Deutscher Tropentag 2002
Witzenhausen, October 9-11, 2002
Conference on International Agricultural Research for Development

Typical Fence-Line Contrasts – Land Degradation in Southern Namibia

Akhtar-Schuster[a], Mariam

a University of Hamburg, Botanical Institute and Botanical Garden, Ohnhorststr. 18, 22609 Hamburg, Germany.
E-mail makhtar-schuster@botanik.uni-hamburg.de

Abstract
Alongside fences that separate different land tenure systems, grazing and browsing-induced changes to the natural vegetation become markedly visible in many farming areas of Namibia. Such fence-line contrasts clearly visualise the long-lasting impact of high grazing pressure on the species composition and biomass production of the natural vegetation.
In order to provide feasible rehabilitation and biodiversity conservation concepts for the degraded drylands in Namibia, the interdisciplinary BIOTA AFRICA research project is carrying out comparative investigations into the grazing and browsing effects, in commercial and communal farmlands. Preliminary results reveal that vaguely defined allocation regulations in communal lands lead to a noticeable degradation-induced destabilisation of livestock ranching, and to a deterioration of natural fuel and construction material.

1 The land degradation issue in the communal lands of southern Namibia

Approximately 70% of the population in Namibia depends on agricultural activities (IIASA Report, 2001). Agriculture in Namibia is extremely polarised in commercial and communal farming. Especially in communally managed farmlands, the degradation of the rangelands has already seriously destabilised many rural household economies. 41 % of Namibia´s total land surface are covered by communal state owned land (BLACKIE & TARR, 1999:6), and the out-migration of family members to cities is regarded as one strategy of communal households to cope with the existing land degradation.

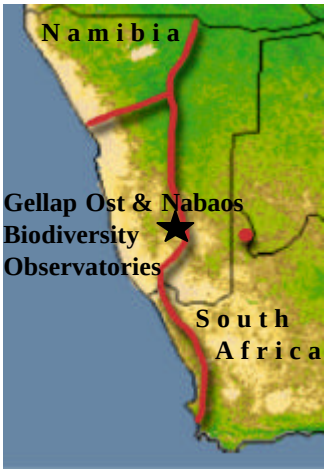

Fig. 1 BIOTA Southern Africa Research transect

Securing the stability of household economies which are based on domestic animal husbandry necessitates the appropriate assessment of the rangeland condition and potential. In order to understand the processes and extent of land degradation, the BIOTA project has developed a standardised, one square kilometre large research site, the so called Biodiversity Observatory.

Biodiversity Observatories are subdivided into 100 hectare plots. Based on a random selection of these hectare plots, the first 20 randomly selected plots in each Biodiversity Observatory are surveyed over several successive years on an interdisciplinary basis.

The standardisation of the methods and investigation scales of each discipline working on these research sites allows the comparability of the multidisciplinary data sets derived out of each of the 28 Biodiversity Observatories that were established in southern Africa in 2001 (JÜRGENS et al., 2001). The results of this paper are based on the recordings of the floristic inventories and respective cover of two consecutive years (2001 and 2002). Field surveys were carried out on 20x50 m, and on 10x10 m large sites in each of the investigated hectare plots of two Biodiversity Observatories (Gellap Ost and Nabaos) which were established in the Namaland in southern Namibia (Fig. 1).

2 Commercial versus communal land use – the ´Gellap Ost´ and ´Nabaos´ Biodiversity Observatories

In 2001, a pair of 1 km² large Biodiversity Observatories were established on the commercially managed Gellap Ost farm (a state owned research station for the karakul industry), and the adjoining Nabaos communal land. A marked fence-line contrast can be observed between the two farmlands (Photo 1).

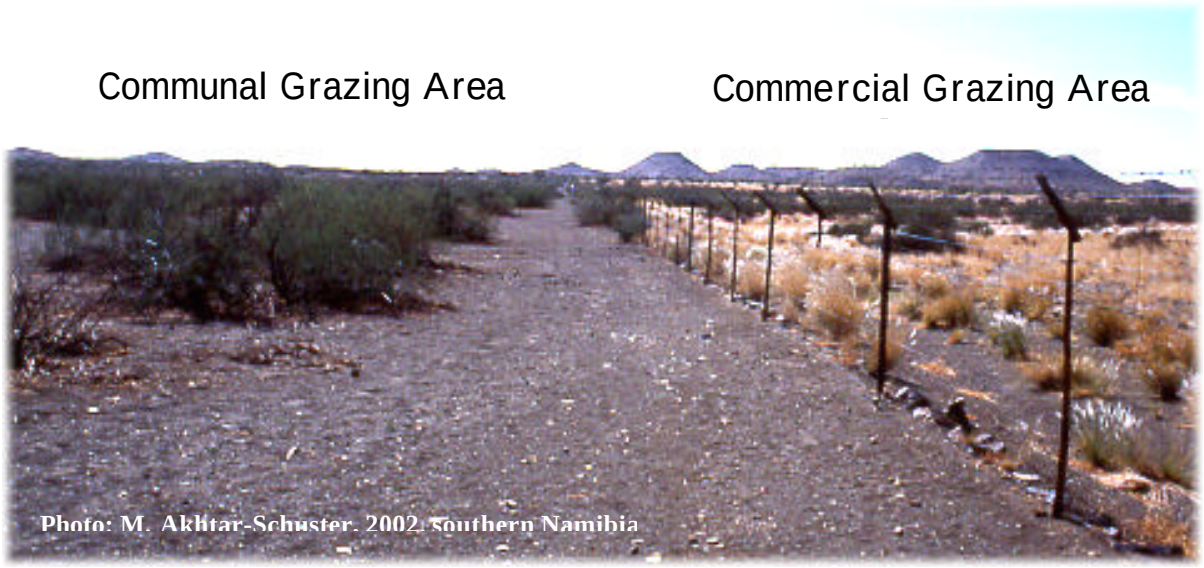

Photo 1 A marked fence-line contrast between a communal and a commercial farmland

The two Biodiversity Observatories were established close to the fence that separates the two farming systems. The Observatories lie about a 150 m apart. This setup allows precise comparative investigations into the impact that different land use intensities have on the biodiversity of this semi-arid area.

2.1 Resources utilisation in the Nabaos communal land

The common property resources of the Nabaos communal land face unregulated and uncontrolled grazing. Everyday, several hundred goats from the nearby, seven household large settlement (13 grown-ups and approx. 20 children) of Nuwe Fontein enter the Nabaos Observatory site unattended to graze and browse. Livestock owners from Nuwe Fontein prefer leaving their goats and donkeys unsupervised as the unrestricted movement guarantees a maximum degree of typal grazing and browsing, hence, enabling the domestic animals to find the best feed resources for ´fattening´ (AKHTAR-SCHUSTER, 2002). The goats are a vital source of income for the people of Nuwe Fontein. During the field observations, all goats came exclusively from Nuwe Fontein (this settlement owns approx. 500 goats). This underlines the fact that the communal land users are very much dependent upon the vegetation condition at the observation site. Only for some time during the driest season, the local feed source is not sufficient so that some herds are moved

to other areas. The number of donkeys observed on the research site differs daily. However, their number does not exceed a dozen animals per day. The donkeys that browsed and grazed on the research site also came from other settlements.

The woody vegetation at the communal Nabaos research site is subject to a three-fold stress. Firstly, this natural resource provides freely accessible feed supply throughout the year for goats and donkeys. Secondly, in order to curtail spending on the purchase of gas, woody vegetation also covers or supplements the daily fuel requirements of the nearby communal settlements. Due to high redundancy rates in the area, and an out-migration of the labour force, communal households in the area frequently consist solely of elderly people and their underage grandchildren. The latter were regularly observed collecting firewood on the Nabaos research site. Thirdly, the natural woody vegetation is also another source of income for the people in the communal lands. In both survey years, it was observed that dry wood is taken to the nearby city of Keetmanshoop on donkey carts and sold there. Although, all wood gatherers emphasised that they only collect the dead dry branches lying on the ground, logging of living shrubs and trees was observed regularly on the research site. The chopped off branches are usually left to dry around the exploited plants, and gathered when dry. “Because these people also need a living ...”, wood cutting and gathering issues are generally not discussed among the members of the Nuwe Fontein settlement, in order to avoid further conflicts in the community (Personal communication, Mr Jan Booysen from the Nuwe Fontein settlement, 2001).

2 Resource management affecting the Biodiversity Observatory on the the Gellap Ost farmland

The entire Gellap Ost Research Station is subdivided into numerous fenced camps. The Gellap Ost Biodiversity Observatory is located in the 261 hectare large Camp B1, and is subject to a rotational grazing system. Although the animals graze unattended, the number of animals (sheep and cattle) that enter a camp, as well as the grazing duration are strictly controlled. The calculated total grazing capacity is not exceeded, and regular field observations are carried out by the staff of this Research Station, in order to discern any signs of overgrazing (personal communication Gellap Ost Research Station, 2001). In the event that indicator plants (e.g. *Leucosphera bainesii* and *Cenchrus ciliaris*) are grazed by over 75 %, grazing intensity in Camp B1 is reduced for some time. Also, the staff at the Gellap Ost Research Station are reluctant to move their animals into this Camp, as thy suspect members of nearby communities from the Nabaos communal land (directly bordering on this camp) of stealing their Karakul sheep. The awareness of, and immediate reaction to the effects of grazing guarantee intact pasture conditions at the Gellap Ost survey site. Consequently, the ecological conditions at the Gellap Ost Biodiversity Observatory are adequate for identifying degradation indicators, as well as for assessing the extent of the land use-induced ecological changes in the neighbouring, communally managed Nabaos land.

3 Degradation indicators in the Nabaos communal land

In comparison to the neighbouring commercial Gellap Ost farmland, less species were recorded on the investigated 15 hectares of the Nabaos communal farmland (Fig. 2). Seasonal, i.e. rainfall-induced fluctuations in the phytodiversity and biomass production emerged on both commercial and communal farmlands. On the heavily grazed site as well as on the intact site, phytodiversity is much higher at the beginning of the rainy season, due to the short-term emergence of annual growth.

Seasonal phytodiversity variations were however more pronounced on the communal Biodiversity Observatory. From the end of the dry season into the rainy season, there is an average increase in phytodiversity by about 2,3-fold in the various habitats (monadnocks - gently

undulating land - episodic run-off channels) of the heavily grazed area of the Nabaos communal land.

In contrast, with an average of 1,8-fold increase during the rainy season, phytodiversity variations are lower in the commercial Gellap Ost research farmland.

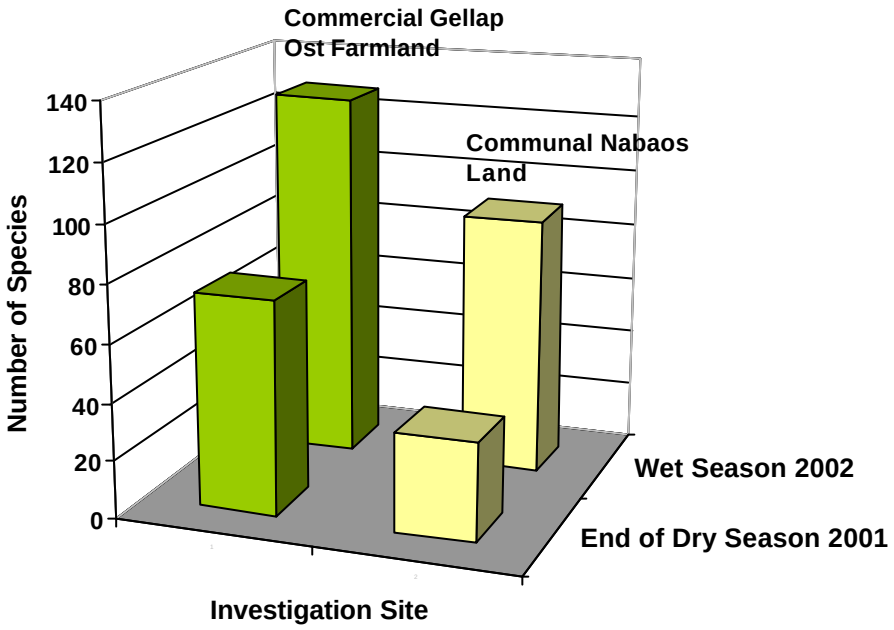

Fig. 2 Seasonal fluctuations in phytodiversity under different land use intensities in southern Namibia

On the heavily utilised Nabaos communal site, a more detailed look into the spatial patterns of the seasonal phytodiversity indicates more pronounced fluctuations in the easily accessible plain (phytodiversity increases by 2,4-fold during the rainy season), and lowest seasonal fluctuations on the steep and rough slopes (Fig. 3). In contrast to the open and gently undulating plains, the coarse textured soils of the rocky slopes in the communal area have a more diverse scrubby perennial cover throughout the year, and only very sparse annual growth emerging during the rainy season. This floristic inventory ensures a more pronounced year-round uniformity in the vegetation appearance. Based on the random selection and distribution of the hectare plots, there are not enough survey plots on the slopes that allow representative statements as yet. However, it can be assumed that on regularly grazed and browsed slopes, the vegetation composition leads to lower seasonal phytodiversity variations. In contrast, on the elevated, unused slopes of the Gellap Ost commercial farmland, perennial and especially annual phytodiversity is altogether higher, thus leading to higher seasonal variations. It has yet to be examined, whether the vegetation of the rough and drier slopes is more vulnerable to grazing and browsing.

In the Nabaos communal land, the natural, seasonal fluctuation in phytodiversity is overlapped by grazing that immediately impacts regeneration and rejuvenation of the exploited species. Investigations into the palatability of the plant species in the Nabaos communal rangelands will show, whether the proportion of unfavourable or even noxious annual species is higher on the heavily grazed site. It has to be checked, whether the statement of one livestock owner from Nuwe Fontein that "... bad plants are not replacing good plants due to overgrazing, it is just that

plant cover is altogether declining ...” actually rules out that invasive species have intruded into the deteriorated ecosystem.

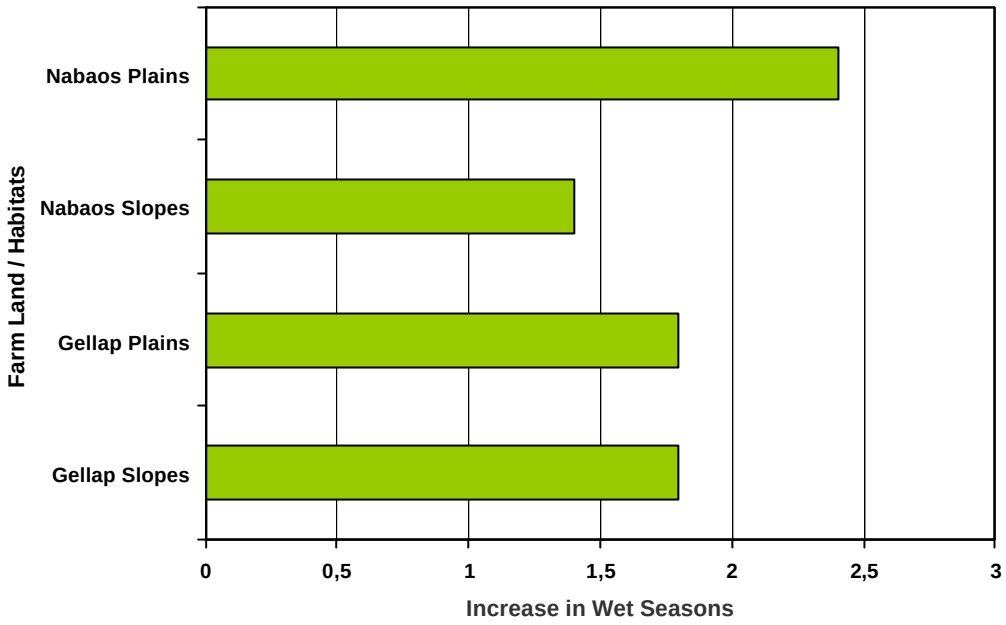

Fig. 3 Phytodiversity increase factor during the rainy season in different relief units of the communal and commercial farmland

Although, two weeks after the onset of relevant rainfall, especially *Acacia mellifera* emerged extensively on the communal grazing site, the 2002 field survey showed that this young growth disappeared within a few days, largely due to grazing.

In the intact grazing area of Gellap Ost, the extensive year-round occurrence of perennial – palatable – growth in the low growing life forms also guarantees an extensive cover of the soil surface, even after the annual species have withered away in the course of the year. In contrast, the overall decline in perennial growth in the Nabaos communal land has enhanced the seasonal fluctuations in feed supply, lowering feed availability and restricting animal husbandry strategies. These environmental observations are in accordance with the statements of livestock holders from the settlement of Nuwe Fontein, who declared that it is the extensively growing succulent leafed *Tetragonia schenckii* that currently secures the sustenance of their goat herds in the area. Livestock owners even commented that if this plant would disappear as well, the *Rhigozum trichotumum* alone would not be sufficient to sustain the current animal herd sizes at Nuwe Fontein. It was also largely lamented that due to the degraded grass cover in the communal land, the much favoured sheep husbandry is not possible at Nuwe Fontein.

4 The capacity for natural regeneration in the degraded Nabaos communal rangeland

In the gently undulating plains of the communal farmland, the rejuvenation of perennial shrubs and trees was most successful, if a plant managed to establish under older shrub or bush stands of the same or of another species. These ´nurse plant effects´ suggest that under constant grazing and browsing pressure, the spatial extent of the natural vegetal regeneration capacity in heavily exploited vegetation is very limited and at best only occurs on sites, where shrubs and bushes, preferably with morphological defence strategies (e.g. thorns), inhibit or reduce the accessibility to their base and interior space.

Steeper relief was not discerned as priority location for grazing and browsing in the Nabaos communal land. Even the goats principally exploited the more easily accessible plains, before moving up the slopes. The more inconvenient access to the vegetal resources in elevated areas, as well as the manifold niches in this uneven terrain suggest that these relief units might be invaluable as regeneration pools for the adjacent, heavily utilised plains. Although, the natural dryness of the coarse textured and shallow rocky soils in hilly regions curtails the extensive occurrence, especially of annual species, and suppresses high biomass production, most of the destabilised species populations that were recorded in the heavily utilised and degraded plains were also documented here. It needs to be studied, whether some populations in the severely exploited plains are merely sink populations that depend on the source populations of the slopes (cf. also SCHMIEDEL et al., 2002). The floristic inventories in several run-off channels, originating in the elevated relief unit, back this assumption.

Even during the rainy season, cover values in the plains of the communal farmland are noticeably lower (average total cover values were below 10%) than in the low grazing pressure (about 30%) areas of the commercial farmland. The sparsely vegetated surface of the gently undulating plains in the Nabaos communal lands favours extensive sheet erosion after erratic rainfall. In the rainy season of 2002, sheet erosion uncovered the roots of young annual plants, partly up to a depth of three centimetres. Within the BIOTA project, investigations into the sub-surface seed reserves have started, and might reveal the influence that enhanced erosion has on the natural vegetal regeneration capacity in the degraded plains.

Finally, investigations into the zoodiversity (ZELLER et al., 2001) show that the loss of vegetation cover and diversity in the Nabaos communal land has also led to a decline in microhabitats and food sources for small mammals. Higher species diversity and densities were recorded in the intact farming area of the Gellap Ost Research Station.

5 Concluding remarks and discussion

In the open access area of the Nabaos communal land, the senescence and reduction of perennial growth-forms, the subsequent proportional increase in annual growth, and finally, the decline in soil surface cover has enhanced the intra-annual fluctuation rates in phytodiversity and biomass availability for animal husbandry. Stalkholders in the communally managed Nabaos farmland unanimously regard this degradation chronology as human made. The communal land users at Nuwe Fontein however stress that if their animals had exclusive rights to graze / browse the area, then the degradation issue would not arise. The community members stress that if they had better access to financial services, they would secure tenure by fencing in the land, excluding other user groups, and create several camps to practice rotational grazing. From an ecological point of view, alleviating financial investment constraints is however two-edged, if other coherent control strategies (e.g. restoration and environmental awareness programmes) are not considered simultaneously. There are justified concerns that stalkholders will also invest in the uncontrolled enlargement of their domestic herds, especially by buying sheep.

6 Perspectives – toolkit for sustainable utilisation

In order to obtain a win situation in the dryland degradation issue, it is necessary not only to react to the existing environmental degradation, but also to develop prevention methods, i.e. risk assessment techniques for areas prone to land degradation. The long-term screening of biodiversity dynamics and patterns on micro- and macro spatial scales within BIOTA´s Biodiversity Observatories and Enclosures will support the assessment of the ecological potential, i.e. the load and resilience capacity, as well as the identification of reversible and irreversible degradation processes in the different semi-arid habitats. The combination of ecological

investigations with social assets, e.g., environmental training, alternative income generating activities (e.g. in restoration and conservation programmes), and ecologically adapted resources allocation strategies is indispensable for the sustainable utilisation of the natural resources in the study area.

7 Acknowledgements

BIOTA Southern Africa is funded by the German Federal Ministry for Education and Research (BMBF, grant 01LC0024).

Special thanks go to the staff of the Gellap Ost Research Station and to the community of Nuwe Fontein for their friendly support.

8 References:

AKHTAR-SCHUSTER, M. (2002): Land Degradation in Namibia – methodological approaches of the BIOTA Southern Africa project Aleppo Paper. International Workshop on Desertification: Rehabilitation of Degraded Drylands and Biosphere Reserves. UNESCO Programme on Man and the Biosphere (MAB) in collaboration with ICARDA. Aleppo / Syria (in print).

BLACKIE & TARR (1999): Government policies on sustainable development in Namibia. (Eds. Directorate of Environmental Affairs, Ministry of Environment and Tourism) Research Discussion Paper no. 28. Windhoek, Namibia.

IIASA Report (2001): International Institute for Applied Systems Analysis (IIASA) Report: Botswana´s Future, Mozambique´s Future, Namibia´s Future – Modelling Population and Sustainable Development Challenges in the Era of HIV/AIDS. Version 1.0, 2001: www.iiasa.ac.at/Research/POP/pde/briefs/na-econ.html).

JÜRGENS, N., STROHBACH, B., AKHTAR-SCHUSTER, M., AUSTERMÜHLE, R., BECKER, T., HACHFELD, B., SCHMIEDEL, U., STROHBACH, M. (2001): Changes in botanical biodiversity with regard to changes in land use practices and climate: standardised monitoring and transect analysis. – In: BIOLOG Status report 2001, German Environmental Research Programme on Biodiversity and Global Change (Phase I, 2000 - 2004). Bonn. 110 – 111.

SCHMIEDEL, U., AKHTAR-SCHUSTER, M., BEHRENS, K., M. & JÜRGENS, N. (2002): Contrasting effects of heavy grazing and browsing on biodiversity and vegetation patterns at different BIOTA research sites. Presented at the Arid Zone Ecology Forum 27-30 August 2002, Middelburg, South Africa (in prep.).

ZELLER, U., ADE, M, DECKERT, J., EISEB, S., GIERE, P., HOFFMANN, A., KOCH, F., MARAIS, E., MEY, W., PLÖTNER, J., UHLIG, M., VOHLAND, K., WENDT, H. (2001): Functional zoodiversity in Southern Africa under changing environments and human use. – In: BIOLOG Status report 2001, German Environmental Research Programme on Biodiversity and Global Change (Phase I, 2000 - 2004). Bonn. 112 – 113.