

Land use practices in Caprivi's changing political environment

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Introduction

This paper presents an account of developments that led to present land use practices in the eastern parts of Caprivi and the effects these practices have on the ecosystem. In the pre-colonial period (–1890), the early inhabitants of east of the Kwando River were hunters and gatherers. Climatic and hydrological conditions enabled the first Bantu communities to practice settled subsistence agriculture in the 18th and 19th centuries, a time when the Lozi and the Kololo kings ruled this area. Its location between perennial rivers made eastern parts of Caprivi good and easily defensible grazing area. Peripheral location and prevalence of malaria and cattle diseases made the area less tempting for European and South African farmers, but also made the colonial administration of east of the Kwando River difficult for Germany 1890–1915 and South Africa 1915–1990. The paper reviews published works and government documents, which is combined with field observations and aerial photos of the area. In particular, our analysis focuses on Salambala conservancy because of its successes and many controversies. The analysis shows that indeed, enactments of law did not address land use in the manner that would have led to fulfilment of the needs of subsistence farmers until Namibia's independence in 1990. Nowadays, almost the whole area is still intensively used for small-scale subsistence farming and agricultural practices have remained traditional. The article describes the efforts of previous administrations and outlines several factors that accounts for present-day land use practices. This account concludes that intensification of grazing and clearing

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of arable land to accommodate the growing population was accommodated by a period of limited yet extensive flooding; the present increased flow of the Zambezi River has created pressure for resettlement, also the creation of game conservancies such as Salambala and parks in the region increases pressure on the remaining land. Although periodic, increased clearing and grazing have locally led to land degradation, there is evidence that the increasing number of conservancies will lead to intensive competition by different land users and beneficiaries.

Introduction

The Caprivi region (Caprivi Strip, Caprivi Zipfel) in North-East Namibia is a political artefact derived from colonial times. Since the 18th century, the area has been subjected to the authority of different African conquerors and colonial administrations, which had different ambitions and strategies related to their own interest in the area. During the German colonial period the Caprivi Strip was created with the intention to connect German West and East Africa using the Zambezi River. Victoria Falls, locally known as “*musi wo tunya*”, translated as the ‘smoke that thunders’, made this intention impossible, but the Caprivi Strip remained as a political and geographical entity governed by German South West Africa. Caprivi region has four perennial rivers, namely Zambezi in the north, Chobe to the south and Mashi and Kwando Rivers to the south and western parts of the region. The region receives the highest rainfall in Namibia. In Caprivi, large areas are covered by fertile soil suitable for cultivation and grazing as a result of annual flooding of the rivers. In addition, the region boasts a flourishing fauna and flora in its three national parks and more than 12 conservancies. Tourism has been said to hold potential for economic emancipation for the regions’ approximately 90 000 people. Despite the region’s potential to be a thriving economy, the majority of the population in the region depend on land to support livelihoods albeit as small-scale subsistence farmers. The question therefore is: what factors accounts for the present land use practices in Caprivi? This paper discusses several factors that account for the present day land use practices from a geographical and historical perspective. Through the analysis of aerial photos, a case study of the Salambala conservancy is used to illustrate the different factors at play during the period between 1970 and 2006.

Data and Methods

The discussion in this paper is based on data derived from historical data, published literature and government reports (Polojärvi 2007). This is complimented by observations we made during seven field trips (2006 – 2009) to the area and a detailed temporal analysis of aerial images of the Salambala conservancy as a case study. During the field trips an inventory of land use and land cover was made using a semi-randomized sampling method. Land use and vegetation were documented using a structured inventory form and the exact coordinates were recorded using a hand held GPS device. A laptop computer with the Intergraph Geomedia Geographical Information System (GIS), connected to a Bluetooth GPS device was used to digitize unmapped roads and tracks. This was often useful as navigating on the flood plain after dark was difficult, and it also made follow up visits efficient. In addition, data on pasture use was obtained using GPS-collars fitted on animals from ten separate herds for a period of two years (2006 – 2007); in total 14 collars were used (Polojärvi, et al. 2011, 2012). Digital aerial images of the Salambala Conservancy area for the years 1970, 1996 and 2006 were obtained from the Directorate of Survey and Mapping in

Windhoek. These images were georeferenced using ERDAS Image and composed into a seamless mosaic using ArcMap 9 and 10. The aerial images of 1970 and 1996 were scanned by the Directorate of Survey and Mapping in Windhoek from black and white original film, the quality of the original images was relatively poor compared to the 2006 high resolution colour orthophotos which were acquired from the same supplier. Additional Aster, SPOT and Landsat satellite images were acquired and used to assess the extent of flooding.

The main objective was to study the change in land use intensity and the underlying causal factors. We digitized for each image mosaic the following objects; animal enclosures, dwellings and buildings, agricultural fields, as well as paved and unpaved roads. In addition, we intended to study the reduction of random error introduced by variation in image quality and human subjectivity a rectangular grid was created, and all features were summarized and tabulated by 500 x 500 meter grid cell. The resulting three chorological matrices (1970, 1996 and 2006) were used to perform the final land use change analysis.

Study area

The Caprivi region is located in North-East Namibia (Figs. 1 and 2). The Zambezi River forms the eastern boundary and its tributary the Kwando divides the region to West and East Caprivi. The southern border is marked by the course of the Kwando known as the Linyanti and the Chobe. The study focused on the eastern part of Katima Mulilo although for the purposes of comparison and patterns, the analysis includes all areas east of Kwando River. Average daily temperatures range approximately from the minimum of 5 °C in winter, to the maximum of 35 °C in summer (Mendelsohn and Roberts 1997). Our measurements in the Salambala showed during 2008 maximum temperatures of 43.0 °C and minimum temperatures of 2.8 °C, in 2006 we even observed -0.42 °C. Caprivi experiences droughts every now and then, however, average annual rainfall is 500–750 mm, and the rainy season lasts approximately from November to March (Mendelsohn and Roberts 1997). The Zambezi peak flow at Katima Mulilo falls between March and May and the Kwando at Kongola between June and August (Mendelsohn and Roberts 1997). During floods water reaches heights up to eight meters in Katima Mulilo. The floodplains of the Zambezi cover the eastern parts of the area. The Linyanti and the Chobe in the southern part of eastern Caprivi also flood annually, forming smaller wetland areas along the rivers. Caprivi is inhabited by Bantu-speaking communities namely the Masubiya, Mafwe, Mayeyi, Matotela, Mambalangwe, Mambukushu and Malozi, who are depended on subsistence crop and livestock agriculture. Inter-marriages are not uncommon. In the western parts of the region, Khoisan speakers, namely the Khwe can be found in Bwabwata National Park. Together, they make the total population of Caprivi to be approximately 91,000 (GRN 2012) a figure that some have interpreted to mean a negative growth when compared to 90,422 people reported in the 1991 National Housing and Population Census (Harring and Odendaal 2012). A closer examination however shows that there is no contradiction because the region's boundaries changed after the 1992 regional and 1998 constituency delimitation commissions, which meant that more than 20,000 inhabitants now became part of former western Caprivi and this population is now counted under the Kavango region. To be precise, in 1992, Caprivi had a total population of 71,027 (Naeraa, et al. 1993).

Of course, HIV has had its toll on the population. A major factor affecting Southern Africa in general and especially Caprivi has been the HIV/AIDS

pandemic. HIV prevalence in Caprivi increased rapidly since 1990 and peaked about 2006 when the prevalence reached levels of near 40 %. AIDS mortality has affected many rural communities and has resulted in a severe decrease of agricultural labour, and had a negative influence on population growth in general (Jayne, et al. 2006). The reasons for the high prevalence of HIV in Caprivi are manifold, but poverty, poor education, risk behaviour and a border transit location are the most important causes.

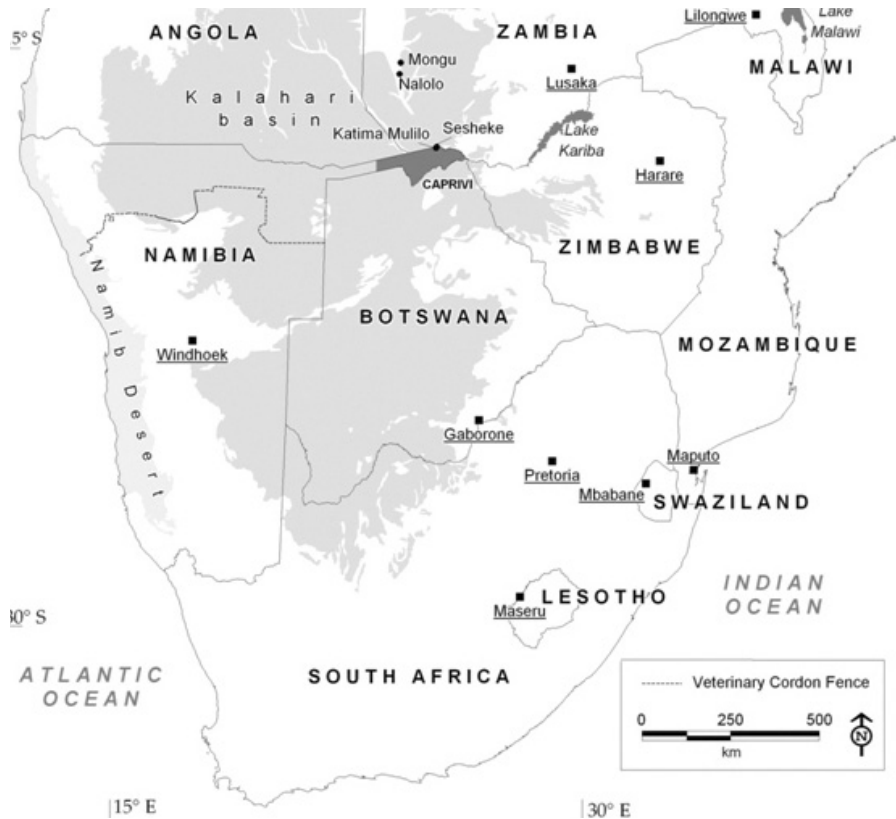


Figure 1. Caprivi and its strategic position between Angola, Zambia, Zimbabwe and Botswana: note the Veterinary Cordon Fence separating the northern areas from the rest of Namibia, conforming roughly to the former German Police Zone border.

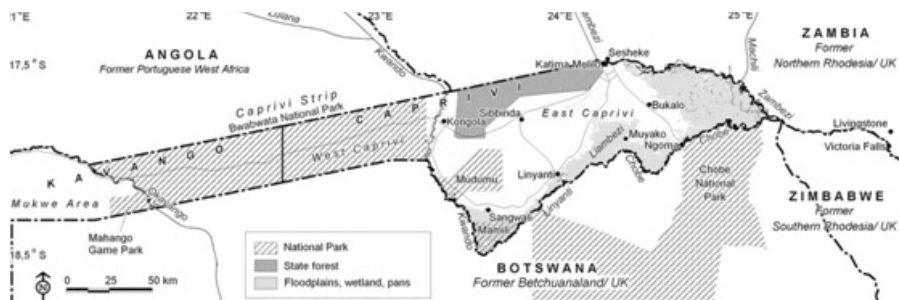


Figure 2. The study area, National Parks, State forest and floodplains of Chobe and Zambezi. consensuaries flooding

Caprivi is part of the Kalahari basin, which is characterized by approximately 100 meter thick deposits of Kalahari sand (Walker 1985). This very flat area is covered by a range of intermediate soils consisting of varying proportions of sand, clay and organic material. The river floodplains are covered by fertile hydromorphic (wetland soils) and organic clay soils (Mendelsohn and Roberts 1997). According to vegetation, ecosystem structure, soil and climate, East Caprivi is classified as nutrient-poor and moist broad-leaved savanna (Huntley 1982). The area is characterized by Kalahari woodlands (e.g. *Burkea africana*) and mopane woodlands (e.g. *Colophospermum mopane*) (Mendelsohn and el Obeid 2005). Open grasslands and wetlands on the floodplains form a significant type of vegetation and landscape.

There are two large national parks in the western parts of East Caprivi, and one large state forest area. There are also a few state agricultural projects in the area, the most important being the two cattle quarantine camps near Katima Mulilo and the Kalimbeza rice farm. As Caprivi is an area with endemic foot and mouth disease, export of meat or cattle is strictly regulated; the cattle quarantine camps are of particular importance, as they enable the trade of cattle to markets outside Caprivi. Since 1906 when some 40,000 head of cattle were observed in Caprivi (Fisch 1999a), over the years the number of cattle has been increasing rapidly to over 100,000 in 1989 and to about 124,000 in 1996 (Government of Namibia 1997). The economic importance of cattle increased further in 1995, when the abattoirs operated by MeatCo in the northern communal areas (NCA) were granted export status to South Africa. Although the number of cattle sold at the abattoir in Katima Mulilo increased, the off-take is still only at 10% (Meat Board of Namibia 2012). That is despite the fact that Caprivi has the highest number of cattle in the country. According to the figures provided by the regional office for Veterinary Services, there were well over 148,000 cattle in Caprivi in 2011. The Meat Board of Namibia has estimated the carrying capacity of Caprivi to be 160,635 Large Stock Units (LSUs). The current total cattle herd in the region, which in 2012 was 151,000 cattle already reaches about 100,666 LSUs, which excludes the large numbers of game especially elephants in the region. Thus, the pressure on land is not only coming from increase in conservation areas but also from increased number of cattle.

Land in the eastern part of Caprivi is mostly communal, but is formally owned by the government, with the exception of where the traditional authorities have the power recognized and confirmed by the government to allocate or cancel customary land rights. Customary law consists of traditions and customs of traditional communities. The decisions of the traditional authorities have legal effect after ratification and registration by the Communal Land Board (Legal Assistance Centre 2005). In 1998 the Salambala Conservancy was established as a local community project, but is embodied in an official Act of Law. In the eastern part of the floodplains is a second new and large conservancy named Kasika. The present day land use system is a mixture of traditional farming and pastoralism. This specific socio-ecological system (SES) is adapted to the local conditions, using the floodplains of the Zambezi for pasture, and utilizing higher grounds for subsistence farming. The present equilibrium of the system is maintained by the limited amount of higher land and regulated by the annual cycle of flooding. This kind of SES would in theory be very resilient to pressure under conditions of low population density and absence of major external influences.

Historical development in eastern Caprivi

Pre-colonial period

In the pre-colonial period, climatic and hydrological conditions, and availability of arable land permitted permanent settlement and subsistence agro-pastoralism (Kaakunga 1990). Fishing, hunting and gathering, shifting cultivation and pastoral land use were the key elements of the rural subsistence economy, controlled by the chief of the tribe. The people traded their surplus and crafts within the region and across the rivers (Zeller 2000). Rainfall, fires and cattle diseases maintained the equilibrium in livestock numbers and grazing (De Klerk 2004). The location of Caprivi surrounded by annual flooding perennial rivers made the area good and easily defensible grazing area that attracted both the Lozi and the Kololo. As a result of the reign of the Zambian Lozi and briefly the Kololo, the ethnic groups of East Caprivi lived in a state of dependency that bordered on slavery (Fisch 1999a), but during that time, animal husbandry improved and the hierarchical traditional system of authority was formed by the Lozi. This development related to animal husbandry and grazing practices as well as traditional authority system and cultural practices has remained as a heritage of the Kololo and the Lozi. The pre-colonial period was a period generally considered traditional conservatism, a concept that refers to an interpretation of indigenous conservation law (or lack thereof) that barred or promoted forestry practices based on religious myth, beliefs and norms about use of natural resources (Hinze 2003). The task of law-making and enforcement was mainly a responsibility of traditional chiefs, district and village headmen. This is still the case, except that there are now four tribal authorities instead of two as was the case before. Information was spread through communications channels that included the use of messengers, community meetings and through word of mouth among others. These traditional channels are still extensively used since rural populations still consider them authentic and reliable. Caprivi communities were historically patriarchal, and predominantly polygamous. Unlike in other Bantu communities, e.g. in the Kavango region, no women have ever served as Chief, King or Headmen in Caprivi. For many years, the cultures have maintained that women should take a less prominent role in society, especially when relating to leadership and power. Men, on the other hand, were seen as the persons with rights, and consequently are the heads of households. In recent times, it appears this male dominance is reducing as women have begun to serve as village headmen and in traditional authority structures. For example, at Ngoma traditional court, there are two women who serve as district headmen.

German colonial period (1884 – 1915)

South West Africa, the present-day Namibia, became a German colony in 1884. The Heligoland-Zanzibar Treaty was signed between Great Britain and Germany in 1890, which resulted in the formation of the Caprivi Strip to give Germany access to the Zambezi and more distant German East Africa (Dierks 1999). According to Fisch (1999a), the German colonial government expected the administrative costs of Caprivi to be extremely high and postponed the formal occupation and development of the area. As a result, the region became a free zone for smugglers, poachers and criminals (Wallace and Kinahan 2011). To end this lawlessness and to bring the area under formal German control a small contingent under command of Captain Streitwolf was dispatched and after a three month journey through present day Botswana arrived in East Caprivi in early 1909.

Captain Streitwolf and his 23 men established a post at Schuckmannsburg, on the banks of the Zambezi River, some 70 km downstream, east of present day Katima Mulilo. Streitwolf and the German administrators after him assessed the economic potential of Caprivi, conducted geographical studies and created administrative incentives, with the aim of establishing an effective administration and curbing lawlessness. Hunting was regulated also among the native population, but otherwise interference in social and other internal problems of the natives were avoided. The main resource of the area was the native people, as labour was in needed on settler farms and for the development of the colony (Zeller 2000). Caprivi however, was remote and far outside the Police Zone established in 1907, dividing German South West Africa in a policed white Germanized area and a northern native area (Kalahari, Kaoko, Owambo, Kavango and Caprivi) remaining mostly without police protection (See Figure 1) (Eckl 2007, Wallace and Kinahan 2011). Streitwolf also started to create a Caprivian identity by reducing the rights of the Lozi kings on the territory and recognizing two local chiefs, one for the MaFwe and one for the MaSubiya (Wallace and Kinahan 2011). The fact that the area was remote, difficult to administrate and outside the Police Zone meant also that the population was spared the fate of the Herero and Nama tribes which stood up to the German occupation of their land and were subsequently drawn into a colonial war which resulted in genocide (Wallace and Kinahan 2011). At the beginning of the First World War in 1914 the territory was occupied by a British contingent after the surrender of the German soldiers.

South African colonial period (1915 – 1990)

The long distance from Windhoek made administration of Caprivi complicated also for the new rulers, and consequently it was transferred from one administration to another especially during the South African colonial period. In 1915, South West Africa came under the colonial authority of the Union of South Africa, in 1920 the League of Nations gave the South African Union the formal mandate over the former German colony, but the administration of the remote Caprivi area was transferred to British Bechuanaland (present day Botswana). In 1935 the regional administration was moved from flood prone Schuckmannsburg to Katima Mulilo. In 1939 administration of Caprivi was again transferred to the South African Union, but the regional administration remained at Katima Mulilo. In 1939 Caprivi came under direct control of the Ministry of Native Affairs in Pretoria.

In 1920, the Union declared the land inhabited and used by natives to be crown land (Hinz 1998). Land with low potential for agricultural production was set aside for “native reserves”. East Caprivi was declared a native reserve in 1940 (Adams, et al. 1990), and thus Caprivians were not relocated like the majority of the population in other regions of Namibia. The remoteness and difficult accessibility of the area kept population levels low by limiting migration from elsewhere. Caprivi was regarded to be unsuitable for white settlement because of isolation from the rest of the territory and endemic cattle diseases (Kiljunen 1981). Also the prevalence of malaria and other parasitic diseases made the area less attractive for white settlement.

During the 1970's the South Africans built agricultural extension stations and carried out several farming projects in the Caprivi region (Zeller 2000), but these activities focused on the commercial sector, not on promotion of small-scale communal farming into commercial entities. Traces of this can be seen in the

Salambala region, where a regular grid network of sand roads was cleared in the forest. Also in Salambala area there was a pilot pig farming project as well as maize production farm known as Dudukabe. The objective of these was probably related to the intensification of some form of agricultural reform. On the shore of the intermittent Lake Liambezi the buildings of an abandoned fisheries research station can also be found. During the 1970's the South African Defence Force established several bases in the Katima Mulilo area, due to the strategic value of the area. Bases like Omega III in West Caprivi were important for the war against insurgency, but apart from some minor incidents the stage of the war moved westward and East Caprivi was relatively calm. The area was however heavily militarized and Katima Mulilo became de facto a garrison town (Zeller 2009).

Independence

Namibia gained independence in 1990, and the Homeland administration that administered Caprivi was abolished and replaced with a Regional Commissioner appointed by and reporting to the President. When the Regional and Local Authorities Act was enacted in 1992, all commissioners were withdrawn and replaced with elected regional governors. Ownership of communal land was vested in the government although traditional authorities retained the daily administration of communal land issues. As an aim to make the political and administrative system more effective, Regional Councils were established, and local government and administration was reorganised (Fosse 1992). In 1992 after the new delimitation of regions, Caprivi became one of the 13 regions of Namibia. As the South African army left the area unemployment increased, which was aggravated by the remoteness and difficult geographical location of the area. In 1999, a short lived separatist movement called the "Caprivi Liberation Army" attacked government buildings in Katima Mulilo. The Namibian government dealt swiftly with the uprising, and took action to integrate Caprivi better into the Namibian State (Zeller 2009). The construction of a new bridge over the Zambezi in 2004 at Katima Mulilo made the area an important hub in the Trans Caprivi Corridor connecting Walvis Bay with Zambia, generating trade and opportunities for the local population (Zeller 2009). This is also an important improvement for tourism, connecting the scenic Victoria Falls near Livingstone, with the game parks and wetlands in Caprivi and the Etosha National Park further west in the north-central parts of Namibia.

The Namibian government started a programme of land reform in 1990. In broad terms, land reform seeks to balance land distribution and access to land, promote sustainable economic growth, lower income inequalities and reduce poverty. The Communal Land Reform Act of 2002 provides the establishment of Communal Land Boards and the registration of all land rights held in communal areas. It also recognises and confirms the powers of traditional authorities and chiefs to allocate and revoke rights on land. Primary functions of Communal Land Boards are: to exercise control over the allocation and/or cancellation of customary land rights, and to consider applications for rights of leasehold. The Act provides for the inheritance of customary allocations through the traditional authority of a particular area. It also seeks to make unused communal land available to individuals under leasehold with an intention to promote agricultural development. This will effectively reduce the areas of jurisdiction of traditional leaders by bringing customary law under the control of the state (Werner 2003, Legal Assistance Centre 2005, Werner and Kruger 2007). This land

reform act is however problematic as customary land rights are not easily recognized or established. The present system of clearance, cultivation and fallow is very complex and can often lead to conflict between families.

New agricultural development projects were established to increase domestic food supplies (Sparks and Green 1992). At the beginning of 1990s, there were some experimental model farms in Caprivi producing cash-crops, mainly tobacco (Fosse 1992). The aim was to exhort local farmers to transform themselves into commercial producers, but it required provision of machinery, improvement of the transport network and development of training and financial possibilities among others that the officials could not provide to a sufficient extent (Adams, et al. 1990). Towards the end of the 1990s, the Government of Namibia decided to promote commercial farming by privatising all government tractors and by giving first priority to individuals with agricultural business proposals. New government initiatives in Caprivi region include the development of a 200 ha rice farm using irrigation water from the Zambezi River, near Isize, east of Katima Mulilo. The area was allocated to the Ministry of Agriculture by the MaSubia Traditional Authority in 1981. Due to weak technical capacities, the idea was considered not feasible until 2009 when the University of Namibia's Faculty of Agriculture researched and piloted rice varieties to determine suitability and efficiency in drought and flooding seasons. The University piloted their research on 26ha, trained local technicians of the Ministry of Agriculture and in 2010 harvested 65 tons of rice, resulting in the farm to be declared a national project. Despite all the efforts, small-scale subsistence production is still prevalent in Caprivi. As of November 2012, only 46 ha were planted by the Ministry of Agriculture, Water and Forestry. Impediments to agricultural development are the lack of a suitable road network, inadequate maintenance services for machinery and limited access to funding and markets, even to those projects that are government-led.

Caprivi, as stated before, is largely communal land. In addition, the state owns Mudumu and Mamili National Parks and State Forest. Since 1998 seven conservancies are registered on communal land. Conservancies are areas where local communities gain rights to use, manage and benefit from the use of wildlife (NACSO 2006). Establishment of conservancies has had many positive effects, such as increased income and employment. However, only a small portion of wildlife contributions goes to local communities (Mulonga and Murphy 2003). Also living with wildlife is not always easy, losses of crop and cattle can be a problem, the establishment of core areas designated for wildlife can create land use conflict and increase pressure on land elsewhere (O'Connell-Rodwell, et al. 2000, Harring and Odendaal 2012).

Changes in the natural environment

The most important natural factors affecting the environment in East Caprivi have been hydrological changes, caused primarily by variation in rainfall in the upper catchments. During the 20th century river flow has been variable (Fig. 3 and 4), with Lake Liambezi experiencing the most dramatic hydrological changes. Lake Liambezi has been variably filled with water, apparently around 1870s, and during the period from 1950s to the 1980s (Mendelsohn and Roberts 1997). According to Timberlake (1998) the rapid drying up of the lake in the early 1980s is not attributable to human activity, but to climate.

Flood level at Katima Mulilo (Zambezi river)

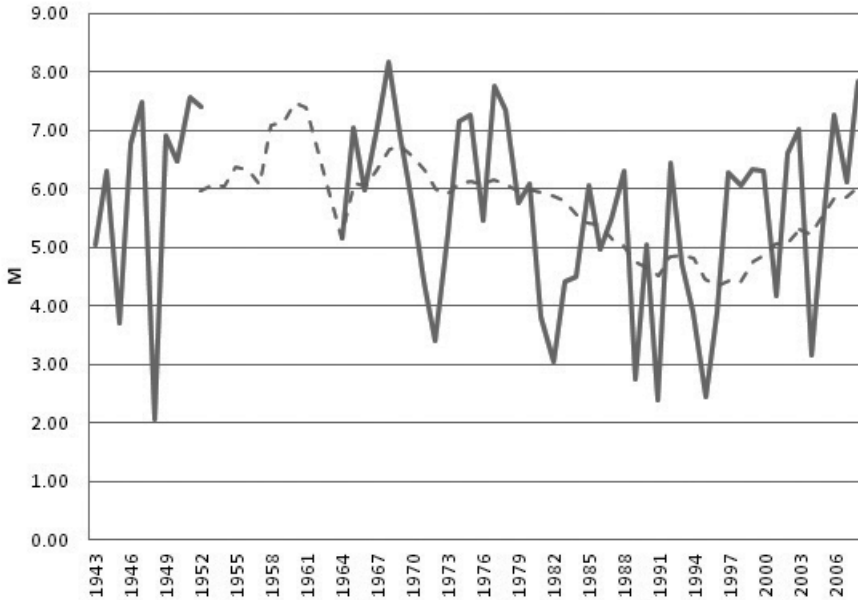


Figure 4. Yearly maximum flood level (m) at Katima Mulilo, Zambezi, dashed line shows the ten year floating average, (1943 – 2009), data Hydrological Services Namibia, Department of Water Affairs, Namibia.

Weaker flooding of the rivers as well as the drying of Lake Liambezi has resulted in an increased area for cultivation and grazing. Nowadays, parts of the eastern floodplains are under permanent settlement and cultivation. The Liambezi area is covered by extensive grassland and fields; and only parts of the area were seasonally covered by floodwater. Low river flow in the Kwando choked the channel with vegetation and reduced the flow of water up into the Linyanti, which flows into the lake. The reduced supply of water in the lake was attributed partly to declining numbers of hippopotamus, which help to keep the channels open (Mendelsohn and Roberts 1997). Recent heavy flooding in the area illustrates however the variability of the climate in these areas, and periods of low flow are eventually followed by periods of increased flooding. Liambezi is also the area where land conflicts between families, and between the Mafwe and the Masubia ethnic groups are most common.

During the period of low river flow, wetland areas shrank, which affected abundance and diversity of plant and animal species. In the 1980s until early 2000, the extent of fish habitat was reported to have reduced and the importance of fishing decreased, especially in the south-western part of East Caprivi (Tvedten 2002). Since the re-flooding of Lake Liambezi in 2004, and the more heavy floods of 2009, fishing has become one of the major sources of income in the region. Fisheries activities (fishing, fish processing, and production of dug-out canoes) have become so major that it has attracted people from as far as northern Zambia and the Democratic Republic of Congo. Many of the fisherman and their business partners actually export and sell fish to Congo in US\$. According to local

officials at the Ministry of Fisheries and Marine Resources, more than 2000 tons of fish was exported via Zambia in 2011 (Mr. Munwela, Regional Chief, Ministry of Fisheries and Marine Resources, personal communication, 2011). Ironically, it has remained an informal business to this day. Nevertheless, the flooding of Lake Liambezi shows the unpredictability of the local climate, which has triggered renewed clearing of more upland areas for crop farming. In addition, grazing land is now under pressure as more in-outward migration to and from the floodplain continues. Moreover, a few fish farms have been attempted without success, primarily because they were established without credible feasibility studies.

Changes in demography and land use

Changes in settlement pattern

Development of the road network and availability of water and arable land have primarily directed human activities in East Caprivi. Anthropogenic land use changes are largely related to population growth and subsequent intensification of land use. The population of East Caprivi increased from 5 000 people in the 1920's, 15840 in the 1960's, 25000 in the 1970's to about 30 000 people in the beginning of the 1980s and 70 000 people in the 1990s (Dugrad 1975, Thomas 1978, Leser 1982, NPC 1994, Zeller 2009). According to the official census since independence, the population was 90 423 in 1991, 79 826 in 2001 and 90 100 in 2011 ((NPC 1994, 2003, 2012). The drop in population in 2001 can be explained by the high incidence of HIV in the area (40 %) but also changes in delimitations of the regions for election purposes. In 2001, the total population of Caprivi was nearly 80 000 of which 72 % lived in rural areas and 28 % in Katima Mulilo, the only urban locality in the region. Every fourth employed worked in agriculture (NPC 2003). However, agriculture is widely regarded as a core activity also among those who have other main sources of income. Originally, sparse settlements were concentrated mainly along the rivers. The development of a modern road network has changed this pattern and drawn population more inland. Access to the road means better access to transport, electricity, safe drinking water, schools and medical services, and thus improves quality of life.

An increasing number of Caprivians started to seek education and work elsewhere in Namibia (Fosse 1992), even though the construction of the Trans Caprivi Highway and tourism brought at least temporarily new employment opportunities (Fisch 1999b, Zeller 2000, 2009). By 1996 settlement had spread around Katima Mulilo, along the main roads and on the eastern floodplains (Fig 5). In addition, Caprivi also hosts a seasonal migration of people; the Masubia, who live on the eastern floodplains migrate during the floods with livestock to the higher ground further west. The concentration of settlements and livestock along the main roads caused localised overgrazing (Adams, et al. 1990). Our field observations as well as analysis of aerial photos confirm this. Settlements concentrated also in areas where accessibility of water was good but quality of soil was poorer. If soil is poor, more land must be cleared and negative ecological effects of land clearing and cultivation will appear quickly and intensified. The spreading of population into the floodplains and the consequences of flooding have produced a nearly annual refugee problem, in 2007. The Red Cross mentions in the Caprivi Emergency Appeal that 15 000

people were relocated in temporary relocation camps (Emergency Appeal 2007). These seasonal movements of people and cattle aggravate the land degradation process on the higher more sandy areas along the road from Katima Mulilo to Ngoma.

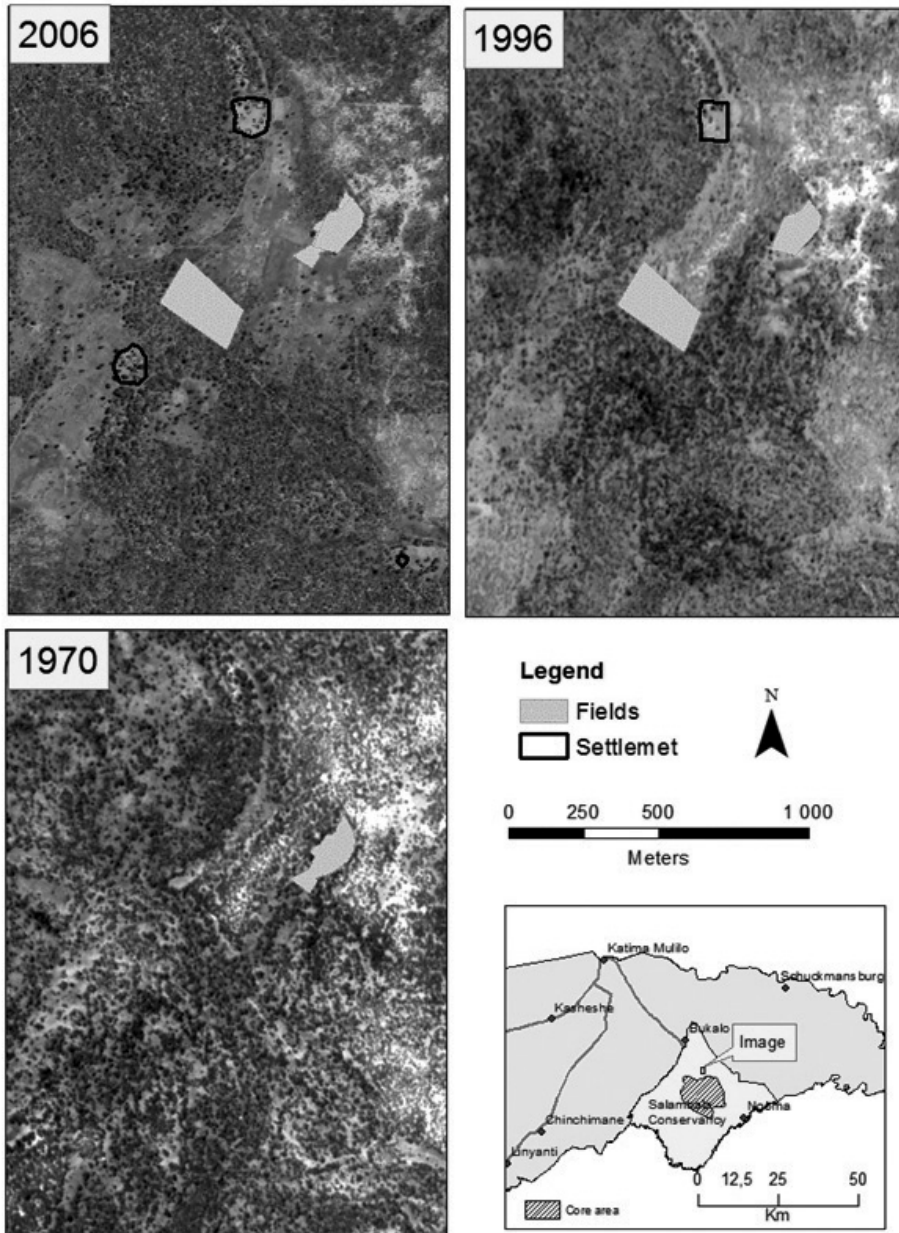


Figure 7. Changes seen in aerial photos from 1973, 1996 and 2006 when compared to 1973 when the area had nearly complete natural forest and bush land. The 1996 image show already one farm and new cleared area and fields, the 2006 photo shows two farms and extensive clearance of the area.

Changes in agricultural land use

The importance of subsistence agriculture in the Caprivi area has increased, both from the perspective of crop and livestock farming. The area cleared for cultivation has increased significantly after the 1970's. The cleared area in Caprivi, including the Mukwe area and Caprivi Strip, was about 80 km² in 1943, about 280 km² in 1972 and approximately 1 700 km² in 1996 (ACACIA Project 2008). During the 1940s and the 1970s land was cleared along the Kwando Rivers and around Sibbinda and Linyanti. Nowadays, these cleared areas have extended and new fields have been cleared along the Linyanti and the Chobe rivers, along the main roads and on the eastern floodplains. Most fields have been cleared on more clayey soils in occasionally flooded areas. The increased land clearing is largely the result of population growth and cultivation practices. Fertilizers and manure are rarely applied, so fertility of the soil decreases after several crop seasons. Thus, old fields are left in fallow and new fields are cleared again. Increased wealth and good availability of draught power due to increased cattle numbers have also enabled farmers to extend the planted area (Mendelsohn and Roberts 1997). About one third of agricultural land is fallowed in Caprivi, (NPC 1997), but the growth of human and livestock population increases pressure on land, resulting in the reduction of fallow periods and a decline in soil fertility. One way to utilize manure accumulated in animal enclosures or kraals as they are locally known is to move the animal enclosure from time to time, cultivate the soil and use it for the production of garden crops. Large numbers of livestock, especially cattle, inhibits the regeneration capacity of the soil. Land clearing is also practised in the areas unsuited for cultivation. Another reason for renewed clearing is the cycle of flooding, during periods of limited flooding the floodplains and the fertile sediments of Lake Liambezi are easily taken into production, but during cycles of increased flooding land has to be cleared on more sandy less fertile upland areas. This of course also is reflected in the settlement pattern.

Fire is commonly used for land clearing, improvement of pastureland (reduction of ticks) and hunting. Numbers of bush and forest fires are increasing, as population growth promotes the frequency of human set fires. Regular natural fires are an important part of the savanna ecosystem, but high frequency and improper timing of human-set fires makes them harmful for vegetation. In East Caprivi the fairly small fields (average size under three hectares) are mostly ploughed using oxen as draught power, an improvement introduced in the 1920's. Ten percent are cultivated using hand hoes and only five percent of fields are prepared using tractors (NPC 1997, 2001). Usually the pattern of cultivations follows a basic setup, a homestead with a more or less square nine to ten hectares clearing of which most is in fallow, used as grazing ground for animals and about three hectares under cultivation. Additional separate small fields can be at considerable distance from the farm.

Changes in grazing pressure and pastureland

Grazing areas were extended due to the weaker flooding of the rivers and the drying up of the Lake Liambezi. However, the grazing pressure on the pastureland has more than doubled during the last 20 years. The number of cattle was about 64 000 in 1986 but increased to 150 000 in 2005 (Directorate of Veterinary Services 2006). Increased cattle numbers are partly caused by extension of pastureland, development of veterinary services, population growth, increasing

wealth, increasing number of cattle owners and increasing commercial value of cattle (Mendelsohn and Roberts 1997). According to Jones (1994), social pressure to maintain large stocks of cattle is still evident, although availability of water constrains the livestock numbers farmers are willing to have. The quantity and quality of pastureland and cattle diseases are also limiting factors. The annual flooding of the floodplains produces a seasonal migration of cattle towards higher ground, mostly around the main road causing locally very high cattle densities, increasing risk of disease and overgrazing. It also produces friction between villages and families as the area of grazing land becomes limited. During the dry season herds have to be moved from dryer areas into the floodplain, mutual agreements and kinship are important tools to regulate this migration.

Cattle densities and grazing pressure are high especially on the eastern floodplains, but also along the main roads and the rivers and around the villages (Mendelsohn and Roberts 1997). If heavy grazing is constant, and rainfall variable, especially palatable perennial grasses may become replaced by unpalatable or annual grasses (Owen-Smith and Danckwerts 1997). Unpalatable trees and shrubs may be given a competitive edge over grasses decreasing the grazing capacity of the pastureland. Intensive grazing can result in bush encroachment and land degradation, for example by decreasing grassy fuel for fires which are intensive enough to prevent expansion of trees and shrubs (Trollope 1982). Bush encroachment has negative impact on biodiversity and carrying capacity of environment as well as productivity of agricultural land.

The Salambala Conservancy

The Salambala Conservancy was registered in June 1998, the third in Namibia, constituting of approximately 93050 hectares, and is inhabited by about 8000 people, of which 3500 are member of the conservancy. The historical reasons for establishing the conservancy was the desire of the Masubia Traditional Authority to protect the Salambala forest from overgrazing and environmental degradation in the 1960's (Harring and Odendaal 2012). The conservancy is administrated by a management committee with 40 local representatives. Daily operations are overseen by an Executive Committee with nine members; other staff includes game wardens, campsite workers and an environmental officer.

The conservancy has a 14 000 hectares core area, mainly forest, where human activity is limited by law and is designed as a breeding area for game, birds and other wildlife, around the core is a buffer area where human activity is allowed (Matengu 2001). To establish the core area about 200 people had to move, which has been a difficult process, the legal grounds were contested, and not all families moved, and indeed, some even recently returned. The conservancy has a rich population of wildlife, including lion, elephant, leopard, buffalo, waterbuck, kudu, duiker, reedbuck, common impala, blue wildebeest, hippo, crocodile, plains zebra, warthog, steenbok, interesting bird life and various fish species. The conservancy provides employment and revenues through the operation of the Salambala Community Campsite, the Ngoma craft center and trophy hunting. Although there is clearly a positive effect in a monetary sense, the establishment of the core area has certainly increased pressure on arable and grazing land in the surrounding areas.

Results

Digital aerial photos from 1970, 1996 and 2006 from the Salambala Conservancy were used to digitize roads, settlements, animal enclosures, agricultural fields under cultivation as well as the area of bare soil. We were able to visualize a continuous increase in population density, land clearing and livestock numbers. Also signs of land degradation around corrals and water holes are visible in the images. Figure 7 shows changes in land use in one village west of Ngoma, where two farms are located in the 2006 image. From oral information we know that the southern farm was active in the 1930's until about 1958. Then the family moved about three km west to Limai due to heavy flooding. The farm was reestablished in 2001. This is evident on the image of 1970, were only one field is visible, but no settlements. The 1996 image shows one farm in the northern part of the image, An area of approximately 500 meter by 250 meter was cleared and two cultivated fields are visible. In 2006 two farms are visible and more land has been cleared. Both farms have livestock corrals, for about 75 to 100 animals each. Table 1 and 2 shows the development of human population, the animal enclosures and road network in the region. The inhabited area comprises all the area in use as building, yards and storage facilities. Animal enclosures are the "kraals" used to keep cattle over night. Each kraal can hold about 75 animals, which makes the number a good indicator of grazing pressure. The area under cultivations is a measure of population density, as is the inhabited area. The expansion of the road network indicates the improved mobility and ability to settle former peripheral areas.

Table 1. Change in inhabited area, animal enclosures and road network between 1970 and 2006 determined from aerial photography.

Year	Inhabited area (ha)	Animal enclosures (no)	Agricultural area (ha)	Main road (km)	Minor road (km)	Roads, total (km)
1970	91,6	82	701,8	49,6	650,3	699,9
1996	553,5	310	3619,2	111,3	1025,8	1137,1
2006	606,2	1149	3161,3	187,4	2197,6	2385,0

Table 2. Change in inhabited and animal enclosures and road network

Year	Change of inhabited area (%)	Change of animal enclosures (%)	Change of agricultural area (%)	Change in main road (%)	Change in minor road (%)	Total road network change (%)
1970 - 1996	504,3	278,0	415,7	124,4	57,7	62,5
1996 - 2006	9,5	270,6	-12,7	68,4	114,2	109,7
1970 - 2007	561,8	1301,2	350,5	277,8	237,9	240,8

It is evident that the period between 1996 and 2006 was characterized by the AIDS/HIV epidemic, which was at its peak at that time. Inhabited area increased only slightly, agricultural land actually decreased. Animal enclosures however, increased, which may be explained by the fact that unlike cultivation,

which needs much manual labor, grazing is a relatively easy task, which can be done by herd boys. The strong increase in the number of animal enclosures indicates very clearly the increase of the grazing pressure. In the same time the improving economical situation of the Namibian State has provided the means for a steady extension of the local networks of main roads, which again has sparked the formation of secondary roads and tracks to farms and new villages.

From our aerial photography time series it comes clear that the fields in the Salambala core area which was established in 1998 as a game sanctuary have been abandoned in accordance with the conservancy law, also the settlements were deserted and little remains were visible in 2007 when we visited the place. The core area provides some income to the local community from trophy hunting and tourism, but due to the fact that the area is situated on higher ground less prone to flooding the sacrifice of the local people had to make was by all means heavy. In an environment where large areas are yearly flooded high ground suitable for farming and grazing are very valuable.

We also paid attention to visible signs of land degradation and erosion in the aerial images. Land degradation and erosion is a particular problem in the more sandy areas, and less in the lower areas with more silt and clay. Although difficult to assess for the older images, it seems that the incidence of bare sand areas has steadily increased from 1973 to 2006, especially near water holes where cattle comes to drink and near settlements where there is heavy grazing. Our observations clearly indicate an increase in bare sandy soil around villages resulting from grazing and trampling. Heavy grazing can also lead to bush encroachment, a phenomenon which can also be noticed in parts of the higher areas, especially around villages and settlements. This process is intensified by the absence of browsers and the dominance of grazers (Walker 2002). On the other hand the black clay soils of the floodplains are good grazing grounds which are very resilient to overgrazing and degradation, resulting in a dual system of higher, less resilient areas and resilient floodplains with heavy clay receiving seasonal inputs of nutrients.

In terms of adaptive cycles (Gunderson and Holling 2002, Gunderson and Pritchard 2002) the response to decadal flood regimes creates pulses of resettlement of higher, less fertile areas (as noticed presently), and pulses of settlement of lower areas closer to fertile river sediments. The transformation of the intermittent Lake Liambezi from fishing grounds to agricultural land and vice versa is a good example of this.

Discussion

Land use in East Caprivi is still characterized by small-scale subsistence farming practiced in a traditional way on communal land. In the absence of major external influences the traditional socio-ecological system remained relatively stable over the centuries, the remoteness of the area ensured that colonial powers had little influence on land use and agricultural practices in the area. The demographical development during the last decades has led to the present situation where most of the arable land is intensively used for crop cultivation and grazing regardless of suitability of the soil for cultivation or availability and accessibility of water. Despite the intensification of land use in East Caprivi, the

agricultural practices and techniques have commonly remained traditional. Ploughing with oxen has remained the most common method in field preparation (Fig. 8). Grazing practices, such as gathering cattle in livestock enclosures, are probably very similar to those in pre-colonial times. The people living on the floodplains of the Zambezi have seasonally migrated with livestock for hundreds of years.



Figure 8. Traditional cultivation method using oxen (photograph Alfred Colpaert 2009)

During the German colonial period, peripheral location far from Windhoek, difficult accessibility, prevalence of malaria and cattle diseases, and thus high costs of administration, diminished the interest of Germany in East Caprivi. The area served as a hunting ground for British and South African hunters, but otherwise East Caprivi was barely utilized by Europeans. The area was outside the German Police Zone, and formal presence was established only in 1909 to impose German rule. The German colonial administration regulated hunting, but the German administration did not significantly change the way local ethnic groups used land and water to provide for their livelihood. The effect of the German colonial administration on present-day land use in East Caprivi is limited as a result of the late occupation and the short period of administration.

The peripheral location, far from Pretoria and Windhoek resulted in an indirect administration. During the liberation war of Namibia, location near the northern Angolan, Zambian and Botswana border made Caprivi strategically important. The region was not a target of development work of South Africa, but the massive presence of SADF resulted in many positive effects on the local economy and development of the region. The present land use in East Caprivi is largely the outcome of the development that started during that time. The road network developed and the process of urbanisation started, resulting in changes in settlement pattern and employment sectors. Availability of water and arable land were not anymore the only factors directing human activities. Subsistence agriculture practiced by local communal farmers was little supported and possibilities to develop cash crop production were very limited. Thus during South African colonial period, the cultivation and grazing practices remained predominantly traditional, with the exception of the 1920s, when new agricultural techniques like ploughing with oxen were introduced to the local population by the European traders. The use of tractors has been limited, because of the high investment needed and the lack of adequate maintenance. Subsistence farming does not generate sufficient cash to invest in modern equipment. For example from the five tractors of the Kalimbeza state rice farm we saw in 2008, only one

was working, the others were not functioning due to lack of service.

In independent Namibia, ambitions to develop domestic agricultural production and food supplies led to the efforts to increase commercial production among the communal farmers. Yet, nowadays, small-scale subsistence production is still prevalent, but the sales of agricultural products and the number of larger commercial farms have been growing (Mendelsohn and Roberts 1997, Tvedten 2002). Although, the amount of land suitable for cultivation and grazing increases in periods of low flooding as a result of climate fluctuations, intensive land use in areas unsuitable for agricultural activities has led to many environmental problems related to soil quality, carrying capacity of the environment, biodiversity, quality and accessibility of water resources, bush encroachment and increased incidence of fires among others. After independence, several National Parks, Conservancies and community forests have been established to address environmental and development issues in rural areas. In East Caprivi, the increase in the number of conservancies, which has led to an increase in the numbers of wildlife, will inevitably lead to increased confrontations between humans and wild animals, and intensify competition for grazing. In future, the importance of sectors such as trade and tourism may increase, but thus far subsistence crop cultivation and animal husbandry have maintained their position as core activities.

Conclusions

We can identify seven factors that have contributed to the current land use:

- population increase and settlement patterns
- seasonal flooding
- economic changes
- political dynamics of the region
- introduction of conservancies
- improvements in infrastructure (health care, clean water, communications)
- communal land administration system that has been unable to accommodate the challenges of change

Undoubtedly, in future, these factors should be studied in detail individually, a matter we do not treat lightly in this paper. However, other researchers must take it from here and tackle them as such. Nevertheless, the increased human population on higher areas, together with increased numbers of livestock and seasonal migration due to flooding have had a negative influence on the local ecosystem. Land degradation in the form of increased area of bare soil is evident along the road from Katima Mulilo to Ngoma. Due to the recent events of severe flooding people actively resettle from the floodplains towards higher areas. The number of settlements along the main road has clearly increased, and associated with this is the number of animal enclosures, indicating the increasing numbers of livestock. Also the reduction of pasture and arable land due to the formation of conservancies is a factor leading to increased pressure of the remaining areas. Improved infrastructure (electricity, water, schools and medical services) along the main roads are key elements in the resettlement pattern.

At the moment the socio-ecological system is characterized as a relatively resilient panarchical system regulated by natural drivers (fire, floods, disease and parasites) utilizing both higher sandy soils and lower heavier soils for subsistence agriculture

and grazing. The recent introduction of veterinary services, improvement of roads, water and electrical infrastructure, and population increase are likely to trigger a change in the present equilibrium state. As the local population lacks monetary means to improve agricultural techniques, and the burden of HIV/AIDS reduce possibilities of improving rural economy; the change in equilibrium will probably lead to social tension and land degradation. This possible scenario could be called a poverty trap.

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