IMPETUS Morocco

Managing unpredictable resources and extreme events: Adaptive land use and its role in mitigating the impact of climate change in Southern Morocco

A. Linstädter [1], G. Baumann [1], K. Born [2], B. Diekkrüger [3], A. Enders[3], P. Fritzsche [3],H. Goldbach [4], H. Kirscht [5], A. Klose [3], G. Menz[3], A. Roth [4] and M. Rössler [5]

[1]Institute of Botany, University of Cologne, Gyrhofstr. 15, Cologne
[2]Institute of Geophysics & Meteorology, University of Cologne, Kerpener Str. 13, Cologne
[3]Institute of Geography, University of Bonn, Meckenheimer Allee 166, Bonn
[4]Institute for Crop Science and Resource Conservation – Plant Nutrition, Karlrobert-Kreiten-Strasse 13, Bonn
[5]Institute of Cultural and Social Anthropology, Albertus-Magnus-Platz 1, Cologne.

Introduction: Land resources in Morocco – today and tomorrow

People in arid landscapes such as in Morocco's Drâa region need to adapt their land use strategies, because the available water for plant growth and drinking is a highly unpredictable resource. In the oases of the Drâa catchment, water scarcity is partly buffered by natural storage and by human management. The vast areas outside the oases are used as rangelands. Here water resources can only be managed indirectly, e.g. via a range management and the underlying mobility decisions of herders. To come to a sound understanding of direct and indirect water resource management for a sustainable land use and to extract general principles, local land use strategies have to be analysed. In the past, research has concentrated on the management of water resource scarcity, because this is an obvious problem of resource management in arid regions. Within the context of IMPETUS, we have applied a broadened approach and analysed all relevant factors on an annual and inter-annual scale. Scenarios assume that extreme weather events will occur more often in the future. We aim to identify key traits of an adaptive management which mitigates negative effects of severe rainfall and meteorological drought in the Drâa region.

Abundant rainfall

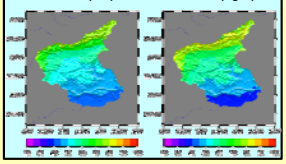
After abundant rainfall, available water allows high plant productivity on pastures and in agricultural areas. Positive rainfall anomalies render abundant water resources but carry the risk of severe rainfalls.

Extreme event: Severe rainfall

Severe rainfalls may trigger extreme erosion rates in this region, as it has a high vulnerability to erosion due to

- a high relief energy, and
- a sparse vegetation which is further reduced by overgrazing.

Climate models predict more severe rainfall events in the Drâa region as 10 year return values for daily rainfall amount [mm] show below, comparing 1960-2000 (left) and 2001-2050 (right).

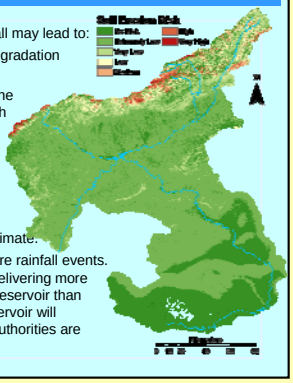


Effects: Erosion and floods

Erosion triggered by severe rainfall may lead to:

- onsite effects such as pasture degradation in the High Atlas mountains, and
- offsite effects, such as silting of the reservoir Mansour Eddahbi, which lost already more than 25% of its original capacity since 1972.

Erosion rates under present and future climate and land use conditions are estimated using the PESERA model, as a function of topography, soil, vegetation and climate.



Floods are a further result of severe rainfall events. They will also increase in future, delivering more water and more sediments to the reservoir than today. Thus the siltation of the reservoir will accelerate, a problem Moroccan authorities are already aware of.

Preventing erosion and floods - PESERA

The SDSS SEDRAA supports local decision-makers to identify areas in the Drâa region for preventive measures to mitigate future erosion effects. Thereby the user has the possibility to choose different climate scenarios and to virtually change the land use in user-specified regions.

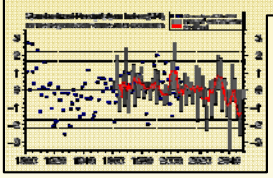
Scenario calculation with **PESERA** showed that erosion risk in the Drâa catchment can be substantially reduced by vegetation protection. Corresponding to the planning of the Moroccan Forest Authority, the virtual afforestation of 100 km² in the upper catchment yielded in a reduction of the area under extreme erosion risk by 83 %. Thus a preventive natural resource management by vegetation protection is a promising measure to reduce erosion risk.

Scarce rainfall

Scarce rainfall are negative rainfall anomalies. They lead to a shortage of available water with the extreme event of a meteorological drought.

Extreme event: Meteorological

Meteorological drought detection is achieved by observation of characteristic drought indices, like the standardized precipitation index (SPI). Future climate scenarios predict that dry periods will return more frequently than today (see Figure below).

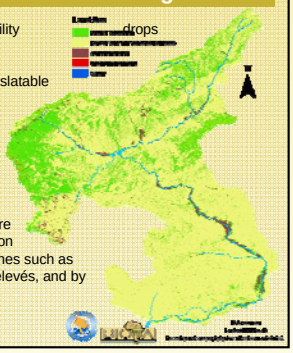


Effect: Socio-economic drought

A drought occurs when water availability below a certain threshold for a specific ecosystem service. Thus a meteorological drought is translatable to other levels of resource scarcity:

- to the levels of plant-available water and available fodder/agric products (agronomic drought);
- to the level of economic activities (socio-economic drought).

The amount of available fodder in relation to rainfall and grazing pressure is assessed with methods of vegetation ecology, using experimental approaches such as grazing exclosures, and vegetation relevés, and by means of remote sensing.



Mitigating drought effects - PLANT

To prevent economic loss, traditional and modern mitigation strategies have to be bundled. The risk management of Moroccan land users mitigates drought effects on all levels of resource scarcity. It comprises of a preventive management, r: abundant and access

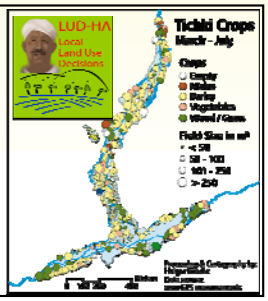
Local Ecological Knowledge
Local knowledge on the quality and availability of fodder on different spatial and temporal scales is a key for pastoralists' management decisions: A good fodder plant is reliable. Local knowledge on fodder plants and related scientific data is made available in the **Information System PLANT.**

Risk management and the importance of institutions – LUD-HA

Only an adaptive land management in the Drâa region ensures the availability and the resilience of water and fodder resources. Due to permanent cultivation and commonly acknowledged water and land rights in the oasis, the management of irrigated fields follows well established patterns which are regulated by the village communities. Although most strategy decisions in agriculture and herding are taken by the family heads, these local communities are the principal cooperative units and political actors responsible for resources management. They are especially involved in arrangements regarding the partition of irrigation water between upstream and downstream riparian users or the coordination of rehabilitation schemes.

Gaining access to sufficient water for irrigation and fertile and safe soils are the basis for management decisions. The variability of the climate and the environment as well as the social and political composition of the local communities is reflected in various cultivation strategies adopted by the local population and presented in the **Information system on Land use Decisions in the High Atlas (LUD-HA).**

In contrast to the privately owned irrigated lands, pastures and the communal land are - in theory - owned and managed by local tribal institutions, which traditionally set the rules for access and use. In practice, the use of these resources is variable, and often disputed between a variety of conflicting control bodies including state institutions, tribal assemblies and external actors with differing interests in the region. To display the complexity of this relations, an Information system ISII is planned.



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