Local perspectives on Inland Fisheries in Kavango River, Namibia: a socio-economic and ecological approach

by

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Women fishing with ***Masasa*** (Fish Fence) in Kavango River

The Kavango River

Fishers happy selling their catches (Tilapia rendalli)

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Declaration

I, *Martin Kasanga Shapi,* hereby declare that this thesis is entirely my own original work, and has not been submitted to any other university for a degree award and all other sources of information have been systematically acknowledged.

Signature: .....

Date: ----------

Place: .....

Dedication

To:

My parents (my late mother Mukurukadi *Kankara kaLikuni* and my father Muswamane *Shapi yaKathila*), for your consistant heartfelt love, care and encouragement.

and

My next $\mathcal{F}_2$ generation, this is for you!

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Abstract

From ancient time fisheries has been a major source of food for humanity and provider of employment and economic benefits to those engaged in it. Namibia is an arid country and with limited freshwater fisheries, chiefly found in the northern part of the country (Kavango and Zambezi River in the Caprivi region). Although freshwater fisheries is limited in Namibia, it serves a vital societal role in terms of food security and source of income.

This study attempts to describe the status of Kavango fisheries from local people's and ecological perspectives. The study further attempts to analyse historical development of fisheries in Kavango and relate it to questions of sustainable resource utilisation in terms of ecosystem dynamic, socio-economic processes, institutions and rules and regulations. This was done by looking at the rationale behind the use of different types of gear (traditional and modern), socio-economic characteristics of fishing population, people's perception about the carrying capacity of fish resource and most efficient way of managing the resource (i.e. traditional, government or both).

The results of this study indicated that some fish species have declined, and there is a growing awareness among local people that modern gears are the cause. People in Kavango seemed to prefer traditional over modern gears. There seemed to be few formal employment opportunities in the area, and the sale of fish as source of income has increased and to continue to increase further in the future.

Both traditional and government laws and regulation are poorly enforced. However, the local people preferred fishing to be traditionally regulated. As is often the case in rural communities in Africa, women have the main household responsibility for food security and they tend to fish more than men.

Co-management (where functions, rights and responsibilities of resource management are shared among stakeholders), provision of good storage and transportation of fish and diversification of agricultural production are among the recommendations made to relieve pressure on the resource.

Key words: Kavango, Freshwater fisheries, Traditional Management, Sustainability, Fish species and Laws.

TABLE OF CONTENTS

List of figures

List of Tables

List of Maps

1. INTRODUCTION

1.1 Overview

From ancient time fishing has been a major source of food for humanity, and a provider of employment and economic benefits to those engaged in it. However, with increased knowledge and the dynamic development of fisheries, it is realised that this resource is finite and needs to be properly managed if its contribution to nutritional, economic and social well-being of the growing world's population is to be maintained (FAO, 2000).

The last two decades conservationists have recognised that hegemonic modern approaches to conservation have been insufficient, because they have ignored the human and social dimension of natural resource management. "Together with experiences from rural development and conceptualisation of 'sustainable development' it has spawned a movement in conservation away from reliance on protection and enforcement. The new approaches place more emphasis on sustainable utilisation of resources and the involvement of local people and other stakeholders directly in conservation decision making" (Jones, 1996).

This study looks at the status of inland fisheries in the Kavango[1] River in Namibia inhabited by the Kavango people with the ethnic groups vaKwangali, vaMbunza, vaShambyu, vaGciriku, and Hambukushu (Gibson *et al.*, 1982). All these five ethnic groups value the significance of artisanal fisheries as an integral part in their livelihood. Only traditional gears were used in the past, and the pressure on fisheries was light due to low population density and limited purchasing power. Another important attribute which limited fishing pressure was the food security

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[1] Kavango means "a small place". The river is sometimes referred as Okavango river instead of Kavango river, due to spellings used by the Oshiwambo speaking people known as Owambo people and Herero people (Gibson *et al.*, 1982). The Owambo and Herero people were first in contact with the expolorers, when they were asked about Kavango they used to say Okavango. Since then most literature uses "Okavango" instead of "Kavango". For me as a descendant of the people from Kavango, I am more used to Kavango than Okavango, because there is no "O" in the beginning of words in the five ethnic languages in the Kavango region.

situation; during the past local people could manage to harvest adequate *mahangu* (millet) and maize for their subsistence.

However, in recent years the conditions in Kavango have not remained the same and gradual change has taken place during. Higher fertility rates, lower mortality rates and migration from the civil war in Angola are the prime causes of the growing regional population (Tvedten *et al.,* 1995). According to preliminary data from the 2001 population census the region's population stands at 201, 093 inhabitants, compared to 137, 000 people in 1991 (Yaron *et al.,* 1992). The annual growth rate is estimated to be 2.6 percent (Preliminary results, 2002 Census). The growing regional population, as well as the increase in purchasing power, have resulted in a rising demand for fish in the area.

The inland fisheries of Namibia, including that of Kavango, have been undervalued, chiefly due to its low contribution to the central national economy. In addition the freshwater fish in Kavango is operated as a common-pool resource regime, or open access system (Løkkevik & Sjølie, 1998). Considering the changes that have taken place in the Kavango, especially the rapid rise in human population and breakdown of traditional rights, the concern has been the possible depletion of fish resources in this area. In the past the system was traditionally governed, and the social ties were robust. Nangula (2001) urgues that the status of the traditional authority has changed over the past years, and some decisions on land allocation have resulted in pressure on agricultural resources.

Most people in the Kavango live along the Kavango river and a parallel road traverses the entire region, making this strip of land one of the most densely populated areas in Namibia. Although urbanisation is increasing primarily around the regional capital Rundu, the population in the Kavango remain mainly rural and the life of the inhabitants revolves around the river. The river is a central component of social and cultural identity, because inhabitants consider fishing and paddling a dugout canoe (*wato)* to be necessary and essential skills. Over 53% of the riverine population, or 41% of the overall population, fish in Kavango. Fishing is also seen as a central component to the livelihood and well-being of Kavango people. Fish is source of subsistence for 91% of riverine households, and sales of fish generate cash income for 46%. As part of the

multiple income strategy adopted by many Kavango households, fishing significantly enhances household food security (Tvedten *et al.*, 1994).

For development activities envisaged in an area such as Kavango to succeed, local knowledge about the sector is of great importance. The proper management of freshwater fish resources cannot be implemented without the participation of the local people utilising and depending on these resources.

In essence, there is a recognition that no one in the nation's capital city Windhoek, where ministries and other decision makers are located, can develop the complete array of knowledge needed to govern and manage common-pool resource efficiently and sustainably (Ostrom, 1994). Combining scientific and local knowledge will be my approach to answering the questions in this thesis and come up with recommendations for the sustainable use of fish resources.

Conservation of natural resources and development of the fisheries are not incompatible, but are mutually dependent. Unless development is guided and directed by ecological, social, cultural and ethical considerations, it will still fail to meet or sustain its desired economic objectives. Many African people live at subsistence level and are highly dependent upon the quality and quantity of adjacent aquatic resources as a means to their survival, Namibia is not exception, including Kavango residents. It is against this background that this study investigates the local perspectives on the prospects of inland fisheries in the Kavango River: to capture the local people's knowledge, views and understanding of resource management and sustainable utilisation of fish resource in the area under review.

1.2 Problem statement

Freshwater fish are considered to be a common pool resource in Kavango and serve imperative social objectives such as a source of protein-rich food, employment creation, and income distribution in the society. However, there is a concern about the possible depletion of fish resources in this area resulting from increased subsistence fishing due to high population growth (Hay *et al.,* 1996), and increase in capital investment in modern fishing gear (Beadle, 1981). For

this reason the study will analyse local perspectives on the prospects of inland fisheries in the area, pertaining to current and future management of the freshwater fish resource. This will be done by focusing on the following key issues:

- Socio-economic characteristics of the fishing population (the poorest and better off)
- The rationale behind different types of gear (traditional and modern)
- The efficiency of various types of gear (catch per unit effort)
- People's perceptions about the carrying capacity of the fish resource
- The most efficient way of managing the resource (traditional or modern).

It is of great importance to specify the differences between various types of increase in fishing effort. Effort may increase in two distinct ways: either horizontally or vertically. An increment in fishing population (e.g more people fishing) implies horizontal growth. Such growth also includes human mobility between economic sectors, as well as between geographical areas. In contrast, increases in investments in the operating units, through growth in capital use and change in technological level, implies vertical growth (Jul-Larsen and Overå, 2000, unpublished). The latter includes the employment of modern fishing gears and to a lesser extent improved skills among the members.

1.2.1 Objectives

The overall objective of the study is to analyse the prevailing fishing activities (production and management) in the Kavango region (project area) by comparing it with the historical development of the same traditional fishing system.

1.2.2 Hypothesis

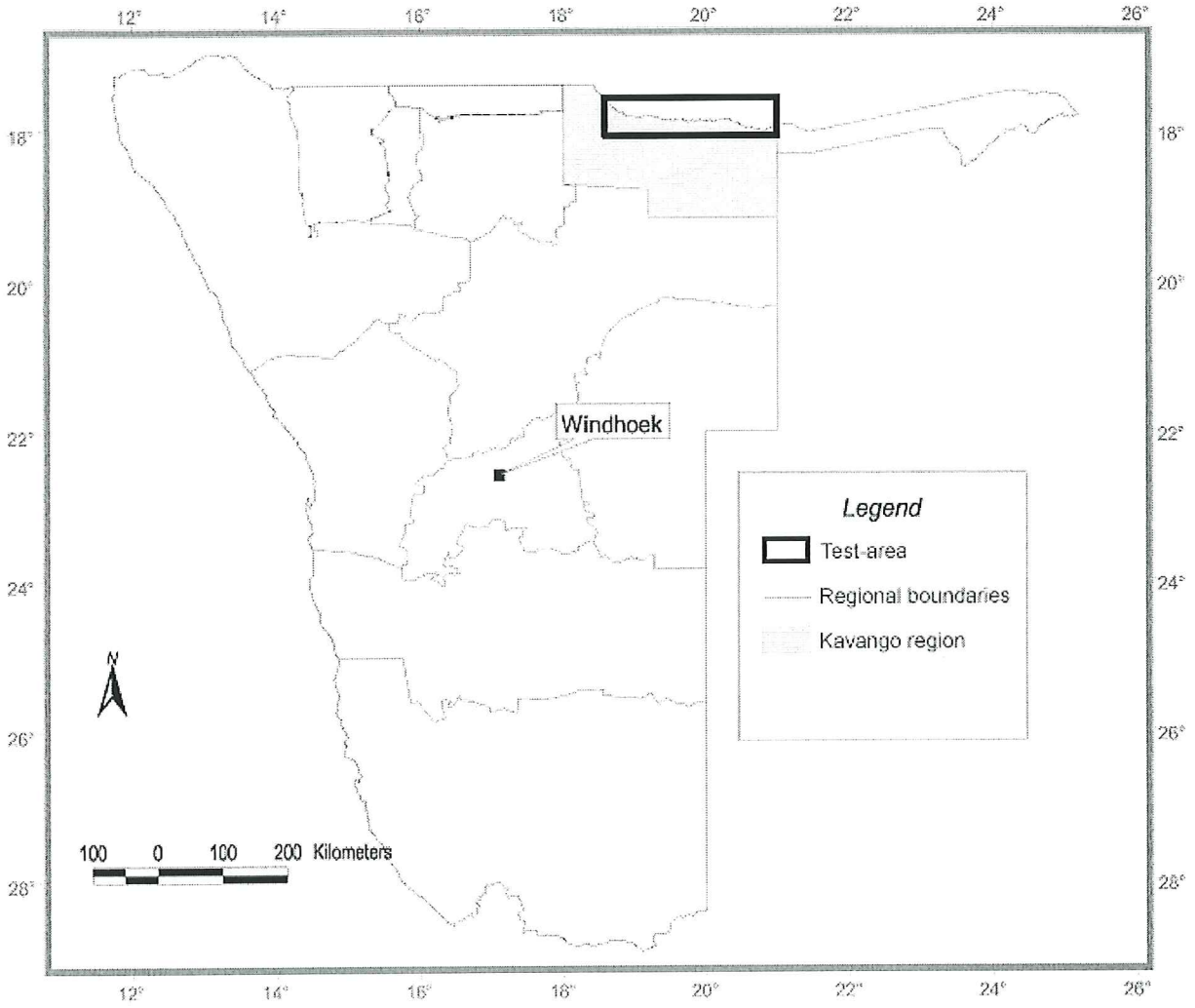
Being a young fisher myself during the early 1980s, I recall very well how we used to fish. During that time there were only a few people engaged in fishing on a full-time basis, and we could catch a lot of fish and big ones too. Fishing was only practiced in the afternoon. It was viewed as a recreational activity, to be done during leisure time. The sale of fish was not

common at all, and did not have any significant meaning at that time because the cash economy was not developed. However, now things have changed. Many people are involved in both subsistence fisheries and fishing for market. The demand and sale of fish is high particularly along the main public road along the river to Rundu. Based on this development the following hypotheses will be tested:

- Increase in fishing effort in Kavango is due to population growth (horizontal)
- Increase in fishing effort in Kavango is due to increased capitalisation/modernisation (vertical)

1.3 General Background

Namibia has a land area of 825, 635 km2, but is inhabited by merely 1.8 million people (Preliminary results, 2001 Census) (see Map – 1). It is located in South-western part of Africa and shares borders with Angola and Zambia in the north, Zimbabwe on the eastern end of the Caprivi strip, Botswana to the east, and South Africa in the south and southeast, while the Atlantic ocean lies to the west. The country has a 1400 km coastline with a narrow coastal desert plain from which the land rises to an extensive interior plateau, 1000 – 1500 m above sea level (Ashley, 1994). Namibia is considered to be one of the most arid countries in the world (Ashley, 1994).



Map 1: ***The map of Namibia showing the Kavango Region***

Source: Nangula 2001

Geographically, Namibia is divided into three landscape types: the Namib Desert, Central Plateau and the Kalahari Desert (DHS, 1992). The Namib Desert is situated in the western part of the country; as the name indicates the Central Plateau lies in the centre of the country from the north to the south; while the Kalahari is found in the eastern part of the country. Despite the barrenness of Namib Desert, it is endowed with rich mineral deposits (DHS, 1992). The plateau is the most fertile area and comprises fifty percent of the total land area and is suitable for human settlement, cattle-raising and crop cultivation. The mountain ranges of the plateau are also endowed with rich minerals, such as copper, lead, diamonds and zinc. The Kalahari is a semi-desert in the

south-eastern part of the country, mainly dominated by terrestrial sand and limestomes. Unlike Namib Desert, vegetation grows in Kalahari.

The rainfall in Namibia is low and variable, evaporation rates high, and there are no permanently flowing rivers in the country's interior. The perrenial rivers are solely found on the edge of the country, constituting the northern and southern borders. The rainfall increases from south-west to north-east. The evaporation rate from open water exceeds rainfall by 420% in the north and 1,750 % in the south (Ashley, 1994). Rain falls in short sharp bursts, resulting in low infiltration, and can be highly localised.

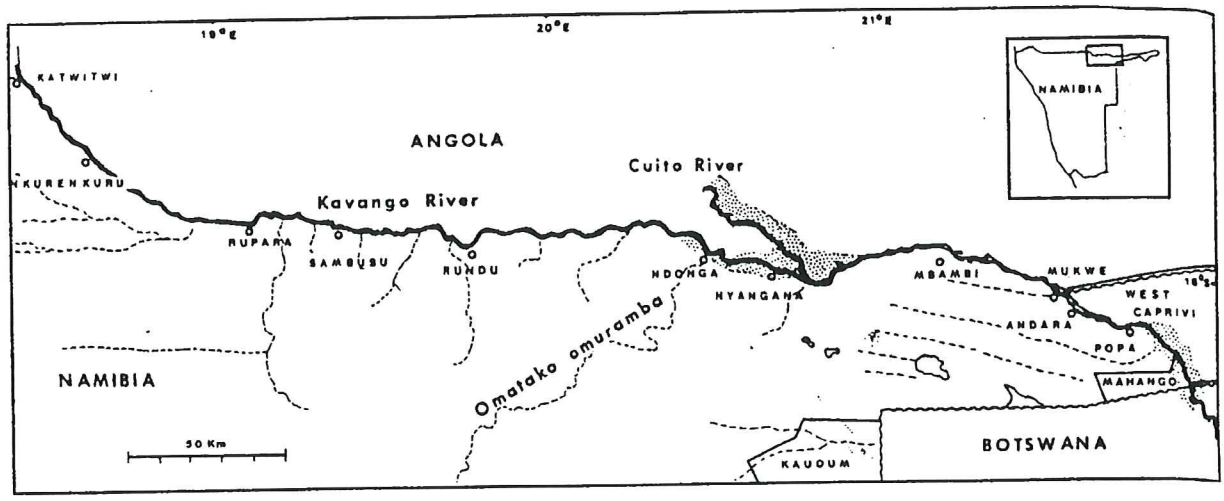
From the national point of view, the primary economic commodity exports are: mining (diamond, uranium, copper, lead, mercury and other base metals); marine fish; beef; and tourism. According to the Economic Intelligent Unit (2002), prepared and preserved fish is number two export commodity in the Namibian economy. The majority of the Namibians base their livelihood on arable agricultural and agro-pastoral production systems.

Kavango is one of the thirteen political regions of Namibia, and is situated in the far north of the country. The region is named after the Kavango river, which is the main supplier of water to the inhabitants. Kavango means a small place in the Rukwangali language of the vaKwangali. This river is one of the largest perennial rivers in the southern Africa. The region covers an area of 46, 000 km^2. Kavango is considered to be one of the poorest regions in the country (Lokkevik & Sjølie, 1998). As mentioned it is estimated that over 200,000 people live in this region, and approximately 90% of this population live within the 5-10 km of the Kavango river (Tvedten *et al.*, 1994).

The northern part of Namibia, with the Cuvelai system, the Kavango River and the Zambezi floodplains in the Caprivi, have for long been known for its subsistence fisheries (Hay *et al.*, 2000). A major concern has been the depletion of the fish resource in these areas, as a result of rapid population growth coupled with commercialisation of the sector and change in local management system. The population in Kavango is rurally based, but the regional capital Rundu with approximately 30,000 inhabitants, represent an important market for freshwater fish.

1.4 The Kavango River

The Kavango River originates in the central highlands of Angola, approximately 1700 m above sea level, where it is known as Rio Cubango (Gibson *et al.,* 1982; Hay *et al.,* 2000). The river enters Namibia at Katwitwi (see Map-2). It flows in a south-easterly direction along the Namibia/Angola border for about 415 km, and continues another 65 km as a primary source of Kavango Delta in Botswana (Hay *et al.,* 2000 ; Charles *et al.,* 1994). The steepest gradient is in the upper reaches of Angola, levelling off as the river enters Namibia, where it creates large floodplains with sandy substrates and rocky outcrop as wells abundant aquatic vegetation (Hay *et al.,* 2000). The Kavango Delta is considered to be one of the true natural wonders of the world, and subject to heavy investment from the tourist industry particularly in Botswana. Nevertheless this does not prevent people in Angola, Botswana and Namibia from utilizing the river's vast water resources.



Map 2: *The position of the Kavango River within the Southern Africa*

Source: Tvedten 1994

The Kavango flood system in Namibia consists of the main river, standing backwaters, swamps and floodplains covered by water only part of the year. The annual flood of the Kavango begins during December, and reaches its peak between February and May. However, the intensity, timing and duration of the flood is entirely dependent on the rainfall in Angola. Summer rainfall

in the catchment area (an estimated 15,000 km^2) is the primary source of inflow into the river (Hay *et al.,* 2000). The annual discharge of the Kavango river passing Rundu is in the range of 5,000-6,000 million m^3.

According to Hay *et al.,* (2000), the Kavango river is divided into four zones based up on habitat type. The stretch from Katwitwi to Kasivi is defined as Zone 1, and is characterised by shallow water with sandy and rocky substrates. Zone 2, which stretches from Kasivi to Mbambi, is characterised by developed floodplains with large oxbow lakes and back-water habitats. From Mbambi to Popa Falls it is defined as Zone 3 and characterised by rapids and a substratum of sand and gravel with large boulders. Finally, Zone 4 stretches from Popa Falls to the Namibia/Botswana border, forming the beginning of the Kavango Delta panhandle and featuring large floodplains.

Several tributaries join the Kavango river from the north, the Cuito river being the major one entering Kavango at Katere, approximately 100 km from Rundu (see Map – 2). The additional water flow of the Cuito nearly doubles the annual flow of the Kavango at Mukwe to over 10,000 million m^3, and hence enhances fish populations downstream (Hay *et al.,* 2000). Furthermore, the Omuramba Omatako is a significant tributary enters the Kavango River from the interior of the country. The study by Hay *et al.,* (2000), which monitored the water quality since 1992 at the stations Kakuro, Matava, Musese, Bunya, Rundu, Cuito, Mbambi, Popa Fall and Kwetze, revealed that pH was lowest (6.0) at Cuito during the spring of 1993 and highest (9.5) at Bunya during the winter of 1994. The majority of the measurements were in the range of pH 6.6 – 7.1 (Hay *et al.,* 2000). If the pH was the only measure for water quality in Kavango river it would seem that the river is not populated, but it is insufficient to use pH alone as a measure for water quality.

Before looking into the inland fisheries in Kavango in more details, I will put the sector in its proper global, African and Namibian context, which is the subject of the following chapter.

2. LITERATURE REVIEW – FISHERIES IN PERSPECTIVE

2.1 Fisheries at the global level

"*Give a man a fish and it will feed him for a day, but teach him how to fish and he can feed himself and his family for life (as long as fish stock last)*" an ancient Chinese proverb.

From ancient times, fishing has been a major source of animal protein food and household income for humanity (FAO, 1991). For these reasons, fish stocks have been under considerable and continuous pressure over the past hundred years. The two main ecological pressures on fish stocks are pollution and overfishing (Cowx, 1994). More recently other factors related to indirect human activities and natural phenomena have increased the pressure. Human activities include land and water resource development (such as land drainage, river regulation, overgrazing and deforestation), while natural factors include siltation of rivers, low flood and soil erosion (Cowx, 1994 ; Hay *et al.,* 1996)

The world fisheries sector comprises a wide range of activities aiming at the exploitation, processing and marketing of living aquatic resources. It is estimated that fish represents the primary source of animal protein for over a billion people in Asia alone, while approximately 60% per cent of people in developing countries derive 40% or more of their animal protein from fish (Konstapel & Noort, 1995). Fish is one of the fastest growing commodities international trade and has overtaken other animal protein commodities such as beef, pork, poultry and eggs.

Between the 1950s and 1960s, world marine and inland capture fisheries production increased on average by as much as 6 percent per year. It trebled from 18 million tonnes in 1950 to 56 million in 1969. During the period of 1970s to 1980s, the average increase rate in fisheries production decreased to 2 percent per year, falling virtually to zero in the 1990s (FAO, 2000). The levelling off was due to the general stable trend of most of the world's fishing areas, which have reached their maximum potential, with the majority of the stock being fully exploited. Therefore, a substantial increase in total catch will depend on the stable climate conditions. Growth in aquaculture production has depicted opposite trend. "Starting from an insignificant total

production, inland and marine aquaculture production grew by about 5 percent per year between 1950 and 1969 and by about 8 percent per year during the 1970s and 1980s and it has increased further to 10 percent per year since 1990" (FAO, 2000).

Due to the changing state of fisheries resources, economic climate and environmental conditions, supply and demand for fish have been fluctuating during the past years (FAO, 1991 ; FAO, 2000). According to the report (FAO, 1991 ; FAO, 2000), the global capture fisheries and aquaculture production declined from 122 million tonnes in 1997 to 117 million in 1998. This was caused chiefly due to the climate anomaly El Niño, having large implications to some major marine fisheries. However, in 1999 the world fisheries industry went through a recuperation with 125 million tonnes being the estimated production. There has been an increment in total production of 20 million tonnes over the last decade. This came into being mainly due to improvements in the production of aquaculture, as capture fisheries production remained relatively stable.

It has been estimated by FAO (2000) that in 1998 the primary capture fisheries and aquaculture production created employment for 36 million people around the globe. Of the figure above, 15 million were full-time, 13 million part-time while 8 million were occasional workers. "Employment in inland and marine aquaculture has been increasing, and is now estimated to account for about 25 percent of the total" (FAO, 2000). The remaining 75 percent is shared by marine capture fisheries and inland capture fisheries, representing 60 percent and 15 percent of the total respectively.

"In terms of generated income, international trade in fishery commodities fell back from a peak of US$ 53.5 billion dollars in 1997 to US$ 51.3 billion dollars in 1998 (FAO,2000). This is still according to the FAO, the result of a combination of factors, including the recession in the East Asia which weakened demand, and lower fishmeal production and trade resulting from decreased catches of anchoveta. Preliminary 1999 data indicate a 4 percent growth in the value of world fishery trade (US$ 53.4 billion). However, there are no indications of increased capture fisheries production in the long term, so any long-term rise in the value of exports is likely to depend on increased aquaculture production or product price".

Konstapel and Noort (1995) report that, of the total world production, 70% is utilized for human consumption and some 27% (40% of the industrial catch) is processed into oil and fish meal for the cattle and aquaculture feed industrial. The remaining percentage consists largely of seaweed, which is utilised primarily in the food, pharmaceutical and chemical industries.

According to the FAO report, F*ish for Food*, (FAO, 1991, see also Konstapel and Noort, 1995), developing regions account for more than half of the world catch and their fisheries are dominated by small scale or artisanal producers. Marine fisheries account for around 80 million tone and inland fisheries for another 6.5 million tonnes in developing countries. Currently aquaculture produces some 13 million tonnes per year (Konstapel & Noort, 1995).

Still according to Konstapel and Noort (1995), globally 100 – 200 million people depend, directly or indirectly, on fisheries for their livelihood. Of these 95% live in the developing world. The sector also accommodates some of the poorest and most marginalized people in developing countries (FAO, 1991).

From the above figures it transpires that globally fish resources are at risk due to a high number of people involved, new technologies, progress in electronics and last, but not least, advances in material science employed. This is accompanied by high demand for fish, and potentially attractive returns on investments in the sector.

Traditionally, fish stocks are predominantly common property. According to the notion of the "tragedy of the commons" (Hardin, 1968) there is no incentive for the individual fisherman to conserve fish resources with. However, traditional management regimes used to manage these resources, but recent trends have witnessed a gradual breakdown of respect for these traditional authorities. Fish being a revenue generator, a source of nutrition and a source of employment sustainability of this natural resource requires proper management that regulate the extraction of it. Thorough management involves the design and implementation of measures to monitor and control the amount, type and seasonality of fishing operations. Thorough management also necessitates a management system that employs ecological processes and comprehend the social structures of the resource users.

In developed as well as in the developing world, industrial harvesting of fish resource is predominantly executed by men. However, women often have an autonomous position in artisanal fisheries and play vital roles in the processing and marketing of the catch. Records of people employed in the aquaculture are more uncertain, as this activity is often done along side with farming or other activities.

Having gone through the global characteristics of marine and inland fisheries, I will now focus on fishing sector in Africa.

2.2 Fisheries in Africa

2.2.1 The role of fisheries in the regional economy

Africa, more especially Sub-Saharan Africa, is endowed with substantial marine and inland fisheries resources. As a result the regional fisheries have developed significantly over the last thirty years (FAO, 1996). Against a general background of macro-economic difficulties on the sub-continent, its performance appears to be an exception compared to other agricultural sub-sectors. This is due to its importance as a major contributor to food supplies and rural employment in foreshore areas, and as a significant foreign exchange earner (FAO, 1996).

The total gross revenue from domestic landings in Africa during the period from 1980 to 1990 almost doubled, from about US$ 965 million to nearly US$ 1.8 billion in 1990 at the 1996 current price (FAO, 1996). However, it should be mentioned that there was little information on the generation of value added by the fishery industry. Based on the 1996 current price and using estimates of the same gross value of landings, the average contribution of fishery sector to agricultural GDP increased from 2.6% in 1980 to 3.7% in 1990, and was estimated at about 4% for 1994. Considering the total value generated (including the secondary sector and various incomes and revenues such as those obtained from access agreements with foreign fishing fleets, licence fees, taxes and levies), the fishery sector's contribution to the regional economy is actually greater (FAO, 1996). The sector plays a particularly significant role in the economy of

coastal areas, where alternative source of employment and food supply are generally quite limited.

Countries for which the fishery sector contributes over 5% to total GDP or to foreign currency earning are Mauritania, Senegal, Madagascar, Namibia, Mali, Ghana, Seychelles and Mozambique (FAO, 1996).

2.2.2 Fishery's contribution to employment

Regional fisheries are labour intensive. According to FAO (1996) 8 million people or nearly 20% of the total agriculture workforce are directly or indirectly involved in the sector, including some 2 million full-time artisanal fishers with a little more than half being engaged in the marine sector. Women play an important role in fish processing and marketing particularly in Western Africa. Most of this employment is created in remote inland or coastal areas far from the main urban settlements, thereby assisting in curbing the rural exodus (FAO, 1996). In a small island states, namely Cape Verde, Seychelles and São Tomé and Príncipe, more than one third of agricultural workforce are engaged in fishery related activities.

However, it is important to recognise that regional figures mask a complex situation at sub-regional or country levels. With regard to biological and economic indicators, important distinctions exist between eastern and western halves of the continent: for instance, countries bordering the Atlantic Ocean ensures 85% of marine domestic landings, while 70% of inland catches are taken in the eastern part of the region (FAO, 1996). Discrepancies are particularly marked on the western coast: while the northern and southern areas are characterised by abundant resources and low population densities, the Gulf of Guinea show opposite pattern. As a result, the trade balance is positive in the northern and southern areas, and largely negative in the Gulf of Guinea area (FAO, 1996).

2.2.3 Inland fisheries

Inland fisheries represent a considerable resource in Africa (Tvedten & Hersough, 1992). Sub-Saharan Africa possesses vast and varied inland waters, with the large water bodies alone covering some 520 000 km ^{2} (FAO, 1996). Large natural lakes (41% of aquatic surface) and river floodplains (34%) dominate, while large artificial lakes occupy some 8% of surface area (ibid). In addition to standing waters, there are some 35 000 km of main river channels. The expansion of small artificial lakes, mainly community water supplies and stock watering ponds, remains unknown in most countries.

According to FAO (1996) the potential catch from the regional inland fisheries in Africa was estimated at 1.9 million tons. Tvedten *et al.,* (1994) reported that total potential yield of the freshwater fish on the continent is estimated to be 2.7 million metric tons, while the actual production was 1.9 million mt in 1990. In many areas, particularly in the floodplains, productivity of the aquatic systems is very high compared with other tropical areas, hence exploitation level of natural stocks is high in this areas.

Artificial and natural lakes are believed to provide the most productive fisheries, while rivers and floodplains are believed to account for merely 350,000 mt. (FAO, 1996). In contrast, the total potential production for marine fisheries in Africa is estimated to be 7.8 million mt, and actual catches 6.5 million mt (Tvedten *et al.,* 1994). Most of the inland fisheries are conducted by national fishers in the small-scale artisanal sector, in contrast to the marine fisheries where foreign fleets catch about 50% of the total landings (FAO, 1996; Tvedten *et al.,* 1995). The aggregated number of inland artisanal canoes on the continent currently stands at about 230 000 units, compared with the estimate of about 160, 000 in mid 1980s (FAO, 1996). Tvedten *et al.,* (1994) reported that aquaculture in Africa accounts for less than 2% of the total domestic fish production, with 85,00 mt. About 35% of animal protein intake in Africa is from fish.

FAO (1996) reports that there has been a net increase in inland fish production during the last two decades, from around 1.2 million tons in 1980 to 1.66 million tons in 1994. The main producers are Kenya, Nigeria, Tanzania, Uganda and Democratic Republic of Congo, which contribute 70%

of the total harvests. However, with the exception of the semi-industrial fisheries of Lake Tanganyika, Lake Malawi, Lake Victoria and Lake Kariba, most of the inland fisheries are relatively localised, small-scale and labour intensive. According to the available data, (Tvedten *et al.*, 1994; FAO, 1994; 1996) a total of nearly 2 million full-time and part-time fishermen are believed to be active in the artisanal sector as a whole. Inland fisheries create employment of 420,000 full-time fishers and virtually similar number on a part-time basis.

Moreover, the current production of the larger lake systems (lake Cahora-Bassa, Chad, Edward, Kariba, Malawi/Nyassa, Mobutu/Albert, Mweru, Tanganyika, Victoria and Volta), which represent over 50% of total landings, is very close to their aggregate average potential (FAO,1996). This means that as the demersal/inshore stocks of the large lakes are subject to heavy fishing pressure; only the lightly exploited pelagic stocks could sustain higher pressure (e.g Lake Tanganyika) (FAO, 1996).

With the exception of limited quantities of Nile perch exported from Lake Victoria, the African inland fish production is domestically consumed, providing nearly half of the local supply.

If production from inland fisheries is to be increased in a sustainable way, then it is likely be derived from three sources: 1) some of the more remote small and medium sized lakes and rivers; 2) the lower value small pelagic fisheries; and 3) small water bodies that are now either underexploited or where productivity can be enhanced.

2.3 Fisheries in Namibia

Due to our highly productive Benguela upwellings coast, Namibia is among the top ten nations in the world fishing industry. The main exploited species are hake and horse mackerel, but a valuable fishery also exists for pilchard, monk, rock lobster, kingklip, tuna, sole, snoek and swordfish. In addition oysters and mussels are being farmed (SADC Review, 2001).

The value of production and export from the sector rose sharply from around N$ 500 million in 1990 to N$ 1.3 – 1.4 billion from 1994 to 1996, and thereafter increased dramatically exceeding

N$ 2.4 billion in 1999. The commercial fishing fleet grew consistently after independence from 214 vessels in 1991 to 332 vessels in 1996, and declined to 293 vessels in 1999. This reduction in capacity, while catches have increased demonstrate a more efficient fishing fleet.

In contrast, about 92% of Namibia's surface area is classified as arid (Naesje, 1999) with inland water covering approximately 5,000 km^2 mainly located in the northern part of the country (Caprivi and Kavango) with additional fisheries in Owambo, Hardap and more isolated inland lakes. According to FAO (2000), Namibia's inland production stands at 1500 metric tonnes (Appendix –1). Tvedten *et al.,* (1994) reported that production of inland fish in Namibia was set at an estimate of 2800 metric tonnes. This is low compared to other African countries with equal inland waters such as Zimbabwe and Angola. Considering the fact that Namibia is an arid country with an area of 826,635 km^2 and with merely 5,000 km^2 inundated with water, the potential of freshwater fisheries development will largely depend on sustainable utilization of the resources and proper water management policies.

As elsewhere in the world, inland fisheries are mainly pursued on part-time or occasional basis, as one of several sources of subsistence and income, and Namibia is no exception. With the exception of formal fish market in the Caprivi region, inland catches in Namibia are mainly informally sold and poorly recorded. Fishery is normally combined with arable agriculture and pastoral production. Many traditional freshwater fisheries have experienced a transition towards an increasingly commercial fishery, often in response to population pressures and growing demands for cheap animal protein from rural areas as well as from urban centers. This has been as a result of urban migration and increased pressure on the rural resource. The transition of the fishing sector has tended to go through three stages, from a primarily subsistence; through an incipient commercialisation; to a primarily commercial fishery (Tvedten *et al.,* 1994).

Stage one includes adaptations that are geared towards consumption or local exchange, with no significant market available. These subsistence fisheries are typically located in areas with low population density and isolated from major population centers. Fishing techniques are generally simple such as hand lines, traps, baskets, small weirs and cast or dip nets. The fishing activity is generally seasonal with prolonged off seasons. Both men, women and children take part in the activity.

Stage two is reached when population density increases and contact with regional and local market expands. A transition to part-time commercial fishing is often accompanied by an intensification of fishing efforts and the introduction of new fishing gears that stimulate large catch per unit effort. Gill net and seine nets are commonly adopted, but traditional fishing gears may remain in use especially for fish caught for subsistence. The increase in production often creates the basis for middlemen and women, especially where market are located at a distance from fisheries.

At stage three the fishery is exploited intensively both for local and regional markets. Fishing is often not only done by local residents but also by outsiders who move into the fishery in the hope of profit. At this stage of primarily commercial fisheries, gill and seine are the most important gear and traditional fishing gears are more rarely employed. The total productivity tends to increase rapidly, but as more fishers become involved, income as well as catch per unit effort drop. The marketing of fish from commercial fisheries is often dominated by middlemen or middlewomen. Continuing the trend from the incipient commercial fisheries, women are rarely involved in the harvesting of fish at stage three, and socio-economic inequality within the sector become increasingly apparent.

According to Tvedten *et al.,* (1994) the last stage may lead to a situation of over-exploitation and subsequent decline in the fisheries productivity of the system. The freshwater fisheries in Namibia is currently seems to be situated somewhere between the first and second stages, but with a few characteristics also from stage three, in the sense that though locally harvested, some people do sale their catches to other region. There are also indications of specific fisheries approaching a level of maximum yields. All this makes it extremely important to analyse socio-economic aspects of freshwater fisheries with close reference to biological and ecological aspects of freshwater ecosystem (Tvedten *et al.,* 1994).

It is important to realise the great significance that inland fisheries play for local communities (Løkkevek & Sjølie, 1998). According to the Government policy paper on inland fisheries (MFMR, 1995) at least 100,000 people derive part of their food, income and informal employment from the inland fish resources. The annual report of the Ministry of Fisheries and Marine Resources (MFMR) of 1999 reported that 120,000 people benefit direct and in direct

from the marine fisheries. Therefore, there is not much discrepancy between inland fisheries and marine fisheries in terms of the benefits accrued by the people even though the marine fishery is much more important economically as Namibia's second largest export sector. The discrepancy is mainly their contribution on the national GDP, where marine fisheries plays a much big role, otherwise in local socio-economic terms they all have similar vital role to the society.

2.3.1 Fisheries in Kavango

As outlined earlier in this study most villagers in Kavango are located along the river and a parallel road, which traverses the entire region, making this strip one of the most densely populated areas in Namibia. Although urbanisation is increasing, the population in the Kavango remains mainly rural and the life of the inhabitants revolves around the river. The river is a central component of social and cultural identity, because inhabitants consider fishing and paddling a dugout canoe to be necessary and essential skills. In their study, Tvedten *et al.*, (1994) revealed that fishing is integral to this tradition. Over 53% of the riverine population (41% of the overall population) fish in Kavango. A substantial number of people use traditional gears such as baskets, funnels and fish fences (*Masasa*) but modern gear is also used. Fishing is also seen as a central component to the livelihood and well-being of Kavango people, as fish is a source of subsistence for 91% of riverine households, and sales of fish generate a small cash income to an additional 46%. As part of the multiple income strategy adopted by many Kavango households, fishing significantly enhances household food security (Tvedten *et al.,* 1995).

With regard to the use and management of freshwater fish in Kavango, it is operated as an open access resource regime. The system seems to have functioned well in the past, due to low population and a limited market (Tvedten *et al.*, 1994; Løkkevik & Sjølie, 1998). However, several conditions have recently changed in Kavango. The civil war in Angola has contributed to a large-scale migration into the region, and there is fairly high population growth rate at 2.6%. The fisheries are now in need of proper management to remedy the new unsustainable practices. Moreover, there is an increasing market for fish in the area meaning that the pressure on natural resource will be intensified.

For development activities envisaged in an area such as Kavango to succeed, local knowledge about the sector is of great importance. The proper management of freshwater fish resources cannot be implemented without the participation of the local people utilising and depending on these resources (Tvedten *et al.,* 1995).

2.4 Fishing Methods

According to the White Paper on "Responsible Management of the Inland Fisheries of Namibia" of the Ministry of Fisheries and Marine Resources (MFMS), fishing practices in Kavango can be classified into two categories. These are active and passive gears, with both traditional and non-traditional or modern gear in each categories (MFRS, 1995). Active gears are dragged or pushed i.e drag net, funnels and push baskets, while stationary gear is set and handled only when fish is recovered, i.e gill net and traps are examples of passive gears. In general, active gear, tend to be most destructive. The water quality suffers, vegetation gets trampled, uprooted and disturbed (MFRS, 1995). Active gear also tends to be most non-selective in terms of types and size of fish it catches.

Moreover, it is imperative to define what is meant by traditional gear. The most acceptable definition of traditional gear is gear manufactured by locals in an artisanal manner making use of natural materials available from the environment (Lokkevik & Sjølie, 1998; MFRS, 1995; Brouwer, 1995; Tvedten *et al.* 1994). This would exclude nets from the fibre attained from old car tires, as well as hooks and line in the shops. As I have shown above in Kavango local people prefer to use traditional gear, the reasons being they are locally and easily manufactured, do not cost much, are simple to use and represent a sustainable practice.

2.4.1 Traditional gear

Usually, different gears are designed to fish during a certain water level and in different seasons. Therefore, certain gears cannot be used throughout the year Brouwer (1995). Moreover, most of the traditional gears in Kavango are gendered.

Sintuga is chiefly, used by women and girls (Tvedten *et al.* 1994; Brouwer, 1995). It is constructed of thin twigs and reeds by women to look like mats of about one meter in length and 80 centimeter in high (Tvedten *et al.*, 1994). One side of the twigs has sharp tips so that the mat can be easily pushed in the water button. It forms a ring when it is placed in water. Millet or maize porridge or the hull of grain is put inside as bait. *Sintuga* is normally set in the ground or placed in the bays or small channels ringed with vegetation (Tvedten *et al.* 1994). It works best in water up to the knee. It can be set up and checked in the early morning or after some hours, when women might go to the river for water or washing.

The most popular fishing gear for women in waist high water is the *Sikuku* (plural *Yikuku*) (Brouwer, 1995). *Sikuku* is exclusively constructed and used by women. It is a large funnel shaped basket of about a metre and half long, with a one to one and half a meter wide mouth. The slit between the twigs of which is made are a maximum of five millimeter (Brouwer 1995; Tvedten *et al* 1994). Usually, the method works best when ten women work together. Wading and stamping half the group of women drives the fish to the other women who are trying to block the river, stream or pool. This gear is still used as much as it was in the past, and women believe that also the extent to which the cooperation has remained unchanged (Brouwer, 1995).

Masasa or fish fence is another active traditional gear. It is a fish fence made of reeds and millet stalks. It is higher than a human being and the length varies from 30 to 100 meter but can be even longer (Brouwer 1995). The slits between the reeds or stalks are up to three centimeter wide (Tvedten *et al.*, 1994). They are placed in floodplains or across small channel to block fish moving from floodplains to the river. Though checked regularly, *masasa* can be left standing for weeks and the valves can be opened or closed with the water flow. *Masasa* was traditionally a communal fishing method, which involve up to 100 people (Lokkevik & Sjølie, 1998).

Erowo, (hook and line) is particularly suitable for fishing in deep water, but can also be used in shallow water. Usually long fishing lines are used, wrapped around a thin long sticks, with a hook tied to the end of the line. Men and boys are by far the main users of *erowo*, however, women can also use it if they want (Tvedten *et al.,* 1994). Small fish such as sardines are used as bait, but worms are more commonly used. The large fish caught this way, like *Nyiru* (tiger fish),

are not only for consumption but also very marketable. Thought scientists classified *erowo* as modern gear as hooks and lines are bought in shops, the local people perceive *erowo* as one of the traditional gear because they used to make their own hooks (so called *´Ncusu`*) prior to the introduction of modern *erowo* (Brouwer, 1995).

Another interesting traditional fishing method is *Muho* (fish spear). *Muho* is about two to three meter long, made of light floating material like reed. Normally, *Muho* is used in the shallow water standing on the river bank, but can also be used while a fisher is in the *wato* (canoe). This method is well suited for catching big fish and is only effective during low water.

When the floods are rising, a fishing method called valve trap (*Muduva,* plural *Nomuduva*) is also used. It is a large basket, and catches only large fish. *Muduva* is only used by men. Towards dark a *Muduva* specialist will go to the river and look for the suitable spot to place his *Muduva.* This usually takes place in the streams or channels where the main river enters the floodplain or pool. Fishers pull out grasses to create an opening for fish to swim into till they are trapped.

A kind of conical basket over a meter long is called *Sididi* (plural: *Yididi*). *Sididi* is chiefly, employed by women and children, but also men can use it to small extent. The wide mouth of *Sididi* is dropped over the fish by which they are captured (Brouwer, 1995). This method is more active during dry season (Tvedten *et al.,* 1994). The catch is collected through an opening on the top of the basket.

When the water is low and people fish a lot in the river itself, they also use *utawonkanza* (bow and arrow). This fishing method is exclusively used by men and boys, and can be used throughout the year. Bow and arrow are one to 1.5 meters long. It is mostly used from the river bank. A hunter has to hide behind high vegetation to wait fish to come close. Once the fish comes in range, the hunter shoots. It concentrates mainly on big fish.

2.4.2 Modern gear

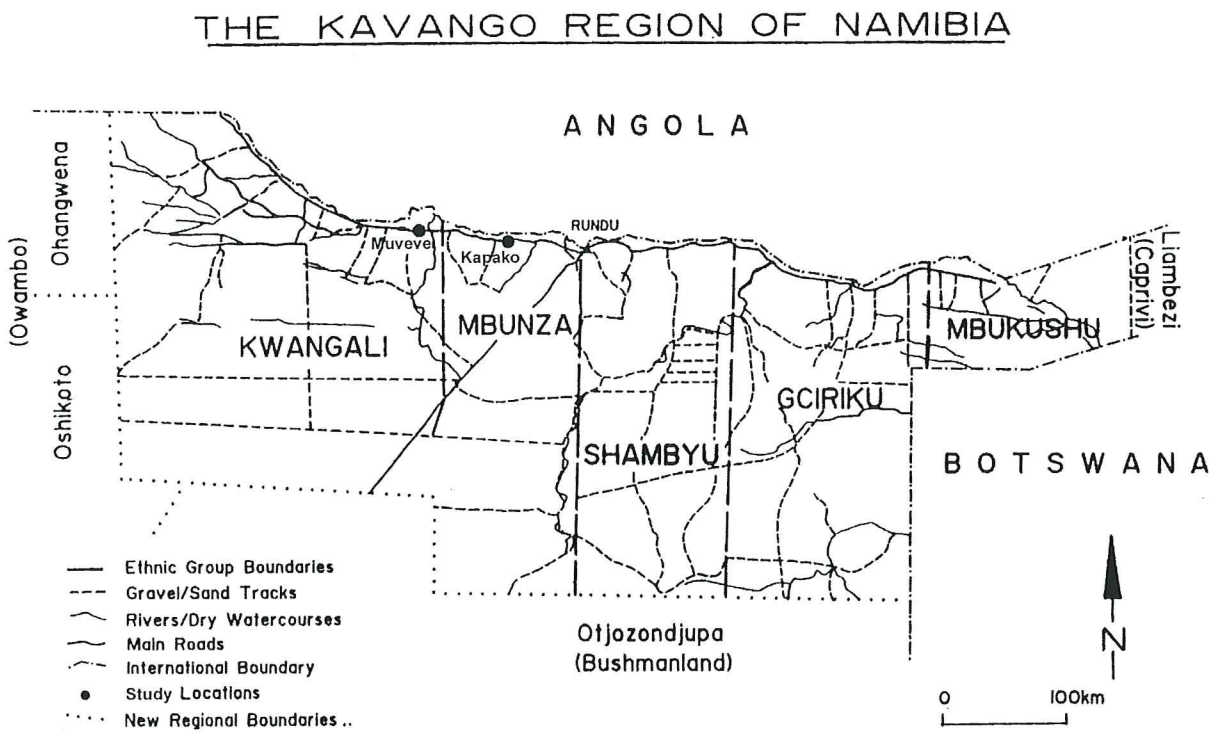
Modern fishing gear includes gill-, drag-, cast-, seine and mosquito nets, and weire fykes (Tvedten *et al.* 1994; Lokkevik & Sjølie 1998). These gears do not necessary have to be bought, to be considered as modern equipment. In Kavango mat gill nets are manufactured from fibre from discharged car tires even though nets are available at a high prices (Tvedten *et al.* 1994, Lokkevik & Sjølie 1998). However, as it was mentioned earlier on there are still debates as to whether the *erowo* is modern or traditional gear.

When the water is low or when the flood recedes, is the time when fish is harvested with various nets. Men are by far the main users of gill nets *(Ekwe)* in the deeper waters along the river banks when the floods are in (Lokkevik & Sjølie, 1998). Nets appeared to be more popular or in large numbers in Kavango approximately 15 year ago (Brouwer, 1995).

3. METHODOLOGY AND MATERIALS

3.1 Site Selection

Kavango River is one of the largest river in Southern Africa. It is a river with large floodplains, and swamps. The floodplains are fish spawning habitats, but have also other important functions apart from fish breeding when inundated by water. People in Kavango region are also agropastoralists and graze their livestock in this productive floodplains, and this reduces its resilience. Unlike the Namibian side of the river, the Angolan side is covered with thick forest and long grasses. This is due to low population compared to the Namibian side. It is also understood that many large lakes with plenty of fish are located on the Angolan side.



Map 3: *Study area within the Kavango Region*

Sources: Tvedten 1994

Two villages were identified as the principal research sites, namely *Kapako* and *Muveve* (See Map - 3). As it was mentioned earlier on, Kavango is inhabited by five ethnic groups; viz *vaKwangali, vaMbunza, vaShambyu, vaGciriku and Hambukushu.* Muveve is located in the vaKwangali tribal Authority while Kapako is in the vaMbunza tribal Authority. The name *Mbunza* means "full of *nzas" (mbu nonza),* and is from one of the fish species - bulldog *marcusenius macrolepidotus* found in the river locally known as *Nza.* This section of the river is full of this species. Some elder people said the name also came from another species of Cichlidae family – Southern mouthbrooder- *pseudocrenilabrus philander*, Purpleface largemouth – *S. macrocephalus* and Nembwe – *S. robustus.* The elders said these were the big fish species, which were in abundance in the past.

The sites are 25 km and 90 km west of Rundu. The principal project sites were chosen because they are considered to be the main fish producers of the region. Also the eastern part of Kavango was considered unreliable as far as the security situation were concerned .

3.2 Household data

Several methods were employed in the data collection process. One was a household survey (see Appendix -3). Each research site had about 110 fishers. A total of thirty-five questionnaires were administered in each research site. The total number of fishers was divided by 35 questionnaires in each village, giving me a basis for systematic sampling respondent interval. This was done to avoid bias representation in the selection of interviewees. Two fieldwork assistants with secondary school education helped with the questionnaires, group discussions, as well as identifying key informants. One fieldwork assistant worked in each village.

3.3 Group Discussions

Triangulated group discussions (group discussions constituted by people from different sectors or levels within the community, e.g fishers, teachers, elderly, young women and men) were also

carried out in both research sites. These group discussions allowed me to relate to local people with different backgrounds, and discuss issues pertaining to fisheries in the area from different perspectives. This was a fundamental instrument for a number of issues including knowledge about species, changing productivity and gear use.

3.4 Direct Observations

Hay *et al.* (1996) state that direct observation in freshwater fishery studies is very important for limitation of possibility of error. Direct observation at the river bank to count fishers, observe fishing in action etc. was inhibited by insecurity instigated by UNITA banditries along the river during the study period, but I nevertheless managed to be part of some fishing activities. In addition, the study is also based on my own long-term experience from the area. Direct observations along the road which is the main market place for the sale of fish and a meeting place for fishers and consumers was not a problem.

As the study is attempting to combine two different perspectives, namely socio-economic and ecological, a scale was used to measure the weigh of fish sold on market in relation to price. This has contributed to the overall understanding, as management policy for a certain resource relates to its economic and ecological importance.

3.5 Key Informants

In order to capture the evolution of the fishing sector in depth, interviews with key informants were carried out. Key informants are people, both women and men, who are able to recall previous fishing activities in the area. From the government's side key informants are people involved in policy formulation and implementation. For that reason, verbal communication with the honourable minister of the Ministry of Fisheries and Marine Resources and the director of the Inland Fisheries Institute of the same ministry was executed. This verbal communication was

intended to gauge what the concerned ministry has done in the promotion, development and sustainable utilisation of inland fishes.

3.7 Statistical Analysis

For a statistical analysis of my data, various statistical packages were used. With the help of Christa Schier, who is a statistician at the university of Namibia, data entry was done by using the SPSS statistical package. This package gives comprehensive, detailed descriptive data. In addition, now with the assistance of professor Ellen Sandberg at Agriculture University of Norway, the MINITAB statistical package was used to run Chi-square test to verify the hypothesises for the study. More especially, Chi-square test was used to compare and analyse the difference within the villages.

Having briefly gone through the methodology applied for the study, I will now move on to the results. Results are presented in figures and text for a thorough comprehension of the reader.

4. RESULTS

4.1 Fishing in Muveve and Kapako in the old Days

Let me introduce this section with some narratives by older fishers, recorded during group discussions in Kavango. The group discussions were carried to document the historical development in the fisheries sector in Kavango which are the proceedings of the following paragraph.

"During the old days we used to catch a lot of fish, and fish were plenty. During that time small fish were not taken home, anybody who would pass by could just pick it up for their own consumption. *Masasa, Runkinda, Yikuku, Yintunga, Marowo, Magondo, Saswata* (long magondo) *Muho, Bow and arrows* and *Sididi* were the common gear used. In contrast, *Yinguwe* are recent gears introduced in [Chief] Morosi's time (1946 to 1954). *Mbunze, Nkundu, Nkusa, Siyeya, Nkungwasirongo, Ntasi, Ncwe* were the most frequently caught species. The list above is not in order of importance. All this occurred during commissioner Nakare's regime (1932 to 1946).

During high flood people, especially men, used to fish with bow and arrows. One had to be fast in taking the shot at the fish because during that time it was very unsafe when it came to crocodiles. This was the time when crocodiles were a big threat to humans.

Usually people used to just eat their catches, give to other family members, or relatives. During that time people did not use gill nets or mosquito nets. They used to fish once a month and practiced a rotational system, whereby if you fish this month in a certain village next time will be in another village. The river was in good state during that time, and it used to flood well because people did not cut so much reeds, trees and other aquatic vegetations. People, especially men, used to climb aquatic trees called *Yikulikuli* and shoot fish with bow and arrow. Now those *Yikulukuli* are no more there due to overgrazing and loggings for building and fuel wood purposes. Therefore, when the rain comes erosion and siltation result.

In the past people used to farm a lot and that enabled them to have sufficient food in their homesteads, which is not the case today. Nowadays, due to the availability of alcohol in the villages, people do not work hard on their fields and fish a lot instead. "Some people are not contemplating farming at all, because they know that they can just run to the river and watch those who are fishing and steal their catches" claimed the group. Another point to mention is that in the past only those who were considered experts in fishing could fish, while today virtually all, if not all, fish. This is so because in the past people would fish for domestic consumption only, and to give relatives as a gift in kind. There was no sale of fish in the old days, as it is today. In contrast, today people are mainly fishing for commercial purposes. Freshwater fish has become on a high demand in the sense that it is scarce, and people want it. Due to its shortage freshwater fish currently pays good price, and consequently this increases pressure on it. Because of its good price, people know that even if they don't work in the fields they can live on fish. But the problem is how long will they continue to live on fish. Our impression of the fish resources in the area is very bleak.

It was a culture [in the old days] that women fished with *Yikuku,* and they made sure that the first fish they caught was smeared on the *sikuku* to get rid of bad luck. This means that rituals were involved in traditional fishing. It was also seen as security for women to maintain their marriage if they caught a lot of fish, because their husbands were happy to see them contributing to the household's daily life. Unlike today, people used to commence fishing only in the afternoon because, during the morning they were involved in other activities. Gears such as *Muho*, *Masasa*, *Marowo*, *Marunkinda* and *Magondo* (which other people call *Ncunsu*) were male based gears. Men used to fish in the deepest water, while women were using *Yintunga*, *Yikuku* and *Yididi* in low and moderate water. *Yididi* were divided into two groups. One was just ordinary *sididi,* while the second one is called *Edidiminye* which was considered the luckiest one once used. Pearl millet husk and ordinary porridge were used as bait. Fishing in the past was important, but limited due to the limited number of people and the lack of a market".

4.2 Most commonly caught species of fish

Looking at the current fisheries there are between 76 and 82 species found in the Kavango river (Hay *et al.*, 2000; Brouwer, 1995) (see Appendex ii). My results show that Redbreast tilapia – *Tilapia rendalli*, (known as *Nkundu* in the local name) is the most commonly available and most caught species (Figure – 1). A substantial number of respondents reported that silver catfish – *Schilbe intermedius,* or *Sipava* in the Rukavango language name, and blunttooth catfish – *C. ngamensis (Hogo)* were the second most caught species in Muveve and Kapako respectively. From the figure it further appears that the next in order of most caught species were Barb *(Ence)* and Bulldog – *marcusenius macrolepidotu*, locally known as *Nzas* - respectively. In contrast, *Ntasi* was the least caught species of those reported in my survey.

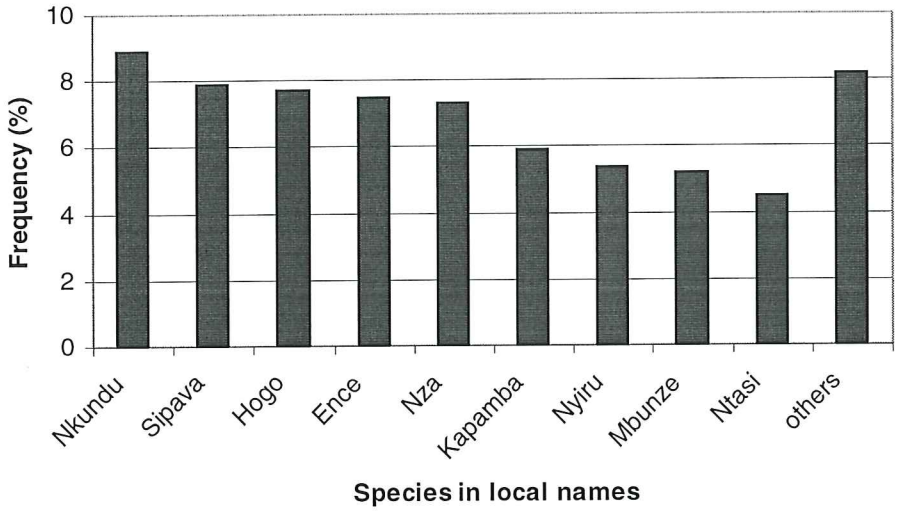


***Figure 1*: -** *Ten most caught species by fishers at Kapako and Muveve village along the Kavango River in Namibia during September-November 2001.*

4.3 Type of gear used

In this study one of the research question was to find out which type of gears (traditional and modern) are most commonly used (see Figure - 2). The results show that the *Sikuku* (fish funnel) was the most used fishing gear followed by *Sintunga* (fish corral trap). Hook and line (*Erowo*) was the third most used gear according to fishers both in Muveve and Kapako village, followed by Gill net. Other fishing gears, such as *Sididi* (push basket), *Masasa* (fish fence), *Muduva* (valve trap), Mosquito net, *Muho* (fish spear), and *Utawonkanza* (bow and arrows), were not equally popular and used. Cast net and *Singundo* were the least frequently used in the two villages under study.

Apart from the general question of which gears are most used, there was also a question about which of the gears that were most preferred (i.e. if a choice could be made irrespective of availability and price). *Sikuku* was again the most preferred gear, followed by *Sintunga*, gill net, *masasa* and *sididi*. Significantly the results show that the traditional gear is more common and preferred than modern gear.

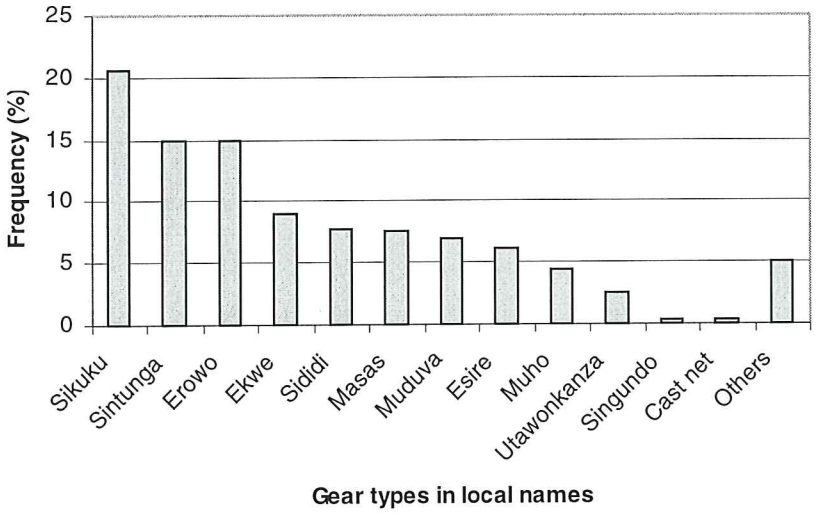


Figure 2: Most used gears according to fishers at Muveve and Kapako village along Kavango River between the months of September and November 2001.

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4.4 Gear efficiency

Gill net gives highest output, followed by *Sikuku* and then Fish funnel (Table – 1). There seems to be a positive correlation between time spent and catch per unit effort in all gear employed during fishing activity.

Table 1: *Gear efficiency per catch unit effort per day according to fishers in the two villages*

Average catch (Kilograms)	Gear used	Hours spent at the river
11.9	Gill net	5
2.5	Hook and line	4
1.5	Fish funnel	2.5

4.5 Socio-economic characteristics of fisheries in Kavango

4.5.1 Price of Freshwater and Marine fish

Prices of three different freshwater and marine fish species were compared. The results show that freshwater fish tend to be more expensive than marine (0.885g of bulldog N$ 8.00 is more expensive than 0.992gram of horse mackerel N$ 6.31) (Table – 2). Unlike marine fish, the bigger the weight of freshwater the more expensive it becomes (e.g 1.075 kg of Nono costs N$ 10.00 while for horse mackerel is less than N$ 10.00).

Tilapia and bulldog are more expensive freshwater fish than catfish. Regarding marine fish, redds seem to be more expensive compared to horse mackerel, but still cheaper than freshwater fish.

Table 2: *Different prices of distinct Freshwater and Marine fishes in Muveve, Kapako and Rundu during September – November 2001*

Freshwater fishes				**Marine fishes**			
Species	**Kilogram**	**Price (NS)**	**Price per kilogram**	**Species**	**Kilogram**	**Price (NS)**	**Price per kilogram**
Bulldog	0.885	8	9.04	Horse Mackerel	0.598	3.80	6.35
Bulldog	0.699	6	8.97	Horse Mackerel	0.992	6.31	6.36
Bulldog	1.075	10	9.30	Horse Mackerel	1.532	9.74	6.36
Catfish	1.927	10	5.19	Redds	1.292	10.48	8.11
Various small fish	1.860	5	2.69	Redds	1.626	13.19	8.11
Tilapia	1.981	16	8.08	Redds	1.076	8.73	8.11
				Redds	1.466	11.89	8.11

4.5.2 *The price determinant of Freshwater fish*

Various freshwater fish price determinants were used to ascertain the most important driving factors that determine the price (see Figure – 3). Species and species size appear to be the most important price determinants. Preference and taste are also important factors that dictate fish price. Furthermore, the time of sale and the number of producers (fishers) affect price virtually in the same manner.

Poverty and quantity of fish produced seem to have fairly low effects on price. It is also clear that forms of processing such as dried, smoked or fresh do not influence the price of fish in the two villages. The same can also be said to the availability of marine fish.

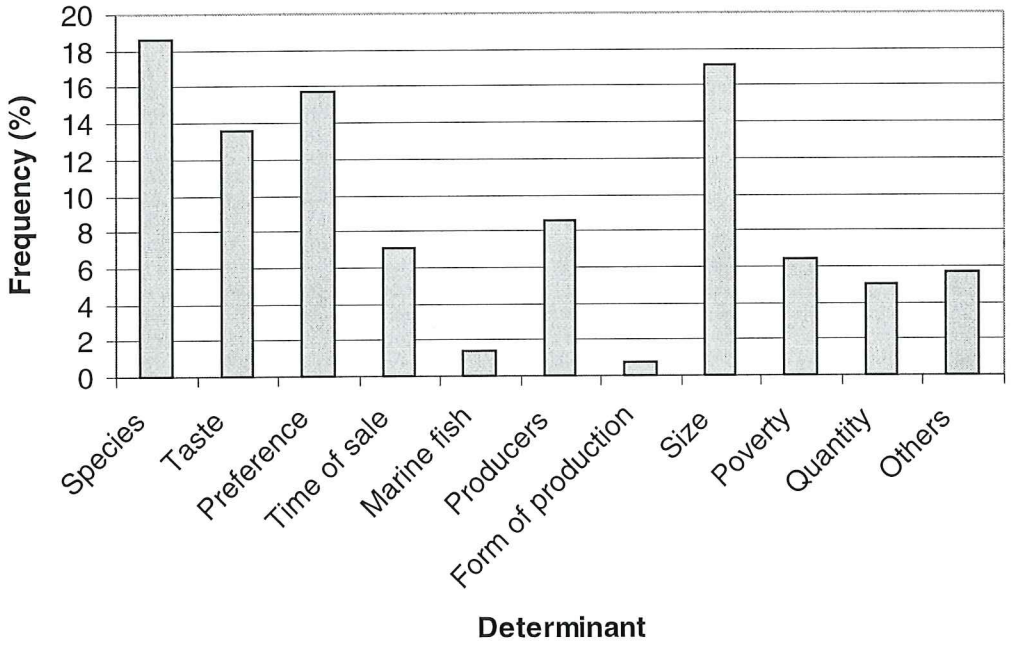

Figure 3: *Determinants of Freshwater fish price in the Muveve and Kapako village along Kavango River between September and November 2001.*

4.5.3 Income generated from Fish

From my data it appears that above 40% of the respondents reported to have generated less than N$ 25 (including nill) per day by selling fish (see Figure – 4). Close to 30% generate income between N$ 25 and N$ 50 from the sale of fish. Very few people made between N$ 50 to N$ 75, and above N$125. Only 15% of the respondents generated money in the range of N$ 75 to N$ 100 per day. And finally only seven percent of the respondents reported to generate income in the region of N$ 100 – N$ 125.

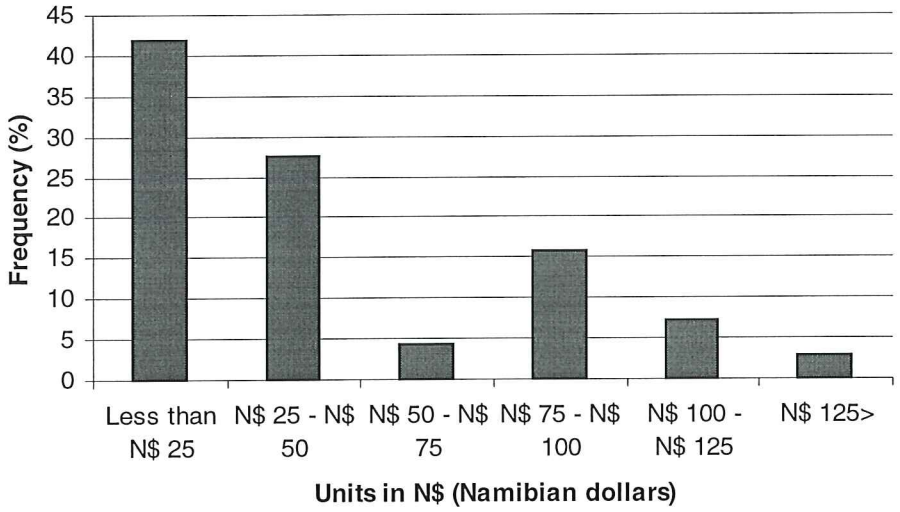

Figure 4: *Proportions of income generated by fishers per day in the Muveve and Kapako village of the Kavango River between September and November 2001*

4.5.4 Other Sources of Income

The formal employment among fishers is very low in the two villages under study (see Figure – 5). The sales of reeds and grasses are the major source of income in both villages. Casual work and crop sales are the second and most important sources of income in the study area. Livestock, wild fruit sales and remittances are somewhat less important, while sale of local crafts is the least important source of income in the area according to the respondents.

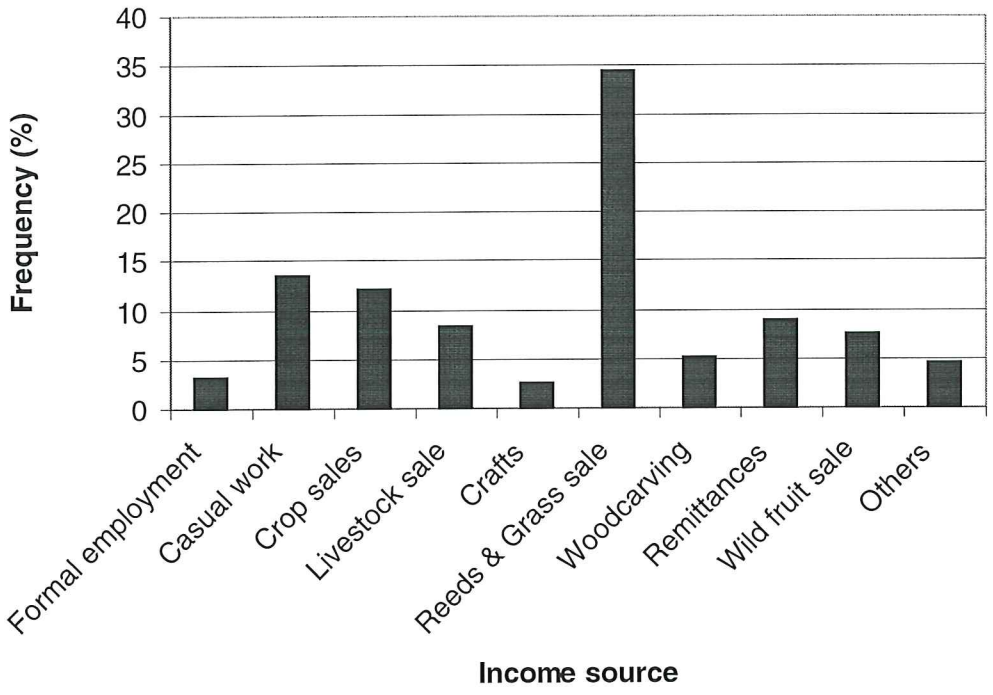

Figure 5: *Other Sources Of Income Generation Apart From Fishing According To Fishers In Muveve And Kapako Villages Along Kavango River Between September And November 2001.*

4.5.5 Educational level among fishers

Most of the respondents (40%) had no education (Figure – 6). The grades in Figure 6 depict the education system in Namibia. Grade one is refers to the first year in lower primary school, while grade 12 refers to the last year at secondary school prior to entering university or colleges. Only very few of the respondents who finished elementary school had a secondary education (7% and 7%) respectively.

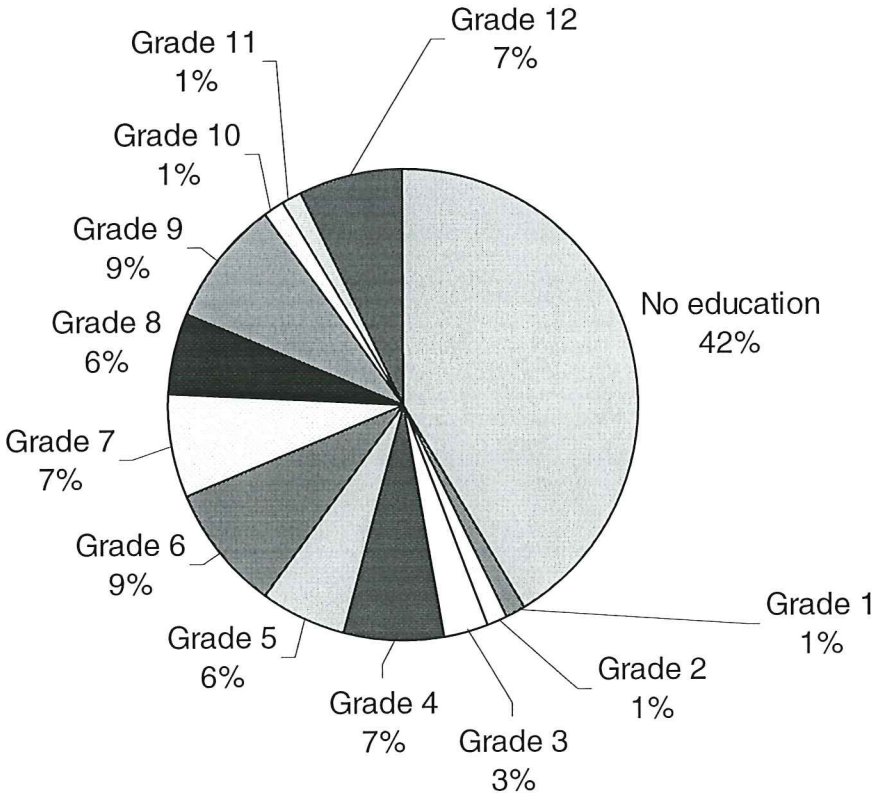

Figure 5: *Educational level among fishers at Muveve and Kapako village along the Kavango river between September and November 2001*

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4.5.6 Various fishers according to social groups

About 40% of the respondents claimed that women fish more than men (Figure – 7). Only 15% of the respondents reported that men fish more than women. Children (boys and girls') fish but less than adults.

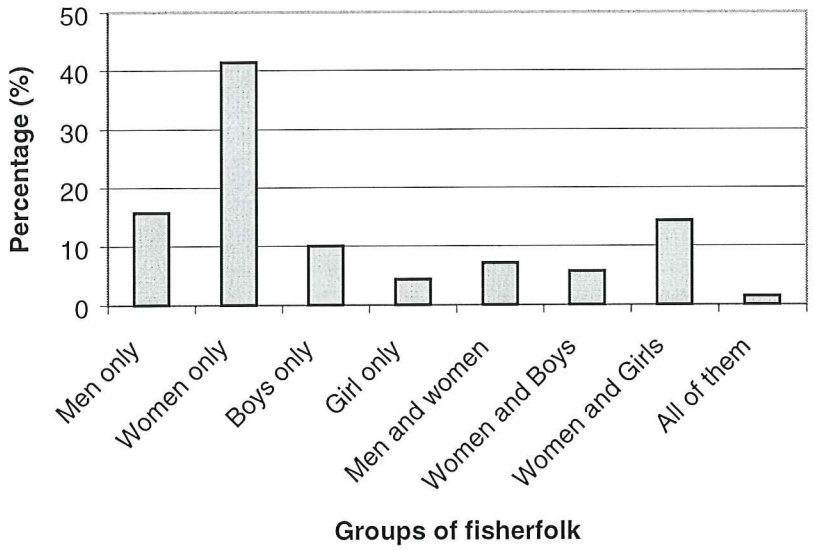

Figure 6: *Various groups of fisherfolk according to which group of fishers fish most in the Kapako and Muveve village during September – November 2001.*

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4.5.7 Reasons why distinct groups of fishers fish

In this study it has transpired that the main reason why men fish is to support their family (Figure 8 a). In contrast, women fish because their fishing equipment is locally available, and they are experienced in the sector (Figure –8 b). Women tend to fish because their livelihood depends on it. The use of mosquito nets by women implies that they tend to fish more than men (fish more means to catch a lot and spent more time in the river or lake).

Moreover, there is not much difference in fishing effort between the use of various gear, and fishing for employment purposes among men. Of importance here is that women fish more because men drink a lot most of the time. A comparison between boys and girls is also presented, in order to see whether similar factors that influence men and women do the same to the young people (Figure – 8 c) & 8 d). Girls fish for two main reasons: They have energy to do it, and catch a lot. Boys fish for the same reason as men, but, in addition they fish in order to support the family with fish.

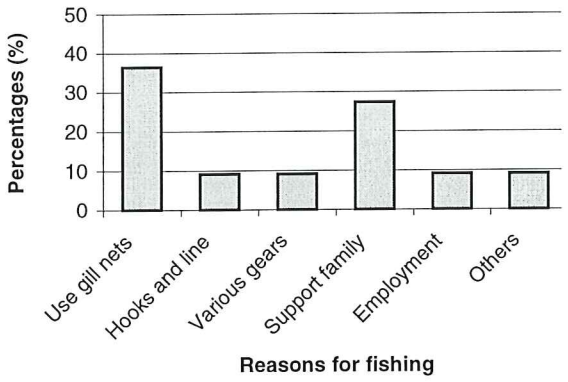

Figure 8(a) Men's reasons for fishing

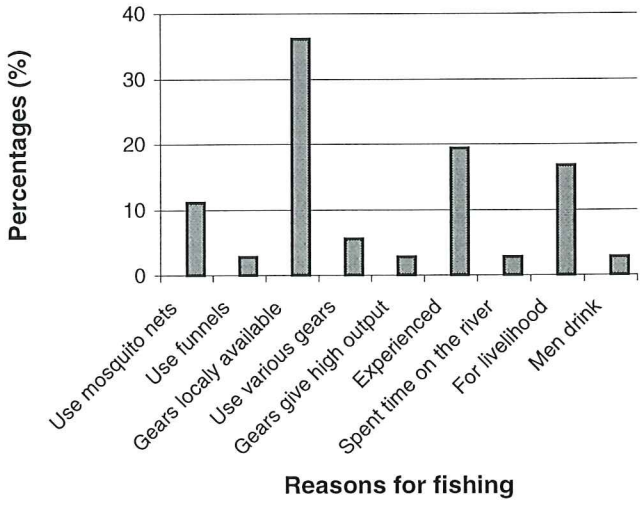

Figure 8(b) Women's reasons for fishing

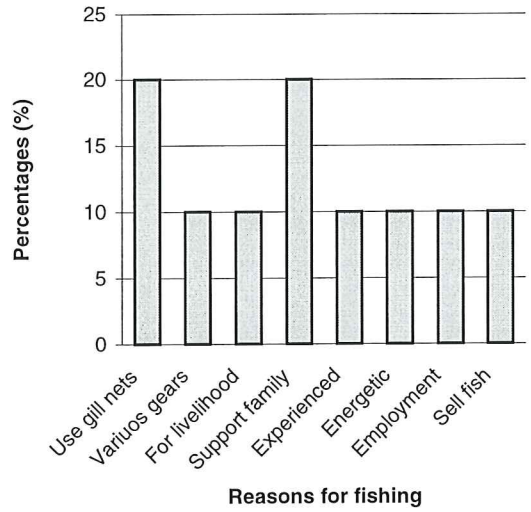

Figure 8(c) Boys' reasons for fishing

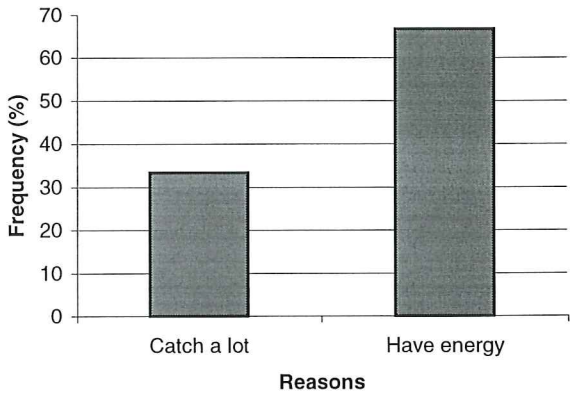

Figure 8(d) Girls' reasons for fishing

***Figure 7**: Various reasons given for fishing among different groups of fishers at Muveve and Kapako village along the Kavango river between September and November 2001*

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4.6 People's perceptions on the availability of fish

Over 81% of the respondents confirmed that some fish species are no longer seen, or have diminished in number and size compared to past years. Of these respondents, 38% said African pike *(Hepsetus odoe)* is the species which went through the most drastic decline. African pike started declining in the eighties. Ten percent of the respondents claimed that bulldog (*Marcusenius macrolepidotus*), locally (known as *Nono)* diminished as number two, otherwise other species have a smaller decline.

More than 32% of the respondents reported that fishing with gill nets is the major cause of species decline. There was also decline due to the use of Mosquito nets and more people fishing, with 16% and 15% respectively. Apart from the gear, the reduction of fish population is a result

of some piscivores such as tigerfish (*Hydrocynus vittatus*), *Eci* and *Mbago* (aquatic animals) found in the river.

Finally, 97% of the respondents agreed that fishing activity has drastically changed during the past years. The main attributes for the changes in fishing activities are more people engaged in fishing (25%), increment in fishing efforts (19%), and the introduction of modern gear (17%).

4.7 Fishing regulating laws

Similar to Kapako, people in Muveve claimed that there are no concrete laws to regulate fish in their area. Traditional laws, now inactive, were that one had to announce well in advance to the community if one intended to erect *masasa*. This had to be approved also by the village headman or headwoman. This was the case because catching fish in *masasa* was also a labour intensive exercise. You need more people to drive fish into small fishing gears such as *sikuku*. The second reason for announcing was that this was the time for distribution of fish among the community members.

Furthermore, there was also a belief that if a *masasa* was erected one should not cross the river. Moreover, if one was not part and parcel of the *masasa* group you were not allowed to sit around their fire. Fishers used to ignite fire around their fishing ground. In addition, people involved in *masasa* erection could not eat other meat and wild fruit.

Because of the strong social ties that prevailed among villagers, people complied to the rules without being forced to. According to the group this was easy because of the absence of fish market and low poverty rate at that time and fish could be distributed in homesteads.

It is asserted in the Namibian Constitution (Article 95) that "*The state shall actively promote and maintain the well welfare of the people by adopting ... policies aimed at --- maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future*". It is against this background the today's government through the Ministry of Fisheries

and Marine Resources developed the following objectives aimed at the advocacy of sustainable use of Freshwater fish in the country.

(a) to ensure the sustainable, optimal utilisation of the freshwater fish resource, and also protect the biodiversity of Namibian inland fish fauna

(b) to ensure that objective in (a) is based on sound ecological knowledge and principle,

(c) to, in communal resource favour utilisation by subsistence households and fishers rather than the commercialisation of the resources,

(d) to ensure that the responsibility for the management of a communal resource is vested at local level rather than with central government through 'top down' system,

(e) to ensure that local subsistence fishers through local community leaders are consulted about the extent the communal resource can be used for competitive and recreational angling by tourists,

(f) to strive for holistic approach in the management of the fish, the rivers and floodplain environments,

(g) to regulate the exploitation of the government owned dams,

(h) to regulate sport fishing in inland water

(i) to ensure co-ordination and co-operation between countries in the region, sharing inland water bodies and rivers with Namibia.

(j) To ensure that income generated from communal resources is shared by the local resource users, and

(k) To regulate the fishing gear by gear restriction,

4.7.1 Required Laws

People in the Muveve village were in support of new effective laws to be enforced, including gear restriction particularly of modern gear. Muveve being adjacent to the river, it is prone to malaria therefore the health workers are in advocacy of the use of mosquito net among villagers to reduce malaria prevalence in the area. The mosquito nets are sold at N$ 30.00 virtually in all big supermarkets in Rundu. Due to low price, the community sees this as a way of promoting the

accessibility or availability of these nets in the area, thus people tend to use them as fishing gears. People buy more than required, using the rest as gear.

Regulating procedures proposed were as follows; a committee constituting a chairperson and other members should be established. This committee will be the watchdog, to see to it that everyone involved in fisheries comply to the rules set by the committee and adopted by the entire community. Rules are 1) Anybody caught fishing with mosquito and gill nets for the first time should get serious warning, 2) Anybody caught fishing with mosquito and gill net for the second time, gears should be confiscated, and 3) If the person is found for the third time, this person should be referred to the relevant authority or line ministry. In addition to the proposed rules which the community want to see, the group members unanimously welcomed the notion of new training in fish farming.

5. DISCUSSION

5.1 Most commonly caught species of fish

In this study, and Tvedten *et al.*, 1994, *Tilapia rendalli* was the most commonly caught species while Hay *et al.*, (2000) reported that tilapia was the sixth on the list of top ten species, and *Pseudocrenilabris philander* was the most caught species of fish. The present study shows that *Pseudocrenilabris philander* was one of the least caught species. This might be the case in the sense that the present study was conducted during the similar period Tvedten's study was carried out. *Tilapia rendalli* occurs widely in Southern Africa including the three major perennial rivers of Namibia, Cunene and Kavango, and Zambenzi river systems, in eastern Congo basin and coastal rivers south of the Zambezi (Hay et al., 2000; Skelton, 1993). It is also translocated to many catchments in southern Africa. *Tilapia rendalli* can grow up to 40 cm and 2 kg, and breeds and raises several broods each summer. It prefers quite, vegetated waters along river littorals or backwaters, floodplains and swamps and feeds mainly on plant material, but may also feed on invertebrates and even small fish.

Schilbe intermedium was not reported in Tvedten study and was number seven in Hay's study. This shows that *Schilbe intermedius* differ significantly from year to year. Like *Tilapia rendali*, *Schilbe intermedium* is also widely distributed in Sub-Saharan Africa. It may reach 30 cm in length and 1.3 kg. It prefers standing or slow flowing water, often shoaling (Hay *et al.*, 2000). It feeds mainly on plants, but can also take other fish. While *Clarisa ngamensis* was the third most caught species in the current study and second in tvedten's study, it is not on top ten list of Hay's study. Cunene, Kavango, Zambezi, Kafue, Save, Limpopo, Zabian Congo system, Cuanza in Angola and Phongolo River systems are where *Clarisa ngamensis* can be found in southern Africa. It can grow up to 73 cm and about 4 kg. During summer rainy season is its breeding period. It feeds on molluscs, plants, insects, shrimps, crabs and snails. Barbs were the fourth most commonly caught in this study, third in Tvedten, and second in Hay. This is the case because local people do not differentiate different types of barbs but so long it is small fish they call it barb (*ence*).

While *Hydrocynus vittatus* was not on top ten list of Hay, it was the fourth in Tvedten and seventh in the current study. Unlike tilapia rendali, *Hydrocynus vittatus* is widespread in whole of Africa. It can can grow up to 70 cm (females), 50 cm (males) and to over 10 kg Hay et al., 2000; Skelton, 19939. It breeds in summer and spawn in shallow flooded areas. Elder *Hydrocynus vittatus* prey on other fish, while smaller ones eat invertebrates.

Surprisingly, *Hippopotamyrus ansorgii* was the third in Hay's study and reported to decline in the present study.

5.2 Gear types and effeciency

In the villages of this study, *Sikuku* (plural *Yikuku*) and *Sintungu* (plural *Yintunga*) were the most commonly used gears by fishers. *Sintunga* is used throught the year while *sikuku* is mainly during low water. Other reasons why *sintunga* is favoured by locals, is that it is appropriate for deep water (during floods), gendered (only female use it), give good yield while no destructive suffered by aquatic vegetation, and locally available. Being appropriate for deep water also makes it preferred, since if the fishing pressure increases fish will move to deep waters. The question of gives good yield without destruction on aquatic vegetation can not be concluded till further studies are done on it's impact on fish stocks and aquatic vegetation. Local availability also puts it on demand, since one can just get it without pay or very low pay if there is any charges.

In the present study, *sikuku* was the most used and favoured gear by fishers. Although *sikuku* require more women can be use by individual. Apart from being female oriented gear and locally available, *sikuku* has become number one of the traditional gear due to the high output it gives. Brouwer (1995) argued that mosquito nets would replace *sikuku,* but this is not verified in this study. I believe this is the case for three reasons; first, local people are becoming aware that fishing with mosquito net is an illicit practice, and to replace mosquito nets, they have to go back to *sikuku.* Second, the way *sikuku* is constructed makes it non-selective and hence gives high output. Thirdly, the fact that the demand of freshwater fish is on the rise, though still not that

really commercialised, favors gear that gives high output, to make money, and at the same time leaves enough for domestic consumption.

Masasa was among the most favoured traditional gear. Traditionally, *masasa* was operated by men. However, today it is mainly being operated by women. This is related to the fact that men have become marginalized as household bread-winners, and after withdrawing from hard work (many ending up with alcohol problems). In contrast, women being *defacto* responsible for supplying the household with food, this forces them to use various productive gears. In the past the setting up of *masasa* used to be announced and undertaken by village based group. Today *masasa* are constructed and staked by either individual or small group of people, normally family members. The most conivenient time for erecting *masasa* is during the period of August to November when the water is becoming low (Brouwer, 1995). However, villagers also reported to have erected *masasa* during the flood period.

Traditionally the Masasa was erected in several ways according to the characteristics of the river section where the fishing is taking place (Brouwer, 1995). When fishing in a pool, it is placed right in the middle from bank to bank. In the opening that is left, a giant type of *sintunga* (the so called *erera*) is placed in a way that does not yet block the opening completely. Now both men and women drive fish with stick through the opening from one side to the other side of the pool. Due to their high concentration, the fish are now easy to catch. To do this, women mainly use *yikuku* and men *muho*. *Sidid* is also used to a lesser extent. Fish caught with *erera* belongs to the owner of the *masasa*. The owner is the initiator of this communal fishing.

When fishing in the river, the *masasa* is used in different way. Held by a large group of men, it covers the river from bank to bank (Brouwer, 1995). While fishing with *yikuku*, women drive the fish downstream towards the *masasa*. As soon as the fish get there, men close the *masasa* all around the women and the fish. The opening in the ring that is formed this way is blocked with *erera*. Again the content of the *erera* belongs to the owner of the *masasa*, and the rest each individual fisher involved in this communal fishing can retain his or her catch. This is the way in which they get their renumeration.

Currently, only a few people are involved in the use of *masasa*, mainly family members. The blocking of the entire river does not seem to take place any more. *Masasa* catch a lot of fish, but is difficult to do because it is labour demanding and one needs time and skills to construct it. Even though people reported that the use of masasa today is virtually individual or in a small group, it really needs more people to give a good yield.

Erowo is also one of the traditional gear contemplated to be less destructive (MFRS, 1995). *Erowo* is likely to continue to be important due to the fact that it is suitable throughout the year, and catches big fish which gives high returns.

Muho is a gear exclusively used by men and boys. It is decreasingly favoured because of it is inefficient and time consuming, catching fish one by one. However, from an ecological point of view *Muho* is a sustainable gear in the sense that it takes only the wanted big fish.

Muduva are no longer effective when floods recede. Presently, young men are not fond of *Muduva* as it is seen as a very old fashion way of catching fish, and does not give high yield. There is not much difference the way *Muduva* and *Muho* catches fish as far as gear efficient is concerned. Therefore, the future viability of *Muduva* is questioned.

Pools and backwaters are the most favourable fishing grounds of *sididi*. *Sididi* was also a very popular fishing method in the past, but now less popular due to its poor yield (Brouwer, 1995). This was true in the present study.

As with *Muho* men and boys do not prefer to fish with *utawonkanza* anymore as it is time consuming and yield low output.

People could not recall exactly when modern nets were first introduced in Kavango. Tvedten *et al.*(1994) reported that only 14% of the respondents had fished with tyre nets, commercial nets or drag net. In the present study only 13% of the interviewed fishers in Kapako and more than 5% in Muveve reported to have fished with gill nets. This may reflect that people are afraid to report using this type without knowing whether gill nets are illegal or not.

Women are main users of mosquito nets or *masire*. *Masire* are used in the same way as *sikuku*, with one or more women chasing the fish into a net held by two women who close the net around the fish (Tvedten *et al.,* 1994). Alternatively the net is dragged against the flow of the river or in other shallow water bodies. People claimed that the origins of nets are former Consolidated Diamond Mine (CDM), currently known as Namibia Diamond Company (NAMDEP) and former member of South African Defence Force (SADF). Until 1990 Kavango being a Malaria prone region, during South African occupation of Namibia their soldiers in Kavango were given many mosquito nets for malaria prevention. However, as a substantial number of the soldiers working for the South African were from this area they started taking the nets to their villages and they spread in the area. Another, source explaining the existing of mosquito nets in the area, is the malaria campaign by the health ministry. The ministry is encouraging people to use mosquito nets to prevent malaria, hence nets are provided at the affordable price N$ 30 per net (equivalent to US$ 2.5).

"*Mosquito nets are so destructive, but the problem is that the Ministry of Health is encouraging us to use mosquito nets to prevent malaria, so, some people tend to buy more than needed nets some are just for fishing purposes*" group discussions.

For mosquito and other environmentally problematic nets to be controlled in Kavango is not that easy, because of the high return of fish associated with them. A better alternative to mitigate the prevalence of nets in the area would be to diversify the agricultural production system. In rural Kavango formal employment is very low. The only main source of income is as I have shown reeds and grass sale. One alternative in Kavango is horticulture development. People should start using the river for purposes other then fishing and drinking water. The community should be educated to engage themselves in gardens along the river. This will allow them to have many sources of livelihood, and ultimately shifting between the various activities.

The community could have a comprehensive timetable which tells them when to fish, when to do gardening and when to plant crops. This would relieve the pressure on fish.

5.3 Price of Freshwater and Marine Fish

The price of freshwater fish have gone up drastically during the past 2-3 years. Lokkevik and Sjolie, (1998) estimated the price of Freshwater fish to be N$ 1 per kilogram. This is low compared to the current price of Freshwater fish (see table – 2). Today the price of bulldog is N$ 9, blunttooth catfish is N$ 5, various small fish species is N$ 3 and tilapia is N$ 8 per kilo.

Lokkevik and Sjolie, (1998) urged that freshwater fish is an inferior product and substitute commodity to marine, meaning that if income of people improves they will not buy more fresh water fish or if marine price goes up the consumers will shift to freshwater fish. The findings of this study do not support this but rather urge that freshwater fish is an alternative. It is alternative because people are highly depended on it as source of income. From our results it became evident that freshwater fish is more expensive than marine, therefore, people can still buy fish even if their income improves or marine price declines. This is so because local people consider that freshwater fish is taster than marine. It has good cultural value attached to it.

5.4 The price determinant of freshwater fish

It makes sense that the bigger the fish the more expensive it is as was showed in the results section. However, species seemed to play major role in price determination. This is the case because local people believe that certain species are taster than others (i.e tilapia, southern mouthbrooder etc), and have attached more value. Consequently this results in preference. This means that even though tilapia is not that big it becomes expensive.

As in a free market, the number of the producers influences the price. If there are many fishers selling their fish the price will go down, but if there are few fishers, hence fish is limited then price will go up. One point of importance to mention in relation to price is availability of customers. Currently there are many people travelling between Rundu and Mpungu. These people are potential customers of fish hence the demand for fish is increasing every day and result in high prices. Poverty is also point to mention in regard to price increase. When a fisher

is entirely depended on fish only as source of his or her income, it compels them to make arbitrary price for quick returns. This will also force them to increase effort during fishing because they would think that catching a lot means more money.

5.5 Income generate from fish

There seem to be a transition from subsistence fisheries to commercial fisheries in Kavango. Tvedten *et al.*, (1994) reported that 58% of the households surveyed during their study sold fish and usually half or more of the catch is kept for household consumption. In this study 75% of the respondents claimed to sell the same percentage of their catch and keep 25% of their catch. Of importance to point out here is the income generated between N$ 75 – N$ 100 and N$ 100 – N$ 125. Unlike today, in the past fish was only for food. The 15% and 7% of the respondents who generated money in the respective range (N$ 75 – N$ 100 and N$ 100 – N$ 125) have a strong impact on the resource.

There is a motivation or incentive for outsiders to enter this industry for the purpose making money, and this will put more pressure on fish stocks.

5.6 Other sources of income

Although Namibia is rated as middle income country by international standards, still the inequality is incredible. The only main sources of formal employment in Kavango outside Rundu are education (teachers), health (nurses) and to a lesser extent sales man or woman in the shops. Due to lack of more alternatives of sources of employment this places pressure on the natural resources.

Reeds and grasses which are the major alternative source of income in the area are also natural resource and need to be sustainably and efficiently utilised. Both reeds and grasses play a significant role in the enhancement of the productivity of a floodplain, such as Kavango, hence promote new stock recruitment. To overcome this problem is that we need to consider several

issues; namely the advocacy of diversification of agricultural production (cash crop) and rural development for job creation. Traditional crop and livestock sale are not reliable due to the unpredictable rainy season the country has. Remittances will not help much in relieving the pressure from fish resources since only few people get it.

5.7 Educational level among fishers

Namibia has been independent for twelve years and the Government is promoting the concept of "education for all" but still it has long way to go. This is demonstrated by the results of this study which show that 42% of the respondents had no education. However, this is not necessarily a stambling block in natural resource management. Natural resources such as fish, forest, grazing land etc in many cases are common pool resource. Therefore, operational rules can be developed irrespective of whether the community is literate or not. Nevertheless, one may urge that the high percentage of illiterate resource users may mean that it will be difficult for them to comprehend written laws and regulation. It is therefore advisable that natural resources of this nature could be better managed through co-management systems.

5.8 Reasons why distinct groups of fishers fish

The main idea of this section was to determine which social groups of fishers actively engaged in this industry and for what reasons. As usual, subsistence fisheries are mainly predominant by women, this was also true in this study. Furthermore, it came apparent in the present study that women fish more than men due to several reasons. They fish because their livelihood depends on fisheries. The fact that women are more responsible for securing food for the household members, force them to fish more. The availability of their traditional gear and the cheapness of mosquito nets (N$ 30 per net) compel them to fish most of the time.

Surprisingly, instead of fishing for the well-being of the family, men fish for commercial purposes. This means that they fish for sale and drink the money or buy any other items.

A close look at young boys and girls of the same age (15 above) was also taken, which revealed that boys' reason to fish is similar to that of men, while girls fish because they have enough time to play at the river. It seems that girls only fish for recreational and domestic consumption. However, this is expected to change soon since the sale of fish currently pays well. Everybody would like to fish for commercial purposes.

5.9 People's perception on the availability of fish

African pike was the main species reported by fishers to be drastic declined. This was also confirmed by field observation. It was only observed once in Muveve village, but not at all in Kapako village. This species normally occurs in Cunene, Kavango and Zambezi rivers. It is also widespread through central Congo and West Africa. African pike can grow up to 47 cm and weigh 2 kg. It breeds during summer months and feeds on fish. African pike likes quiet and deep water in channels and lagoon of large floodplain (Hay *et al.*, 2000; Skelton, 1993).

The fact that African pike prefers quiet and deep water and apart from Hay's study, no other reliable biological studies were done in the Kavango River to determine the state of Afrikan pike it may be not correct to infer that the species has drastically delined.

Bulldog (*Marcusenius macrolepidotus*) was the other species reported to decline. This species is found in Central and Southern Africa. In Southern Africa, it is found in Cunene, Kavango and Zambezi Rivers of Namibia and in the coastal rivers and lakes from Tanzania to Natal, and also in the upper Congo. Bulldog can grow up to 30 cm and weigh 0.5 kg and breed during rainy season, and feeds on invertebrates (Hay *et al.*, 2000; Skelton, 1993).

The catch per unit effort in Kavango fisheries has drastically diminished over the past years (Brouwer, 1995; Hay *et al.,* 2000; Tvedten *et al.*, 1994). This was confirmed also in the present study.

Apart from the introduction of modern gear, people attribute the decline in fish population to some aquatic animals (*Eci* and *Mbago*), which prey on fish. However, this may not have big impact since they are part of the ecological processes.

5.10 Fishing regulating Laws

There seem to be well developed laws and regulation both at community and government level, but these are poorly enforced at all levels. At community level, things started changing at independence where people misleadingly interpreted the concepts of "it is my right". This concept led to cultural erosion, which had very strong social ties among villagers.

Furthermore, government had overlooked the importance of traditional laws in the past year, but recently it has realised that disregarding tradition laws at community level does harm to sustainable use of natural resource. Currently the government is incorporating local people in the management of natural resource. This is evident in their objective in the Responsible Management of Inland Fisheries of Namibia. The establishment of Institute of Inland Fisheries at Hardap Dam alone for the entire country was also the weakness of government. However, it is contemplated that a new institute of inland fisheries to be established in the Kavango region in the near future. This will be good for co-management of the resources and to rectify some loopholes in government policies on inland fisheries, such as restriction of gears through community consultations. This was not properly done earlier in the sense that the government was far from resources users.

5.11 Land tenure

After more than 70 years of South African administration, which imposed the *apartheid* system of racial segregation and culminated in a liberation war, Namibia gained her independence in 1990 – decades after most other African nations. This colonial system resulted in the majority of the population being confined mainly in the northern part of the country, hereafter, communal areas. The interior was proclaimed as police zone and divided in farm units and allotted to the white people. People in the interior were put in the reserves or camps. "Colonial injustices in land allocation, and a commitment to land reform, were major issues in the liberation struggle" (Turner, 1996). However, since independence the pace of land reform has been slow notwithstanding several conferences on land reform and land question took place since then. Therefore, the tenure system still looks quite similar as it was at the time of independence.

After independence, the article 100 of the Namibian Constitution officially awarded ownership of all land "not lawfully owned" – in other words, including the communal areas - to the state. At present this is merely a legal statement on land tenure in the communal areas. However, although all land belongs to the state, there is a considerable body of statutes dealing with communal land administration, but studies show that the statutory rules in practice are undervalued in practice (Corbett & Daniels, 1996). Namibia communal land is chiefly administered and allocated by customary or "indigenous law" as it can sometimes be called. It is a source of law relevant to common poor resources management. It furnishes a set of legal rules, particularly for the allocation and use of the resources, which regulate communities living on communal land (Corbett & Daniels, 1996). Indigenous law is generally unwritten and therefore survives in an oral tradition. This makes its ascertainment more sophisticated and its rules unsystematic and subject to diverse interpretation (Corbett & Daniels, 1996). Consequently, its enforcement and efficacy is entirely dependent on the respect and legitimacy received from the traditional authority structures charged with its implementation.

The land tenure system currently in place cannot give a clear indication for assigning property rights to effective, efficient and sustainable resource management; the subject of the next topic.

5.12 Property Rights as a management tool for sustainable fisheries

One of the ways people are connected to their natural environment and resource use is via property rights systems (Hanna *et al (ed).*, 1996). Regimes of property rights – the structure of rights to resources and the rules under which those rights are executed (Hanna et al., 1996), are mechanisms people use to control the use of the natural resource within their jurisdiction and their behavior towards one another. Property rights as bundles of entitlements confer both privileges and responsibilities (FAO, 200). Property rights are a part of society's institutions; the human device constraints that shape human interaction with the environment.

Furthermore, references to rights-based management systems can be references to anything along the very broad spectrum of different types of fisheries management systems. Right-based fisheries management systems may be based on the use of input controls or on the use of output controls. One way in which property rights are created is by licensing, and other forms of access limitation systems. Some are created by fisheries management systems and specify the value of fisheries resources for particular communities (community development quotas) in particular areas - territories use rights in fisheries, and of particular stocks (stock use rights in fisheries). In addition some property rights are created by individual quota (IQ), individual fishing quotas (IFQ), individual transferable share quotas (ITSQ) and individual transferable quotas (ITQ).

Therefore, the ways institutions are designed will robustly induce the interaction between people and their natural environment. Questions can be asked like: How the rights are defined – namely who has the right to the use of fish resources? Who has the right to the Nature? Is it possible to exclude some from the utilization of Nature based on defined rights? How are rights are allotted among competing interests? To what extent are they connected to spatially and temporally, and how do they evolve? Are those rights in line with the dynamics of resource stocks and process and functions of ecosystem?.

The consequence of human – environment interaction affects both the quality and quantity of the resources. " Environmental problems are problems arising from incomplete and asymmetric information coupled with incomplete, inconsistent, or unenforced property rights (Hanna *et al*

(ed)., 1996). Where property rights are well defined, decision makers would take a well-calculated decision. However, this is rarely the same with the natural environment. It is awkward if not impossible, to establish well-defined property rights for a "public goods" viz atmosphere, climate, or migrating fish population. These are poorly enforced resulting into the pattern of unconstrained resource use which some scholars called "the tradegy of the commons" (Ostrom, 1997; Bromely & Cernea, 1989; Hanna *et al* (ed)., 1996).

Each fisher finds him or herself into a system that compels him or her to increase the effort without limit in a river that is limited. In this case fishers can go fishing at any time for any length per day because the river is open to all. Since the right to fish is unspecified and unlimited, fishers continue to fish more or add more fishing equipment to maximize production, taking merely their own benefits and costs into consideration and disregard the collective effect of their actions. The pressure will result into overfishing, because there is no system of rights and responsibilities, that describes how fishing is to take place and how is to be sustained.

Apart from the essence that fish migrate and it is a common pool resource in Kavango, property rights on fishing grounds can be specified in a way that is not private but is nevertheless limited. Several alternatives are relevant in Kavango: The first is to revitalise the system of village owned fishing rights as community property (which has recently become inactive), restricting the use to village members, and regulating their use. The second one is to permit all the citizens of the state, especially people from Kavango region, to own fish or fishing grounds with the state management agency making decisions on fishing practices and setting Total Allowable Catches (TAC) consistent with the social goals of the communities and environmental justice of the river. In either case of public ownership, rights to the natural resources should be specified and allotted by collective decision making (Hanna *et al (ed).*, 1996).

However, both private and public ownership of fisheries, situations may prevail which lead to over-extraction of resource. Private owners may decide to catch a lot for the benefit of fast cash earning for the investments that have higher return. Village owners may find that expanding employment opportunities elsewhere lowers the future productivity of the ecosystem, and so lower enforcement efforts and rules of access. This also may result in the breaches of a collective

agreement – for some villagers to fish more than what was agreed initially. State owners may succumb to political pressures exerted by some interests, advocating higher levels of short-term resource use (Hanna *et al (ed).*, 1996), and effective management and monitoring of say TAC is questionable.

"Without a solution to property right problem, the environmental problem will remain. Economic development and sustainable resource use ultimately depend on institutions that can protect and maintain the environment's capacity and resilience" (Hanna *et al (ed).*, 1996). Furthermore, scholars argue that in some contexts, collective ownership is more appropriate for the management purpose of natural resources, which I believe can be the approach to sustainable management of inland fisheries in Kavango. Policies for sustainable fish utilisation in the inland fisheries of Kavango should be geared towards establishing property rights designed to fit cultural, economic, geographic and ecological context of the Kavango river. The basic functions of natural resources management are coordinating users, enforcing rules and adapting to changing environmental conditions. These cannot be fostered without a system of property rights. As resource becomes depleted or as demand increases, property rights must account for more trade offs and spill over effects, increasing the costs of program design and regulatory measures.

Due to rapid population growth and increase in per capita demand of resource and other factors, many property right systems have failed and will continue to fail if precautions are not taken. Under condition of technological, economic or environmental change, patterns of resource use that are maintained in a relatively stable situation may be disrupted. This may lead for example to changes in behaviour that alter the property rights regimes and change the rates of resources use. In Kavango when the local market opened up the fish harvest increased and will continue to increase even further once the regional or international market exerts influence. Groups may not be able to adapt to rules that direct appropriate behaviour. However, the market may respond swiftly to protective regulations, the topic of the following section.

5.13 Creating market as an incentive for sustainable fisheries

Market is a means by which environmental managers exchange goods and services in pursuit of their livelihood interests (Wilson & Bryant 1997). Because environmental managers sought to exchange natural resources that they extract or produce for other resources, the market has been associated with various policies and practices of environmental managers. Secondly, market puts a commonly recognised economic value on resource. The value depends on the significance of the resource in question to the environmental managers. The importance of a resource reflects several issues; viz supply of a given resources, how essential is the resources to the managers' livelihood needs, issues relating to cultural construction of resource and resource needs. The market has resulted as a way in which to facilitate interaction between environment managers in the pursuit of livelihood interests, via the creation of uniform pricing system that regulate access to natural resources. It creates a platform whereby natural resources can be exchanged. Market attaches value to the resources through the medium of exchange – that is the value of a particular resource is ascertained via a continuing process of price adjustment, based in theory on supply and demand. From environmental management perspectives this translates that market facilitates the exchange of resources over a large distances, which finally encourages large-scale production or massive extraction of resources to meet the demand of a wide area. This is evident in Kavango, where fish harvested and sold to other part of the region only in certain places of the river. There is evident when the catches are hung on the roadside for buyers who are travelling from Mpungu to Rundu or vice versa.

Market has a direct response to resource management. Not only do the environmental managers exchange resource; they also tend to modify their policies and practices to adhere to profit maximisation theory. It serves as a vital mechanism by which resource scarcity is regulated. Scarcity is the physical availability of natural resources. Therefore, the market can depict the tension at times between market and the quest for predictability of resource availability to the environmental managers or resource users. Moreover, scarcity can be the reflection of political and economic factors that may generate "imposed scarcity" (Wilson & Bryant 1997). These may reflect a variety of motivations such as power, profit or prestige (e.g OPECs Petrol price is set

only by the organisation either because of profit purposes or resources scarcity). Most of the resource scarcity problems have manifested as a result of the combination of rapid population increase and intensified per capita resource use, and impacts on environment has placed a growing pressure on some resources like forest, clear water and air (Wilson & Bryant 1997).

A good functionable market system is highly required in Kavango. Currently there is no well established infrastructures where the catches can be store without being spoiled. The only form of fish storage and processes is either selling it while fresh or dried. This makes it necessary for the fishers to fish everyday, just because he or she knows that some of the catch can easily get spoiled. In addition to that, the market price of fish is hard to maintain. For one to clearly comprehend the importance of the market in relation to resource utilisation, basic renewable resource theory is presented in the next section.

5.14 Over-fishing

There is no reliable data on the productivity of the Kavango river as to whether the present activity is under the (Maximum Sustainable Yield) MSY, at MSY, or in the over-fishing stage. Estimates of Maximum Sustainable Yield (MSY) in the Namibian section of the Kavango river is in the range of 840 –3000 tonnes (Tvedten *et al.* 1994; Skelton, 1993). However, the study of Tvedten and his colleagues (1994) assume that the fishing activity in Kavango is approaching the over-fishing stage. They estimate the productivity of the system to be 1, 045 tonnes per annum. Though there are no reliable data on the system's productivity, a general conclusion can be depicted below in figure 5.7.3. For us to know the level of exploitation we have to introduce other concepts in the figure. These are cost and efforts. Figure 5.7.3 below shows a simple fishery economics model on the basis of which fundamental concepts of capture fisheries such as over fishing, MSY and an increase in the fishing efforts. The figure refers to a theoretical model from which no predictions can be made, but only aims at providing an insight into the effects of catch on the finite natural resource. Similarly, the model demonstrates the need for the effective management of fisheries.

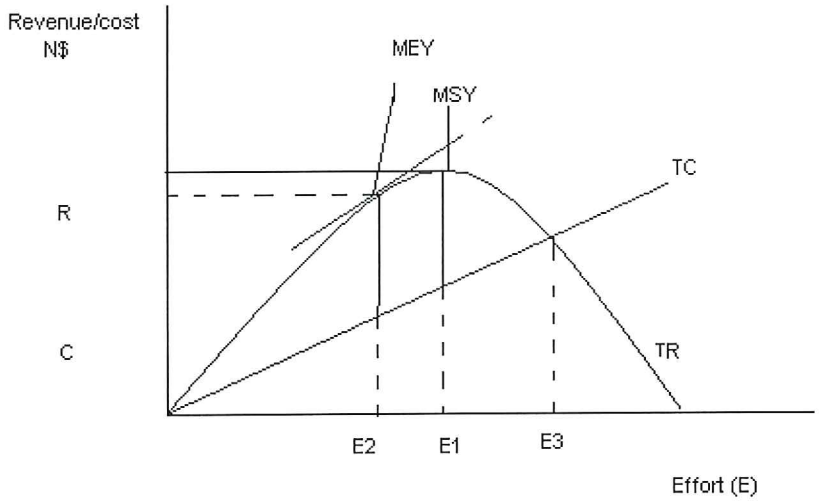

Figure 8: *Over-fishing and profit maximization*

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In the figure the horizontal axis represents the fishing effort. It can increase in many ways such as an increase in number of fishers (which is the case in Kavango), number of boats, the amount of gear per boat or fisher, the introduction of modern gear (also relevant in Kavango), an increase in the average amount of time spent fishing (the case in Kavango), or as a result of a combination of the above factors. The vertical axis indicates the magnitude or the value of the cost associated with a particular level of effort.

The Total Revenue (TR) curve shows the change in value of catch as fishing effort increases. The Total Cost (TC) line indicates the change in total cost as the fishing effort changes and is based on a fixed sum per unit of fishing effort. A fisher or a net spending a certain amount of time in the water can be considered as the unit of fishing effort.

Now, let us start from a non-exploited fish resources, revenue initially increases rapidly as the fishing effort increases. After a while the point will be reached where the increase in value of the

catch increase insignificantly and ultimately becomes zero. In the figure this point is at E_2 if the total fishing effort remain constant and the fish population stays unchanged, then in principle the same quantity of fish can be harvest in long term over and over. This quantity is what we refer as maximum sustainable yield (MSY).

However, it is unlikely the situation to remain the same. The fishing effort will increase further if there are no control measures such as entrants' control or lack of food and other sources of income in a situation, which is akin to Kavango. If this is the case then the situation evolves towards that of over-fishing. What usually happens is that the yield level decreases beyond point E_2 though the optimum may not be clearly discernible.

The total profit of the fisheries, the so-called 'resource rent' is the difference between the cost incurred and the total yield and is represented in the figure as the distance between the cost line and the yield curve. The total yield where the resource rent is at its maximum (that is the distance between the Total Cost line and the Total Revenue curve is greatest) is situated at E_1 and is referred to as the Maximum Economic Yield (MEY). If the fishing grounds were private property or if the administrator had complete control over the fishing effort and was motivated only by economic factors then the fishing would most likely to take place at E_1, since that is the point where fishing is producing high profit. Beyond this point profits are reduced, since the extra yield resulting from the increase in fishing effort is smaller than the costs of the extra effort.

What then will happen in the case of open access resource such as the fisheries under review? In this case the fishing will in general perpetuate to increase until the level is reached where the profit per effort unit equals zero. In the figure 5.7.3 this is at E_3 at which the Total Costs line intersects the Total Revenue curve (the Zero rent point or Open Access Equilibrium). At this point the fish population is heavily exploited. In theory a fisher at E_3 has an income equal to what he could earn outside the fisheries sector 'opportunity income'. If there are no opportunities to make income outside the fisheries this income ('opportunity income') will be (virtually) zero. In a situation of this nature fishers in commercial fisheries will continue fishing so long they can still cover their direct variable costs (fuel, repayment on loan for the purchase of fishing gear and vessels possible cost for third part labor) with this income. At subsistence, with no other source

of employment and other sources of food security, people will continue to harvest even heavily over-fished stocks which yield only minimal catches, and this is the case in Kavango subsistence fisheries.

5.15 Collaborative management (co-management)

Collaborative management or Co-management involves the sharing of functions, rights, and responsibilities of resource management among various stakeholders and resource users (Nyikahadzoi, 1995; Mölsä *et al.,* 1999; Francis & Bryceson, 2001; Tvedten, 2002). The main stakeholders in the co-management usually include government authorities, NGOs and resources users. In other words management is viewed as a multi-layered process, which, involve many stakeholders (Wilson & Bryant, 1997). Through the co-management initiatives, significant achievements can be made, by mitigating the impacts of a number of environmental threats (Francis & Bryceson 2001; Tvedten, 2002).

In many instances of co-management practices, the government remains the legitimately responsible for the overall management of the resources, while the resources users' needs are considered in planning and implementation processes (Francis & Bryceson, 2001; Tvedten, 2002). However, it is vitally important to point out that the success of co-management of a certain resource will entirely depend on how fast the parties involved are prepared to change their attitude towards the adaptation of co-management approach to resource.

To relate co-management to sustainable fisheries in Kavango, the communities (resource users) with their traditional knowledge, know which section of the river they can get which type of fish species, when can they get it, and during what season of the year certain species are in big number. Traditional knowledge is here defined as " a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission about the relationship of living beings with one another and with their environment" (Nangula, 2001). Traditional knowledge is an evolving subject and has in recent years become very imperative among scientists, managers, planners, and police makers. The notion of considering the local people as ignorant and environmental destructors has become dissipated in

the current scientific debate. Interest in traditional knowledge began with the study of species identification and classification and then proceeded to considering the people's understanding of ecological processes and their relationship with the environment (Nangula, 2001).

From a scientific point of view collaborative management will also bring into being the scientific ecological knowledge from scientists' perspectives. Payne *et al.,* (2001) reported that there are six fish families along the Kavango river. These are Cichlidae, Cyprinidae, Cyprinodontidae, Characidae, Siluriforms and Mormyridae. Of those families more than 53%, of the total are from Cichlidae family. Most of the Cichlidae families are K-*strategists* species such as *Tilapia rendalli* and *Tilapia sparramii.* Some K-selected piscivorous – *Serranochromis* species and Tigerfish appear in low number during November and grow to juveniles by February (Payne *et al.,* 2001).

According to Smith, (1996) and Smith & Smith (2001), K-*strategists* are competitive species with stable populations of long-lived individuals. Among selections K-*selected* species favors genotypes that confer a slow growth rate at low population, but have the ability to maintain that growth rate at high densities. K-*strategists* have the ability to cope with physical and biotic pressure. They possess both delayed and repeated reproduction, and have larger body sizes and slow development. K-*strategists* produce few seeds and eggs and hence few offsprings or fingerlings. Among animals the young ones require parental care in K-*selected* species.

The next fish species in big number are the cyprinids family, 29% of the total (Payne *et al.,* 2001). Most of these families are *r-strategists* and typically short-lived (Smith, 1996; Smith & Smith, 2001). These types favor genotypes that confer high reproduction rate at low population densities. They are of early and single-stage reproduction, rapid development, small body size and large number of offsprings or fingerlings but with low survival and minimal parental care. According to Payne *et al.,* (2001) *r-selected* species in Kavango river peak in May (65%), June (77%) and September (68%) during the height of flooding and were available as prey to young piscivores. The destruction of aquatic vegetation might be seen as an environmental threat to the river and fish reproduction, because grasses around the pans-floodplains in this case are highly productive for fish spawning. However, Payne, et al., (2001) reported that destruction of aquatic

vegetation due to overgrazing of livestock permits the re-entry into system, and hence will enhance the productivity of the system.

A comprehensive understanding of resource management requires collaborative management system in place. In the case of Kavango the local people have to know also about the K-strategists and r-strategists species for them to exploit this resource in a sustainable manner. And this can only be achieved by collaborative management approach to resource utilization, which encourages sharing and exchanging of knowledge from different disciplines. There seems to be less incentives to conserve *r-selected* species if we know that they are not going to live longer. Communities should also know that r-selected species favor high reproduction rate at low population, while it is a reverse with K-*selected* species.

It is also imperative for the community to know that young K-strategist species require parental care, therefore the more we catch the big ones the higher risk we stand to reduce their population size, even to the extent of species extinction.

On the other hand the local people know that for instance why tigerfish peaks in November. It is because that is the beginning of good rainfall in the area and some ants are in huge quantity for tigerfish to feed on. They also know why tilapia species prefer to be in the back-water or increase during floods, because they are herbivore and feed on mud soil and grasses. This clearly demonstrates the significance of co-management in order for various disciplines of knowledge to complement each other. Local people will also be in a good position to tell the scientists which lakes along the river have many fish and during which season fish are in big number and what types of species there are in each lake.

6. CONCLUSIONS AND RECOMMENDATIONS

In this thesis, I have outlined and analysed the freshwater fisheries in the Kavango Region of Namibia. I did this by first putting the Kavango fisheries in context: on a global scale freshwater fisheries are important for employment and nutrition among both rural and urban people. Freshwater fisheries are vital for a number of rural communities in Southern Africa, which has a number of large lakes and perennial rivers.

Namibia is a semi-arid country with relatively few freshwater resources and where marine fisheries dominate, and freshwater fisheries are limited. However, these freshwater fisheries are important for the population in the north east (Kavango and Caprivi) which are the locations of the large rivers Kavango and Zambezi. In Kavango, fisheries has become more important with increasing population and poverty, and increasing domination of the market and hence dependence on money. With increasing fishing pressure, management systems are becoming more difficult to implement.

According to Tvedten *et al.,* (1994) and Brouwer, (1995), poor families seem to fish more than the wealthier family. In my study, well above 78% of the respondents claimed fishing is not wealth-dependent. It has come to light both in the formal survey, the group discussions and from key informants that both rich and poor eat fish as a source of protein and they also fish for income generation purpose. The better-off families may not be involved in the fishing activities on the ground, but employ other means of getting fish such as hiring someone to fish for them, or buy from the fishers' catch. More than 25% of the respondents claimed that fishing activities have increased due to population growth and only 17% said that it is due to the introduction of modern gears.

A large proportion of the respondents (40%) were illiterate. However, this should not be seen as the stambling block for sound communal natural resource management.

There are several different reasons for fishing in Kavango. Women were reported to fish more than men due to their household responsibilities. More than 40% of the respondents generated income below N$ 25.00, and close to 30% below N$ 50.00 a day from fish. Selling of reeds and grasses is the main alternative for income generation in the area.

Species and size of fish are the main determinants of freshwater fish price in the area, followed by customers' preference and taste. Freshwater fish is more expensive than marine fish.

The formal employment in the area is very limited. This will have a strong impact on the fish resource since it is viewed as the quick income generation source.

Traditional gear appear to be more favoured than modern gear due to the rising awareness among local people that modern gear are destructive and some are illegal. Traditional gears are gender based. *Sikuku* is the gear most preferred by women, while men prefer *erowo* and gill net. Gill nets tend to be more efficient in terms of CPUE compared to all other gears. Furthermore, not all traditional gear are effective throughout the year, some are seasonal.

Tilapia and silver catfish were the most caught species. There seemed to be awareness among local people about the disappearance of some fish species from the river. African pike and bulldog are reported to be drastically decreased. The main causes of the decrease of some species are the use of gill net and mosquito net. People in Kavango were generally not aware as to whether fishing is currently controlled by themselves or by the government, but they informed us that there were some traditional rules which governed fish resources but that these are now inactive. Both group discussions and the survey questionnaire show that, people prefer fishing to be traditionally regulated. Until now the Maximum Sustainable Yield of Kavango River is unclear.

It appears evident that management of freshwater fisheries in Kavango needs to strike a balance between traditional practices and government laws and regulations through co-management. As argued the market is an important regulatory factor. Perhaps most importantly, however, is a diversification of sources of income particularly in agriculture, which would relieve some

pressure on the fisheries resource. However, a functional market can only exist if good infrastructure and means of transportation are available. In terms of fish product, without good storage facilities it gets spoiled easily and this compels fishers to fish more often and intensively. Whereas with good market infrastructures in place the fishers would be able to sell their catch at fair price. This might act as control mechanism to make fishers harvest only what they need. Therefore, line ministries are requested if possible to provide decent infrastructures at certain points in the region where fishers could bring their catch for sale.

Involving local people in the decision-making pertaining to the utilization of Kavango River is of crucial importance. More scientific research, both ecological and socio-economic, must be carried out on a continuous basis. During the period of UNITA control of southern Angola, the pressure on the fish resource was limited on the Angolan side. Now transboundary co-operations both between the resource users and governments will be important. Even though the MSY of the system unknown, the recruitment of fish populations differs from year to year. Therefore, seasonal closure for some lakes along the river should be investigated towards sustainable maintenance of fish stocks. Fishers should be encouraged to record their catch in order to team up with scientific studies to determine the MSY of the system. Total allowable catch per fisher must be agreed upon between local communities, scientists and government. The impact on fish populations of the use of mosquito nets should be investigated, and if necessary banned and strict supervision should be put in place through co-management systems involving local communities.

Environmental education both in schools and in the community should be emphasised, with inclusion of freshwater fish resources, in order to sensitise people on how to co-exist with their environment harmoniously.

In sum and returning to the original hypothesis, then increasing fishing pressure in Kavango appears to be both due to population growth and increase in fishing effort. This implies a particular challenge to sound management that will retain freshwater fish as a vital source of food and income generation for the riparian population of Kavango region.

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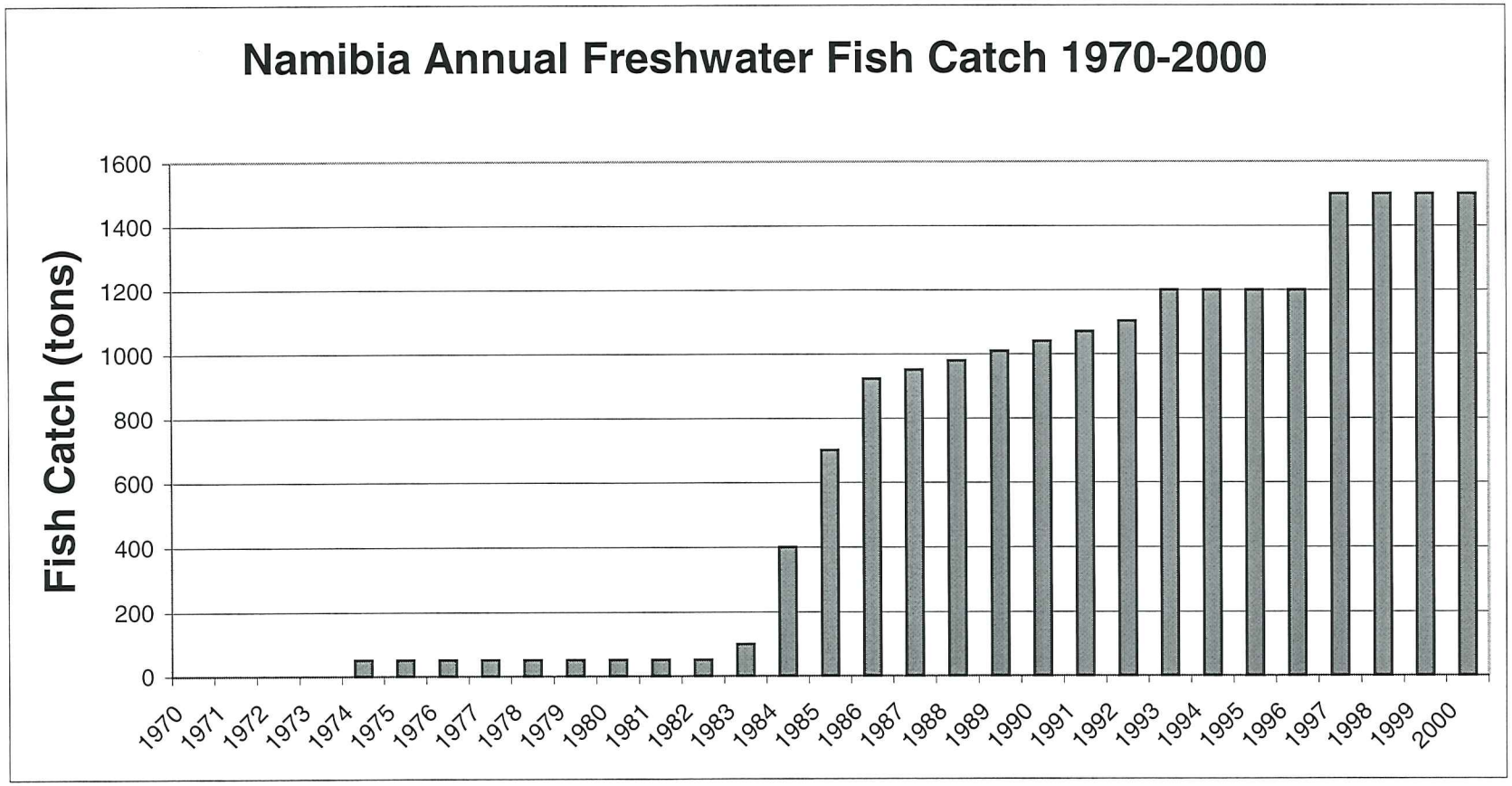
List of Appendices

***APPENDIX* I:**



Source: FAO (2002) Fishstat+ version 2.30

APPENDIX II

Table – 3 *Scientific, English and Local names (in Rukwangali) of Freshwater fish of the Kavango River*

Scientific Name	Common English name	Common Local name	Notes
Hippopotamyrus ansorgii	Slender stone basher	*Kakofu*	Important for subsistence fisheries
H. discorhynchus	Zambezi parrotfish	*Nono*	Important for subsistence fisheries
Marcusenius macrolepidotus	Bulldog	*Nono/Nza*	Interesting for aquarium subject and potential for subsistence fisheries
Mormyrus lacerda	Western bottlenose	*Nono*	Caught by subsistence fisher and angler
Barbus afrovernayi	Spottail barb	*Ence*	Attractive and peaceful in aquarium
B. barnardi	Blackback barb	*Ence*	Attractive aquarium fish
B. barotseensis Pellegrin, 1920	Barotse barb	*Ence*	Potential aquarium species, possible the same as broadstriped barb
B. bifrenatus	Hyphen barb	*Ence*	An attractive aquarium fish may be confused with bow strip barb
B. breviceps	Shorthead barb	*Ence*	A little known species described from longa river, in Angola
B. brevidorsalis	dwarf barb	*Ence*	Attractive aquarium fish
B. codringtonii	Upper Zambezi yellowfish	*Egcuvance*	Similar to largescale yellow fish and many represent the same species, potential for subsistence fisheries
B. eutaenia	Orangefin barb	*Sisoso*	Attractive for aquarium
B. cf. eutaenia	Orangefin-like barb	*Sisoso*	
B. fasciolantus	Sickle-fin barb	*Ence*	Attractive for aquarium barb

B. haasianus	Redspot barb	*Ence*	Suited to well-aerated aquarium
B. kerstenii	Line-spotted barb	*Ence*	An attractive aquarium fish
B. lineomaculantusB. miolepis	Zigzag barb	*Sisoso*	Suited for large aquarium
B. multilineatus,	Copperstripe barb	*Ence*	An attractive aquarium species distinguished from juvenile orangefin
B. paludinosus,	Straightfin barb	*Sisoso*	Mainly found in Malawi
B. poechii	Dashtail barb	*Sisoso*	Bait for tigerfish, suitable for large aquarium or pond
B. radiatus	Beira barb	*Sisoso*	Attractive aquarium fish, a member of subgenus *enteronium*
B. thamalakanensis	Thamalakane barb	*Ence*	Attractive aquarium fish
B. unitaeniatus,	Longbeard barb	*Ence*	Important for subsistence fisheries
Coptostomabarbus witti	Upjaw barb	*Ence*	Attractive aquarium fish
Labeo lunatus	Upper Zambezi Labeo	*Enduvi*	Caught by subsistence fisheries in floodplains such as Kavango
Mesobola brevianalis	River sardine	*Enduru*	Introduced to dams as forage for large game fish in Zimbabwe
Opsaridium zambezense	Barred minnow	*Piri muhero*	Rare in South Africa, threaten by water abstraction and pollution
Brycinus lateralis	Striped robber	*Kayeve*	Bait for tigerfish and large bream, caught in subsistence fisheries
Hydrocynus vittatus	Tigerfish	*Nyiru*	Major angling gamefish also important commercial species (1977 184 tonnes were harvested from lake Kariba alone)

Micralestes acutidens	Silver robber	*Kayeve*	Attractive in large aquarium, used for forage fish and as a bait for tigerfish and pike
Rabdalestes maunesis	Slender robber	*Kayeve*	Attractive in aquarium
Hepsetus odoe	African pike	*Mukunga*	Excellent angling species on light tackle, also good for subsistence
Parauchenoglanis ngamensis	Zambezi grunter	*Situnda wiru*	Potential species for aquarium
Schilbe intermedius	Silver/butter catfish	*Sipava/Engweru*	Important for subsistence fisheries target, angling species but often recorded as nuisance and occasionally kept in the aquarium due to its predatory habit. Previously known as *S. mystus* and *Eutropius depressirostris*
Claria gariepinus	Sharptooth catfish	*Hogo*	Angling and food fish species, control over its movement is essential
C. ngamensis	Blunttooth catfish	*Hogo*	Essential for subsistence and commercial floodplain fisheries
C. theodorate	Snake catfish	*Hogo*	Caught by subsistence fisheries and occasional aquarium pet
Chiloglanis fasciatus	Kavango suckermouth / rock catlet	*Eputu*	Caught by subsistence fisheries
Synodontis leopardinus	Leopard squeaker	*Eputu*	Important for subsistence fisheries
S. macrostigma	Largespot squeaker	*Eputu*	Important for subsistence fisheries
S. macrostoma	Largemouth squeaker	*Eputu*	Important for subsistence fisheries
S. nigromaculatus	Spotted squeaker	*Eputu*	Important for subsistence fisheries

S. thamalakanensis	Bubblebarb squeaker	*Eputu*	Important for subsistence fisheries
S. vanderwaali	Finetooth squeaker	*Eputu*	Important for subsistence fisheries
S. woosnami	Upper Zambezi squeaker	*Eputu*	Caught by subsistence fishers
Aethiomastacembelu s frenatus	Longtail spiny eel	*Haruzwazwa*	Potential aquarium species, possible the same as the shire spiny eel and similar
Hemichromis elogatus	Banded jewelfish	*Nkudu*	Occasional aquarium fish, slightly harvested by subsistence fishers
Oreochromis andersonii	Threespot tilapia	*Kapamba*	Valued in aquaculture and fisheries, also popular for angling species
O. macrochir	Greenhead tilapi	*Mboyena*	Valued fisheries, aquaculture and angling species
Phyryngochromis acuticeps	Zambizi happy	*Ntunguru*	Potential aquarium fish
Pseudocrenilabrus philander	Southern mouthbrooder	*Mbunze*	Aquarium species, Used for behavioural and evolutionary research
Sargochromis carlottae	Rainbow happy	*Kakwanya*	Subsistence and commercial fisheries, angling target. Useful snail control agent
S. codringtonii	Green happy	*Nkudansa*	Subsistence and commercial fisheries, angling target. Useful snail control agent
Serranochromis altus	Humpback largemouth	*Mbanda*	Previously confused with the thinface largemouth

S. angusticeps	Thinface largemouth	*Mbanda*	Popular angling target, important for subsistence and commercial .
S. macrocephalus	Purpleface largemouth	*Mbunze*	Angling target important component of subsistence and commercial fisheries
S. robustus	Nembwe/Tsungwa	*Mbunze*	A major angling target with bass-like qualities of subsistence and commercial fisheries
S. thumbergi	Brownspot largemouth	*Mbunze*	Angling target important component of subsistence fisheries
Tilapia rendalli	Redbreast tilapia	*Nkundu*	A popular angling species, valued in aquaculture and fisheries, used for weed control in dams
Microctenopoma intermedium	Blackspotclimbing perch	*Mbwindi*	Interesting aquarium species extremely rare, susceptible to aerial spraying of insecticides Angling target important component of subsistence

Source: Ministry of Fisheries and Marine Resources 2002
Skelton 1993

Appendix iii

Questionnaire form

The prospects of Inland Fisheries in Kavango River - Namibia

Respondent's Information

Village _____

Name of respondent _____

Sex

Male	1	Female	2

Age _____

Educational Level _____

Marital status _____

Date of the interview _____

1. Socio-economic characteristic of fishing population

3.9 Do people fish in this village?

Yes	1	No	2

3.9.1 If yes, who fish most of the time? **(circle all that applies)**

Men	1
Women	2
Boys of 15 years above	3
Girls of 15 year above	4

3.9.1 Explain your answer above, if there is gender or age difference, why is this?

_____

3.10How often do fishers go and fish? (circle one only)

Once a day	1
Twice a day	2
Once a week	3
Twice a week	4
Thrice a week	5
Four time a week	6
Once a month	7
Twice a month	8
Thrice a month	9

Others specify	10

3.9How much does a fisher catch per unit effort? (explain what is meant by unit effort – gear types and effort measured in man-hour used)

_____

3.10How much of your catch do you sell?

None	1
25%	2
50%	3
75%	4
100%	5

1.5 Does your proportion of sale differ with seasons **(dry and wet seasons)**

Yes	1	No	2

1.5. (a) If yes, how much of your proportion do you sell during wet season?

None	1
25%	2
50%	3
75%	4
100%	5

(b) How much of your proportion do you sell during dry season

None	1
25%	2
50%	3
75%	4
100%	5

3.9 What determine the price of your catch? **(circle the three most important only)**

Species	1
Taste	2
People's preferences	3
Time of the day	4
Availability of marine fish	5
Number of producers	6
Form of production	7
Others specify	8

1.7 Where doe you sell some or all of your catch, how and how much? **(circle that applies)**

Marhet place		**Species**	**Form**	**Batches in wet season per catch**	**Batches in dry season per catch**	**Price per batch in N$**
A long the road(Fish tree)						
At the cucashop						
In Rundu town						
At Rundu open						

market						
Other specify						

3.9.1If you do not sell some of your catch why is it so?

_____

1.8 How much do you make a day?

N$ 25 – N$ 50	1
N$ 50 – N$ 75	2
N$ 75 – N$ 100	3
N$ 100 – N$ 125	4
N$ 125 >	5

1.8 What do you use the money?

Buy food	1
Pay school fees	2
Pay health fees	3
Buy beer	4
Buy clothing	5
Buy personal care product	6
Buy utensils	7
Others specify	8

1.10 Apart from fish sale, what are your other source of income? **(circle the three most important)**

Formal employment	1
Casual work	2
Crop sale	3
Livestock sale	4
Basket and poultry	5
Reeds and grass sale	6
Woodcarving	7
Remittances	8
Wild fruit sale	9
Others specify	10

2. Types of gear and their efficiency for catch per unit effort

2.1 What types of fish species are found in this river **(circle all that applies)**

Nkundu – redbreast tilapia	1
Ence – Barbs	2
Hogo – Blunttooth catfish	3
Kapamba – squeaker	4
Mbanda – Greenhead tilapia	5
Sipava – Silver catfish	6
Kancuva – Zambezi parrotfish	7
Mbunze – Purpleface largemouth	8
Mboyena – Threespot tilapia	9
Nono – Western bottlenose	10

Sinduwi – Redeye labeo	11
Nyiru – Tigerfish	12
Mukunga – African pike	13
Enchuvance – Barotse barb	14
Nkaramamanya – S. mouthbrooder	15
Nkusa – Unknown	16
Nza – Bulldog	17
Ntasi – Unknown	18
Ngce-	19
Kakofu	20
Mbwind – Climbing perch	21
Others specify	21

2.2 Which are the most caught species? **(circle all that applies)**

Nkundu – redbreast tilapia	1	Value per batch/fish/kilo	Gear used	Fish processing
Ence – Barbs	2			
Hogo – Blunttooth catfish	3			
Kapamba – squeaker	4			
Mbanda – Greenhead tilapia	5			
Sipava – Silver catfish	6			
Kancuva – Zambezi parrotfish	7			
Mbunze – Purpleface largemouth	8			
Mboyena – Threespot tilapia	9			
Nono – Western bottlenose	10			
Sinduwi – Redeye labeo	11			
Nyiru – Tigerfish	12			
Mukunga – African pike	13			
Enchuvance – Barotse barb	14			
Nkaramamanya – S. mouthbrooder	15			
Nkusa – Unknown	16			
Nza – Bulldog	17			
Ntasi – Unknown	18			
Ngce-	19			
Kakofu	20			
Mbwind – Climbing perch	21			
Others specify	21			

2.3 Which types of fishing gears are most used fishing equipment and Why? **(crcle all that applies)**

Gear Type	**Reasons for the use of gear**
*Sikuk*u (fish funnel)	
Sintungu (fish corral trap)	
Erowo (hook and line)	
Muho (fish spear)	
Sididi (push basket)	
Muduva (valved traps)	
Masasa (fish fence	

Mosquito net	
Gill net	
Cast net	
Lishino (scoop basket)	
Singundo (push basket)	
Utawonkanza (bow and arrow)	
Others specify	

2.4 a) Which are the three most preferred gears? **(start in the order of importance)**

_____

b) Who prefers which gear? (any gender, age or traditional differences)

_____

2.5 Does the water volume in the river influence gear preferences?

Yes	1	No	2

2.5.1 Explain your answer above.

_____

2.6 Is the use of gear the same throughout the year?

Yes	1	No	2

2.6.1 Explain your answer above.

_____

3.9Is the effectiveness of the gear the same throughout the year?

Yes	1	No	2

2.7.1 Explain your answer above.

_____

3. People's perception on the availability of fish stock

3.1 Is there still enough fish in the river for everyone?

Yes	1	No	2

3.1.1 Explain your answer above.

_____

3.9 Does fish availability vary from year to year?

Yes	1	No	2

3.2.1 Explain your answer above.

_____

3.3 Describe how was the fishing activity regulated in the past with reference To the following.

a) Laws/rules that were in place

_____

b) Enforcement of those laws/rules

_____

c) The role of institutions

---

d) What were the incentives for the compliance?

3.4 How is it currently regulated? **(circle only one)**

Traditional	1
Individually	2
State	3
Jointly (state and local people)	4
Others specify	5

3.5 How would you like it to be regulated? **(circle only one)**

Traditional	1
Individually	2
State	3
Jointly (state and local people)	4
Others specify	5

3.6 Why do you want it to be regulated that way?

3.7 Do you remember some fish species that are not seen any longer or have diminished significantly?

Yes	1	No	2

3.7.1 If yes, which fish species?

3.8 Why do you think the above mentioned species have disappeared or become scarce? **(circle all that applies)**

Fishing with mosquito nets	1
Fishing with nets	2
Drought	3
More people in the village	4
Increase in predators	5
Catching young fish	6
Pollution	7
Others specify	8

3.9 Is there any change in fishing activities compared to the past (during your childhood)?

Yes	1	No	2

3.9.1 If yes, what changed? **(circle all that applies)**

Fishing with mosquito nets	1
Fishing with nets	2
Drought	3
More people in the village	4
Increase in predators	5
Catching young fish	6

Pollution	7
Others specify	8

3.10 Do fishing activities depend on wealth status?

Yes	1	No	2

3.10.1 Explain your answer above.

_____