from high frequency datasets.

Application of Remotely Sensed Forest Inventory in Monitoring Desertification in Uzbekistan

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Abstract

In Khorezm, a region in Uzbekistan, forests and tree stands only occur under two circumstances: naturally, as in the Tugai forests in floodplains along the Amu Darya River, and artificially, such as with the shelterbelts and plantations in irrigated landscapes. The monitoring of Tugai forests and assessment of planted tree stands in irrigated lands can be seen as part of the wider UNCCD desertification monitoring task. Geographic Information Systems (GIS) forms the basis for desertification monitoring (digital map database, software and models of cartographic data processing), including monitoring of the state of natural resources i.a., vegetation, wildlife and ecosystems at various levels; assessment of farmlands and woodlands, restricted areas and reserves, and national parks and recreational areas (National Report of the Republic of Uzbekistan on the Implementation to Combat Desertification, Tashkent, 2002).

Existing forest patches and shelterbelts in Khorezm have been inventoried using remote sensing with low altitude aerial photographs obtained from Uzbek authorities. In-depth analysis of two investigated transects crossing N-S (320 km²) and W-E (230 km²) directions in Khorezm, covering virtually all typical landscapes was conducted. Stereo pairs of the photographs (scale 1:20 000) were analyzed with the VISOPRET12 analytical stereo plotter using AUTOCAD and ARCVIEW. The GIS tree and forest map of Khorezm is based on technologies developed in a PhD study at ZEF (University of Bonn)/UNESCO Khorezm Project and Altmann & Moellenkamp GIS Company (Goettingen), which will be applied to satellite imagery for the whole of Khorezm in a follow-up study.

Interpreted APs provided information on form, size, position, mean stand height and crown density for the native forests and plantations as well as the height, length, width, density and configuration for windbreaks in irrigated lands. Additional dendrometric data,

species composition, and stand assessment of damage/health were collected during ground truthing.

This PhD thesis is in progress. A few preliminary conclusions can be made:

- An inventory of tree stands and forests from aerial photographs can be successfully carried out in Central Asia.
- Investigated forest compartments of Tugai forest have shown a decrease in forested area by a third compared with the last inventory data from 1990.
- Forest vegetation types and tree stand productivity are changing according to an irrigation gradient from the Amu Darya River to the Karakum Desert.
- Due to functional constraints, most of the inventoried strips of trees do not properly function as windbreaks.
- Mulberry, which is coppiced and used in silk production, is the dominant species of the trees planted in rows.

REMOTE SENSING APPROACHES IN SUPPORT OF SUSTAINABLE LAND USE MANAGEMENT IN SEMI-ARID ENVIRONMENTS

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Abstract

Semiarid and subhumid landscapes have always been under strong ecological pressure, but natural ecosystems and certain land use practices have successfully adapted to the harsh conditions. However, a great threat for these regions is caused by socio-economic and climatic changes in recent times, endangering the diversity and the sustainability of these unique ecosystems. To ensure long-term productivity of land resources, it is essential to identify and to localize threads and dangers in time so that appropriate actions can be taken before effects are difficult or even impossible to reverse. Furthermore, sustainable land use management does not only include monitoring and assessment of desertification, it also includes programs for soil and biodiversity conservation as well as crop production and rangeland management systems. As Part of the projects BIOTA and GLOWA VOLTA, biodiversity, Land Use management and Land Cover properties in the African tropics are mainly influenced by environmental and socioeconomic development in these regions and therefore of great interest for governmental and industrial decision making.

As a tool for sustainable land use management, land status indices are proposed by many studies. Most of these indices are based on surface properties which can be acquired

remotely by measuring the spectral characteristics of the land surfaces. Using new methodologies and a combination of high spatial and high spectral resolution imagery, detailed, timely, and process-relevant information can be obtained operationally at various scales. A feasibility study will be conducted using airborne hyperspectral sensors (HyMap, ARES) and available satellite sensors (e.g. ASTER, Hyperion). As a future product, regularly updated vulnerability and risk maps based on the synopsis of environmental and socio-economic indicators will be available. These can serve as a valuable and cost-effective base for decision processes of individual land users, local and national governments. Objectives of this talk are the discussion of approaches towards: 1) Development and evaluation of a biophysical and socio-economic model based on multi- and hyperspectral remote sensing techniques for the assessment and quantification of the nature, extent, severity and impacts of land degradation processes 2) Development of a data evaluation scheme for this purpose 3) Integration of land degradation assessment techniques and sustainable land use management systems

New Hyperspectral Approaches for the Assessment of Dryland Degradation. Application Example: Ground Cover Estimates

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Abstract

Previous studies have shown the potential of remote sensing to deliver information which is closely related to variables or parameters specific to or indicators of desertification and impacts of droughts on natural ecosystems. This includes indicators for processes and factors of change at different spatial levels, both static and dynamic, requiring different remote sensing approaches. Examples are standard products like vegetation indices and land cover maps as well as in-depth information on the status and bio- / geo-physical composition of soil and vegetation. For the in-depth monitoring of ecosystems which are dominated by photosynthetically inactive species or dead annuals during most of the year, hyperspectral remote sensing is thought to be an adequate source of information due to the increased ability to discriminate between dry vegetation components and bare soils.

Application

As an application example, the quantitative estimation of ground cover fractions by airborne hyperspectral remote sensing is presented. Ground cover estimates are frequently used in land degradation models, since the type (photosynthetically active vegetation, non-photosynthetically active and dead vegetation, bare soil and rocks), the

degree (sparse vs. dense canopies) and the spatial distribution pattern of ground cover patches alter the surface runoff and thus the erosion potential. Additionally, physical and biological surface crusts (esp. lichens) have to be included in the analysis, since they also affect the vulnerability to degradation.

To fulfil these data needs, a new approach based on the combination of multiple endmember spectral unmixing and knowledge-based feature identification is currently tested in a case study conducted near Almeria, Southern Spain. During different phenological stages, airborne HyMap data has been recorded over a test area showing a typical semi-arid landscape in a state of transformation from traditional dry land farming and pasturing towards (semi-)natural vegetation.

Conclusions and Outlook

For the application 'ground cover fraction', first results indicate that using the proposed (semi-) automated approach, qualitative and quantitative subpixel information can be derived with improved accuracy, resulting in reliable ground cover fraction maps. In particular, changes in lithology can be identified, ground cover can be estimated with a higher accuracy, and an additional classification of scene components is accomplished.

Starting this winter, a fully automated data preprocessing chain for hyperspectral data will be available at DLR. Included is the automated retrieval of value-added products like leaf area index (LAI), the fraction of absorbed photosynthetically active radiation (FPAR) and additional radiation and heat fluxes.

As a future perspective, the new airborne ARES sensor will be operational from 2005 onwards, enabling new applications due to improved data quality. In order to accomplish an operational long term monitoring system with global coverage, the DLR will continue to support initiatives towards the development of hyperspectral satellite instruments.

Ist das Konzept der Desertifikation überholt? Ein Beitrag auf Basis eigener Forschungen im Sahel Westafrikas

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Abstract

Seit dem Beginn der neunziger Jahre des letzten Jahrhunderts wird das Konzept der Desertifikation zunehmend in Frage gestellt (u. a. HELLDÉN 1991, NICHOLSON et al. 1998, REYNOLDS & STAFFORD SMITH 2002). MAINGUET titelt ihr letztes Buch aus dem Jahr 1999 nicht mehr "Desertification" sondern "Aridity". In der Onlineausgabe vom New Scientist vom 18. September 2002 wird sogar von einem "spektakulären Rückzug der Wüste" berichtet.

Was sind die Gründe für diese Entwicklung?

Zunächst ist sich die Wissenschaftsgemeinde nicht einig, was Desertifikation eigentlich bedeutet. Wie erkennt und quantifiziert man Veränderung? Welcher Zeitraum wird zugrunde gelegt? Welche Niederschlagsperiode wird als Vergleichsbasis gewählt? usw. usf.

Nicht hilfreich ist ferner, dass, bedingt durch kurze Projektlaufzeiten, die assoziierten Arbeitsgruppen selten länger als 10-12 Jahre an der Fragestellung arbeiten können. Dann erfolgt ein Generationswechsel, die nächste Generation fängt häufig wieder bei Null an. Erkenntnisse, die zwanzig oder mehr Jahre zurückliegen, werden nicht mehr wahrgenommen.

Zudem weist das Phänomen Desertifikation eine starke politische Komponente auf. Lobbys in den Industrienationen wie auch in den Entwicklungs- bzw. Schwellenländern arbeiten mit diesem Begriff und setzen ihn entsprechend ein. Forschungsgelder werden je nach Interessenlage bewilligt oder ausgesetzt. Gemäß der Instrumentalisierung der Desertifikationsdebatte verwundert es nicht, wenn eine sachliche Bearbeitung des Phänomens in den Hintergrund gerät und vielleicht auch gar nicht wirklich gewünscht wird.

Aus den genannten Gründen wird auch ersichtlich, warum häufig die gleichen Fragen, wie sie - teilweise wesentlich ausführlicher - auch schon 1977 in Nairobi diskutiert worden sind, gestellt werden.

Für den westafrikanischen Sahel wird, auf Basis eigener Forschungen, eine Stellungnahme zu diesem Thema gegeben.

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Abstracts der Poster

Abstracts of the posters

CONTENTS

Übersicht der Poster	38
Comparison and sensitivity of measurement techniques for soil salinity detection	39
From Hillslope to Landscape Scale – Soil erosion research in Burkina Faso	39
Soilscapes of the Drâa basin / Southern Morocco	40
What is Desert*Net?	41
Participatory research in Namaqualand / South Africa - approaches towards science-land user co-operation	42
Management of semi-arid to arid areas for maintaining essential populations of aculeate wasps and bees: pollinators and predators	43
The Potential of <i>Moringa stenopetala</i> Seeds for Water Clarification in Semi-Arid Areas of Ethiopia	45
Modelling soil degradation due to water erosion in the upper Ouémé catchment (Benin)	45
The potential of cash crop halophytes (<i>Atriplex nummularia</i> and <i>A. leucoclada</i>) to maintain yields and reclaim saline soils in arid areas	46
Quantity, quality and economics: Reviewing the use of mineral fertilizers on key crops in the Aral Sea Basin	47
The estimation of tree distribution and dynamics using high spatial resolution images in Burkina Faso	48
Deterioration of rangeland in southern Africa due to overgrazing	49
GIS Infrastructure, Databases and Capacity Building for the ZEF/UNESCO Khorezm Project in Uzbekistan	50
Variation of interaction intensity among life history stages	51
Optimizing supplemental wheat irrigation in a low-rainfall zone of Syria	52
Genetically Modified Organisms for the Third World? The Example of Drought-tolerant Plants	53
Diversification of Smallholder' s Animal Production Systems: an Alternative to Mitigate Desertification in Northern Patagonia, Argentina?	54

Übersicht der Poster

Akmal Akramhanov , J. Hendrickx , S. Park & P. Vlek	Comparison and sensitivity of measurement techniques for soil salinity detection
Almut Brunner & P.L.G. Vlek	From Hillslope to Landscape Scale – Soil erosion research in Burkina Faso
Britta Chafik	Soilscapes of the Drâa basin / Southern Morocco
Desert*Net Board	What is Desert*Net?
Julika Doerffer & Ute Schmiedel	Participatory research in Namaqualand / South Africa - approaches towards science-land user co-operation
Sarah K. Gesso & Friedrich W. Gesso	Management of semi-arid to arid areas for maintaining essential populations of aculeate wasps and bees: pollinators and predators
Ingrid Hartmann	The Potential of <i>Moringa stenopetala</i> Seeds for Water Clarification in Semi-Arid Areas of Ethiopia
Claudia Hiepe & Bernd Diekkrüger	Modelling soil degradation due to water erosion in the upper Ouémé valley (Benin)
Sayed Hussin , N. Geissler , S. Eisa , S. Habib & H.-W. Koyro	The potential of cash crop halophytes (<i>Atriplex nummularia</i> and <i>A. leucoclada</i>) to maintain yields and reclaim saline soils in arid areas
Kirsten Kienzler , John Lamers , Nazar Ibragimov , & Paul Vlek	Quantity, quality and economics: Reviewing the use of mineral fertilizers on key crops in the Aral Sea Basin
Toshiya Okuro , Paul Vlek , Katsuyuki Minami , Joerg Szarzynski & Tia Lazare	The estimation of tree distribution and dynamics using high spatial resolution images in Burkina Faso
Corinna Rickert , Christina Wolkenhauer and Mariam Akhtar-Schuster	Deterioration of rangeland in southern Africa due to overgrazing
Gerd R. Rücker , Omonbek Salaev , Gulbakhor Ruzieva , John Lamers & Günter Strunz	GIS Infrastructure, Databases and Capacity Building for the ZEF/UNESCO Khorezm Project in Uzbekistan
Katja Schiffers , Katja Tielbörger & Florian Jeltsch	Variation of interaction intensity among life history stages
Wilko Schweers , Armin Rieser , Murari Singh & Theib Oweis	Optimizing supplemental wheat irrigation in a low-rainfall zone of Syria
Susanne Stirn , Benjamin Crost & Volker Beusmann	Genetically Modified Organisms for the Third World? The Example of Drought-tolerant Plants
Sebastian Villagra , Clemens Wollny , Celso Giraudó & Guillermo Siffredi	Diversification of Smallholder's Animal Production Systems: an Alternative to Mitigate Desertification in Northern Patagonia, Argentina?

Comparison and sensitivity of measurement techniques for soil salinity detection

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Abstract

The fact that land management practices in arid regions are hampered by soil salinity is well accepted. Salinity appraisal in the Aral Sea Basin region however, is still dependent upon traditional soil surveys with subsequent laboratory analyses for the total dissolved solids (TDS). The paper explores the adaptation of existing commercialized or locally manufactured electrical conductivity (EC) devices in order to quickly measure soil salinity. Also, equipment's sensitivity to individual salt ions is evaluated using regression trees. Locally assembled soil paste EC meter showed good correlation with TDS and could detect salinity with 75% accuracy. Methods based on apparent EC (ECa measured with 3 devices) had accuracy in the range of slightly below 50%. Sensitivity analyses showed that ECa based devices are equally sensitive to chloride ions, which confirms that used devices are comparable and can be used to quantify individual ions. Results of the EC measurements should, however, be taken with caution as they only provide approximate indications of salinity. Nonetheless, the methods are very useful for quick appraisal of large areas and affordable both time- and money-wise.

From Hillslope to Landscape Scale – Soil erosion research in Burkina Faso

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Abstract

Soil erosion is one of the major factors causing land degradation and soil nutrient depletion in the semi-arid environment of Burkina Faso. Soil erosion processes seriously restrict the use of arable land for food production and are, moreover, often first signs of expanding desertification. Especially on a landscape a more holistic approach is required to analyze the interactions of climate, soil, geomorphology, hydrology and vegetation as well as human-influenced land use and land management impacts. Additionally, off-site effects of soil erosion, such as the sedimentation of reservoirs, play an important, but often neglected role in countries depending on water harvesting agriculture.

Therefore, this research aims 1) to identify components affecting soil erosion and sedimentation on different scales in the South-Western part of Burkina Faso, 2) to develop a soil erosion model, which considers the interactions between system components and 3) to evaluate the impact of soil erosion and sedimentation dynamics for vulnerable landscapes.

Qualitative and quantitative pedo-geomorphological methods, remote sensing techniques, Geographical Information Systems and Cellular Automata are used to get insight into the spatial behavior of the environmental system. Soil investigations include the description of soil profiles along transects to obtain information about soil genesis and landscape development. The redistribution pattern of soil is analyzed by measuring the amount of Cs-137 in sediments. This approach presents a possibility to quantify soil losses and gains during the last 30-40 years. In addition, sedimentation rates of several small reservoirs in the loba-region are measured by quantifying the sediment input into dams and by determining the contribution area. A soil erosion model is developed with Cellular Automata in order to consider complex spatial patterns and dynamics based on simple, but computationally efficient rules. Remote sensing techniques are used to derive land use cover changes and geomorphometric parameters and to generate a Digital Elevation Model from ASTER images.

These techniques contribute to analyze erosion dynamics and sediment distribution patterns from hillslope to landscape scale, to identify so called "hotspots" of erosion as well as to evaluate sedimentation impacts and restoration problems of small reservoirs and finally to provide a soil erosion risk map for the loba-District of Burkina Faso.

Soilsclapes of the Drâa basin / Southern Morocco

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Keywords

soilscape, aridity, Southern Morocco, IMPETUS

Abstract

The Drâa is situated in the dry zone of the southern part of the High Atlas Mountain in southern Morocco. A large N-S-transect (> 400 km) along an extreme gradient of altitude (3.200 - 445 m) and aridity (600 > 50 mm rainfall per year) at 6°30' W longitude is taken. From periglacial up to desert landscapes 13 study sites are chosen. Their soil cover was investigated 2001-2003 to detect differences in their potential use and degradation risk. This was in the framework of the project IMPETUS, - an integrated approach to the efficient management of scarce water resources in West Africa. So-called

soil(land)scapes are build up by several polypedes or pedocomplexes and correspond to the pedochore after the choric idea of soil geography (SCHLICHTING 1970). The different soils of a soilscape result in a soil associations. Different soilscapes are presented here using the World Reference Base for Soil Resources (ISSS-ISRC-FAO 1998).

Calcisol-soilscales on steep slopes and a transmountain basin of the calcareous High Atlas are rich in carbonates (up to 58 %). The silty and loamy silty texture has high contents of gravel (20-86 %). The soil cover of the Leptosol-Regosol-soilscape in the crystalline Anti-Atlas is generally very thin (5-25 cm soil depth) and incompletely conserved between volcanic outcrops. The Leptosol-Regosol-Calcisol-soilscape of the escarpment relief of sedimentary rocks of the middle Drâa is developed with deep Calcisols and their eroded relict as free-rinsed calcrets of a total eroded escarpment. All these soilscales on slopes indicate a strong degradation by water erosion.

The Arenosol-Fluvisol-Anthrosol-soilscales of some Drâa oasis include important arable land. These alluvial deposits suffer rising salinization with the South up to 16,1 dS/m and are no more used there. The occurrence of a low ground water table less quality, a more fine soil texture and probably more salty alluvial deposits of the southern terrace can explain this situation. The drying former lake Iriqui (end of the Drâa river) is characterised by a Solonchak-soilscape. The Arenosol-Calcisol-soilscape of a neighboured dayet is used as rainfield.

What is Desert*Net?

Desert*Net Board

Abstract

Combating desertification and mitigating the effects of drought are rising challenges that are generally not sufficiently considered in regional development projects in drylands. The German Competence Network for Research to Combat Desertification (Desert*Net) was founded in order to form a binding link between different scientific fields, international institutions (e.g. UNCCD), policy makers and public institutions. Desert*Net - as a network of scientists and experts - provides multi-disciplinary regional data, and gives interdisciplinary advice on various desertification-related topics, scientific methods and projects.

Desert*Net's expertise is based on a group of scientists representing numerous disciplines with long-term field and laboratory experiences in basic and applied research on desertification.

The aims of Desert*Net are to

- identify pressing problems with regard to desertification;
- raise public awareness to the alarming state of desertification;

- develop innovative and interdisciplinary research concepts for combating desertification that are feasible and applicable;
- strengthen and support research capacities in order to promote scientific co-operation with affected countries;
- establish and intensify linkages with international research partners;
- establish a mechanism for policy advice for supporting the implementation of sustainable land use strategies.

The network is open to all scientists sharing our vision. We support the United Nations Convention to Combat Desertification (UN CCD), and its Committee on Science and Technology (CST). We facilitate and structure the communication on knowledge, and mobilise the necessary research on dryland degradation issues.

In-depth research on natural processes in dryland ecosystems, investigations into the ecological and socio-economic causes and impacts of land mismanagement, as well as understanding the complex social and economic situation of people in drylands are indispensable for developing measures to promote sustainable land use. The German Competence Network for Research to Combat Desertification integrates a wide spectrum of disciplines and scientific institutions with long-term experiences in more than 40 countries.

Participatory research in Namaqualand / South Africa - approaches towards science-land user co-operation

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Abstract

Since the mid 1990 the trend of participatory research was taken up by many natural and agricultural scientists. Participatory approaches are applied in research projects in many ways and are considered to be the key to co-operative research and development towards a sustainable utilization of the land.

In the frame of BIOTA Southern Africa (Biodiversity Monitoring Transect Analysis in Africa) a participatory approach was developed and conducted in co-operation between BIOTA S06 (the botanical subproject of BIOTA Southern Africa), the Soebatsfontein community / South Africa, and Bettina Koelle (INDIGO Development & Change / South Africa).

Soebatsfontein is a small community situated in the arid north-western region of the Northern Cape Province, the Namaqualand. Since 2001 a BIOTA *Biodiversity Observatory* is situated on the communal land of Soebatsfontein.

The communal land of Soebatsfontein was given to the community in 2000. Keeping of livestock, seasonal work on surrounding commercial farms and labor in the mines are the main income sources for the people in Soebatsfontein. The climatic conditions do not allow intensive agricultural activities on the land, thus there is a great demand for income diversification.

The following questions reflect initial ideas for the participatory study:

- How can rural communities benefit from scientific research conducted on their land?
- Can science-land user co-operations be strengthened through participatory approaches?
- How to involve local institutions and stakeholders in participatory research approaches?
- What resources are available to improve the living conditions and diversify the income resources with the aim of a sustainable use of the region's biodiversity?

Methods were mainly taken from the PRA methodology (participatory rural appraisal). Different methodological steps were intended to gather visions and ideas of the people without focusing on scientific research interests, but rather with a focus on the situation in the community. Another aim of the implemented methods was concerning the co-operation between the community, BIOTA Southern Africa, the Namaqua Nationalpark and the municipal authority.

Two project ideas which resulted from the first participatory workshop were implemented. An information trail as a first step towards community based tourism and a community knowledge exchange.

The people's visions, interests and ideas may act as guidelines for further participatory research activities in the future.

Management of semi-arid to arid areas for maintaining essential populations of aculeate wasps and bees: pollinators and predators

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Abstract

In any one sizeable area of land in the semi-arid areas of southern Africa one can expect to find several hundred species of aculeate wasps and bees, numbers of species decreasing with increasing aridity. Most of these are solitary species, that is each female

nests independently of other females. All visit flowers to obtain nectar for adult nourishment and those, which, in size and behavior, fit the flowers that they visit, should be considered potential pollinators. Bees and pollen wasps provision their nests with pollen and nectar for the nourishment of their larvae and therefore undertake many more flower visits than do the majority of aculeate wasps, which provision their nests with insects or spiders. In consequence bees and pollen wasps are generally likely to be more efficient pollinators than are predatory wasps. Predatory wasps like all predators must play an important role in maintaining balanced population sizes of their prey.

To maintain viable populations of aculeate wasps and bees their nesting requirements must be taken into consideration. Aspects of agricultural land use seen to be adversely affecting the diversity of insects, particularly of solitary bees and aculeate wasps are: excessive stocking rates; heavy selective grazing and browsing; excessive trampling; water pollution by stock; large-scale impoundment of water; canalizing of water; extensive replacement of natural vegetation by cultivated pastures; extensive replacement of natural vegetation by crop plants; use of insecticides for crop and grazing protection; the spread of invasive exotic plant species; bush cutting; intensive removal of dry wood.

Basic management practices for maintaining essential aculeate wasp and bee populations on land used for agriculture or game, which can be put into practice are: care can be taken not to overstock, reducing danger of excessive trampling and excessive selective grazing and browsing; the effects of seasonal selective grazing and browsing can be reduced by moving stock at frequent intervals; nesting areas of ground nesting bees and wasps can be protected from trampling; the needs of bees and wasps can be catered for when designing irrigation systems or stock watering points; when creating cultivated pastures, strips of natural vegetation can be left untouched; when natural vegetation is replaced by crop plants, strips of natural vegetation can be left untouched; if insecticides must be used, their effects on organisms in areas other than those targeted can be taken into consideration and precautions taken against contamination of surrounding areas and water sources; invasion by exotic plant species can be controlled; bush cutting can be undertaken in such a way that areas or strips of bush covered land are retained; removal of dry wood can be restricted; populations of cavity users can be enhanced by the provision of blocks of wood drilled with suitable holes.

The Potential of *Moringa stenopetala* Seeds for Water Clarification in Semi-Arid Areas of Ethiopia

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Abstract

Research up to now has shown, that the use of *Moringa stenopetala* seeds for water clarification could address the two core problems of drinking water in semi-arid areas: turbidity and faecal pollution. The high potential of the plant in regard to its water clarification capacities however is not known in many local areas, where the plant naturally grows. Although the results in biophysical terms are quite evident, still a lack of research on the socio-economic factors hampers the application of this easy and cheap technology for water clarification.

Modelling soil degradation due to water erosion in the upper Ouémé catchment (Benin)

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Abstract

Local scale investigations concerning soil degradation in the first phase of the research project IMPETUS (Integrated water resource management in West Africa) have shown that soil erosion by water and nutrient depletion are significant problems in subhumid Central Benin which lead to food insecurity and migration. Soil degradation is promoted by high rainfall intensity and specific land use-systems (e.g. cotton or yam planted in the direction of the slope).

In the current second phase of the project the challenge is to transfer the understanding of processes obtained at the local scale to the regional scale to calculate soil degradation for the whole Upper Ouémé catchment (14000 km²) for different scenarios considering possible future climate and land use changes until 2025. Therefore the physically based continuous erosion model SWAT (www.brc.tamus.edu/swat) has been chosen to quantify sediment yield and runoff processes. Calibration and validation of the model for recent and past years will be carried out with runoff and suspended sediment measurements at subcatchments of different sizes. Simulations for the years 1998-2003 for the Terou subcatchment (3000km²) showed a good agreement with runoff measurements. The combination of the modelling results with indicators for soil fertility will enable spatial

conclusions about the future development of soil fertility. If the parameterisation of a crop model for all dominant crop types is successful a loose coupling with the erosion model would allow to study the effects of different agrarian management strategies (including soil conservation) to soil fertility and crop yield. For improvement of model parameterisation the 38 soil types of the existing soil map at the scale of 1:200.000 (Faure 1977) are currently related to physical and chemical soil properties derived from recent representative profiles. Furthermore efforts are made to refine the delineation of soil types in the soil map using information from remote sensing, a digital elevation model and field surveys. Special attention has been given to the delineation of the hydromorphic soils in the inland valleys because of their high relevance for hydrological modelling. Concepts and first results for the improvement of the soil map and the erosion modelling are presented.

The potential of cash crop halophytes (*Atriplex nummularia* and *A. leucoclada*) to maintain yields and reclaim saline soils in arid areas

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Abstract

About 7% of the world's total land area is affected by salt, as is a similar percentage of its arable land. When soils in arid regions of the world are irrigated, solutes from the irrigation water can accumulate and eventually reach levels that have an adverse affect on plant growth. Of the current 230 million ha of irrigated land, 45 million ha are salt-affected (19.5 percent) and of the 1,500 million ha under dryland agriculture, 32 million are salt-affected to varying degrees (2.1 percent). There are often not sufficient reservoirs of freshwater available and most of the agronomically used irrigation systems are leading to a permanent increase in the soil-salinity and step by step to growth conditions unacceptable for most of the conventional crops. Although careful water management practices can avoid, or even reclaim damaged land, crop varieties (such as cash crop halophytes) that can maintain yields in saline soils or allow the more effective use of poor quality irrigation water will have an increasing role in agricultural land use in near future.

Halophytes such as *Atriplex ssp.*, have distinct physiological and anatomical adaptations to counter the dual hazards of water deficit and ion toxicity. This study was aimed to obtain information about the salt tolerance of *A. nummularia* and *A. leucoclada*. Plants were irrigated with different salinity levels up to 150% seawater salinity in a quick check system.

A. nummularia shows a higher salt tolerance but lower Water use efficiency in comparison with *A. leuococlada*. Salinity (*A. leuococlada* up to 25% SWS and *A. nummularia* up to 50% SWS) stimulates growth of both species. An explanation for differences in salt tolerance could derive from the differences in ion accumulation being higher in *A. leuococlada* as in *A. nummularia*. Plant water and osmotic potential became more negative with increasing salinity. It was shown that an important mechanism in both species - to avoid toxic element concentrations inside the plant tissues - is the excretion of the salts via the bladder hairs.

A. leuococlada is better suitable as *A. nummularia* to become a cash crop halophyte in dry saline and vice versa in wet saline areas. They both have a high potential to maintain yields and reclaim saline soils in arid areas.

Quantity, quality and economics: Reviewing the use of mineral fertilizers on key crops in the Aral Sea Basin

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Abstract

Former fertility research in the Central Asian Republic of Uzbekistan has been conducted to identify optimum fertilization time and rates to increase yields of cotton and winter wheat, the two most dominating crops. However, the recommendations based on this research are outdated and in part do not consider additional aspects such as the baking quality of wheat or the cost-effectiveness of fertilizer use on both cotton and wheat. Yet, a judicious application of mineral fertilizers influences not only the amount, but also the quality and financial returns.

The response of irrigated winter wheat to three different N-fertilizer application rates (120, 180 and 240 kg N ha⁻¹) using ammonium nitrate was studied on two different soil textures in Khorezm region, Uzbekistan. Yield and yield components, grain quality as well as the economic feasibility of fertilization rates were determined. Results showed that higher N-fertilization rates significantly increased yields as well as protein and gluten content of the grain, thus improving the baking quality and nutritional value. When classifying the wheat findings to international standards, only the wheat with highest N fertilization rates could be classified as "good". On the other hand, higher application rates negatively affected the potential income generation by farmers. Similar findings were obtained with cotton as the second crop studied. N-fertilization increased cotton yields, but hardly influenced the fiber quality, whereas the highest rates of return were obtained with lower rates. The findings strongly suggest that better than giving blue-print recommendations, recommendation *domains* should be issued based on which especially private farmers can make their own decisions depending on their priorities and interests.

The estimation of tree distribution and dynamics using high spatial resolution images in Burkina Faso

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Abstract

Land surface conditions, including vegetation, soil and land use, influence the energy and water balances at given regions. With respect to vegetation, its distribution, structure and dynamics directly affect erosion and hydrological processes, as well as biological production. Therefore, vegetation-related parameters are needed for meteorological, hydrological modeling and estimation of biological production. In the phase I of the GLOWA-Volta project, some vegetation parameters derived from satellite images such as NOAA-AVHRR have been successfully incorporated in meteorological models. The field investigations for vegetation parameters have been also conducted through RS ground truth. In the phase II, additional vegetation parameters are to be estimated. To derive those information, both the research on capacities of new remotely sensed information and more systematic field investigation are being planned.

The change of tree distribution caused by land use intensification has been recognized as one of the most important factors for the changes of hydrological processes in savanna vegetation. Therefore, intensive researches on fine scales are needed to extract more detailed vegetation parameters such as cover, tree density, species/PFTs (plant functional types) composition related to water use efficiency and rooting system, which would be important for the water balance change modeling. The work on this scale is also expected to fill the gap in vegetation parameters between a field scale and a basin scale.

The main objective of this research is to build efficient methods to detect the tree distribution (size class, density...) and to characterize vegetation dynamics quantitatively in different land use types or landscape units, on an air-photo scale.

It is expected that the following output will be produced through the image analysis and field investigations; (1) Tree distribution map based on appropriate image analysis methods, (2) Tree density, coverage, size distribution, dispersion structure and trends of their changes in several sites of different land use/landscape units. The vegetation parameters and other results derived from this work will be also combined with the following aspects; (1) Physiological and meteorological parameters on a field scale such as heat/water flux, evapotranspiration, LAI, (2) Erosion process related to tree distribution, topography and land use on a field scale, (3) Vegetation parameters derived from satellite images with low resolutions on a regional scale.

Deterioration of rangeland in southern Africa due to overgrazing

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Abstract

The interdisciplinary research project of BIOTA Southern Africa uses standardised methodologies and tools for the long-term monitoring and analysis of the ecological effects of climate change and the impact of different land use systems. Following the main rainfall-gradient, we established 30 permanently marked *Biodiversity Observatories* along a 2000 km long transect that covers the major biomes from northern Namibia up to the Cape of South Africa. Two directly neighbouring 1 km² large *Biodiversity Observatories* were established in similar abiotic environments, which are however exposed to different land use systems.

Since 2001, the botanical subproject (S06) documents the abundance, life-form composition and cover values of the vegetation during the rainy seasons and analyses additional vegetation parameters on each of these *Biodiversity Observatories*.

In southern Namibia, marked fence-line contrasts are the visible effects of different management systems in the semi-arid savannah. Whereas at the Gellap Ost research station the rotational grazing system and regular field monitoring support the maintenance of a dense grass cover, uncontrolled grazing has led to degradation of the plant cover and increased the risk of severe soil erosion on the Nabaos communal land.

Field surveys in the successive years of 2002, 2003 and 2004 document a strong difference with regard to the species diversity in the observatories of Gellap Ost and Nabaos. We found significantly more species on the Gellap Ost research site than on the Nabaos communal land in the rainy years of 2002 (190mm/a) and 2004 (126mm/a) as well as in the dry year of 2003 (57mm/a).

Uncontrolled grazing and trampling by goats could be identified as the main reasons for the degradation of the communally managed rangeland of Nabaos. A dense and soil-stabilising grass cover is missing, and the soil is exposed to erosion. Due to the advanced degradation, the natural regeneration of the degraded rangeland might not simply depend on favourable precipitation events and/or the restriction of the currently existing grazing intensity.

The long-term goal of the BIOTA-project is to develop cost efficient restoration methods for degraded rangelands, and to develop and promote strategies for the sustainable management of biodiversity in close co-operation with the local communities living in the affected areas.

GIS Infrastructure, Databases and Capacity Building for the ZEF/UNESCO Khorezm Project in Uzbekistan

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Keywords

Geographic Information Systems, land and water management, irrigation system, interdisciplinary research, GIS training, GIS Center Khorezm, Aral Sea

Abstract

The Khorezm irrigation region is located within the lower Amu Darya River Basin in Uzbekistan. This region is characterized by unsustainable socio-economic conditions and marked on-going ecological degradation that is the subject of the interdisciplinary research project "Economic and Ecological Restructuring of Land- and Water Use in the Region Khorezm (Uzbekistan)" (<http://www.khorezm.uni-bonn.de>). The goal of this project is to formulate feasible socio-economic and ecological recommendations for optimized land- and water use. The research project is a joint effort of Uzbekistan experts and international scientists from Germany and other countries. The project scientists investigate this agro-ecosystem from multi-thematic research domains, e.g. natural resource management, production systems, economy, society and institutions. This research requires many data from Geographic Information Systems (GIS) to perform spatial analyses for designing site-specific technologies. The objectives of the project's GIS Center in Khorezm were to develop a Central GIS Database containing multi-thematic data on different spatial and temporal scales and a www-accessible Meta-Information-Database.

The GIS Center Khorezm has a state-of-the-art GIS infrastructure including six workstations with ArcGIS and remote sensing software, digitizer, scanner, plotter, printers, GPS and digital cameras. With support of the German Aerospace Center (DLR), the GIS coordinator and two assistants perform GIS data entry, data quality check, database construction, data query, spatial analyses and presentations. Based on a cooperation network with Uzbek institutions, GIS data were exchanged. All GIS data were quality checked, coded and integrated into a central GIS database that cover a wide range of topics, e.g. soil salinity, soil bonitet, ground water table/salinity, crop production, trees, settlements, irrigation channel, and land use distribution. Meta-information, such as spatial and temporal data coverage and data quality, was integrated into a WWW-accessible database (<http://131.220.109.8/mdb/index.php>). The team of the GIS Center conducts GIS training for strengthening the capacity of Uzbek and international students. Within the past two years, project students have used this GIS data to analyze various research topics at

different spatial scales, e.g. ground water dynamics in Khorezm during the last 20 years, hydrological-economic River-Basin-Model, distribution of water-based diseases in districts, distribution of trees within transects, land use classification of Khorezm, and soil salinity distribution at farm level.

The management of the Khorezm multi-thematic GIS-Database and Metainformation-Database is a core project task. Selected GIS-data will be integrated into a Decision Support System (DSS) called the *Khorezm Ecological Economic Optimization Model (KEOM)*. This study is funded by the German Ministry for Education and Research (BMBF: project number 0339970C).

Variation of interaction intensity among life history stages

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Abstract

Interactions among plants are one of the most important factors determining the structure of plant communities. However, most empirical studies of plant-plant interactions have focused on a single response variable and have failed to observe possible shifts in interaction strength throughout the whole life history of a plant.

In this study, we tested whether intensity and direction of interactions among annuals shift from early seedling survival and growth to juvenile survival, growth and adult seed production. Removal experiments were at three study sites along a climatic gradient in Israel. Two annual species *Hymenocarpus circinnatus* and *Biscutella didyma* were monitored throughout the season from germination until seed set in treatments with and without neighbours. Six response variables were tested for differences.

The results indicate that direction and intensity of interactions were highly dependent on the observed life history stage of the plants. The relative neighbour effect shifted from slight facilitation short after germination to strong competition at the end of the growing season.

Comparison between different levels of productivity showed that the transition from positive to negative effects was 'delayed' with decreasing productivity. Our overall results suggest that the results of experimental studies on plant-plant interactions may largely depend on the time at which a target plant is observed.

Optimizing supplemental wheat irrigation in a low-rainfall zone of Syria

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Keywords

supplemental irrigation, water productivity, groundwater salinity, wheat (*Triticum aestivum* L.), low-rainfall zone, Syria

Abstract

A fragile environment, often threatened by overgrazing and desertification, characterizes arid lands. Within the sustainable abstraction limits, groundwater can stabilize socio-environments in dry areas by more reliable production of fodder, staple food and cash crops. Khanasser valley is situated on the margin of the Syrian Steppe. Average annual rainfall is 210 mm. Only 3-4 % of the cropped area in the valley are irrigated. 80 % of agricultural water is used for supplemental irrigation of winter crops, mainly of wheat (*Triticum aestivum* L.). Groundwater salinities are high in some parts of Khanasser valley due to formation salts from paleo-sabkhas. After a ban on cotton irrigation in 1999, groundwater levels have become quite stable in the study area.

Two irrigation experiments with farmer cooperation were conducted on wheat. The objectives were to find the optimum level of irrigation with respect to full supplemental irrigation using sprinkler and basin methods. Under the conditions of the 2003/04 trial season, characterized by near average annual rainfall with a long dry period in spring, basin irrigation was superior to sprinkler irrigation both in terms of natural and economic water productivity. This was in contrast to results obtained by water use monitoring in the previous season with exceptionally high rainfall. Levels of 80% supplemental irrigation with sprinklers (EC 6 dS/m) and about 140% (EC 10 dS/m) with basin irrigation were indicated as optima under the trial conditions.

Recommendations were made as to how the farmers could improve their irrigation practice based on these results. The trials would have to be repeated under a range of climatic and salinity conditions to create a database that allows a more comprehensive analysis of optimum irrigation levels and timing for individual wells. Inverse regression or algorithms could help accomplish the optimisation

Genetically Modified Organisms for the Third World? The Example of Drought-tolerant Plants

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Abstract

In our presentation we will summarize the state of the art of research on genetically modified plants in and for less developed countries. As an example we chose stress-tolerant plants because large parts of arable land in less developed countries is prone to heat, water or salt stress and the negative impact for agricultural productivity may extend to further areas due to the expected climate changes.

Most of the genetically modified plants already on the market are not of direct use for agriculture in drylands because they are adapted to climatic and agricultural conditions in developed nations and rely on the supply of water and nutrients.

In developed countries a lot of research is devoted to develop plants tolerant to abiotic stresses but most of these are still far from being marketed. Additionally, most of the research is concentrated on the so called 'high cash' crops like maize, wheat and cotton as well as turf grasses for golf courses.

In less developed countries a few national and international research centres are developing genetically modified stress-tolerant plants. They are concentrating on crops relevant for the respective areas (in the case of the CGIAR research centres: their mandate crop plants).

At the experimental phase are projects to develop drought tolerance in pigeon pea and groundnut, salt-tolerant barley as well as heat-tolerant bananas. Some genetically modified stress-tolerant plants have already been tested in field trials (e.g. drought-tolerant wheat in Mexico, salt-tolerant wheat in Egypt or salt- and drought tolerant rice in Thailand).

When the so-called 'lower biotechnologies' were included in the study, promising results were revealed: With the help of embryo rescue a new upland rice variety called 'NERICA' (New Rice for Africa) has been developed which combines the higher yields of Asian rice with abiotic as well as biotic stress resistance of African rice. Additionally, molecular markers might be used to identify the best suited parents in conventional breeding, thereby facilitating breeding for complex traits. Research is underway to identify markers for deep rooting in chickpeas. Chickpeas with exceptional deep extending roots can better use the receding water at the end of the growing season.

Genetic engineering and biotechnological methods may serve as new tools for breeding strategies relevant to less developed countries. However, agricultural research in this area is a non-profitable market for big international companies. Publicly funded projects are

necessary, but funding is regressive, leading to a fierce competition between different projects/strategies (breeding with/and without gene technology as well as farming systems research).

In a cost/benefit analysis all costs have to be included: in the case of genetically modified plants, a safety assessment has to be performed from the lab to the market. The capacity to conduct safety assessments might be lacking in most developing countries, and the safety assessment of new traits (stress tolerance) in less frequently transformed plants is more challenging than assessing herbicide or insect resistance where experience has already been gained.

Therefore, when countries want to invest in gene technology, cases have to be identified where GMOs have special advantages. Additionally, participatory approaches to involve the demands of the local farmers and enhanced collaboration between publicly funded institutions are necessary.

Diversification of Smallholder' s Animal Production Systems: an Alternative to Mitigate Desertification in Northern Patagonia, Argentina?

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Keywords

Diversification, Patagonia, smallholder production systems, wool production

Abstract

In Río Negro Province, Northern Patagonia, more than 4,000 producers practice extensive small livestock farming. Approximately 80% are smallholders, mainly fibre production oriented. The production system faces an environmental and socio-economic crisis due to grassland degradation, desertification, high production costs and widespread poverty. Ecological sustainability, economic feasibility and socio-political acceptability are the three dimensions of sustainable development. The main objective of this study is to evaluate the impact of diversification on the range condition of the farms and on the farmer socio-economics, under the following hypothesis: "An increasing degree of product diversification avoid grassland degradation without decrease incomes in smallholder livestock systems of Southern Río Negro".

Field studies were conducted between December 2002 and April 2004.

A comparison of the diversification impact on grassland condition, grassland tendency, desertification indicators, and grassland production in diversified and non-diversified farms is being carried out through vegetation census analysis.

Standardised interviews were applied on a representative sample of 107 farms involving diversified and non-diversified farms. Through an economic analysis at farm level, the impact of the product diversification on farm household income is evaluated.

Results on the following areas are expected:

- Ecological analysis will provide information on the potential productivity of the grassland under different management practices
- Economic analysis will elucidate the rationale of the farmers on the desertification process
- Formulation of adequate policies

Preliminary data analysis show a positive relationship between degree of diversification and economic parameters.