

DRAFT

**Water and Ecosystem Resources in Regional Development:
Balancing Social Needs and Wants in International River Basin Systems**

Socio-economic and Environmental Change

WP 4.1

Livelihood Options and Strategies

Arable Agriculture and its Significance in Terms of Spatial
Coverage, Job and Income Generation Potential

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1 Economic Activities in and around the Okavango Delta

The majority of people in Ngamiland maintain a diversified income generation system as means of reducing risks in an unstable environment. The main economic activities in the district are rainfed and flood recession cultivation, livestock management, fishing, hunting, gathering of veld products, small scale commercial business enterprises like the production and sale of crafts and local food and beverages, wage labour in the tourism industry, and formal employment in the government sector. “The importance of the individual economic activities varies from household to household; from community to community; from season to season and from year to year in response to variations on rainfall and flooding, access to resources, labour and capital, and cultural and other factors influencing preferences” (IUCN, 1992 pp.2-10).

1.1 Spatial Coverage of Different Land Use Activities

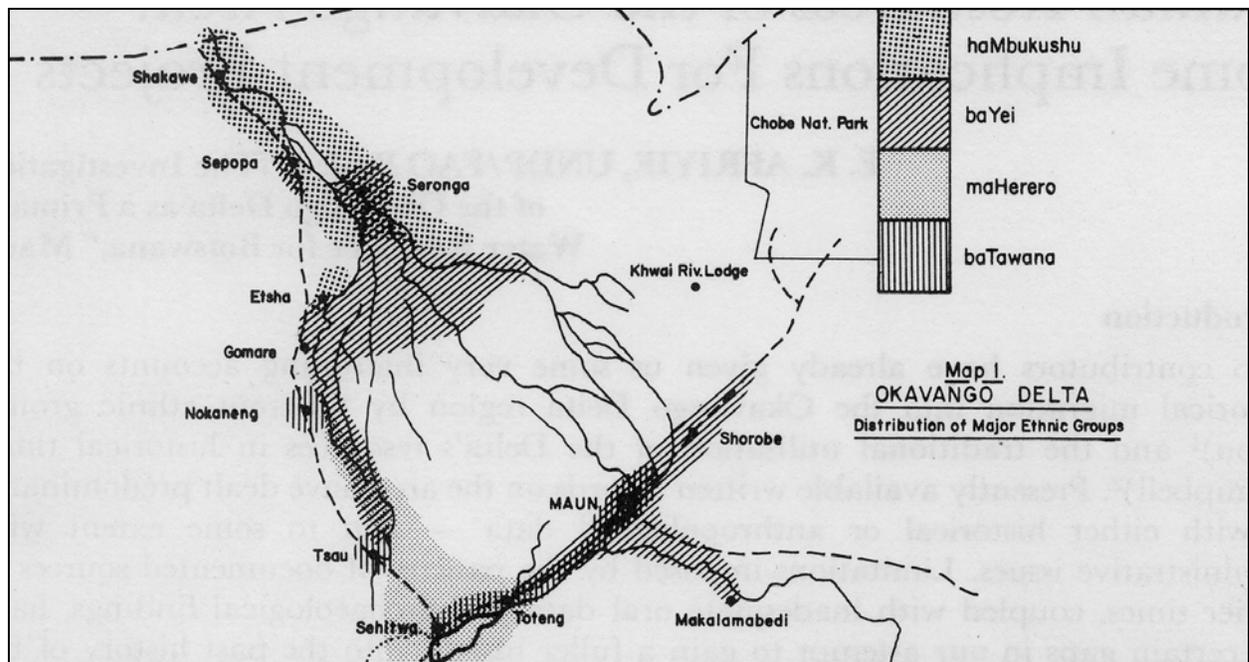
The distribution of the particular types of land use in Ngamiland depends largely on natural factors like the distribution of water, soil and range land quality (Langdale-Brown & Spooner, 1963), and the presence of vector diseases (tsetse flies) but is also strongly related to the traditional preferences of different ethnic groups for particular economic activities (Bendsen & Gelmroth, 1983). Furthermore, government policies and the zoning and land use planning decisions made by district and tribal authorities have influenced the spatial coverage of different land use activities.

According to a land use assessment carried out by the HOORC in cooperation with the University of Sachsen Anhalt (Meyer et al, 2002) using the most recent remote sensing material (Landsat Image Mosaic from 2002, complemented by aerial photography from 1983) the total area cleared for cultivation in Ngamiland amounts to 48,900 ha. Out of this, 75 % are dryland fields and 25% of the lands are located in temporary inundated floodplains (in Setswana molapo, plural melapo). According to the Agricultural Statistics (Agricultural Statistics Unit, 1968-2002a) out of the total arable area only about 10,700 ha are cultivated on the average per cropping season.

While along the Okavango Panhandle and in the Etsha area, where the HaMbukushu are the dominant ethnic group, arable agriculture, in particular dryland farming, is the main land use activity, molapo cultivation is found in the floodplains at the western and south eastern fringes of the Delta. The main floodplain cultivation areas in Ngamiland District are the Tubu Flats, the Shorobe-Matlapaneng area (northwest of Maun), the Lake River and Kunyere River channels, the riverbed of the dried up Lake Ngami, and the Thamalakane and Boteti River basins. The Land Use Map of Ngamiland produced in October 2002 at the HOORC (Meyer et al) illustrates that the main dryland cultivation areas in Ngamiland are located around Etsha and at both sides of the Okavango Panhandle, while molapo cultivation is still concentrated in the Shorobe and Gumare floodplains (see Map 2). Looking at the land use pattern in Ngamiland West it becomes obvious that the area cultivated per household decreases from north to south. At the same time the number of cattle per household increases gradually towards the south (Bendsen

& Gelmroth, 1983 and DAHP, 2002). The areas from Nokaneng southwards up to Kareng, Bodibeng, and Makakung, and the rangeland around Lake Ngami up to Toteng are foremost a livestock rearing area, only intermixed with small arable fields. There the Herero, who are mainly pastoralists, are the dominant ethnic group. The BaTawana are arable farmers and simultaneously keep livestock mainly around Tsau in Ngamiland West and in the Toteng and Maun areas. The HaMbukushu, who reside in northern Ngamiland, place arable agriculture first in importance among their subsistence activities (Gibson et al., 1981 p. 217). However, they are increasingly accumulating livestock. (See Map 1 and Map 2, Afriyie, 1976 p.180). The TGLP ranches in the Hainaveld, in the dryland south of Maun, have been developed in the last 25 years as commercial livestock zone. More detailed mapping of all land use activities has been carried out at the HOORC under work package 4.2 (Meyer et al, 2002).

Map 1: Distribution of Major Ethnic Groups in Ngamiland



(Source: Afriyie, 1976: 180)

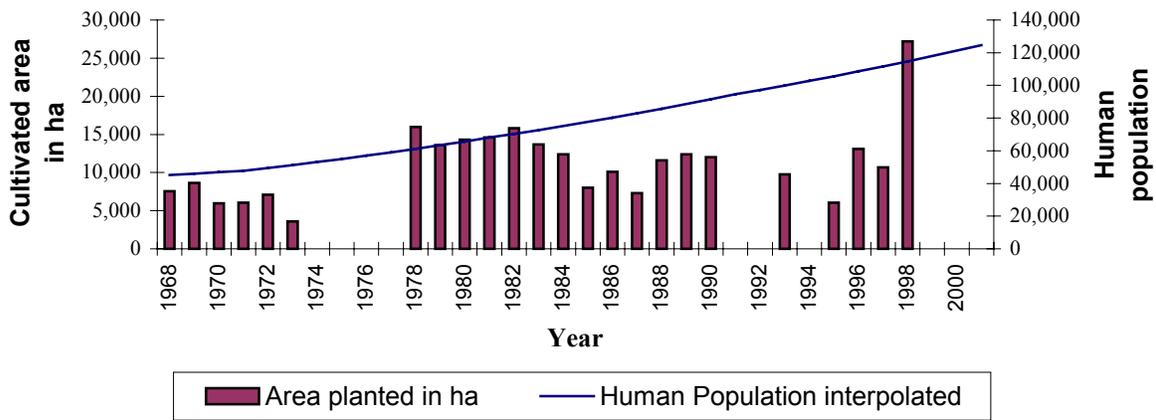
2 Crop Production Systems¹

Despite the limited potential for crop production and high risks this activity carries, the majority of households in Ngamiland are involved in crop production. During the last 30 years on the average 66% of the agricultural holdings in the district planted crops (Agricultural Statistics Unit, 1968 – 2002). After 1996, when all the cattle in the district

¹ Some of the information on the agricultural system in Ngamiland is based on the experience and in-depth knowledge the author, H. Bendsen, gained during her long-term assignment as Land Use Officer for the MoA, and as consultant for the NWDC and the TLB in the District during 1979-1989.

had been culled due to the outbreak of Contagious Bovine Pleuro Pneumonia (CBPP or cattle lung disease), arable agriculture became one of the major alternative sources of livelihood for population in Ngamiland (Fidzani et al, 1999). In comparison to the drastic population increase between 1968 and 2002, the cultivated area has remained almost static (see Figure 1). Although the area farmed per household is in decline, arable agriculture remains an important source of livelihood for communities in Ngamiland (Scott Wilson, 2001 p.31).

Figure 1: Demographic changes in relation to area cultivated in Ngamiland



Source: Agricultural Statistics Unit, 1968-2002b

Most farmers cultivate small areas for subsistence purposes. At present only 10% of the farmers reach full subsistence level and live mainly from their own production (Ndozi, Nthibe & Bandeke, 1999 p.36). According to the Agricultural Statistics (Agricultural Statistics Unit, 2002a), not more than 10,668 ha have been cultivated in Ngamiland in 1997. Looking at the long-term average 2.1 ha are ploughed annually per household (Agricultural Statistics Unit, 1968-2002b). An arable lands survey carried out by Ngamiland DLUPU (1979) maintains that larger areas used to be cultivated per household in the past. In 1978, 39% of the farmers ploughed up to 4 ha, 36% between 5-14 ha, and 18% cropped lands areas of 15-20 ha (DLUPU et al, 1979).

The main cereal crops grown in Ngamiland are sorghum (33% of the cultivation area), followed by millet, and maize covering 29% and 31% of the cultivation area (see Figure 2). Secondary crops like beans, pumpkins, and watermelons and occasionally sweet reed and peanuts are grown in varying quantities throughout the region (Afriyie, 1976 p.183).

Figure 2: Changing distribution of cultivation areas between different crops in Ngamiland

	Average 1968 - 97 area in ha	%	1998 area in ha	%
Maize	3,283	31%	23,157	85%
Sorghum	3,592	33%	1,392	5%
Millet	3,079	29%	1,261	5%
Pulses	552	5%	1,277	5%
Others	242	2%	124	0%
Total cultivated area	10,748	100%	27,211	100%

Source: Agricultural Statistics Unit, 1968-2002b

The selection of millet as against sorghum can mainly be attributed to traditional preferences of particular ethnic groups. The HaMbukushu who are dryland cultivators predominantly grow Millet in the dryland in Ngamiland West in Etsha and on both sides of the Okavango Panhandle.² Most of the other ethnic groups like the BaYei and the BaTawana prefer maize and sorghum as their staple grain crops. Sorghum is also processed into a traditional alcoholic beverage called locally Bojalwa ja Setswana. The BaYei who consider themselves “river people” grow maize in the floodplains at the fringes of the Okavango Delta while sorghum is planted in the higher, drier parts of a molapo field. The fact that in 1998 the cultivation area had increased by 250% and that mainly maize was planted has to be attributed to a government tractor ploughing and free seed distribution scheme introduced to overcome the negative effects of CBPP. The scheme has failed its goal to facilitate food production in the district. The maize yield obtained on these large mechanically ploughed lands was as low as 1 kg/ha (Agricultural Statistics Unit, 2002b).

On average only 40% of the total area cultivated can be harvested at the end of the cropping season (Agricultural Statistics Unit, 1968 – 2002b). In some years, the ratio between area harvested and planted is even less favourable. These figures clearly illustrate the uncertainties crop-farming bears. The high failure rate can be attributed to drought or erratic rainfall patterns (see Figure 3 and 4), flooding (in flood-recession farmland) and crop losses or crop damage by livestock, wildlife, birds (particularly quelea), rodents and pests. Even though millet is more likely to be damaged by birds, it is far more drought resistant. When comparing the likelihood of crop failure between different crops due to drought, it becomes apparent that maize and sorghum are more vulnerable to total crop losses than millet.

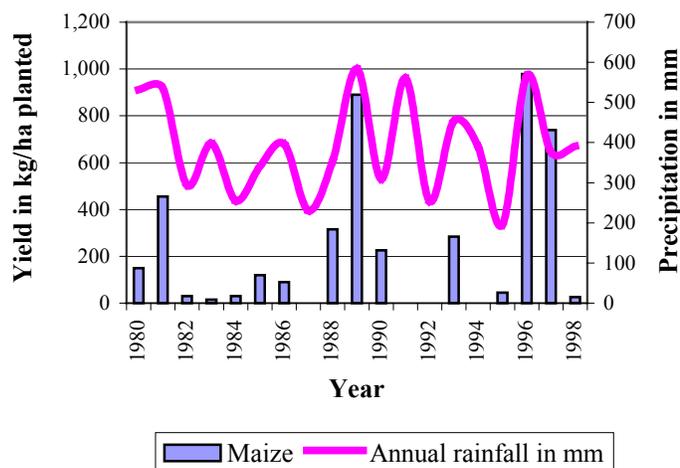
Figure 3: Failure rate of different crops

Crop	Sorghum	Maize	Millet	Pulses
Long term average or ratio area harvested to planted	42%	29%	49%	25%

Source: Agricultural Statistics Unit 1968-2002b

² For further details on the HaMbukushu see Gibson, Larson & McGurk (1981)

Figure 4: Maize yield variations in relation to precipitation rates



Source: Agricultural Statistics Unit, 1981-2002b

In general, traditional arable farming is an extensive system with minimal input and occasionally fair but more often low returns, depending largely on unpredictable environmental conditions during the cropping season, which are beyond the control of farmers. A minimal input approach in crop production is reflected in traditional cultivation practices (Riezebos et al, 1991 p.38). As the natural conditions change drastically, yields vary considerably from year to year, from crop to crop and even between different arable zones in Ngamiland during the same cropping period.

Due to the high rate of total crop failure yield figures are commonly based on the area harvested and not to the area planted. According to calculations based on the Government’s agricultural statistics, long-term yield averages for all the grain crops harvested amount to 142 kg/ha in Ngamiland (Agricultural Statistics Unit, 1968-2002b). Long term average yields for maize are 162 kg/ha, for Sorghum 121 kg/ha, for millet 144 kg/ha and for pulses 28 kg/ha.

The strength of the traditional agricultural system is its flexibility and the spread of risk it allows. Farmers change to more drought resistant crops in periods of low flooding or persistent low rainfall. Others, who have the option, shift from flood recession cultivation to dryland farming or vice versa. If crop losses occur early during the cropping season, replanting is commonly practised. In years when crops fail there are always other sources of income such as livestock rearing, fishing, collection of veld products (like wild fruit, berries, mushrooms, traditional building materials etc.), production of traditional crafts, in former times also hunting, and these days increasingly formal employment in the tourism sector to fall back on (Rashem, 1988 p. 6).

2.1 Cultivation Practices

Farmers broadcast a variety of seeds consisting of maize, sorghum, millet beans, watermelons, sweet reed and different types of pumpkins on untilled land. More than 80% of the farmers ploughed and planted at the same time (Ngamiland DLUPU, 1979 p.7). The farmers see mixed cropping as a method of reducing the risk of a complete crop failure (Ngamiland DLUPU, 1979 p.7). Every crop has different ecological demands and tolerance levels to withstand extreme natural conditions (drought, water-logging, pests). Furthermore mixed cropping has the advantage that the different crops mature at different times, allowing for some food to be available more quickly. An additional advantage is that the labour demand for harvesting is spread out more evenly.

Despite the fact that the agricultural extension workers have tried to convince farmers to use improved farming techniques, like row planting, harrowing and early weed control, most farmers have not altered their traditional cropping system. While in 1980, 88% of the farmers in Ngamiland broadcasted (Agricultural Statistics Unit, 1980 p.106) the above-described seed varieties the same farming practice was used by 89% of the farmers in 1990 (Agricultural Statistics Unit, 1991). Broadcasting is still the predominant planting technique (Makhwaje et al, 1995 p.13). After hand sowing, the field is immediately ploughed using most commonly a one-furrow mouldboard plough drawn by one or more spans of oxen or donkeys. Even though farmers in Ngamiland hardly make use of planters, a traditional row planting technique is found amongst some of the HaMbukushu dryland cultivators whereby seeds are hand planted in every third furrow. In 1980, 14% (CSO, 1980 p.107) of the farmers in Ngamiland West used this hand row planting method. A farming systems research project carried out in the Tubu area during the eighties found many reasons which explained the reluctance of the traditional arable farmers to except modern cultivation techniques. Row planting for example was found to have no comparative advantage against broadcasting unless combined with mechanical weeding. Latter however requires additional animal draft power, which is not readily accessible to 50% of the households (Rashem, 1988).

According to the Agricultural Statistics (CSO, 1980-1991) about 50% of all arable framers have their own draft power while the remaining farmers hire or borrow a draft team or have access to draft power under the mafisa arrangement.³ In the heavy molapo soils draft power requirements are usually higher than on the sandy dryland soils. Traditionally, a span consisted of at least six oxen (Rashem, 1988 p.36) but spans of eight and ten animals were also common for ploughing in the floodplains. According to Rashem (1988 p.36), the use of so many draft animals is neither necessary nor efficient. The use of large draft power teams is a question of prestige and a tool to make resource poorer households dependant on wealthier farmers who control the draft power (Sutherland, 1981). Being forced to cultivate with reduced draft power teams because of the culling of the entire district cattle population during the Contagious Bovine Pleuro

³ In this system a person who looks after somebody else's cattle is paid a minimal wage or does not receive any remuneration but can make free use of the milk and the draft power in return.

Pneumonia (CBPP or cattle lung disease) outbreak in 1996, it appears now that farmers are able to plough with two oxen or with one team of donkeys even in the molapo areas.

One characteristic of the agricultural production process is a clear gender division of labour. While fencing and ploughing are male tasks, most other agricultural activities such as weeding, thinning (not commonly practised), protection of the field against crop damage by livestock and wildlife, bird scaring, harvesting, threshing and crop storage are traditionally done by women (Dorloechter, 1989 p.19).

Most agricultural lands are fenced against domestic and wild animals (Gibson, Larson & McGurk, 1981 p.220). Traditionally, this is done by planting hardwood poles (e.g. *Colpospermum mopane*) along the field boundaries and reinforcing these with thorn-bush branches. However fences cannot protect crops effectively against destruction by elephants, baboons, monkeys, birds or pests like locusts. Therefore, small shelters are erected within or close to the fields. Women or children spend parts of the cropping season there to guard the standing crop against stray livestock and birds (Dorloechter, 1989). During the early morning hours they are usually busy in the fields while during the heat of the day some women might carry out income generating side activities like weaving baskets for sale or brewing palm wine out of mokola palm (a speciality of the Shorobe area) (Dorloechter, 1989).

During the eighties, a number of Government subsidy programmes were initiated to help small farmers to raise their level of crop production and to elevate the consequences of the long lasting drought. Many farmers in Ngamiland made use of the Arable Lands Development Programme (ALDEP) established in 1978 (presently discontinued and under revision) and the Accelerated Rainfed Arable Programme (ARAP), in operation from 1985 to 1990, and destumped, ploughed, and wire fenced their fields individually (Kirkels, 1992). In places where the cultivation areas were located in well-defined blocks (as in Etsha and in the inter-dune valleys in Ngamiland West), farmer's groups were formed to protect their lands jointly with wire fences. These groups were assisted with fencing material by the Agricultural Extension Law 10, AE10 Programme (in practise since 1980) (Kirkels, 1992).

Improved seeds, which give higher yields than seeds taken from the harvest of the previous year, (Riezebos et al., 1991 p. 39) are widely used in the District as they are usually supplied to farmers by the Agricultural Demonstrators (ADs) in times of drought or disaster or are available for sale from the Botswana Agricultural Marketing Board (BAMB). As farmers in Ngamiland are repeatedly affected by natural disasters (droughts) and disease outbreaks (Nagana, CBPP) they have become accustomed to receive certified seeds (mainly maize and sorghum) in restricted quantities (10 kg per household) free of charge.

Most farmers (96%) practise early weeding (a month after planting) as promoted by the agricultural extension service. Weeding is done once (by 37%) or twice (by 52%) of the farmers (DAR, 1985 p.77). In the moist fertile floodplain soils plant but also weed growth

is accelerated. Consequently weeding in molapo fields is very labour intensive and has to be done more frequently.

Neither chemical fertiliser nor kraal manure are commonly used to improve the soil fertility (Pilane, Tvedten & Gaosegelwe, 1981 p.75 and Makhwaje et al, 1995). The high risks, which characterise the arable sector, explain the reluctance of farmers to invest in costly inputs like fertiliser, insecticides and herbicides.

As crop production is primarily subsistence oriented, farmers only market crops when the subsistence demand is sufficiently secured or when a special cash need forces them to sell some of their products (Dorloechter, 1989). Especially in years of good rainfall, when good yields can be achieved, a small portion of the crop is marketed either locally or to BAMB. The traditional practice of bartering crops for other commodities can still be found, particularly in remote areas. During the drought years of 1983-86, crop marketing virtually ceased. In 1989 small amounts of crop surpluses (580 t of maize and 250 t of sorghum) (Dorloechter, 1989 p.34) were marketed again to BAMB in Ngamiland

After the harvest, crops are stored in traditional granaries made out of reeds or papyrus (mabinda mats) sealed by cow dung and mud. The storage bins are placed on an elevated pole platform. Alternatively, very densely woven baskets out of Mokola (*Hyphaene Ventricosa*) leaves are used to store crops or the seeds for the next season. Storage losses by pests and rodents are considerable despite of the fact that traditional control measures are used e.g. by applying Motswere (*Combretum imberbe*) ash to the crop.

Two types of crop production systems can be distinguished in Ngamiland: dryland (or rain-fed agriculture) and molapo (or flood-recession) farming.

2.2 Dryland Farming

Dryland farming is the predominant arable system in Ngamiland practised by 85% of the farming households (Ngamiland DLUPU, 1979). Even though most settlements are located around the Delta, only dryland is available for farming. Areas suitable for floodplain cultivation are limited. In the late seventies 35% of the farmers cultivated molapo land (Ngamiland DLUPU, 1979). The Agricultural Statistics Reports of the Central Statistics Office do not distinguish between the two farming practices.

As irrigation of cropland is not practised in traditional agriculture in Ngamiland, yields are directly related to the annual precipitation rates and the rainfall distribution pattern during the growth period.

In Ngamiland people do not burn the crop residues but rather let the draft animals graze in the fields after the harvest. Farmers believe that with fire too many nutrients are lost, whereas if they leave remnants standing in the field, termites move organic matter down to the root zone. Burning of the vegetation is only practised when new fields are prepared (Cassidy, 2002 personal communication of unpublished field survey results).

2.3 Molapo Cultivation

Floodplain cultivation is a traditional farming system commonly practised in and at the fringes of the Okavango Delta mainly by BaYei farmers. The floods peak at Shakawe in northern Ngamiland in March to April and spread gradually throughout the Delta. In Maun the water level starts to rise usually three months later (June-August). Depending on the precipitation rate in the catchment area of the Okavango Delta, the Angolan highlands, the flood level can vary considerably from year to year. After the recession of the floods melapo land gradually dries up (as result of evapo-transpiration and outflow) until it becomes available for cultivation. According to the Arable Lands Survey (Ngamiland DLUPU et al, 1979), about 35% of the farmers were engaged in molapo cultivation. The results of the land use assessment carried out by the HOORC (Meyer et al, 2002) indicate that presently only 25% of the total cultivation area is molapo land.

Two different types of molapo can be distinguished according to their landform characteristics: saucer-shaped and channel type floodplain (Staring et al., 1981). The shallow saucer-shaped floodplains are mainly found in the Shorobe- and Nxaragha areas in Ngamiland East between the Kunyere and the Thamalakane Fault. These treeless gentle depressions are located between islands, which are densely vegetated with riparian woodlands at their edges. Seasonal flooding is caused by spill over or back-flow from the main rivers: the Boro, the Santantadibe, the Gomoti in the Shorobe area and the Xudum and the Matsibe River near Toteng and Nxaragha. Annually farmers adapt the area they cultivate within a particular arable zone to the flood level. The lowest part of the depression is rarely farmed as it might fill up with water when the local rains set in, causing water-logging and damage to the standing crop.

The channel type molapo occurs mainly in the floodplains along active river channels like the Gomoti, the Santantadibe, the Boro, and the Boteti Rivers in Ngamiland East and at old oxbows, or blocked sections of the defunct Thaoge River as well as along the Karongana River in the Tubu area (near Gumare, Nokaneng) in Ngamiland West. Small molapo fields can be found as well in remote Delta villages (e.g. the Jedibe floodplains south of the Okavango Panhandle). Long narrow strips of arable land border the shallow riverbeds. They vary between 50 m and 1000 m in width. The central part of the stream is neither cultivated nor fenced in order not to obstruct the movement of boats. The molapo fields flood when the water level in the main rivers rises in June-July (in Ngamiland West) and August (near Maun). As the water recedes they become available for cultivation much earlier than the dryland fields, which are usually cultivated only after the rains, have started between November and January.

2.4 Dry Melapo Cultivated under Rainfed Conditions

Due to constant changes in the flood distribution pattern some molapo fields do not get flooded every year but benefit from the raising groundwater table or run-off from adjacent areas and are cultivated under rainfed conditions. As the magnitude and distribution of the floods vary considerably from year to year, farmers are forced to adapt their cultivation patterns accordingly. In 1974-78 for example, the floods never receded so large parts of the Shorobe molapo area could not be cultivated (Staring et al., 1981 p.6), whereas in 1986-87 (Rosenow, 1990) and during the 90ies parts of the melapo were not flooded at all and could only be cultivated after the onset of the local rains. There are a number of depressions (e.g. the old bed of Lake Ngami in the Sehitwa-Makakung area), which have not been flooded for many decades, but usually receive moisture from rainfall. They are still referred to as “melapo” and chosen by farmers as prime cultivation areas (Pilane, Tvedten & Gaosegelwe, 1981) even though yields tend to be considerably lower than in flooded melapo fields. On trial plots in the Shorobe area 500 kg/ha sorghum could be obtained under rainfed cultivation whilst under optimal flooding conditions 1800 kg/ha - 2900 kg/ha sorghum have been recorded in 1986/87 (Rosenow, 1990 p.55). In inter-cropping trails in a non-flooded molapo, record yields of 5230 kg/ha of maize plus cowpeas were achieved (Loos, 1988 p.24).

To protect their standing crop from the second flood caused by the precipitation over the Okavango Delta (setting in between November and January) and to benefit optimally from this additional source of moisture, the molapo farmers traditionally constructed small hand-built dams (bunds) out of grass sods. These structures were meant to control the rainwater distribution but did not obstruct the main flood. They subdivided the cultivated melapo in sections to avoid rainwater from collecting in the lowest places.

2.5 Advantages and Disadvantages of Molapo Farming Compared to Dryland Cultivation

Local farmers recognise a number of advantages of the unique system of floodplain cultivation. Molapo farmers are able to cultivate their fields early (October-December in the Maun area) right after the recession of the flood. Consequently they have a prolonged cultivation season. As crops benefit from the residue of moisture stored in the soil profile, planting does not depend entirely on the local rainfall. Soils are relatively fertile in comparison to the Kalahari sands (Belien-Stockhardt, 1978 p. 4). Molapo soils are fine alluvial deposits with varying sand, clay, loam and peat contents (Staring et al., 1981). Soil types and characteristics vary with elevation according to flooding frequency and duration (Loos, 1988 p.1). Several surveys confirm the perception of the local farmers regarding the outstanding soil quality in the molapo areas. As noted above yields in the floodplains are usually higher than in the dryland. Furthermore the first crops from the molapo areas are getting ready for harvesting as early as December (Shorobe area), at a time when food is scarce (Rosenow, 1990 p.55 and Staring, 1991 p.6). Finally because the natural vegetation in the melapo consists of grasses, sedges, and reeds, farmers neither have to clear tree vegetation nor need to destump their fields.

Amongst the disadvantages related to floodplain cultivation is the high labour demand for weeding due to accelerated weed growth. Also the draft power requirements are usually higher in the heavy molapo soils than in the sandy dryland. Molapo land with ideal moisture conditions is also scarce and access to good land is restricted. In the floodplains the traditional land tenure system is still prevalent whereby local titleholders are controlling access, as well as size, and quality of the land given to individual households for ploughing in a particular cropping season. In years of high floods, molapo land might never dry or the standing crop might be damaged by water logging or lost completely to the second flood caused by heavy local rains.

Crop losses due to stray domestic stock or wildlife are a widespread problem as well. As the molapo fields are often located close to open water, regularly frequented by livestock, they are even more vulnerable to crop damage than dryland cultivation areas. Traditional fencing materials (like thorn bushes) are not readily available in the floodplains and fencing of narrow worm shaped cultivation areas in and along dry water channels is often not done adequately as it is uneconomical. The increasing numbers of elephants, concentrated in the north-eastern part of the Delta, have caused crop losses in dryland and molapo fields.

2.6 Commercial Irrigation Farming

Since the beginning of the nineteenth century the abundance water in the Okavango Delta has always raised the hopes of people to develop large-scale arable projects. Early travellers (e.g. Stigand 1913) as well as development agencies (Langdale-Brown & Spooner, 1963; Siderius, 1970; Swedeplan, 1989 and SMEC, 1991) carried out comprehensive surveys and identified areas with some potential for irrigation farming. The Nokaneng Flats and the area around Lake Ngami were repeatedly recommended for agricultural development. However, many adverse factors, some of them associated with the constant alteration of the natural flow regime others with market constraints and environmental impacts, dampened the optimism of decision makers and investors.

Several attempts have also been made to grow crops at a large commercial scale in Ngamiland. Except for two commercial irrigation schemes, still in operation south of Shakawe, where there is abundant perennial water, all the commercial projects have failed and have been abandoned. Most of the historical irrigation trials were located in Ngamiland East. During the eighties a rice project was initiated in the lower Boro area under the assistance of Chinese experts. Along the Thamalakane River, south of Maun, a farmer tried to cultivate onions for sale and in Dikatlhong, at the Thamalakane/Boteti junction, maize was grown at a commercial scale by a private entrepreneur using a centre pivot irrigation system. Along the Boteti River in the Samedupe area a commercial passion fruit farm was in operation for a few years and in the seventies cotton was grown at Nxaraga research station.

The reasons for the failure of these commercial irrigation projects are many, but perhaps the prime one is that the main rivers in Ngamiland East dry out periodically. Local

producers have also not been able to compete with the prices of produce from South Africa mainly because inputs, especially fertiliser and pesticides, which are imported, are expensive (Natural Resources and People, 2001 p.37). Despite the improvement of the road network in Ngamiland in the past ten years, the area remains remote and transport costs for marketing farm products are still relatively high. Development projects aimed at building local skills and initiating interest in communities to take up commercial farming have not been successful as traditional farmers have not been willing to bear the great risks these investments would involve.

The two ongoing irrigation schemes in the panhandle area, 125 ha and 12 ha in size, have been struggling to grow and market a changing variety of cash crops profitably (Natural Resources and People, 2001 p.37).

For almost two decades Maun Senior Secondary School successfully ran a vegetable and fruit farm that catered for the needs of the school and supplied the Maun market. In the early nineties, when Maun was faced with a water crisis, the activity had to be discontinued and has never been revitalised. A few small fruit and vegetable gardens have been established at some of the schools throughout the district. Assisted by the Financial Assistance Policy (FAP) funding a few individuals and one women's group (at Shorobe) have started to grow fresh vegetables and spices at a small scale. They marketed their products directly to the safari industry or to the retailers in Maun. Along the Boro River at the Kunyere fault prisons has an irrigation scheme and is growing vegetables.

3 Changes and Trends in Arable Agriculture

During the last 30 years the population of Ngamiland has increased rapidly at an annual rate of 3.6 % from 1971 – 81, 3.3% from 1981 - 91 (CSO, 1999 p.10) and 2.4 % between 1991 and 2001 whereas the area cultivated in Ngamiland has stagnated or even been slightly reduced (1980 = 14,300 ha, 1993 = 9,756 ha, 1996 = 13,853 ha) (CSO, 1980, 1995, 2000). There are more factors hampering arable production than elements stimulating the sector that need to be analysed to explain this trend.

3.1 The Effect of Fluctuations in the Natural Conditions

Arable farmers in Ngamiland have been repeatedly hit by disasters and short and long term fluctuations of the natural conditions for crop and livestock farming. Extremely high floods (in 1978/9), severe droughts (in 1964-65, 1982-88, and 1995), as well as gradual changes in the flood distribution pattern over the last century have all negatively affected arable agriculture.

To be able to respond to these constant fluctuations in the environmental conditions, the land use systems in Ngamiland are both dynamic and resilient. An extreme example of the natural fluctuations, which occurred during the last century, is the drying up of the Thaoge River, formerly the main water tributary for the Tubu floodplains in Western

Ngamiland. Consequently some of the major molapo cultivation areas between Habu and Gumare had to be abandoned. A few of the farmers who used to rely on flood recession cultivation moved their lands to the northwest into the Karongana area. However, the total area cropped or suitable for floodplain cultivation in Western Ngamiland has decreased considerably (Bendsen, 1983).

Outbreaks of vector diseases (such as the Rinderpest in 1896, CBPP in 1996, and the cattle Trypanosomosis outbreak in 2000) killed or drastically decimated the cattle population thereby also reducing the draft power of crop farmers. Farmers who choose to remain in the fly belt had to revert to the more inefficient hoe cultivating method (Davies & Bowles, 1976). Despite of unfavourable circumstances most traditional farmers still try to grow crops, even if at a reduced scale. Historically, the reoccurring invasion of the Delta and its fringes by tsetse flies affected both domestic stock and humans and forced people to abandon some of their settlements and floodplain cultivation areas (especially during the peak of sleeping sickness outbreaks in 1942 - 1946 and 1971) (Okavango Community Consultants, 1995). Some villages located on islands at the western and at the northern fringe of the Delta (like Gabamukuni) had to be moved further to the dryland (Langdale-Brown, Spooner, 1963).

Comparing the agricultural statistics of the last decades, it becomes obvious that whenever the livestock sector has experienced severe losses, as during the persistent drought of the 1980's when 86,000 head of cattle starved to death in Ngamiland, crop production was simultaneously affected. Another serious detrimental effect on arable production in Ngamiland was caused by the outbreak of CBPP in 1996 when the entire cattle population of Ngamiland district had to be culled. The Government tried to alleviate the draft power shortage by assisting farmers with an ALDEP Donkey Subsidy Scheme. Even though farmers made use of the programme they were still faced with a severe lack of animal traction for ploughing (Ndozi, Nthibe & Bandeke, 1999). Many farmers fell back upon utilising the traditional hoe cultivation technique. One of the relief measures taken by Government to overcome the detrimental effects of CBPP was the introduction of tractor ploughing scheme. This explains the drastic expansion of the cultivated area in Ngamiland from 10,000 ha in 1997 to 27,000 ha in 1998. An evaluation of the socio-economic impacts of CBPP in Ngamiland indicates that before the outbreak of the disease, 25% of the population perceived arable farming as the most important source of income, while after the cattle culling this activity was ranked as main source of livelihood by 37% of those interviewed (Fidzani et al, 1999). The proportional contribution of crop production to the livelihoods of the rural population in Ngamiland increased.

During the mid eighties a massive infestation of locusts and quelea birds damaged or destroyed the standing crop. In combination with the drought, it had a negative cumulative impact on crop production. The increasing elephant population is constantly causing crop losses particularly in the remote villages in the southeastern Panhandle. All these factors combined with the erratic unreliable rainfall make crop production a high-risk activity. Consequently, over the years farmers have not intensified their arable activities nor expanded their cultivation.

An analysis of land use changes in the Shorobe area comparing five series of aerial photographs (1951, 67, 73, 83, and 85) over a 35-year period (Bendsen, 1987) indicates, that certain prime molapo cultivation areas in and along the main riverbeds have been cultivated almost constantly over the last 30 years. As temporarily unused floodplain fields become heavily invaded by weeds, farmers attempt to cultivate lands with good to fair moisture conditions on a permanent basis. In 1963, 1974, and 1977/78 cropping seasons the floods were so high that the water did not recede from the Shorobe floodplain cultivation area. This forced farmers to shift their arable activities temporarily to the dryland. As soon as the flood conditions allowed, farmers moved back to re-cultivate the more fertile soils of the melapo and largely abandoned the dryland fields despite the fact that some of them had been protected by wire fences to keep livestock and wild animals out (Bendsen, 1987).

When farmers decide upon the location of their arable lands, they tend to select areas with relatively superior soil fertility (e.g. floodplains, or inter-dune depressions). Declining soil fertility in the dryland is one of the reasons why farmers are discontinuing to use the previously cleared cultivation areas (Kirkels, 1992). However no clear pattern of fallow is detectable. Farmers often rotate the cropped section within their cleared arable plot.

3.2 Employment Alternatives to Arable Farming

The low labour productivity and high risk in agriculture have forced traditional farmers in Ngamiland to search for more lucrative income generating options. In the 1960s and 1970s many men took up work in the South African goldmines. The massive out-migration resulted in scarcity of male labour for ploughing. Many of the temporary contract workers assisted their families with remittances which enabled them to supplement the reduced arable production by purchasing industrially produced consumer goods. Since the 1980s South Africa has been able to largely meet their own labour demands. Consequently the Witwatersrand Native Labour Organisation (WENELA) stopped recruiting foreign workers. While in 1991 15,614 Batswana were employed in the South African mines, of whom only 76 came from Ngamiland, (CSO, 1999 p.78) the countrywide employment figure dropped drastically to 8,652 in 1999 (CSO, 1999).

As subsistence agriculture offers low returns, many young men migrate to larger villages and urban areas looking for employment opportunities (Rashem, 1988 p.27). The district capital Maun has expanded into an administrative centre housing many central and local government institutions. Considering only formal employment options in Ngamiland, the agricultural sector still absorbs the largest share (40%) of the district labour force (CSO, 1999 p.78). However, other sectors like construction, wholesale and retail, domestic services, and in particular tourism are increasingly providing employment alternatives. Maun and the camps in the Okavango Delta have absorbed some of the rural labour force in the tourism sector or in providing support services for this fast growing industry (like transport and travel agencies, air charter companies, garages, hotels, and catering

services, retailing of food and beverages, camp construction and maintenance etc.) Hence, Maun has experienced disproportionate population growth during the last 40 years. While the district population has tripled, the population of Maun has expanded almost 10 times from 4,549 inhabitants in 1964 to 43,776 in 2001.

Alternative employment offers have changed over time. While during the 1960's and 70's many men were working in the South African mines, today the tourism and service sector in Ngamiland is absorbing some of the male labour force. As formal employment becomes more readily available for men, arable agriculture is faced with a lack of male labour. Although women carry out most of the activities in crop farming, ploughing is considered to be a male domain. The fact that a growing number of households in the district are female headed (in 1980 27%; in 1996 38%, and in 1998 47%) (CSO, 1980, 2000 and 2001) with limited access to male labour and to draft power for ploughing, contributes substantially to the stagnation of the arable sector. Traditionally, husbands, partners, or male relatives are socially obliged to provide ploughing services for the women (Dorloehter 1989). Men engaged in formal employment often try to take leave during the ploughing season in order to cultivate. As tourism (particularly hunting) is of seasonal nature, crop production is a convenient way to diversify and complement the family income. Most part time farmers only plough areas large enough to meet the subsistence needs of their families but do not expand the arable areas in order to produce marketable surpluses (Dorloehter, 1989). As other activities are of greater benefit farmers do not allocate more labour to develop arable farming (Rashem, 1988).

The increasing level and quality of public services have motivated many people to leave the lands and spend more time at permanent homes in larger villages. School attendance has expanded rapidly and children are only available to a limited extent to carry out farm activities. Only 40 years ago, the majority of the population in the district was illiterate and had never attended school. However in remote communities and in some ethnic groups (esp. HaMbukushu and San) people are more likely to keep their kids out of school for farm labour (Cassidy, 2002 unpublished field survey). Survey results in Ngamiland West CSDA indicate, "the youth has lost interest in agriculture" (Kirkels, 1992). Parents are not sending their children to school to become better farmers but with the aspiration to increase their chances to find formal employment (Rashem, 1988).

3.3 Government Subsidy Schemes and their Influence on the Arable Sector

Government programmes like the ALDEP Draft Power Subsidy Scheme and the ARAP ploughing, planting, weeding, destumping and fencing payments, introduced during the late seventies and, enforced during the severe drought in the eighties, had a considerable impact on farmers initiative to expand their cultivation areas beyond the size they could or intended to actually cultivate during any given cropping season. In Ngamiland particularly, the ARAP ploughing subsidy was widely used by farmers (Ngamiland District Council, 1997 p.24). Especially around Maun, where tractor traction was available, large lands areas were cultivated using the ARAP ploughing assistance. The draft power subsidy was the component most readily used by farmers in the district

followed by assistance for ploughs and fencing material (Ngamiland District Council, 1997 p.24). When ARAP was discontinued in 1991 a number of farmers, who were merely attracted by the direct monetary benefits of the programme (payment of P50/ha for ploughing etc.), no longer cultivated the entire area they initially cleared. According to observations by an Agricultural Demonstrator (written statement AD Sepopa in: Kirkels, 1992) a quarter of the farmers in his extension area failed to plough after the discontinuation of ARAP. ALDEP funds were frozen in 2001. The programme is presently under revision.

As Ngamiland has been repeatedly hit by natural disasters, farmers have become used to relying on Government assistance. For example, after the cattle lung disease culling, 43% of the households in the district participated in Labour Intensive Public Works (LIPW) or received free food rations (69% of the households) (Ndozi, Nthibe, & Bandeke, 1999). In 1999, 14% of the households in the district were dependent exclusively on Government rations as their source of food, 36% complemented their own production with government rations while 12% depended on a combination of government rations and wages from formal employment. This means that only 38% of households did not rely on direct Government support for their livelihoods. Only 8 % of the households gained subsistence from formal employment and only 10% of the farmers lived from their own agricultural production (Ndozi, Nthibe, & Bandeke, 1999 p.36). Farmers apparently prefer to accept low wage casual employment (e.g. Labour Intensive Public Works) to arable farming with its uncertain returns, especially as simultaneously Government subsidies like ALDEP are frozen.

A new option for maintaining arable production and simultaneously working in the tourism sector has come up recently through the CBNRM joint venture agreements for community trusts administering a Controlled Hunting Area. Some communities receive free access to tractor traction for ploughing as an additional benefit from the safari operator, who is their joint venture partner. Farmers readily accept this assistance but might not necessarily be committed to engage more in farming in order to increase production. Conflicts may arise as this form of assistance by the joint venture partner is directed not to the whole community but to individuals

4 Aspirations of Farmers

A survey of livelihood options carried out in 2001 in 10 villages in Northern Ngamiland (Bendsen & Motsholapeko, 2001) indicates that arable agriculture is still seen as the most important subsistence activity. However, asked for their priorities in resource allocation, formal and casual employment as well as cattle ranching is given higher priority (Rashem, 1988). Even though people do not always have the option to be employed in the formal sector, they see it as more beneficial. The results of the aspiration survey indicate, that in the long run, the relative significance of agriculture is likely to decline with increasing availability of alternative, more reliable sources of income. However as people have experienced drastic drawbacks in all sectors, they prefer to maintain diversified livelihood strategies.

ABBREVIATIONS AND ACRONYMS

AD	Agricultural Demonstrator
AE 10	Agricultural Extension Law 10,
ALDEP	Arable Lands Development Programme
ARAP	Accelerated Rainfed Arable Programme
BAMB	Botswana Agricultural Marketing Board
CBNRM	Community-Based Natural Resources Management
CBPP	Contagious Bovine Pleuro Pneumonia
CFDA	Communal First Development Area
CSDA	Communal Second Development Area
CSO	Central Statistics Office
DAHP	Department of Animal Health and Production
DAR	Department of Agricultural Research
DLUPU	District Land Use Planning Unit
FAO	Food and Agricultural Organisation
FAP	Financial Assistance Policy
IUCN	International Union for the Conservation of Nature and Natural Resources - The World Conservation Union
LIPW	Labour Intensive Public Works
MFD	Ministry of Finance and Development Planning
MLGL	Ministry of Local Government and Lands, (old title)
MLHE	Ministry of Lands, Housing and Environment
MoA	Ministry of Agriculture
NWDC	North West District Council
SMEC	Snowy Mountain Engineering Corporation
TLB	Tawana Land Board
UNDP	United Nations Development Programme

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Population Growth in Ngamiland between 1964 and 2001

	1964	1971		1981		1991		2001	
	Population	Population	Growth Rate						
Country	514.378	574.094	1,6%	941.027	5,1%	1.326.796	3,5%	1.680.863	2,4%
Ngamiland	41.820	47.723	1,9%	68.063	3,6%	94.534	3,3%	124.712	2,8%
Maun	4.549	9.614	11,3%	14.925	4,5%	26.768	6,0%	43.776	5,0%

Source: Central Statistics Office