Ecological and economic aspects of water for nomadic animal husbandry in the Sahelian zone of the Sudan

Gerold Rahmann

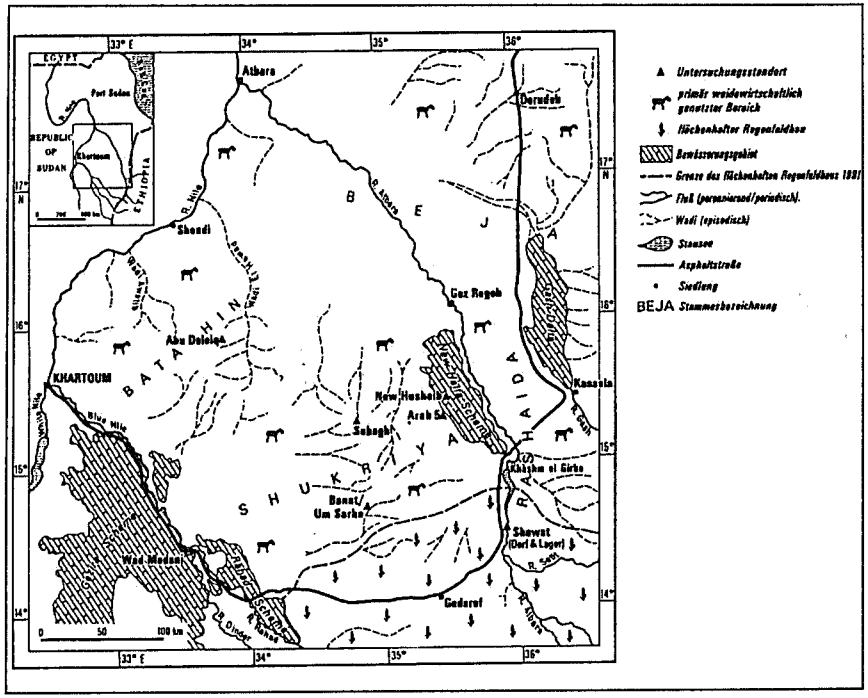
1. Introduction

The Sahel is well known as an area of water shortage. Human beings, however, have learned to survive in the harsh environmental and climatic conditions. As nomads they have been able to use the resources for their livelihood. They have been making a livelihood mainly by animal husbandry but other activities are relevant (wadi cultivation, trade etc.). Particularly in areas with a shortage of rainfall (below 250 mm per year), animal husbandry depends more on water than on fodder from natural pasture. This is valid for most of the land in the Sahel.

Water is the limiting factor of human survival in the Sahelian zone. Animals and human beings use the same (and often heavily contaminated) water. So water is not only a seasonal but also a quantitative question. The major question is how it can be stored for the dry season and how it can be exploited. Where there are no water holes, rivers or ground water, pump stations provide this human and animal need; the time of using the land is limited to the rainy season. In the dry season, humans and animals gather around water places. This concentration leads to degradation gradients in relation to the distance to these places. Being closer to the watering area means over-exploitation and the degradation often ends in desertification. Water shortage causes fodder shortage. An interdisciplinary research project (1990-1994) tried to assess the recent performance and the reasons of this disaster of the last decades in the Butana/East Sudan.[1]

[1] Members of the research project were Holger Pflaumbaum, Michael Kirk, Uta Holter, Heike Bremm, Ralf von Schutzbar, Axel Weiser, Schami Elgunaid and Gerold Rahmann (and others) and the results are published in Mensching HG and Seifert HSH (1994) Tierhaltung im Sahel. Rezente Entwicklungen und Perspektiven in der Republik Sudan. Forschungs-Endbericht. Göttingen.

Figure 1: The Butana

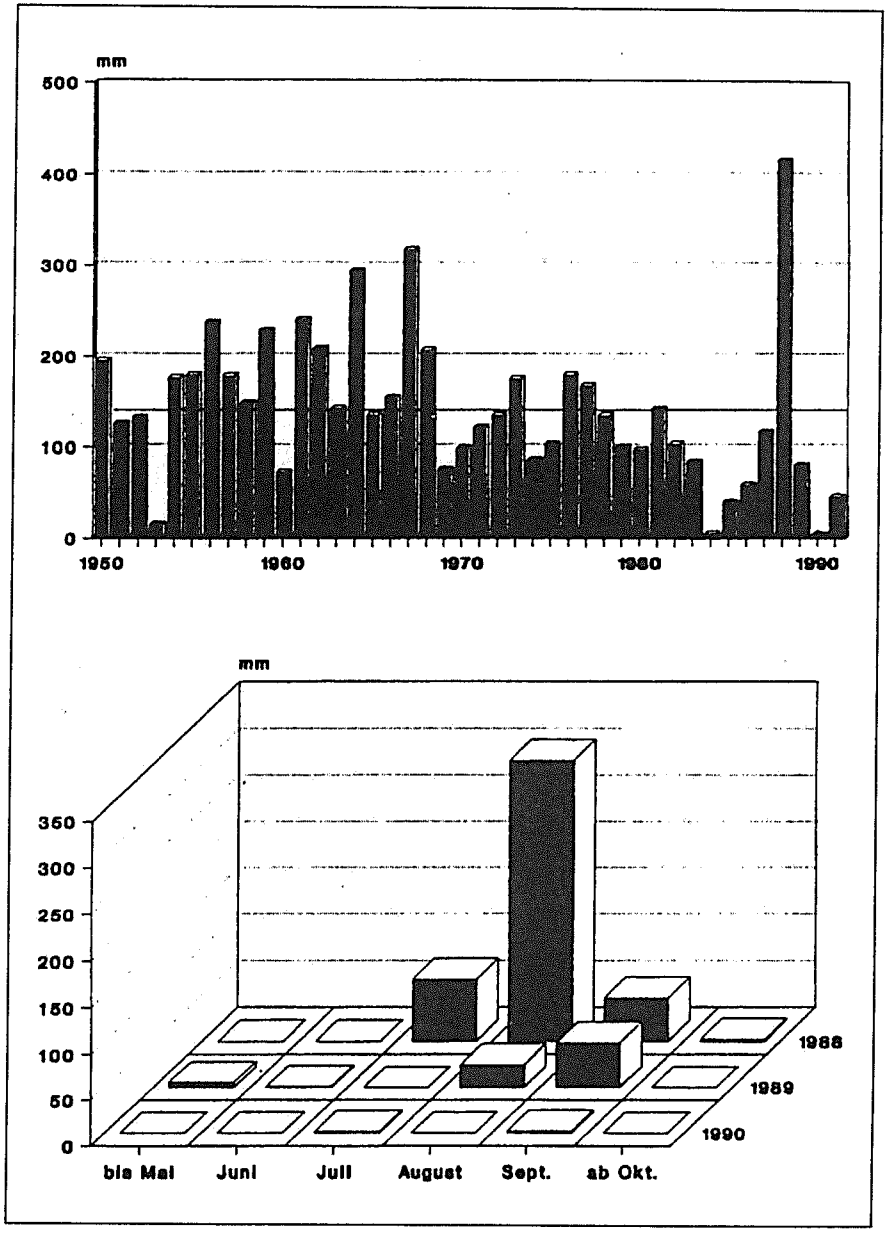


Source: Basic map of the research project "Animal husbandry in the Sahel", designed by PFLAUMBAUM/AKTHAR 1994

2. Water for animal and human purpose in the Butana

The production year of the nomads depends on the seasonality of rainfall: the year starts with the first rainfall, called *Rushaash* (± June). The rainy season is called *Kharif* (June - October), followed by the hot and dry months of *Darat* (October and November) and the cold and dry season of *Seef* (December til March). The hot and very dry summer *Shita* (April til June) is the hardest time for animals and humans, as fodder, food and water are finished and everybody waits for the *Rushaash*, the beginning of the rainy season. In a case of a drought, humans do not perceive it in advance. Not until the *Darat* (October) do they know the production conditions til the next *Rushaash*.

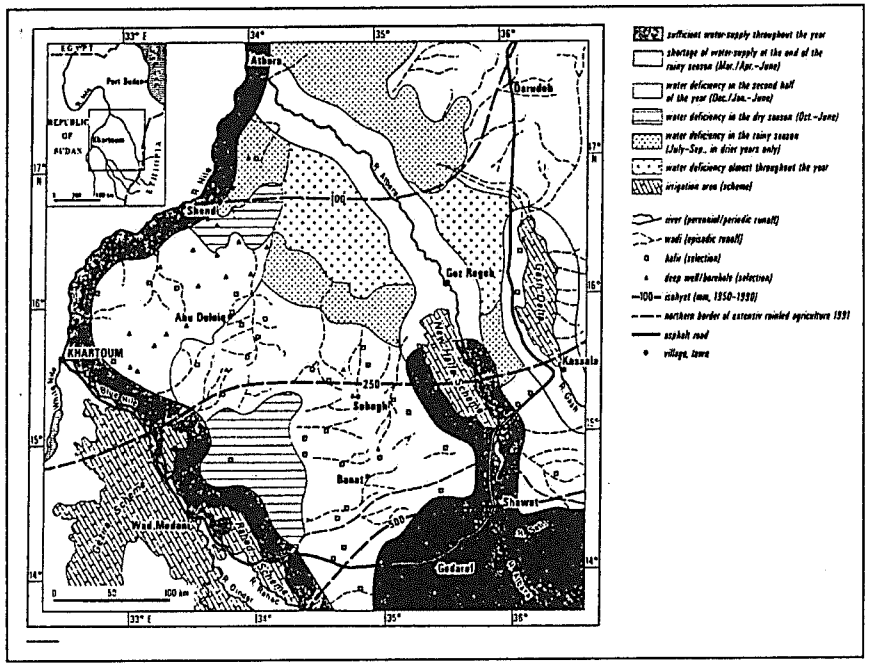
Figure 2: Quantity and seasonality of rainfall in the Butana (50 year period)



Source: compiled by PFLAUMBAUM 1994a

The Butana has an average rainfall (1950-1990) of 66 mm p.a. in the north (station Atbara) and 586 mm p.a. in the southern area (station Gedaref). This rainfall is very seasonal (July til September) and with a high variability in between the years (Atbara: 60 %, Gedaref: 13 %). Periods of drought occur irregularly and are unpredictable. During the last decades there has been a heavy shortage of rain (drought definition: two years with less than 50 % of the 50-year average): 1969/70, 1974/75, 1979/80, 1982-1986 and 1990/91. Contrary to these droughts, good rainfall was experienced at the beginning of the Sixties, in 1987-1989 and 1992-1996. In 1988, there was more rain than ever before (for example, 4 August 1988 rainfall of 200 mm/sqm). The desert has been encroaching since 1950. In the period 1975-1985 the 150 mm isohyete was 100 km more southward than in the period 1950-1965, the 400 mm isohyete 50 km (PFLAUMBAUM, 1994a).

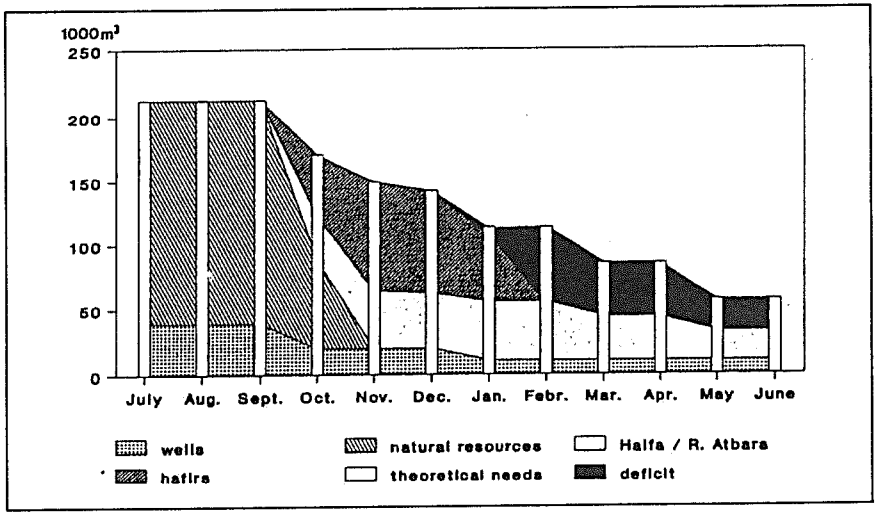
Figure 3: Map of the water resources in the Butana Region



Source: designed by PFLAUMBAUM (1994b)

VOIGT (1989) estimated the water needs of humans and animals living in the eastern part of the Central Butana for the Eighties. The drinking water deficit starts in December til June with about 210,000 m³ (31 % of 675,000 m³ in that period). Despite the fact that water is scarce, there are several water resources usable for humans and animals. There is no difference between drinking water for humans and animals but some resources cannot be reached by animals. Watering places can be divided into ground and surface water, natural and man-made hafirs.

Figure 4: Theoretical water requirements (bar chart) and available resources in the eastern Central Butana



Source: data collected by HOLTER, KIRK, PFLAUMBAUM, RAHMANN, SCHUTZBAR; VOIGT 1989, model calculated and draft PFLAUMBAUM 1994

Rivers: Three rivers border the Butana: the Atbara, the Blue Nile and the Nile. These rivers have water the whole year but the access is difficult because crop farmers have occupied the banks and there are only a few paths through the fields for the herds.

Wadis: Wadis are seasonal rivers. The wadi water is available in a season where no shortage of water exists. The water soon flows to the rivers (basement peneplains and alluvial plains) or seeps into the ground (sandy areas = nubian formation and dunes).

Natural pools: After rainfall the water persists in small pools but they dry very quickly. For animals like cattle, goats and sheep they are important in remote grazing areas where the distance to the next watering place is more than one day away (on foot). Only camels are able to survive with very little drinking water (in the rainy season green, fresh plants are sufficient) and they have an excellent capability of storing water in the body.

Channels in irrigation schemes: There are four irrigation schemes which give access to water in the channels: the New Halfa Scheme and the Rahad Scheme in the Butana and the Gezira Scheme and Gash Scheme in the adjacent areas. These schemes are limited for the nomads' animals. The water of the channels can only be used for animal keeping when it is at the edge of the irrigation schemes.

Hafirs: Hafirs are human built dams in the wadis which catch the water flood in the rainy season to keep it for the dry season. The size and the storage capacity is very different. They can be between 100 and 5.000 sqm and 1 to 5 metres deep. Depending on the quantity of water they can catch in the rainy season, the seepage into the ground, evapo-transpiration (30 %) and the removal for human and animals' purpose, they supply water for a special period. Only a few of the hafirs have water for the whole dry season til the next rainy season.

Irrigation dams: The *Kash'm El Girba Dam* dams up water from the Atbara river and was constructed to deliver water for the New Halfa scheme. The water is not or only limited for animal keeping.

Wells: The villages have their own wells in the wadis. Even some mobile nomads dig wells for water. VOIGT (1989) estimates that 300,000 m³ water is delivered by wells and HASSAN (1991) evaluated that there are about 250 wells in the central Butana, but only 60 deliver water the whole year, 60 for 6 months between July and December and 130 only 3 months between July and September. The daily capacity is 3 to 5 m³ per day for about 10 months.

Ground water bore holes: There are five deep ground water bore holes in the Butana which deliver between 5 and 35 m³ water per bore hole and day and together about 110,000 m³ water per year. The fossil water is not renewed by rain so it is limited for sustainable water resource management.

Transported water: when there is no water available, the water can be brought to the animals and humans. This is very limited and costly and only rich nomads can afford it.

3. The socio-economic aspects of water for nomads

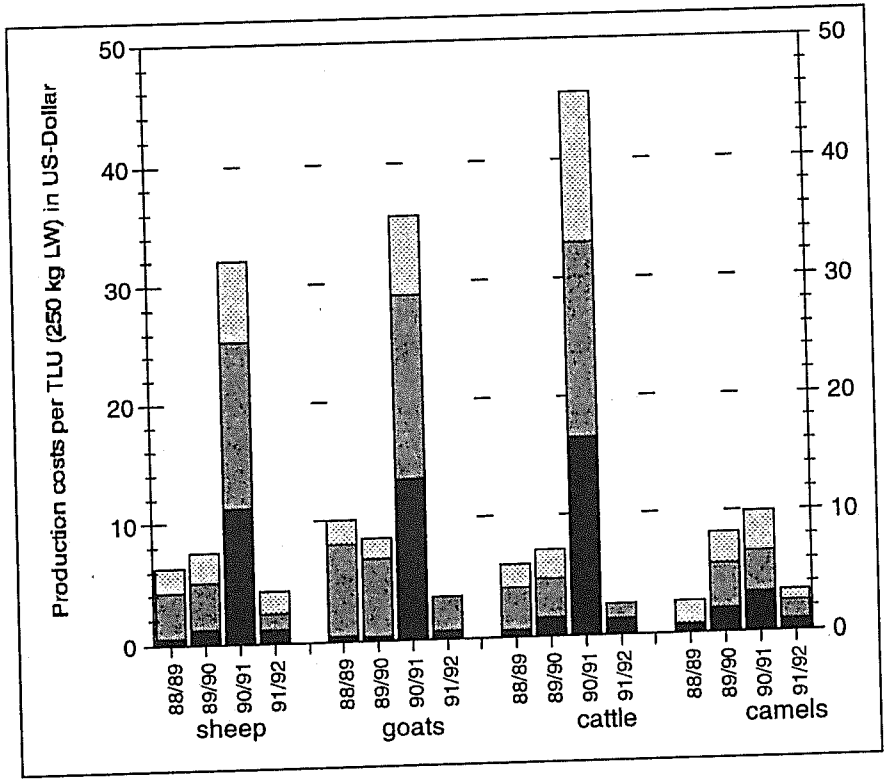
Water has always been an aspect of property rights and conflicts. The '*dars*' (synonym for homeland or tribal land) regulated the property rights and use of the resources on the land where natural surface water in pools and even beside the rivers were a part of the common properties belonging to the tribe. Man-made wells could become private property because the digging of a well could be two to six years work (ABU SIN 1990). Wells can be inherited and the owner (family) can charge others for water. Recently most of the wells and the hafirs are stated to belong to individual persons or tribe groups (SÖRBÖ 1991). Members of the tribe had the right to get water, but they had to pay. The use of water could be prohibited to non-tribe animal holders. This was a way of controlling the grazing pressure on land for the '*dars*', the limitation of access to water (KIRK 1994).

In 1970 the Sudanese Government abolished the tribal rights on water and declared all natural resources in the grazing areas (like the Butana) as free goods. Crop farmers with private properties on land and water gained from the new property rights declared by the government. Mainly from southern parts of Sudan, animal holders entered the Butana with their herds in big numbers. These farmers took their own fodder resources (sorghum and finger millet straw) for their own herds. In the rainy season they exploited the natural grazing areas and left little for the indigenous nomads, who depended on the natural resources. With the control instrument "water", the nomads lost the control of the grazing resources (KIRK 1994).

Contrary to the free use of the natural grazing areas, the nomads had to buy fodder from the farmers to feed their animals in the dry season. The farmers in the rainfed agricultural area had enough fodder. They started, however, in the drought 1984/85 to charge the nomads heavily for by-products (standing hay/straw). Animal holders were heavily charged even for the water. In some months of the drought year 1991/92 the nomads had to pay 30 per cent of the herd to buy fodder for the remaining herd. These ended in the collapse of the nomadic animal economy where no costs for fodder and particularly water were integrated (RAHMANN 1995). [2]

[2] The empirical figures below cover the period from 1988/89 to 1991/92. These four production years were different in rainfall and hence in the conditions for animal production: the year 1988/89 was with excellent rainfall, 1989/90 was moderate, 1990/91 was with nearly no rainfall and 1991/92 was with rainfall 75 % below the average.

Figure 5: Water (black bar), fodder (grey bar) and other costs (bright bar) for sheep, goats, cattle and camels in different climatic conditions 1988/98 - 1991/92 (in TLU) [3]

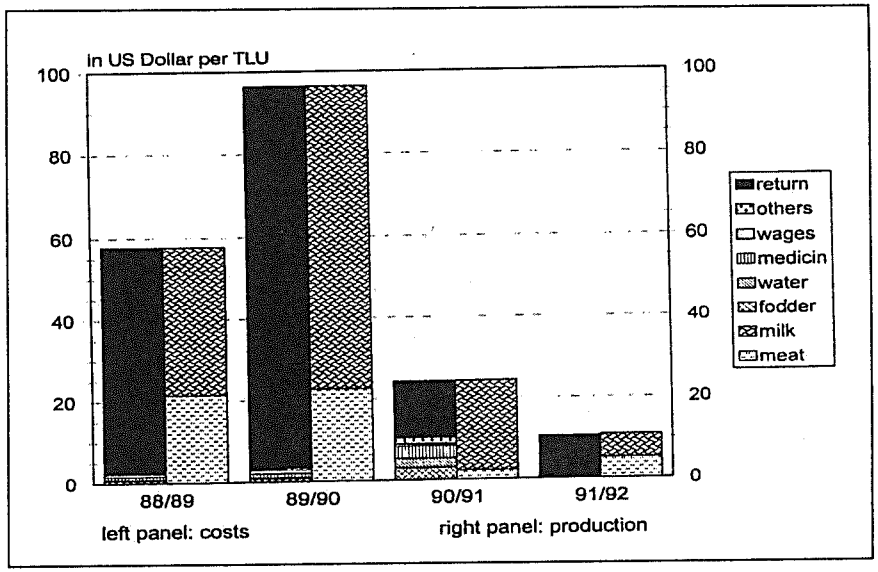


Source: RAHMANN 1995

The costs for fodder and water in the year 1991/92 decreased because the herds were smaller after the severe drought year 1990/91 due to selling of large numbers of the herds to meet the costs for water and fodder for animal husbandry as well as for getting money for human needs (staple food). [4] Animal losses because of starvation had only little impact. The marginal income in animal keeping was positive even in the drought year 1990/91 but of very little extent. The need for selling livestock to meet the human consumption needs is to be higher than the production rate, despite the consumption being reduced to the minimum level (surviving level).

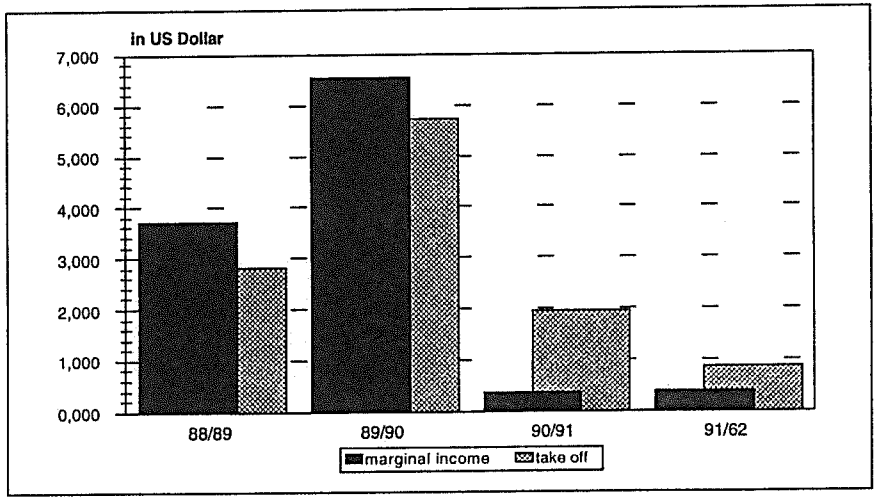
[3] Sheep, goats, cattle and camels are equalized in TLU (Tropical Livestock Units) with a liveweight of 250 kg: Camel = 1,0 TLU, cattle 0,7 TLU, sheep and goats are 0,1 TLU.

Figure 6: Marginal income in animal keeping in drought conditions



Source: RAHMANN 1995

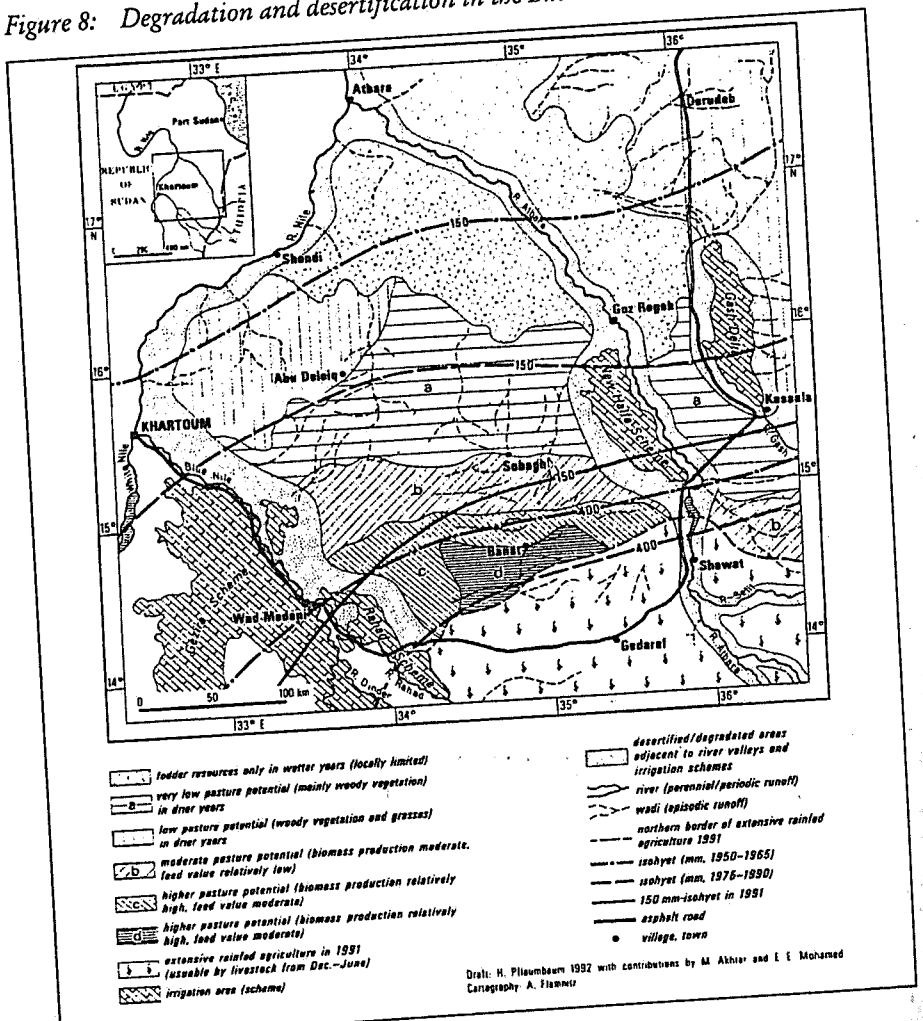
Figure 7: Marginal income[4] and take off for human needs in animal keeping of nomads (1988/89 - 1991/92) (average herd size 1988/89 = 77 TLU)



Source: RAHMANN 1995

The animal holders stay as long as possible in the natural pastures which are close to the private rainfed schemes, in order to limit the fodder and water costs as much as possible. Ten-thousands of animals stay until the last stalk of grass before they leave the Butana. This leads to the overgrazing of the natural pastures (AKTHAR 1994).

Figure 8: Degradation and desertification in the Butana



Source: AKTHAR, 1994

4. Degradation and desertification around watering places

The overgrazing is the start of degradation and ends in desertification. The watering places concentrate the animals seasonally and the surroundings become overgrazed. This has happened beside the rivers in the last 100 years, and particularly after the governmental declaration in 1970 that surface water in natural grazing areas is free to everybody (i.e. free of charge). The result is desertification to an extent of 50 to 100 km width from river banks into the pastures. The construction of hafirs and channels around the irrigation schemes, the digging of ground water wells by the government or in the British period with open access led to the same problem: over-exploitation of pastures arround these water places. Exploitation gradients (grazing pressure) are nil where animals have no possibility of watering.

5. Conclusion

The Butana has probably enough fodder for all animals using the area but water limits equal use. Some areas are overgrazed (close to watering places), others are undergrazed (too distant from water places). The solution of this problem could be the digging of wells or hafirs in remote areas as has been done in the past. The effects of the abolishment of tribal regulation instruments 1970 shows that the positive effects of such efforts will be only for the short run. Soon the degradation will appear after the construction of new watering places and without control, desertification without reversiblity. Resources for human survival will then be lost for the future. Water has the important role in the sustainable use of natural grazing areas as an excellent instrument for grazing control. The governments in many Sahelian countries are not effective in avoiding over-exploitation. Tribal rights before the state property rights declaration have shown that communal property rights have the potential to control over-exploitation of resources. Property rights is the way to find a solution for the problems of social and ecological degradation in the Sahelian zone of the Sudan, the Butana.

[4] The monetary value is given in US-dollar on exchange for the Sudanese pound. In rural areas, money is less important in terms of trade to other goods. The value of the Sudanese pound varies between rural and urban, southern and northern parts of the country. This is accompanied with calculation problems, because the Sudanese pound is a Government controlled currency. For the exchange rate the black market rate (BR) in the capital of Khartoum was used. Other exchange rates are the governmental rate (GR) and the free market rates (FR). Exchange rates to US-dollar in the order GR, FR and BR: 88/89: 2.4, 6.5, 25.0; 89/90: 2.5, 8.1, 34.0; 90/91: 7.5, 12.2, 60.0; 91/92: 8.1, 17.5, 120.0 (RAHMANN 1995).

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Herausgeber der Schriftenreihe:
Deutsches Institut für Tropische und
Subtropische Landwirtschaft GmbH, Witzenhausen;
Universität Gesamthochschule Kassel, Fachbereich Landwirtschaft,
Internationale Agrarentwicklung und Ökologische Umweltsicherung, Witzenhausen und
Verband der Tropenlandwirte e. V., Witzenhausen

Der Tropenlandwirt

Journal of Agriculture in the Tropics and Subtropics

Der Tropenlandwirt

ISSN 0173-4091
ISBN 3 88 122-95 -8

63

Beiheft Nr. 63

Nachhaltige Wassernutzung in der Landwirtschaft

Nachhaltige Wassernutzung in der Landwirtschaft

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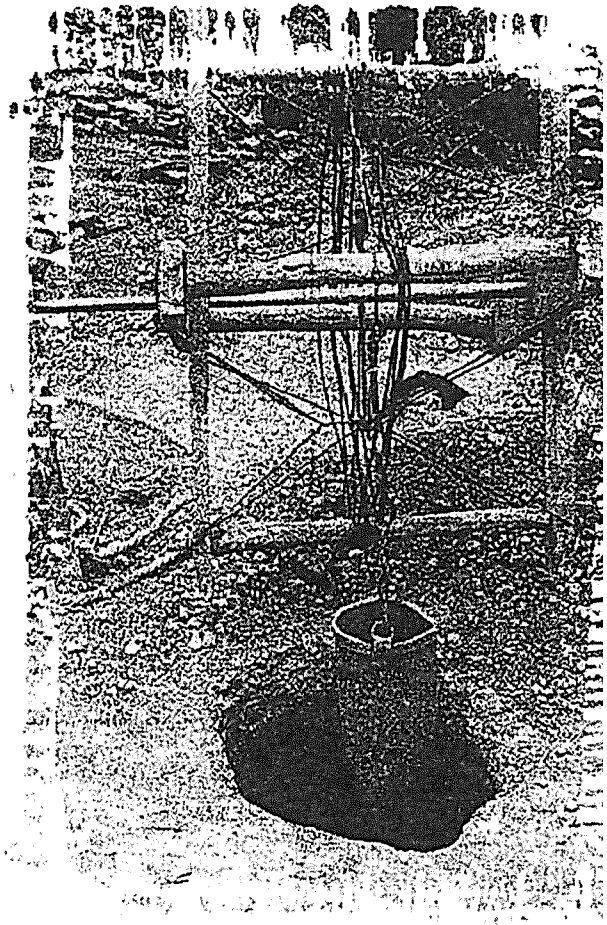

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Rahmann, Gerold

Ecological and economic aspects of water for nomadic animal husbandry in the sahelian zone of the sudan

In: Der tropenlandwirt. beiheft. journal of agriculture in the tropics , ISSN 0173-4091
1998, Beih. N. 63, S. 137-151

Bestellversuch in JASON

Quelle: IBZ

Fachbereich 11
Landwirtschaft, Internationale Agrarentwicklung
und Ökologische Umweltsicherung

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and Environmental Protection

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Aktenzeichen

Datum 21. 8. 1997

An
Herrn Dr. Rahmann
Fachgebiet Internationale Nutztierzucht und -haltung

Sehr geehrte liebe Kolleginnen und Kollegen,
sehr geehrter Herr Dr. Rahmann,

unser Kollege, Prof. Dr. Peter Wolff scheidet zum Ende des Sommersemesters 1998 aus dem aktiven Dienst der Universität Gesamthochschule Kassel aus. Wir konnten in Erfahrung bringen, daß er sich über eine Festschrift, die zum Zeitpunkt seiner Pensionierung erscheinen würde, sehr freuen würde. Aus diesem Grunde wenden wir uns nun an Sie, mit der Bitte, sich mit einem Artikel an der Entstehung dieser Festschrift zu seinen Ehren zu beteiligen.
Als Arbeitstitel haben wir uns im Zusammenhang mit seinem Fachgebiet - Kulturtechnik und Ressourcenschutz - den Titel **„Nachhaltigkeit der Wassernutzung in der Landwirtschaft“** ausgedacht.
Wir haben den Titel bewußt etwas allgemein gehalten, um Ihnen die Möglichkeit zu geben, sich an dieser Aktion zu beteiligen. Die Beiträge werden in einer Sonderausgabe „Der Tropenlandwirt“ erscheinen.
Falls Sie bereit sind, einen Beitrag zu leisten und mit diesem Arbeitstitel einverstanden sind, möchten wir Sie bitten, Ihren Beitrag bis spätestens **31. Januar 1998** an einen von uns zu schicken.
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Mit freundlichen Grüßen

(Prof. Dr. Eckhard Baum)

(Dr. Siawuch Amini)