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MINISTRY OF FISHERIES AND MARINE RESOURCES

WHITE PAPER

ON THE

RESPONSIBLE MANAGEMENT OF THE INLAND FISHERIES OF NAMIBIA



White Paper
on the
Responsible Management of the Inland Fisheries of
Namibia

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FOREWORD

The future role of fish in food security paint a gloomy picture of falling catches and an increasing human population. As with other key food items this trend is most disturbing from the viewpoint of the poor, for as the spiral of diminishing supplies and rising demands and prices continues, by free market forces and related entrepreneurial actions, the fish now available to the poor will be commercialised and thus wealth will only be created for a few individuals to the detriment of those who have been dependent on the fish from time immemorial. It is the responsibility of the Government as the agent of the people of Namibia to see to it that our available resources are utilised in the most beneficial way in line with Article 95 of the Namibian constitution.

The policy spelled out in this White Paper benefited from the inputs made by the communities with a vested interest in inland fish. It can therefore be said that the policy paper truly reflects the views and sentiments of the people it aims to serve. The draft bill that is to put the policy into effect likewise bear evidence of legislation by the people for the people.

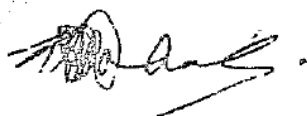
The emphasis in this new policy and the legislation that is being drafted is on sustainable management of resources, protecting the historic rights of subsistence households and discouraging commercialisation of the resources in unfair competition with traditional fishers.

This white paper also embodies a novel approach in that the management of a communal resource will be vested to a large extent with those that utilise the resource. Income that may be generated by the resource will in principle be channelled back to the communities. The benefits communities will reap from resources will therefore to a large extent depend on the wise management of the resources by the communities. The Ministry will however play the role of watchdog, especially to guard against abuse and over-exploitation.

The policy and the draft bill take into consideration the considerable differences in the various inland systems and proposes very different approaches in the different systems. As experience is gained on the management the future legislation will undoubtedly be amended to enable the management system to evolve and change as the needs may arise.

The policy developed for Namibia in the management of its inland fish resources may serve as a model for other countries in Africa that grapple with the same problems in their inland fisheries. The nature of the perennial river systems shared by Namibia with neighbouring states, especially the fact that the catchment basis of our rivers are basically outside Namibia and not under our jurisdiction, is problematic in terms of management. It therefore calls for timely action in negotiating with the relevant countries to reach a mutually agreed code of conduct on the management of the shared river systems.

I believe that should the principles spelled out in this White Paper be implemented, the benefits from our inland fish resources will be available to our children and grandchildren to enjoy, but above all, our country will be a wise manager and user of what Mother Nature provided.



HIFIKEPUNYE POHAMBA

MINISTER OF FISHERIES AND MARINE RESOURCES

EXECUTIVE SUMMARY

This document addresses the policy of the Government of Namibia on the sustainable management of inland fish resources based on the following principles.

- (a) As a broad principle the approach is to allow sustainable utilisation of resources but to also protect the biodiversity of the Namibian inland fish fauna.
- (b) In consideration of the diverse nature of the different systems, different management approaches are devised to deal with the circumstances particular to the different river systems.
- (c) The protection of the interests of subsistence households in terms of the availability of fish from the rivers as a supplement to diets is given priority and the need to control the commercialisation of the resources is emphasised.
- (d) The control of fishing and the protection of the resources through gear restrictions is adopted. Preference is given to passive gear over active gear and traditional gear in preference to modern nets.
- (e) It is accepted that control and law enforcement is to be carried out by police officers and law enforcement personnel already employed by other Ministries with the assistance of traditional communities and the traditional authorities. A limited number of fisheries extension/liaison and law enforcement officers will represent the Ministry of Fisheries in rural communal areas.
- (f) The principle that local people in communal areas should share in the income generated by commercialisation or use of communal resources is followed.
- (g) Future research policies on inland fish and the founding of a multi-disciplinary research station to eventually serve the region is addressed.
- (h) The need for regional co-operation on inland waters and related matters between states in the region that share river basins is emphasised.

INTRODUCTION

It is stated in the Namibian Constitution (Article 95) that *"The state shall actively promote and maintain the 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"*.

The above principles of the Namibian Constitution are echoed in the Rio Convention on Biological Diversity, which states: *Many indigenous and local communities with traditional lifestyles have a close and traditional dependence on biological resources and need to share equitably in the benefits arising from biodiversity. Governments have sovereignty over their biodiversity and States are responsible for conserving their biodiversity and using their biological resources in a sustainable manner.*

Namibia is a desert country, wedged between the Namib desert on its western seaboard and the vast Kalahari desert on its eastern border. In the south, along the Orange River, Namibia borders on the bone-dry Richtersveld of South Africa. It is only the north eastern regions of Caprivi and Okavango that are relatively humid but even these areas suffer periodic droughts.

The availability of water is therefore a major limiting factor and any industry demanding good quality, fresh water is unavoidably in competition with the demand for potable water for man and animals.

In the whole of Namibia, within its approximate 823 290 km², no significant fresh water lakes occur; the only permanent water bodies being man-made dams and sinkhole lakes. Even perennial rivers are absent from the interior, the only ones being confined to the southern and northern borders.

Because of the more amicable climate and the availability of water along the northern rivers, about 50 % of the total population of 1.4 million lives near these rivers and, in spite of the bleak picture of a dry interior, at least 100 000 people derive part of their food, income and informal employment from the inland fish resource. That fresh water fish is an important factor in the daily lives of many people can therefore not be ignored. Special consideration should therefore be given to protect the interest of subsistence fishers against uncontrolled commercialisation.

The fresh water fish fauna of Namibia is moreover very diversified and merits conservation, especially the species which have already been identified as indigenous and endangered. Above all, efforts should be made to preserve the genetic diversity of the fish fauna and to prevent genetic pollution. To reach these goals towards responsible management, utilisation and conservation of the Namibian fresh water fish resource, the Namibian Government intends to, through appropriate legislation, create

a cost effective management regime, involving traditional, regional as well as central authorities, to ensure the optimal benefit from the resource to both present and future Namibians. These benefits should include, in a well-balanced manner, direct catches, tourism, aquaculture, fish trade, fish products and aquarium species, taking the utmost care to ensure that these benefits accrue to as wide a spectrum of Namibians as possible.

THE OBJECTIVES OF THIS DOCUMENT

This document spells out the policy of the Government of Namibia towards the management of its fresh water fish resources in the Namibian inland waters as listed in Appendix III. It will form the basis for the drafting of an Act to regulate the utilisation, conservation and management of the fresh water fish resource. Aquaculture will be addressed in separate policy documentation.

Most of the inland waters are easily accessible and existing legislation promulgated by the previous Ministry of Wildlife, Conservation and Tourism does not adequately ensure that resources, especially in rural communal areas, are adequately protected and activities adequately regulated. Most importantly, neither does this legislation protect the interests of rural, communal communities. This relevant parts in this legislation, Nature Conservation Ordinance, 1975 (No 4 of 1975, Chapter V: Fish in Inland Waters) will have to be repealed (for the relevant wording of the Ordinance, see Appendix IV) and appropriate legislation is to be formulated based on the principles and guidelines spelled out in this document.

In the new legislation the objectives will be -

- (a) to ensure the sustainable, optimal utilisation of the fresh water fish resource,
- (b) to ensure that the objectives in (a) are based on sound ecological knowledge and principles,
- (c) to, in communal resources, favour utilisation by subsistence households and fishers rather than the commercialisation of the resource,
- (d) to ensure that the responsibility for the management of a communal resource is vested at local level rather than with central Government through a "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 towards a holistic approach in the management of the fish, the rivers and floodplain environments,
- (g) to regulate the exploitation of fish in Government owned dams,
- (h) to regulate sport fishing in inland water, and
- (i) to ensure co-ordination and co-operation between countries in the region, sharing inland water bodies and rivers with Namibia.

1. INLAND FISHERIES : BASIC CONCEPTS

1.1 Inland Fisheries

1.1.1 Inland Fisheries in the African Context

The importance of inland fisheries varies considerably between different regions in Africa, with southern Africa being the region where it is the most important. Lake Victoria at present accounts for 25 % of the total catch in Africa and about 60 % of the total is being landed in SADC countries. Seven countries, including Zambia and South Africa, account for 95 % of the aquaculture production. In an Africa-wide context it is reported that more than 450 000 km² are covered by water and the potential yield of fresh water fish is estimated at 2.7 million metric tons with a present annual production of 1.9 million mt. This figure represents an increase of about 10 % per year over the last 10 years. Rivers and floodplains are believed to yield about 350 000 mt, second after reservoirs and natural lakes. This compares with the estimated marine production of 6.5 million mt per annum with a potential of 7.8 million mt.

With the exception of Lakes Tanganyika and Kariba, most inland fisheries are artisanal based, small scale and above all, labour intensive. Nationals land practically all the inland fish whereas 50 % of marine catches are landed by foreign fleets. Of the remaining 50 % caught by nationals, only half is landed by artisanal fisherman.

Inland fisheries in Africa employ about 420 000 full-time fishermen and nearly as many on a part time basis (Table 1). It is alleged that for every single fisherman, five persons are involved in support actions in processing, preservation, transport, marketing, production and maintenance of boats and gear, giving a total of 2.5 million people who in some way or another, benefit from inland fisheries.

Table 1. Key Data on Inland Fisheries in Southern Africa (After Tvedten *et al*)

COUNTRY	DOMESTIC MARINE PRODUCTION (mt) ¹	INLAND WATERS (km ²)	INLAND POTENTIAL PRODUCTION (mt)	INLAND PRODUCTION (mt)	FULL-TIME EMPLOYMENT IN INLAND FISHERIES	PART-TIME EMPLOYMENT ² IN INLAND FISHERIES	AQUACULTURE PRODUCTION (mt)
Angola	98 942	2 000 *	16 500	8 000	7 000	50 000	-
Botswana	-	20 000	15 600	1 900	200	500	-
Lesotho	-	-	300	30	200	n/a	30
Malawi	-	24 000	115 000	80 000	5 164	10 000	121
Mozambique	34 720	18 000	37 000	280	10 000	25 000	30
RSA	534 100	n/a	33 000	2 300	n/a	n/a	4 556
Swaziland	-	n/a	150	110	100	100	20
Tanzania	-	52 000	400 000	330 000	48 000	66 000	375
Zambia	-	53 680	150 000	64 484	24 000	50 000	1 110
Zimbabwe	-	4 000	30 000	25 000	7 200	3 440	175
Namibia	289 751	5 000 ³	15 000 ⁴	2 800 ³	750 ³	64 000 ^{3,5}	-

1 All figures are from Seki and Bonzon 1993 unless otherwise stated

2 Bonzon and Horemans 1988

3 Tvedten *et al* 1994

4 United Nations Institute for Namibia 1986 : 224

5 Includes both part-time and occasional fisherfolk

* The Ministry of Fisheries and Marine Resources is unsure as to the accuracy of this figure

From Table 1 it is evident that Tanzania, Malawi and Zambia stand out as the countries with the most significant inland fisheries, with Botswana and Namibia at the other end of the scale. In Namibia more than 100 000 people derive direct or indirect benefits from inland fish resources and the fish supply per capita is estimated at 10 kg per annum whilst fish supply 10.2 % of the animal protein consumed (Table 2).

The nutritional value of fish is relatively high and of its live weight, usually contains 20 - 30 % protein and 2 - 12 % fat, although precise values vary considerably depending on species, diet, sex, season, etc.

Table 2. Contribution of Fish to Total Animal Protein Supply in Southern Africa (1990) (After Tvedten *et al*)

COUNTRY	FISH SUPPLY PER CAPITA (KG/YEAR)	FISH AS % OF ANIMAL PROTEIN
Angola	19.7	42.9
Botswana	3.0	4.9
Lesotho	1.5	5.1
Malawi	9.2	47.1
Mozambique	2.5	21.2
RSA	9.3	10.7
Swaziland	0.1	0.3
Tanzania	13.8	37.6
Zambia	7.7	25.2
Zimbabwe	2.7	9.7
Namibia	10.0 *	10.2

Source : Seki and Bonzon 1993

* Ministry of Fisheries and Marine Resources data suggests 6 kg to be a realistic estimate.

1.1.2 Inland Fisheries in the Namibian Context

The attention given to inland fisheries by Government and international aid organisations in comparison to marine fisheries has been limited. The discrepancy in "visible" economic importance seems to be the major reason for this. For Africa as a whole the value of inland fisheries is estimated at about 22 % of that of marine fisheries and in Namibia this discrepancy is especially large. In terms of the numbers of people who benefit from the two sectors, the contribution by the inland fish resource, however, comes to the fore. It is calculated that the marine fishing sector supplies jobs to 12 000 people in Namibia at present. With a high average number of 10 dependants per job,

this brings the number of people benefiting to 120 000. This is only slightly larger than the number benefiting from the fresh water fish resource although the level of income probably differs in favour of the marine resource. This comparison, however, puts the socio-economic importance of the fresh water resource in perspective.

1.2 Principles of Fisheries Management

1.2.1 Fresh Water ecosystems

From a fisheries viewpoint perennial rivers can be divided into two major classes; reservoir and flood rivers. Reservoir rivers have a stable flow throughout the year where flood rivers show large seasonal variations in rainfall over the catchment area are transmitted down river as a pulse of increased flow. The great fluctuation in water level cause a seasonal cycle of flood and drought over much of the river. However, a core of permanent water does persist in the main river channels and on the floodplains. Extreme changes in water chemistry and, as a result in primary and secondary production occur throughout the cycle, giving rise to continuous changes in the ecosystem. All of Namibia's perennial rivers are of the second type which reflects in the cyclical nature of productivity of the rivers.

1.2.2 Concepts of Management of Fish Stocks

In reaching a decision on sustainable use and whether to follow a policy of maximum sustainable use versus optimum yield, various aspects have to be considered. For the purpose of this document optimal sustainable yield is defined as the maximum level of harvesting at a sustainable level which will not irreversibly effect the species composition and genetic diversity of an ecosystem. Maximum sustainable yield harvesting strategies focusing on the production levels only may cause species composition to be driven into undesirable directions. In practise this leads to sought after species being replace by undesirable ones which holds implications for food security. In terms of food security a policy of sustainability and therefore optimal and not maximum yields, should be pursued. It is, in terms of food security, much more desirable to be guaranteed of a long term, optimum level of exploitation than pursuing a more risky maximum sustainable yield approach. It must furthermore be kept in mind that, in an extremely complex system such as, e.g., the Zambezi and Okavango Systems, the total tonnage extracted may seemingly be successfully kept at the level set as the maximum sustainable yield, while the species composition of the landings and therefore the fish population may in the meantime be driven into an unacceptable imbalance. To attempt to set individual quotas for each species, or even to set a quota for a system to meet optimum exploitation and attempt to regulate that, is, to say the least, an impossibility. It is furthermore so that the differences in the systems merit different approaches. In the case of the Cuvelai System e.g. where water bodies are mostly non-perennial, the principles at play in maximum sustainable yield versus optimum yield models do not exist.

It is, not being practical to set quotas, unavoidable that the regulation of the fishery should be through gear and effort restrictions and control. It is furthermore considered most important to secure the role fish play in the Okavango/Capri regions in food security. The latter goal, therefore, is of prime importance and any harvesting at maximum levels and commercialising of the resources should always be measured against the impact it may have on the food security.

Finally, it is clear that a policy of dynamic management based on continuous monitoring will have to be pursued. Through constantly monitoring the fish fauna and by using it as an indicator of change in the ecosystem, be it from fishing pressure or other parameters, continuous and timely adjustments in management should be effected to mitigate adverse effects or stop and reverse undesired trends.

1.2.3 Management of Complex Ecosystems

The complexity of the fresh water ecosystems, especially in the perennial rivers on the borders of Namibia, cannot be over stressed. The inland perennial river systems in Namibia with its floodplains, irregular floods and multitude of species and habitats, are orders of magnitude more complex than the relatively simple Benguela marine ecosystem off the Namibian coast characterised by the low number of species with high numbers of individuals per species. Fish resources, even relatively simple ones like that of the Benguela System, are notoriously difficult to manage, even if the political will to do so exists. Dynamic management through constant monitoring of the inland system advanced in 1.2.2 as the desired management option should theoretically work. To rectify undesired trends to manage the fish population in the extremely complex ecosystem may, however in practise, prove to be extremely difficult and even impossible.

A further extremely important aspect about the management of these ecosystems is the fact that some of the most important causal factors in the deterioration of the ecosystem is not controlled by the Ministry of Fisheries and Marine Resources. Of these factors the deterioration of floodplains through overgrazing and the resultant erosion and siltation of the river systems may be the most important. The sharing of the river basins with neighbouring countries, especially having the major catchment areas of all the Namibian rivers outside the national borders, is likewise a complicating factor. To attempt to rectify an observed adverse trend that may have its origin elsewhere in the river system, without good regional co-operation, will be futile.

1.2.4 Options for Regulatory Measures to be applied

A number of measures to regulate the different types of fisheries will be implemented as appropriate :

- (a) regulating by closed seasons,

- (b) proclamation of closed areas and/or breeding sanctuaries,
- (c) regulating the fishing effort, through implementing gear restrictions, which in part may contribute to the restriction of fishing effort. This includes e.g. the banning of certain gear, limiting the number, length, mesh size of gear,
- (d) the total banning of certain fishing methods e.g. poison, anaesthetics, electric shockers, explosives and using artificial light to fish with at night.
- (e) a licensing system,
- (f) bag limits,
- (g) size restrictions, and
- (h) enforcing the protection of certain species, its breeding stocks and fry.

2 FRESH WATER ECOSYSTEMS AND INLAND FISH RESOURCES OF NAMIBIA

2.1 Overview of Ecosystems in Namibia

The following fresh water ecosystems are identified (Figure 1):

1. Perennial River Systems and floodplains (Zambezi River System including the Kwando/Linyanti and Chobe Rivers, Okavango River, Kunene River and Lower Orange River)
2. Sinkholes and Caves (Guinas and Aigamas)
3. State and Private Dams
4. Non-perennial rivers and minor waterbodies

2.2 Types of Fresh Water Systems in Namibia

2.2.1 Perennial River Systems

2.2.1.1 Zambezi River System (including the Kwando/Linyanti and Chobe Rivers)

The Zambezi River system can be divided into three sections: Upper Zambezi, from the source to Victoria Falls (1 078 km); Middle Zambezi, from the Falls to Cahora Bassa Rapids (853 km); and the lower Zambezi from Cahora Bassa Dam to the sea (593 km). The Zambezi River originates in north west Zambia on the Zaïre border and east Angola at about 1400 meters above sea level. Estimates of the total catchment area range from 1193500 km² to 1570000 km². The river then heads southwards through Zambia and the Barotse floodplains, towards the Caprivi strip. The Zambezi River System in the Caprivi region lies in an almost gradientless inland sandy basin. Gradients of 1:13 000 along the Linyanti/Chobe, e.g., result in water flowing in opposite directions in the river channels depending on the flood levels of the rivers it is linked to, that is the Zambezi and Kwando.

The featureless, low gradient landscape explains the enormous areas that become flooded with a few meters rise in water level in the feeding rivers. The extent of floods depends on the flood levels of the feeding rivers and the last decade has seen lower average floods than the previous decade. The permanent canals, not normally connected to the perennial rivers, e.g., Lisikili, Maningmanzi, Nkasa and Mutwalwizi as well as streams and depressions in the floodplain are only seasonally flooded when high enough flood levels occur in the feeding perennial rivers. The lower flood levels experienced in latter years have resulted in the drying up of Lake Liambezi. When the lake was filled it had an average depth of about 6 meters and covered approximately 10 000 ha.

Research by the fresh water section of the Ministry of Fisheries and Marine Resources to gain a better understanding of the systems commenced during 1993. A long term monitoring programme is followed with the following objectives:

- (a) to obtain data to compile a fish species list,
- (b) to use indexes to assess environmental degradation, seasonal changes and exploitation on the fish population,
- (c) to obtain ecological and biological data to determine the population dynamics of the different species,
- (d) to determine the species composition, relative densities, catch per unit effort (CPUE) and mass per unit effort (MPUE) of the different mesh size gill nets,
- (e) to determine the species composition, relative densities, CPUE and MPUE of the different fishing apparatus of the fisherfolk,
- (f) to calculate the MSY for the system,
- (g) to determine the status of the fish species and to recommend measures to protect the species diversity, and
- (h) to obtain socio-economic data on the role played by fish in food security.

A total of 81 fish species has so far been recorded in the upper Zambezi River and in the wetlands associated with the Zambezi River. Biological and ecological data on some of the species and on the different fish populations are available.

2.2.1.2 Okavango River

The Okavango River rises in the Angolan highlands south of Nova Lisboa and flows eastwards to form the border between Angola and Namibia, traverse the Caprivi strip and eventually spills out in the Okavango delta in Botswana. The total length of the river is approximately 1 727 km. The gradient gradually decreases from the upper catchment in Angola to the delta in Botswana. The Okavango River receives its water from two main tributaries, the Cubango River which has a catchment area of 115 000 km², and the Cuito River which has a catchment area of 65 000 km². At Katwitwi, the Okavango River enters Namibia, at an altitude of 1 100 m above sea level. From Tondoro the river widens to form a floodplain. The floodplain is present continuously along the river and is developed mainly on the northern side of the channel. As the river becomes wider it shallows out, resulting in the regular flooding of the floodplains during the annual floods. The width of the floodplains varies from a few meters, up to six kilometres. Over the entire distance between Nkurenkuru and the confluence of the Cuito River with the Okavango River (260 km) the river drops a mere 35 m. The Cuito River traverse swamps in Angola and maintains a more constant flow

and experiences a later flood peak than the Cubango River. The confluence of the Cuito and Okavango Rivers result in a larger stream flow and a wider river channel. From the point of confluence the floodplain narrows and the channel becomes braided. Quartzite outcrops appear between Mucossa and the Popa rapids which causes the river to split into several streams resulting in the formation of several islands covered by riverine forests. The river drops about 2,5 m over the Popa rapids which is situated 25 km from the Botswana border. Popa lies at the end of a series of rapids whereafter the canals re-unite to form a single wide channel. Sandbanks appear and a floodplain forms again. The river crosses the Namibia/Botswana border at Muhembo.

Research by the fresh water section of the Ministry of Fisheries and Marine Resources to gain a better understanding of the systems commenced during 1989. A long term monitoring programme is followed with the following objectives:

- (a) to obtain data to compile a fish species list,
- (b) to use indexes to assess environmental degradation, seasonal changes and exploitation on the fish population,
- (c) to obtain ecological and biological data to determine the population dynamics of the different species,
- (d) to determine the species composition, relative densities, catch per unit effort (CPUE) and mass per unit effort (MPUE) of the different mesh size gill nets,
- (e) to determine the species composition, relative densities, CPUE and MPUE of the different fishing apparatus of the fisherfolk,
- (f) to calculate the MSY for the system,
- (g) to determine the status of the fish species and to recommend measures to protect the species diversity, and
- (h) to obtain socio-economic data on the role played by fish in food security.

A total of 82 fish species has so far been recorded in the Okavango River. The fish resources are intensively exploited and a very broad spectrum of species are caught. Researches differ in their estimates for the exploitation rate. Indications are that over-exploitation occurs at least in some areas of the river but the degree of over-exploitation is poorly known.

2.2.1.3 Kunene River

The total catchment area of the Kunene River is 106 500 km², of which only 14 100 km² lies in Namibia. The headwaters of the river lie at elevations of between 1 700 and

2 000 m above sea level. Extensive floodplains occur in the upper reaches of the Kunene River in Angola. Over the 45 km stretch from Calueque to Ruacana, the river drops approximately 210 m (average slope 1:1215) over a series of rapids with the biggest drop of 120 m at the Ruacana Falls. In the 340 km distance from Ruacana to the Atlantic Ocean, the total drop is 760 m, consisting of several rapids and falls, of which the Epupa Falls is the highest. No floodplains are developed west of Ruacana due to the steep gradient and the fact that the river flows in a well defined channel cut into complex geological formations. The Kunene River does not form a true estuary at the mouth.

Research by the fresh water section of the Ministry of Fisheries and Marine Resources to obtain a better understanding of the systems commenced during 1990. A long term monitoring programme is followed with the following objectives:

- (a) to obtain data to compile a fish species list,
- (b) to use indexes to assess environmental degradation, seasonal changes and exploitation on the fish population,
- (c) to obtain ecological and biological data to determine the population dynamics of the different species,
- (d) to determine the species composition, relative densities, CPUE and MPUE of the different mesh sizes gill nets, and
- (e) to determine the status of the fish species and to do recommend measures to protect the species diversity.

A total of 76 fish species has to date been recorded from the Kunene River. Biological and ecological data on the different fish populations are available.

2.2.1.4 Lower Orange River

The Orange River is the longest river in southern Africa, south of the Zambezi, with a total length of 1 950 km. It rises in the mountains of Lesotho and flows westwards through the semi-arid and arid southern Orange Free State and northern Cape into the Atlantic Ocean. The total catchment area of the Orange River is approximately 852 000 km², 47% of the total surface area of South Africa. The river system can be divided into three sections:

- a) Upper Orange - from the origin to the Orange-Vaal confluence
- b) Middle Orange - from the confluence to Augrabies Falls, and
- c) Lower Orange - from Augrabies to the river mouth, the only section of concern to Namibia.

The Lower Orange River forms the southern border of Namibia. Although the catchment area of the Lower Orange River covers a large area, the annual rainfall is low. It is estimated that the catchment area of the lower and middle Orange River provides only 1,8% of the annual flow of the Orange River.

The total catchment area of the Fish River, the main tributary of the Lower Orange River and transversing the southern Namibia interior, is approximately 80 300 km². The Fish River originates mainly in the Nauchas highlands in the western parts of the Rehoboth area. It flows southwards parallel with the Atlantic coast over a distance of 805 km and joins the Orange River at a point 112,7 km from the mouth of the Orange River.

To date a total of 14 species has been recorded from the Lower Orange River. The status of the different fish populations is poorly known. A monitoring programme is planned to commenced in the near future with the following objectives:

- (a) to obtain data to compile a fish species list,
- (b) to use indexes to assess environmental degradation, seasonal changes and exploitation on the fish population,
- (c) to obtain ecological and biological data to determine the population dynamics of the different species,
- (d) to determine the species composition, relative densities, CPUE and MPUE of the different mesh sizes gill nets, and
- (e) to determine the status of the fish species and to do recommend measures to protect the species diversity.

2.2.2 Sinkholes and Caves

A few sinkholes and caves occur in Namibia. From a conservation perspective both Lake Guinas and the Aigamas Cave are very important.

2.2.2.1 Guinas

The endemic *Tilapia guinasana* occurs in Lake Guinas, a sinkhole lake situated on Guinas Farm, about 50 km north-west of Tsumeb. The surface area is approximately 70 m² and it is about 120 m deep. The sinkhole cavity resembles an upside down mushroom with the vertical walls of the sinkhole opening into an underground bowl. Because Guinas is so deep, the fish have to breed on the rocky ledges and vertical walls and feed on the algae that grows on the walls. *Tilapia guinasana* is unique amongst the *Tilapia* in that it has five different colour morfs or forms. The population is fairly small (approximately 4000 individuals) and the species is listed as endangered.

A project to gain a better understanding of the status of *T. guinasana* commenced during 1989 with the following objectives:

- (a) to determine the status of *Tilapia guinasana*,
- (b) to obtain biological and ecological data to determine the population dynamics,
- (c) to determine if there are genetic differences between the colour forms,
- (d) to determine why there are two size groups within the *Tilapia guinasana* population,
- (e) to determine if pair formation and territoriality of *Tilapia guinasana* is similar to that of other Tilapias, and
- (f) to determine if *Tilapia guinasana* will breed on artificial platforms.

2.2.2.2 Aigamas

Clarias cavernicola, an endemic, blind catfish, occurs in the Aigamas cave near Otavi. The depth of the cave varies between 30-52 m and the surface area is about 18 m by 2,5 m. This blind cave catfish is the only fish known from Aigamas. The fish mainly subsist on insects, bat and baboon droppings. The fluctuating water level in the cave is at present the main factor endangering the species. Research to breed the species artificially in captivity to ensure its survival, is ongoing. A project on *Clarias cavernicola* commenced during 1989 with the following objectives:

- (a) to breed *C. cavernicola* artificially,
- (b) to determine the status of the Aigamas population,
- (c) to study the biology of *C. cavernicola*, and
- (d) to make recommendations that will ensure the survival of *C. cavernicola*.

2.2.3 State and Private Dams

2.2.3.1 State Dams

State Dams are primarily for the supply of household water. Research by the fresh water section of the Ministry of Fisheries and Marine Resources to determine the production of the dams commenced during 1983. The fish in the major State Dams are monitored on an annual basis and the objectives are:

- (a) to obtain data to complete a fish species list,

- (b) to obtain ecological and biological data to determine the population dynamics of the different species,
- (c) to determine the species composition, relative densities, CPUE and MPUE of the different mesh sizes gill nets, and
- (d) to determine the MSY of different dams.

Biological and ecological data are available on the different fish populations (Table 3).

Table 3 List of major State Dams with the number of species of fish present and the calculated maximum sustainable yield (MSY)

Name of dam	Number of species	MSY (kg/annum)
Daan Viljoen	2	*
Hardap	7	124 375
Naute	4	99 506
Oanob	5	*
Olushandja **	39	*
Omatako	2	71 385
Otjivero Main	3	*
Swakoppoort	5	*
Von Bach	5	19 101

* MSY not yet calculated

** Olushandja Dam is artificially linked with the Kunene River and therefore the high species diversity.

The exploitation of fish in Hardap Dam at Mariental had been given out on tender. This venture was, however, financially unsuccessful.

2.2.3.2 Private Dams

Reliable statistics on the numbers, distribution and stocking of private dams are not available. Management and harvesting strategies are the prerogative of the owner.

2.2.4 Non Perennial River Systems and other Waterbodies

The interior of Namibia is divided into several drainage systems (Figure 1):

1. Cuvelai System
2. Nossob- and Olifants System
3. Omuramba Omatako System
4. West Flowing Rivers

2.2.4.1 Cuvelai System

The Cuvelai System is independent from the Kunene River. The Cuvelai River has its origin near the Sierra Encoco Mountains in Angola, between the upper reaches of the Kunene and Okavango Rivers. Permanent waterbodies are present in the upper reaches, but it is not, as was previously believed, a perennial river. Water accumulates during the summer rainy season and flows southwards (*efundja*) into the Oshikoto, Oshana, Omusati and Ohangwena regions. Exceptionally heavy floods drain into the Etosha Pan that acts as a reservoir for water from the Oshana Etaka and Oshana Oshigambo. Since 1972 the Cuvelai System has been artificially linked with the Kunene River by a pipeline and canal system.

2.2.4.2 Nossob- and Olifants System

Drainage of the central western interior is in a south easterly direction through the Nossob and Olifants Rivers. Both rivers end up in the Kalahari sand dunes, eliminating any possibility that fish may get distributed down these rivers.

2.2.4.3 Omuramba Omatako System

It has its origin in the Otjiwarongo and Okahandja districts, continues north east through the Otjozondjupa and Okavango regions and joins the Okavango River east of Rundu. Although the Omuramba Omatako is seldom in flood and is in places blocked by sand dunes, it can still serve as a route for fish distribution. Alien species have indeed been identified from this system, which increase the danger of these species reaching the Okavango River.

2.2.4.4 West Flowing Rivers

These rivers (Kuiseb, Swakop, Omaruru, Ugab, Huab, Koigab, Uniab, Hoanib, Hoarusib and the Khumib) traverse the Namib Desert and have a limited potential for fish distribution, as these rivers are seldom in flood, and when this happens, the fish migrating down stream end up in the cold Benguela current, which makes any further distribution impossible. Several isolated fish populations are, however, known from isolated pools and fountains in these rivers.

2.2.4.5. Canals and Pipelines

The Eastern National Water Carrier (ENWC) is an integrated water supply scheme, which is planned to eventually bring water to the central interior of Namibia from the Okavango River. At present it is linked only to the Karstveld near Tsumeb and Grootfontein. It will eventually link the Okavango River with the Omatako, Von Bach and Swakoppoort Dams. Two entirely different drainage systems with different fish populations will thus be linked. Fish will therefore be able to migrate from the Okavango River, via the ENWC, to the State Dams and *vice versa*.

Since 1972, the Cuvelai and Kunene Rivers are linked with a canal and pipeline. The canal system starts near Calueque where water is pumped into the system and then flows into the Olushandja Dam and from there further down towards Ogongo. The non-perennial nature of the Cuvelai renders the distribution of fish from the Kunene not serious but the opposite distribution may cause genetic pollution.

2.2.4.6 Fish species present in the non-perennial river systems

A long term project initiated by the Ministry of Fisheries and Marine Resources, namely "The status and distribution of fresh water fish in Namibia" commenced during 1988 with the following objectives:

- (a) to compile a fish species list for Namibia,
- (b) to establish the distribution of species in Namibia,
- (c) to determine the status of the species, and
- (d) to identify alien and red data species.

To date a total of 46 fish species have been reported in the Cuvelai system. Species diversity depends on floods. A total of 4 species has been recorded from the Nossob- and Olifants River System, Omuramba Omatako System and the West Flowing Rivers.

3 FISHING METHODS

Fishing methods and gear for the purpose of this document can be classified roughly into active and passive categories based on the type of gear used, with both traditional and non-traditional gear in each of these categories. Active gear implies gear dragged or pushed i.e. drag nets, funnels and push baskets, while passive gear implies stationary gear set and handled only when gear or fish is recovered i.e. gill nets and traps. In general it is the active gear that tends to be destructive; the water quality suffers, vegetation gets trampled or uprooted and disturbed. Active gear in general also tends to be less selective.

From survey results it appears that confusion exists amongst people in the communal areas as to what is regarded as traditional gear and what not. The same gear, depending on who is using it and other criteria, may be regarded as either traditional or non-traditional. In Caprivi, Oshikoto, Oshana, Omusati, Ohangwena and Okavango regions most people still prefer to use traditional gear, the reasons being given for this are that traditional gear is easily manufactured, does not cost much and is simple to use. From interviews it is also clear that there is a growing awareness not only of the efficiency and economic potential of modern gear but also of its destructiveness.

3.1 Traditional Methods

To draw a clear distinction between "traditional" and "modern" gear will be easier to define in theory than to find an acceptable definition that will fit the perceptions of all groups everywhere. The most acceptable definition will probably be that *"traditional gear is gear manufactured by the local population in an artisanal manner making use of natural materials available from the local environment"*. This would exclude nets made from fibre obtained from old car tires as well as hook and line sold in shops. Some modern methods such as, e.g., hook and line may be preferred to some traditional methods that are more active and more destructive and careful consideration will have to be given to defining different methods in the envisaged legislation. Traditional methods and the popularity of specific methods and gear differ in different regions and are dependent e.g. on age and gender of the user and season.

3.1.1 Passive Traditional Methods

Survey results indicate that the most commonly used method is the so called fish kraal of which women are reported to be the main users. The trap is constructed from reeds and sedges and is baited with locally available material, e.g., millet porridge or grain husks. Being passive, the trap requires little attention and can be checked whenever it is convenient. Although the yield of individual traps may be low, the little effort and time spent on it makes the effort worthwhile.

Fish spears are constructed from long, light reeds tipped with barbed, metal points. This is used to spear individual fish and is almost exclusively used by men. Fish bow and arrow is also used. 'Runkinda' as this type of gear is known in Okavango, is a type of fishing basket, used at the beginning of the flooding and during receding. It is constructed from plant material and has large openings. The baskets are placed in shallow water and typically trap larger fish, e.g., tiger fish and *Tilapia*. It also has the advantage that it can be checked whenever convenient. The baskets seem to be used exclusively by men.

Another kind of fish trap in certain areas known as 'mukuko' is also placed across floodplains and channels to prevent fish from returning to the main river when floods recede. These structures trap larger fish and, with variation in trap opening size, can be selective. This method was traditionally a village-based undertaking and the setting was regulated and announced. The less effective, although less destructive, nature of this method, in comparison to nets, renders this method less popular than the latter. The traditional names used here are from the Caprivi region but similar equipment is known by local names elsewhere.

Baited hook and line is used in various ways. Some confusion, however, exists in the minds of the local people as to whether hook and line is a traditional or non-traditional method. Being passive and non-destructive this is, however, one of the methods that may be allowed without hesitation, especially in the hands of subsistence fishers.

3.1.2 Active Traditional Methods

The most common active methods involve some kind of funnel (locally known by various names e.g., 'sikuku', 'sidid', 'lishino' [scoop baskets], 'singundo' [push basket]) constructed from locally obtained plant material. These baskets or funnels are used mostly by women and young girls, either solitary or, more commonly, in groups. The fish is either driven into the funnels while the funnels are held into the current, or it can be dragged against the current to catch fish. Another type of basket is called the 'sidid' in Okavango and similar apparatus is also used in the Cuvelai and Caprivi. These baskets are slammed down over fish in ankle to knee deep water and the fish are then taken out through a window in the side of the basket. This type of basket is primarily used by women on the floodplains in areas where the water has become shallow enough to operate the baskets.

3.2 Modern Methods

Many people are ill-informed as to the present legality of using or not using nets, but, as has been mentioned, there is a general, and growing, awareness of the destructiveness of nets.

3.2.1 Passive Modern Methods

Gill nets are mainly used by men who suspend these nets in deeper waters along the banks when the floods are in. The use becomes more widespread as the floods subside and fish densities increase. In Okavango single strand nylon nets are sometimes used. Nets manufactured from fibre from discarded car tyres are more common but not as efficient. Floats, e.g. in the Caprivi, are made from locally available material such as sesbania stems, while weights attached to footropes are also manufactured from locally available materials. In Caprivi, on the contrary, however, tyre fibre nets are outnumbered by single strand nylon nets, usually purchased in Zambia or Botswana. In these countries nets are allegedly readily available from government fishery departments and in the trade.

3.2.2 Active Modern Methods

Active modern methods encompass a whole array of net types constructed from various types of material as well as netting material used as fish nets but primarily manufactured for other purposes, like e.g. mosquito nets and shade cloth. Mosquito nets are mainly used by women. Conflicting views are held on the effect of mosquito nets. These nets became widely available through the presence of the South African Defence Force and perhaps also through World Health Organisation campaigns against malaria. The nets are often used as a corral in which to chase fish into, two women holding the net and one or two others chasing the fish into the net. A second method, where the net is dragged along the bottom, is probably more destructive, damaging plant life on the substrate in the process. Shade cloth is considered to fall into the same category and because it is easily available, its use is on the increase, especially in the Cuvelai.

Drag and seine nets are reported to be exclusively used by men in commercial or semi-commercial ventures. In Caprivi, drag nets are considered to be the most productive gear as up to 250 kg may be landed with a single drag. Drag nets, however, demand considerable effort and manpower and this has resulted in cheap labour, mainly foreigners, being recruited from outside households, and even extended families, to fish with these nets. The nets are used in all types of water bodies, being set in a half circle and then pulled along the bottom. In general this type of fishing tends to be much less selective than fishing with gill nets. Because of the damage inflicted to the substrate and other organisms in general it is viewed as the most destructive of all methods.

The relatively high capital cost of a drag net, which amounts to about NS3,75 per meter (1993 prices) as well as the labour involved and availability thereof, are the main constraints in the purchasing and use of these nets. Nets are therefore largely owned by people with permanent employment. This is developing into a situation whereby the rich are becoming richer in unfair competition with the poor, for the average bruto income of a drag net operation can be in the vicinity of N\$10 000 p.a. It is alleged that

the owner of the net receives the lion's share of the income, which may make such an investment rather attractive. Conflict between modern and traditional gear does exist and in certain areas the use of traditional gear decreases as the use of modern gear increases and becomes dominant in spite of the clear notion amongst fishers that, particularly modern gear, threatens the long term sustainability of the fish resource.

4 PATTERNS AND MANAGEMENT OF EXPLOITATION AND THE SOCIO-ECONOMIC ROLE OF FISH IN COMMUNAL AREAS

4.1 Patterns of exploitation

Inland fisheries is mainly subsistence based and is typically labour intensive, with a low catch per unit effort (CPUE) and catches are mainly consumed by the fishers, their immediate families, extended families, or within their communities. Very little is sold outside communities with the fish market in Katima Mulilo (Caprivi Region) being almost the sole exception. Some trade in dried fish does, however, take place between regions, with especially catfish from Caprivi and Okavango being sold in the Omusati, Oshana, Oshana and Oshikoto Regions.

General surveys indicate that traditional gear with low efficiency (low CPUE) is used mainly by women and children and older men, except for mosquito nets which are mainly operated by women. Younger, unemployed men tend to get involved in more productive fishing with modern, non-traditional gear in rivers, lakes and dams. Whilst women tend to dominate aspects such as processing and trade, men tend to be involved in all aspects with increased commercialisation. Young men are instrumental in the commercialisation of fisheries by an intensification in the use of gill and drag nets. It is also the increase in commercialisation that leads to conflict with traditional intentional and unintentional conservation measures. Without appropriate management, increased commercialisation of the fisheries will not only lead to an escalation in conflict but will eventually marginalize most fisherfolk from the traditional fishery communities. Inland fishery in Namibia at present seems to be in transition from purely subsistence to becoming increasingly commercialised in some systems.

There are clear indications that sheer fishing pressure with traditional gear and modern nets, with commercialisation playing a major role, results in over-fishing. There are also signs of a decline in productivity, especially in the Okavango, with very low returns to all types of fishing. This carries the potential of physical depletion and even extinction of, at first, certain components in the system but will, if not reversed, lead to irreparable damage to the resource as a whole. The social consequences of this development is a widening socio-economic gap between the majority, the small scale subsistence fishers, and a minority of successful entrepreneurial fishers and the ever increasing exclusion of women and children from the sector.

Perennial systems merit a completely different approach to the dams and non-perennial systems. These former systems house standing fish stocks which breed locally and become replenished from upstream and/or downstream areas, especially during floods. This aspect makes the management of especially upstream areas, which in the case of

all Namibian perennial rivers lie in neighbouring states, of paramount importance and underscores the necessity of liaison with neighbouring countries. The nature of these systems and the contribution from these systems to the diet of subsistence households along the rivers, calls for a management approach that will strive towards sustainable utilisation.

4.1.1 Perennial River Systems

4.1.1.1 Zambezi River System

Fish occupy a central place in the Caprivian culture and daily life. Fish is therefore the dominant commodity at the central market place in the regional capital, Katima Mulilo. The regional economic statistics clearly indicate the importance of fish - 15% of the households in the Caprivi see fishery as an important source of income, and the number of households fishing for own consumption is considerably higher. 82% of the fishermen in the Caprivi market at least a portion of their catch. Based on a total estimated production of 1500 mt and an average of N\$ 6/kg, the value of the Caprivi fishery in theory approaches N\$ 9 million per annum. The six most common species caught are the threespot tilapia (*Oreochromis andersonii*, 21%), catfish (*Clarias gariepinus* and *C. ngamensis*, 17%), greenhead tilapia (*Oreochromis macrochir*, 16%), redbreast tilapia (*Tilapia rendalli*, 15%), tigerfish (*Hydrocynus vittatus*, 10%) and pike (*Hepsetus odoe*, 6%).

The utilisation of the different types of gear varies in the different regions of the Caprivi. In the eastern floodplain and along the Zambezi and Chobe Rivers gill and drag nets dominate, but also have the heaviest concentration of traditional gear. The concentration of fish and the conditions on the floodplains and along the rivers are conducive to an intensive and varied fishery. In the Kwando/Linyanti area with its steep river banks, absence of a proper flooding regime, fishing with modern gear, except for hook and line, is limited. In the north western part of the Zambezi River, close to Katima Mulilo, gill and drag nets dominate with a much more limited use of traditional gear. 30% of the fisherfolk catch an average of more than 15kg, 17% an average of between 11-15 kg, 30% an average of 6-10kg and 23% an average of less than 5kg per fishing trip.

A total of 3600 households (20% of the total number) in the region are involved in fishing. The average household in the Caprivi consist of 6,9 members of whom 25,9% are below 10 and 3,6% above 60 years of age. With an average size of a fishing household of 6,9 the total number of men, woman and children fishing on a full time, part-time or occasional basis, is approximately 8000. The majority are men and adolescent boys (85%), whereas women and adolescent girls make up only 15%. Children under 10 years and people over 60 years represent 6% each of those fishing. It is being estimated that the consumption of fish is 400 g per capita per week.

The fishing activity is combined with other sources of income and subsistence as well as domestic tasks . Of the inhabitants, 87% are involved in agriculture on a subsistence basis and 8% market parts of their yield. Of the fishing households 44% possess cattle, and of these 25% sell part of their herd. Additional sources of income are related to informal activities like traditional beer brewing, informal trade and casual labour. The average monthly income of the fishing household is N\$ 474,00. Fish represent as much as 41% of the income for these households.

4.1.1.2 Okavango River

Compared with the rivers in the Caprivi Region, the Okavango River is relatively small and because of the relatively denser human population, can be expected to be under more pressure. As elsewhere in communal areas, households in Okavango depend on multiple food and income sources, one of which is fish from the Okavango River. This multiple source approach reduces risk and enhances food security. Agriculture, which is predominant as a subsistence activity, is practised by 97 % of households on an average 4 ha plot. Livestock also contributes and 59 % of households own livestock, primarily cattle. Other sources of subsistence include the production of household goods, such as baskets, tools and also fishing equipment. Only a small number of households earn cash by marketing surplus agricultural products.

The main, non-subsistence income comes from wages earned outside the region. The river and its floodplain support numerous resources which locals utilise as part of their subsistence strategy, and this in a way determines also how people use and view the river and its resources such as fish. Many households rely on the river for household water and for watering their livestock. Surveys indicate that 32 % of the households draw water from the river and 31 % wash and bathe regularly in the river.

The riverine vegetation furthermore provides construction material, food and herbal medicine as well as grazing for animals. The edible plants act as a buffer in times of food shortages. The role of fish and fishing is to be seen against the background of a population where 53 % of the people live below subsistence levels and 27 % to 32 % of households are headed by women. The smaller female-headed households (average of 5.8 versus 6.4) tend to have more dependants (e.g. children under 15) and are, on average, less well off.

The backdrop to this social structure is the 470 km of Okavango River in Namibia with its 2 - 6 km wide floodplain of between 119 km² (dry season) and 434 km² during peak flood season. Over eighty three species of fish have been documented from the river, comprising resident fish species, present throughout the year, fish species which migrate downstream from Angola and fish species that frequent isolated bays and backwaters. The most commonly landed fish species are of the families Cichlidae,

Cyprinidae, Clariidae, Characidae and Mochokidae. The productivity of the system is poorly known with estimates varying between 840 and 3 000 mt annually. The latest survey by Tvedten *et al.* (1994) estimates a yield of 1 045 mt.

Indications are that most people in the Okavango Region use traditional gear and a large majority actually seems to prefer this kind of gear. The reasons given for this by the local people are that traditional gear is inexpensive, easy to manufacture from material available locally and is simple to use. A growing number of people, particularly young men, are fishing part-time. The fish landed are sold on a small scale or exchanged in kind, especially west of Rundu. This is interpreted by some researchers as an "incipient commercialisation". Fishing intensities and catches vary but are at peak in September when floodwaters recede and water levels are lowest. Various factors influence the selection of gear, notably the flood regime, gender and generation and to a lesser extent whether fish are for consumption or for sale. Demand on time from other activities such as agricultural practices also influences fishing effort and gear selection. When time has to be spent on ploughing, etc., passive gear that has a lower demand for time spent on it, is preferred.

4.1.1.3 Kunene River

Because of the low population density and the fact that the Hereros and Himbas inhabiting the area along the Kunene River do not traditionally fish, the fish stocks are presently not exploited to any significant degree.

4.1.1.4 Lower Orange River

Available data indicates that some fish for subsistence consumption comes from the southern part of Namibia. Casual observation has shown that migrant workers from the northern areas employed along the Orange River and Fish River areas do fish, sun dry their catches, especially barbel, and take or send the dried fish back to their places of origin. For the reasons mentioned the role of these systems in food security and in the economy as far as fish production is concerned, is negligible.

4.1.2 Sinkholes and Caves

No exploitation exists at present in caves and sinkholes and the intentions of the Ministry of Fisheries and Marine Resources is to maintain the *status quo*.

4.1.3 State and Private Dams

The dams are not subject to any traditional fishery except for Olushandja Dam.

4.1.4 Non Perennial River Systems and Waterbodies

4.1.4.1 Cuvelai System

The quantity of fish caught annually in this system depends on the extent of the flood. Despite the irregular nature of the floods, fish is a popular and important source of food in the Oshikoto, Omusati, Ohangwena and Oshana Regions. Besides the fish caught locally, there is a considerable market for marine fish. As much as 150 metric tons are currently sold per month from 3 dealers operating from Oshakati. The preference for fresh water fish is indicated by its higher price (N\$ 6-8 per kilo as opposed to N\$ 2.50-3.50 for marine fish such as hake and horse mackerel). According to a local spokesperson, "*it is our own local fish. It can be dried without losing its taste and rural households have not yet switched over to marine fish.*". A large part of this fish is bought by female hawkers who prepare and sell the food at local markets (*okapana*). In addition fresh water fish originating from as far afield as Angola, Okavango and Caprivi also appear on the local markets. This is primarily catfish (*obushi/ehepala*), which is very popular in the area.

There is no reliable data on the number of people involved in fishing in the region itself. In relation to the total population within the Cuvelai system area (approximately 400 000 people) the number is small, but fishing is important in specific areas during the short and hectic season.

Intensive fishing in the upper parts of the system when the floodwater (*efundja*) flows down the canals effectively inhibit the fish from reaching the lower parts. Traditionally the local headman or chief had jurisdiction over fishing rights. By decree tribal authorities regulated issues like the season of fishing, exclusive rights to specific communities and the type of gear to be used. The traditional management practices currently seem to have died out, but were observed as late as 1976 (van der Waal 1993). Equally important from a management point of view is the fact that the water in pans and vleis is primarily used for household and stock watering, with fishing being seen as a secondary activity.

4.2 Historic and Present Management of Exploitation

4.2.1 Historic Management

4.2.1.1 Zambezi, Chobe, Kwando and Linyanti River Systems

The tribal authorities or *khutas* of the main ethno-linguistic groups consist of a hereditary chief (*mulena*), the deputy or advisor to the chief (*ngambela*) and a dozen or more senior ward headmen (*induna silalo*) representing groups of villages or wards. Each individual village is under the authority of an *induna wa munzi* or headman who is normally the male head of the first family to settle in that particular location. The

khuta itself mainly handles legislative matters according to traditional codes, but has a considerable influence on other aspects of life down to village level.

Management of fresh water fish resources was not traditionally seen as a way of protecting stocks, but to secure access to fish in a specific geographical area for specific social groups. The exact nature of the territorial rights exercised vary first and foremost with the type of natural environment and waterbody in question. For the perennial rivers Zambezi, Chobe and Kwando-Linyanti and the larger inland lakes (*lisa*) there is a clear notion of community based territorial rights. Rivers are clearly demarcated into zones, each belonging to a ward under the jurisdiction of the *silalo* induna. Along the 60 km stretch of the Chobe River from Ngoma to Kasika, for example, the zones are recognised as Ngoma, Masikili, Ihaha, Ibilibinzi, Mbalasinte and Kasika. All fishermen know exactly where the boundaries are. Within these boundaries people from the ward (*silalo*) can, in principle, fish where they want, but in practice there are sub-zones related to each individual village (*munzi*). Within such a zone there are several small inlets along the river bank where individual households keep their nets (*tunyandi*) and other fishing equipment that are not taken to the village to be mended. Fishing is done at various points in the zone depending on the level of the water, time of the day and the perceived movements of the fish. Outsiders who want to fish in a given zone must approach the *silalo* induna to ask for permission. It is generally acknowledged that among outsiders, people from neighbouring wards are to be favoured, followed by people from other areas but belonging to the same ethno-linguistic group. However, it is relatively rare that the *silalo* indunas are approached for permission to fish by outsiders, which is an indication of the strong notion of ward and village based rights. When outsiders are allowed to fish, they are expected to sell their catch to people in the area.

For floodplain depressions or *mulapo* there is a clear perception of individual or household based territorial rights. The individually based territorial rights to the *mulapo* primarily seem to have developed because of the superior productivity of the soil for agriculture. These rights were then extended to include fishing rights. The individual right to the *mulapo* is from the outset absolute, but may be extended to households who have been given permission to use the *mulapo* by the titleholder. The jurisdiction of the *silalo* induna over the *mulapo* is thus limited, and is in any case difficult to exercise due to the long distances between them on the large floodplain. In the words of one fisherman "the river belongs to every one [i.e. within the village], but the *mulapo* have people belonging to them. If my forefathers fished there, then my children and their children fish there. Everyone else must come to me. Every old man has his *mulapo*. If you don't have it you must ask permission to fish or plough".

Finally, as regards the floodplain proper, with the plain and streams, the territorial rights in principle rest with the tribal group living in the area under the jurisdiction of the chief. At incoming and receding floods anybody belonging to the group in question

can fish on the plain and in the streams through which the water flows, and there is thus in practice free access. The rights may also be extended to relatives and tribesmen who have moved out of the area, for example to Katima Mulilo. People from Katima tend to come in large numbers to exploit the short and hectic fishing season on the plains. In addition to territorial rights, other management practices are:

Inadvertent Practices	Intentional Practices
a) The multi-purpose economic strategies most fishing households pursue. The fact that people are occupied with other tasks during certain periods effectively reduces the fishing effort. b) Technical inadequacies, or the fact that available technologies prohibit the catching of otherwise available fish stocks and that physical constraints inhibit fishing at times. The traditional gear used in Caprivi can generally be used only in shallow water and the main types of modern gear is most effective in intermediate water depths. c) Ritual prohibitions against fishing in certain areas were the Lozi king (<i>litunga</i>) and the Mafwe and Basubia chiefs have their Royal water-bodies kept in honour of their forefathers. People still know where these water bodies are, but a total ban on fishing in these waterbodies is no longer upheld. d) Taboos against eating specific types of fish is still practiced. The upper Zambezi Labeo (<i>linyonga</i>) is seen as possessing supernatural powers. These powers can cause canoes to capsize and prevent people and animals from fleeing from the floodplain timeously when flooding sets in. Catfish (mainly the <i>ndombe</i>) is clearly considered a second rate fish. Other species like the eel <i>Aethiomastacembelus frenatus</i> are avoided because of their snakelike characteristics.	a) This mainly involves gear restrictions: At the level of tribal authorities (<i>khutas</i>) the use of fish poison was banned in the 1970's, dragnets were banned as late as 1991. At the level of the wards and villages, gear restrictions are implemented in an informal and flexible manner by the local induna. The restriction are first and foremost related to mesh size of gill nets and drag nets, but the use of specific types of traditional gear (mainly larger fish fences) is also known to have been prohibited. b) Closed seasons: Historically this played a significant role. No fishing on the floodplain took place before the chief had opened the season with a ritual called the <i>mubingu</i>.

The traditional management methods outlined above are all still practised in all areas where fishing is pursued, but the extent and intensity with which they are implemented differ significantly. In the south-western part of the region i.e. the areas bordering the Kwando/Linyanti, River and swamps, traditional management practises are currently relatively unimportant. There are two reasons for this development. One is the establishment of the Mamili National Park and the second is the general decrease in the fish stocks of the Kwando/Linyanti System.

There is also strong pressure on the traditional management practises in the north eastern part of Caprivi, i.e. in areas close to Katima Mulilo. With the influx of people, the process of urbanisation and the commercialisation of the fishery, both traditional fishermen and traditional leaders have lost their authority.

In the eastern floodplain proper (i.e. the eastern part of the Zambezi and the Chobe River and floodplain) the management systems as described are still actively implemented and supported by the local fishermen.

4.2.1.2 Okavango River

In the Okavango region, access to and utilisation of natural resources have been subject to both formal regulation and informal customs and practices. Local headman have traditionally regulated access to productive land and to common grazing areas. However, the dynamics of traditional fisheries management is more complex than those of other resource systems. Fish, people frequently point out, are different than land and trees. "Nobody can claim to own fish or waterways, fish move through with the water." A range of informal practices, often based on notions of collective responsibility, have guided traditional management of fishery in Okavango. Traditional management is, however, constantly changing, and political and economical changes are at present causing some practices to fall away. In addition to territorial rights, other management practices are:

Inadvertent Practices	Intentional Practices
a) Limiting access: Although these vary by district, some past practices had the effect of limiting access to the river and floodplains by "outsiders"	a) Regulation of fishing methods: In Okavango, restrictions on certain gear or methods used in community-based fishing expeditions explicitly aim to regulate the fishery, i.e. tradition dictates that groups who wish to close off a pool with a fish fence or spreading poison (<i>rushungu</i>) must first inform the headman of the proposed site. The group then subsequently announces the event to the community, inviting the communities to
b) Taboos: No taboos regarding the consumption of fish exist in the Okavango.	
c) Technical inadequacies; Dangerous parts of the river, including deep fast-flowing water or sites with crocodiles, preclude fishing and thus conserve fish stocks.	

d) Seasonal constraints: This practice does not appear to have been adopted in Okavango, although the placing of the <i>masasha</i> (fish fence) with the rise of the flood unofficially signalled the start of the season. The trend is to follow the regulations of nature. There are times when people fish, and times when people do not, and this allows the fish to breed and grow.	fish. In the 1950's, <i>rushungu</i> and other fish poisons were prohibited, by colonial law and local headman assisted in enforcing this act.
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In Okavango, the effectiveness of local (traditional) management is constantly being eroded by increasing pressure on natural resources, increasing socio-economic stratification, increasing commercialisation of resources and a shift in political authority from traditional leaders to central Government. Tribal customs regulating fishing are also breaking down. Increased population pressure is one factor, for as villages expand, family ties and neighbourliness erode the sense of belonging to a "community". The waning of the authority of traditional leaders is especially noticeable amongst members of the younger generation.

4.2.1.3 Cuvelai System

In traditional laws of this area restrictions on fishing were primarily geared towards the protection of the water and not primarily to protect fish. According to a local senior headman, "*We the traditional leaders are not against fishing, but we are opposed to some of the modern and traditional tools which are destroying water as a resource for our animals. We are aware that fish is an important source of protein for many people in this region, but there must be a time to fish and certain types of equipment must only be used at the appropriate time*". Currently, traditional leaders emphasise that there is a need for government regulations to assist in the proper management of the fishery in the Cuvelai area.

4.2.1.4 Other Systems

None of the other systems are or were ever fished traditionally with the result that no management systems were developed.

4.2.2 Present Management

Government management practice is at present controlled by the Nature Conservation Ordinance, No 4 of 1975. This ordinance governs access to fishing in inland waters, requiring everyone except inhabitants of communal land to have a permit to fish. Permitting only hook and line fishing for those with permits, the acts also places

restrictions on certain gears and methods, such as explosives, or fishing with more than two lines. The ordinance basically addresses fishing with hook and line e.g. restricting fishing with more than two lines. No mention of traditional gear or nets is made, nor is the ordinance applicable on communal land except for prohibiting the use of e.g. explosives and fish poison. For the full wording of the ordinance see appendix iv.

5 ENVIRONMENT AND FISHERIES

5.1 Maintenance of the Integrity and Bio-diversity of the Different Systems

Public opinion in the world became increasingly condemning about the abuse and destruction of natural resources during the last decades. This trend resulted in the Earth Summit in Rio de Janeiro in June 1992 where the Convention on Biological Diversity (CBD) was adopted. This convention that recognises the importance of maintaining the biological diversity and integrity of ecosystems has now been ratified by 110 countries and came into force on 29 December 1993.

In compliance with the Namibian constitution and following general principles for the conservation of/and the wise and sustainable use of natural resources, the genetic integrity and biodiversity of the different fresh water systems will be maintained. Special attention will be given to the implications of sharing all the major river systems with neighbouring countries. The effects of agriculture and forestry activities, e.g., deforestation and overgrazing and the resultant erosion and siltation of riverbanks and rivers respectively, will be studied.

The release and accidental transfer of aquatic organisms between different systems (drainage basins) and also in some cases within systems, will be prevented, and general guidelines to protect the bio-diversity in systems to prevent genetic pollution and to keep out invasive alien species will be adopted. These are:

- (a) The intentional introduction of alien species into drainage systems shall be prohibited by national laws and every effort should be made to co-ordinate and enact such restrictions on a regional basis.
- (b) Unintentional, accidental transfer of alien species such as e.g. water weeds by boats being transferred from one system to another, all be curbed by regulating the transfer and or disinfection of boats if deemed necessary.
- (c) Vulnerable species, habitats and areas of special ecological significance all be identified and given special protection status under the Act.

5.1.1 The Assessment of possible impacts of various parameters on the aquatic environment

The Ministry of Environment and Tourism is in the process of formulating a general policy covering environmental impact assessments (EIA) for Namibia. In the light of this development the need for detail policy formulation and legislation on environmental impact assessment specifically for fresh water fish, falls away.

It is, however, necessary to draw attention to the fact that the impact on fresh water ecology does not necessarily stem from major projects e.g. dam construction and water

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the water is not consumed and remains available for other users. Moreover, the generated power creates the potential of pumping and piping water to other users.

The international nature of the border rivers also implies a conflict in fishing and complaints, especially in the Caprivi, already stream in. Pirates from Zambia and, to a lesser extent, Botswana frequently cross the international border and fish in Namibian waters, not only on the Namibian side of the river channel, but even in the backwaters on the floodplain. These conflicts will have to be addressed through bilateral discussions and perhaps with SADC intervention. A final solution may only be possible through increased monitoring and policing.

5.1.3 Land Use

At present, land use for intensive agricultural purposes is not yet at a level where spin-offs have a bearing on the river and floodplain ecology. Should planned projects for large scale irrigation projects, e.g. the sugar cane project proposed in Lake Liambezi, become a reality, this may change. The floodplain, covered by water during peak floods, forms a most important link in the ecosystem. Ploughing and planting on floodplains may initially seem to bear little threat but it may, if valuable assets like sugar cane fields are flooded and destroyed, result in pressure to regulate the spread of flood waters. This may take the form of pressure to erect barricades to keep the floods out of the cultivated areas or may lead to efforts to dig drainage canals around the area. Any such manipulation of the natural flood will have to be closely assessed to mitigate any effects. Such large scale agricultural projects will also lead to the entry of fertilisers into the natural streams and water bodies. The algae blooms that result are not desirable and cause disruption through eutrophication and eventually anaerobic conditions in natural systems.

Urbanisation is likewise not yet a problem but can be expected to become one in time. This will bring along greater demands for water for household use which in itself may not be of consequence but the management of effluent that will be produced may become a problem. This polluting effect may be amplified by the concomitant development of both formal and informal industries which by their nature usually produce pollutants in some form. All these aspects can, however, be addressed and managed with proper planning and foresight.

5.1.4 Alien species and negative effects of introductions

The introduction of alien species and the resultant genetic changes are regarded as detrimental by conservationists. Two categories of genetic impact are distinguished, intraspecific gene flow between geographically separated populations of the same species and interspecific hybridisation. The latter occurs during breakdowns of normal species-isolating barriers, is usually irreversible and has a greater effect than intraspecific hybridisation because of the larger number of gene differences that

normally separate species. Alien species normally find their way into river systems through the actions of man and very often simply through the dumping of unwanted aquarium fish or fish being introduced as a curiosity. In countries where water is a scarce commodity, water is often piped or channelled over vast distances. Very often from one drainage system, across watersheds, into another system. In Namibia this is the case in the water flowing from the Kunene at Calueque to the Olushandja dam and past to the Okandjere area. The Eastern National Water Carrier also conveys water from the Okavango drainage basin to that of the Swakop and Omaruru Rivers. In the case of the Calueque/Olushandja canal the probability of *Oreochromis mossambicus* reaching the Kunene via the canal is high.

5.1.5 Boats

Through transferring boats between systems, the unintentional transfer, especially of water weeds like the water hyacinth, is well known. The use of engine powered boats for fishing furthermore opens up the river systems over large areas and expands the fishing pressure into formerly inaccessible areas that used to serve as unproclaimed but effective conservation sanctuaries and breeding areas. The high bow waves created by fast, engine powered boats cause the erosion rate on river banks to be drastically stepped up. Traditional dug out canoes are very often endangered by speeding power boats. It is the intention to regulate the use and transport of boats to mitigate these effects.

5.1.6 Roads

The construction of roads traversing flood plains used to concentrate on engineering problems and tended to ignore the effect these structures have on the floodplain environment. Too few culverts tend to divert water movements and concentrate sheet flows into channels, resulting in erosion. These man made structures, in concentrating the flow, create focal points for netting migrating fish. The blocking of such structures will be regulated and the general effect of roads especially in wetlands, is to be thoroughly planned in future by insisting on thorough, properly conducted environmental impact assessments. Attention should be given to the details of the design of such structures so as not to cause the migration of the fish to be impeded.

6 PERSPECTIVES FOR DEVELOPMENT

6.1 The Role of Fresh Water Fish in the National Economy

Although not important in the formal economic sector, and likewise in generating revenue, fresh water fish plays a major role in the informal sector and especially in food security and as a protein source in the rural communal areas.

6.2 Subsistence Fishery

The role fresh water fish plays differs in different river systems, the least significant being along the Orange River and the most important, both in terms of quantities and socio-economic role, is in the rivers of the Caprivi Region. (These river systems are treated separately for the sake of clarity).

6.3 Commercial Fishery

There can be little objection against small scale commercialisation of the fresh water fish resource by artisanal fisherman that employ non-destructive gear. The ideal situation would be that surplus fish be sold at affordable prices to generate cash income to the fisherfolk. The resources in general are, however, not of a magnitude that can bear commercial exploitation without strict quota systems and suitable control. The latter two prerequisites are, however, by the very nature of the fresh water systems, not attainable. It is, however, a fact that preferences for specific fish types in certain areas do exist and it is to be expected that if fish such as catfish are sought after in an area and not highly regarded in another, that a trade between the two areas will develop. The success of such ventures will depend on the price structure and the willingness of people to pay a premium for a preferred species in preference to cheaper marine fish now readily available almost everywhere.

6.3.1 Fish Markets and Prices : Communal Areas

The only major formal fish market is the one in Katima Mulilo in the Caprivi Region. Fresh fish is sold on a daily basis and forms the major outlet for the fish landed by the fledgling commercial operators in the area. In other areas fish is marketed more informally by bringing fish to so-called "fish trees" where sales are made on an irregular and informal basis. In other areas, e.g., near Ombalantu in the Omusati Region, fish is merely hung outside huts in a visible position to draw business. Prices paid for fish depend on various factors such as, e.g., the species (this again is influenced by the regional preferences), the time of the day, the availability of marine fish, etc. Some of the systems are already under pressure and commercialisation of fishing will certainly disrupt patterns of subsistence consumption of fish. The cost of regulating commercialisation of fresh water fisheries will be exorbitant in relation to its potential commercial value. To develop a formalised marketing system and to promote the commercialisation of the resource seems not to be based on sound economic, socio-economic and ecological principles.

6.3.1.1 The Role of Marine Fish

As has been experienced in other markets, e.g., Zimbabwe, the ready availability of cheap marine fish brings massive changes to the protein market. In Zimbabwe the availability of Namibian horse mackerel caused a 25 % reduction in beef and chicken prices. The cultural resistance against an unknown species was broken down by the affordable price in a very short time (much to the surprise of socio-economist working in this field). It is expected that, as was the case in Rundu, horse mackerel will also in time appear in large quantities on the Katima fish market. This may render commercial ventures on fresh water fish unprofitable and may impair the development of such ventures. This may, in fact, be a blessing in disguise for it may prevent the destruction of the fresh water systems through intensive entrepreneurial commercialisation. Should commercial activities, however, develop to such a level that the environment and subsistence fisheries is endangered and threatened, consideration should be given to encourage marketing of marine fish in Caprivi and Okavango.

6.3.2 Fish Markets and Prices : State Dams

Two concessions for the harvesting of fish from State Dams have been granted in the past. In both cases a tender system was followed and the highest offer was granted the fishing right. Although the development of commercial capture fishing in State Dams should not be neglected it is not seen as having major development potential

6.3.2.1 Hardap Dam

The concession was taken up for three years at a levy of 51c/kg with a quota of 145 mt per annum. The concessionaire managed to take out only 115 tons in three years despite a reasonably high fishing effort. The catch consisted of 10 % bream, less than 5 % catfish and the rest was mudfish (*Labeo*). The large percentage of mudfish could not be marketed even at the reduced price of N\$1,60 per/kg. At an alleged loss of about N\$100 000 the concessionaire stopped fishing.

6.3.2.2 Omatako Dam

This concession was also put to tender and was allocated at 15c/kg. Fishing started off with beach seines but the effort then shifted to longlines. The catch consisted of 90 % catfish and about 12 tons were landed before fishing was stopped because of a drop in CPUE. Catfish was sold at N\$1,50/kg in Windhoek, the price also charged for the cheapest marine fish and no problems were experienced in marketing and selling the fish. This concessionaire allegedly also lost on the experiment but is of the opinion that a mobile unit with a concession to fish a number of dams may be successful. The figures quoted, however, indicate that, at best, between 200 and 400 mt of fish can be harvested from the State Dams in the central area (Hardap, Swakoppoort, Goreangab, Omatako) although it is insignificant in comparison to Namibia's marine resource.

6.4 Recreational and Sport Fishing

Recreational fishing for the general urbanised public and for tourist in Namibia is fairly important and angling is done in the major State Dams, along the lower Orange, Kunene, Okavango, Kwando, Chobe and Zambezi Rivers. Fishing for tiger fish e.g. has become a very important tourist attraction. In the past, permits for angling were needed only for angling in State Dams. The latest statistics on the numbers of these permits issued by the Ministry of Environment and Tourism are not available. Lodges offering angling trips as part of their portfolio are found along the northern rivers. There are five of these lodges in the Caprivi region, three along the Kunene River and eight along the Okavango River. Tourist from Lodges along the Chobe River situated in Botswana also fish in Namibian waters. Organised sport fishing is practised by the 110 members of the seven angling clubs registered with the Namibia Freshwater Angling Association (N.F.A.A.).

These activities will be regulated for each system as deemed necessary on advice from the Fresh Water Research personnel. Competitions will be regulated through two tiers of authority. The first tier is envisaged to be a national body formed by registered angling clubs (registry is to be with the national body). The numbers of competitions that can be allowed in different water bodies and systems should be advised upon jointly by the Ministry (research personnel plus management personnel) and the national body. Individual clubs should then apply to the national body where allocations should be made, programmes be compiled and submitted to the Ministry for final scrutiny and approval. The following principles should apply for fish caught during competitions:

- (a) released after weighing and measuring, if practical,
- (b) the number of fish that may be kept as trophies by a participant shall be determined by the Permanent Secretary as a condition,
- (c) some species or size categories be removed upon advice from the Directorate of Resource Management to augment population and system management, and
- (d) fish removed with the exception of those in (b) *supra* should, in rural areas, be made available to the local population for household consumption. Regional Council members and traditional authorities will be involved in the fair distribution of fish, free of charge to local, needy households and institutions such as old age homes, hospitals, etc. Care should be taken to prevent such fish from entering the trade.

It is important to note that the registration of boats is of the utmost importance to control the movement of boats from one catchment area to another. Foreign boats should also be registered when entering the country. A system of licensing a boat for a specific system will be followed. A system for easy identification by law enforcer, enabling the verification of the boat to be used in the system, will be implemented.

Boats will not be allowed to be licensed for more than one system at a time to facilitate good control on the movement of boats between systems. Temporary licences for the use of a boat in a system for a short period only will, however, be issued.

6.5 Aquaculture and Aquarium Trade

6.5.1 Aquaculture

It is the policy of the Government to treat aquaculture and mariculture matters separately from general fisheries matters and the Ministry of Fisheries and Marine Resources will compile a policy document, act and regulations to facilitate the proper management of these activities.

6.5.2 Aquarium Trade

There are a few pet shops currently trading in aquarium fish. The biggest pet shop in the country imports fish and aquarium plants on a monthly basis for an amount that varies from N\$ 8 000.00 to N\$ 10 000.00. The Ministry will enact proper regulations to control the importation, exportation, keeping, distribution and release of aquatic organisms in inland water bodies:

- (a) two classes of permits are proposed, a Class A permit for commonly imported species that can be issued annually, and a Class B permit for species not appearing on the list of commonly imported species,
- (b) when an application is made for importation the Ministry may require a health certificate from the corresponding authority of the country of origin or may insist on a period of quarantine,
- (c) any indigenous species may only be exported under a permit from the Ministry,
- (d) any exploitation of a Namibian inland resource for the purpose of exporting fish or fish products alive may only be done by permit issued by the Ministry, and
- (e) no species kept as aquarium species shall be released back into the wild whether alien or indigenous. The organisms must be destroyed.

7 INTERNATIONAL ASPECTS OF NAMIBIAN FRESH WATER RESOURCE MANAGEMENT

7.1 Watershed Management

Being in the unenviable position of having the catchment areas of all major Namibian rivers in neighbouring countries, Namibia has little direct control over watershed management in the catchment areas. It is therefore critical that Namibia negotiates this and secures the right to make inputs on the manner in which the upper reaches of the Namibian rivers are being managed.

7.2 Regional Collaboration

If a resource is a common property and no limitations on its utilisation are enacted, it will be rational for individuals or households to extract as much as possible from the resource as soon as possible for maximum personal gain. In such a system, limited exploitation will be based on individual cost/benefit considerations and not with reference to the long term sustainability of the resource. Thus a common property or open access resource will tend to stimulate over-exploitation and eventually the depletion of the resource.

The principle that utilisers of a communal resource tend to lose sight of long term sustainability for short term gains is also true for resources common to two or more nations. Regional collaboration on watershed management, introduction of alien species, fishing management strategies and conservation of ecosystems in general will be in the interest of all countries sharing the river systems in central Southern Africa. A forum, perhaps under the SADC umbrella, should be created where these matters can be addressed.

7.3 Bi- and Tri-lateral Collaboration

Some issues e.g. the proclaiming of sanctuaries by two countries bordering a river, may be better served in bi- or tri-lateral discussions and negotiations. It is envisaged that broader issues of regional policy will be better served by the forum for regional collaboration but that more practical on-the-ground matters will have to be addressed in Bi- and Tri-lateral committees more or less on an *ad-hoc* basis.

8. POLICY AND STRATEGIES

8.1 Introduction

Management strategies proposed in this paper have taken cognisance of local traditions and the role of traditional and local leaders in regulating fishing in different areas against the backdrop of the Namibian Constitution. For this reason the Hon Minister of Fisheries and Marine Resources, held a series of meetings with local authorities, local traditional leaders and other interest groups, especially in communal areas, presenting the first draft of this paper to the communities and invited comments and recommendations. The final draft of this paper and the draft bill have been presented and discussed on several workshops held with the community leaders in various regions (Caprivi, Okavango, Oshikoto, Ohangwena, Oshana, Omusati, Kunene, Hardap and Karas) before tabling the documents before Cabinet and the National Assembly. The management measures developed, especially for the rural areas, are therefore the result also of the inputs, suggestions and comments of rural riparian communities. The enforcement of measures is therefore seen as a partnership between central government, local government and traditional leaders through a system of delegated powers to be defined in the new Fresh Water Fisheries Act which is to replace the present legislation of the Ministry of Environment and Tourism pertaining to fresh water fish.

8.2 Policy for Resource Management

It is the policy of the Government of Namibia to allow the exploitation of inland fish resources on a sustainable basis and at an optimal level. Resources will be managed to ensure long term food security to the riparian populations who will be involved in the management and control of the resources and to whom the benefits from the resources must accrue. It is furthermore the policy to prevent harmful impacts on traditional fishers dependent on inland fish resources for food security by uncontrolled commercialisation of the resources, both directly by commercial fishing and through exploitation of the resources for tourism.

Patterns of exploitation will moreover be tailored to protect endangered or vulnerable species, the eggs, fry and breeding areas of such species. This will be accomplished through restricting effort by regulating types of gear to be used e.g. by stipulating minimum mesh sizes, setting bag limits, closing certain areas and declaring closed seasons, outlawing the use of fish poisons, the use of artificial light and certain types of destructive modern gear. In the evaluation of gear types to be allowed or not, preference is given to non destructive passive gear in contrast to non-selective destructive modern gear. It is the policy to protect the resource from activities other than fishing that may have a negative impact on the sustainability and biological integrity of the resource. Whenever actions that may have an impact on inland fish are planned, the Minister will have to be consulted and environmental impact studies must be affected to the satisfaction of the Minister.

To serve the proper management of the shared river systems with catchments in neighbouring countries, mechanisms to liaise on uniform management policies with neighbouring countries will be set up.

8.3 Food Supply And Food Security

Namibian inland fisheries provides an important supply of food of high nutritional value to local communities. The Government aims to secure the supply and consumption of fresh water fish especially to subsistence households in Namibia.

8.4 Pursuing a Holistic Multi-stock Management Strategy

The Government will pursue a holistic, multi-stock management approach to protect the fish resources and the fishery from possible negative effects of all activities impacting on the inland ecosystems. Before any such activities are executed, the Ministry will have to be consulted and an environmental impact study undertaken. Special attention will be given to prevent the deterioration and/or destruction of the habitat of the river and wetland areas, also through non-fisheries related activities such as the overgrazing of floodplains and the extraction of water and damming of rivers. Special care will be taken to monitor the species composition and diversity as well as genetic integrity in the various systems and to adjust management strategies to ensure that the natural balance of species is not fundamentally affected.

8.5 Conservation and Maintenance of Bio-diversity and Genetic Integrity

It is the policy of Government to conserve and maintain the natural fish fauna indigenous to Namibian inland waters and to prevent any further introduction and translocation of alien and potential harmful invasive species between major systems that may be detrimental to the integrity of the fish fauna of Namibia as a whole.

8.6 Policy on Research Strategies

The Ministry will fund and develop the Institute for Inland Fisheries Resource Research. The objectives of the Institute will be to provide advice and information on all matters pertaining to the management and potential of the various resources, their geographical and seasonal fluctuations, distribution and production potential and to provide advice on fishing methods (e.g., gear), and to set up a system for the collection of statistics in the detail necessary for good administrative socio-economic and biological research purposes. Included are advice and recommendations regarding possible future catch quotas on the various selected stocks and the implementation of management strategies through fishery regulations. This will require the development of the necessary competence of scientific and technical staff as well as the acquisition of relevant research and other equipment.

Whereas in former times the emphasis in fresh water fisheries research was focused on the central area and the communal areas were neglected, a new approach, also in terms of research priorities, will be developed. It is being realised, by virtue of the number of

people dependent on fishing, especially in the northern communal areas, that research effort in these areas has to increase. The systems fished by the local inhabitants, especially in Caprivi and Okavango Regions, are highly diverse in species and habitats and therefore highly sensitive. As part of the highly productive wetland systems, it should be treated and managed with the utmost care. The level of understanding of the functioning of the systems at present is unsatisfactory. Research projects in the past, before independence, were mainly carried out by researchers attached to universities in South Africa. The research component of the Fresh Water Fish Institute at Hardap concentrated its efforts before independence more on the State Dams in the central area and on aquaculture, especially the production of fingerlings for sale to farmers in the commercial areas and for the stocking of State Dams. After independence the scientist of the Fresh Water Fish Institute expanded their efforts and commenced with long term research projects in the Kunene, Okavango, Zambezi, Kwando/Linyanti, Chobe and Orange Rivers as well as conservation studies on endangered fish species.

Careful consideration will be given to the time and effort spent on estimating sustainable yields and monitoring fish populations in State Dams. The small amounts of fish available from this source do not merit much scientific effort.

A nucleus of research on fresh water fish already exists in Namibia. An expansion of staff is urgently needed in the short term in resource assessment, fishery management, collection of statistics, etc. There is also an urgent need to implement intensive resource and socio-economic surveys to provide data for updating assessments of the resources, especially those in the northern regions. This data is required to enable the Ministry to formulate and update general management strategies for the natural inland resources and for their continued exploitation and conservation.

A multi-disciplinary research institute will be considered in the northern communal areas. The model used for this institute is the Desert Ecological Research Institute (GOBABEB), situated in the Namib Desert along the Kuiseb River, and which functions as a multi-disciplinary research station in the study of the desert-ecology. Participation will be solicited from the Ministries of Agriculture, Water and Rural Development and the Ministry of Environment and Tourism. Ideally, a national institution situated at a central position in Namibia, and wedged in between Angola, Zambia, Zimbabwe and Botswana, should, in time, become a regional institution. Such an institution, by its nature, being involved in food security, maintenance of ecosystems and biodiversity, and being potentially of regional importance, should prove attractive to foreign donors.

8.7 Commercialisation of/and Employment Through Developing the Inland Fish Resources

The nature of the rivers and water bodies and in general the scarcity of water and the sandy nature of soils in Namibia is such that it does not lend itself to obvious large scale commercial aquaculture development. Employment and income creation potential of this sector at present is regarded as limited. Future technological development for large scale projects may lead to extensive developments. Small water bodies at present hold the greatest potential for small scale development, but development is likely to be constrained by the relatively high production costs in relation to market prices.

8.8 Potential Export Earnings

The major part of the fish caught is consumed or otherwise utilised in Namibia. However, the nature and species diversity of the indigenous fish fauna has substantial potential for the development of exports for the aquarium trade. Careful stimulation of this aspect could lead to the establishment of a foreign currency earning industry.

8.9 Specific Management Regimes

As has been pointed out, recognising the differences in the various systems, different management regimes are proposed in each system to suit the particular needs of a system. The different systems identified in chapter 2 are therefore considered separately in terms of the proposed management regimes for each category of systems.

8.9.1 Central Systems

8.9.1.1 State Dams

Will be managed in liaison with the Department of Water Affairs and the Ministry of Environment and Tourism to properly regulate activities and ventures:

- (a) that may seriously affect the water quality in dams, especially those supplying household water, and
- (b) that may endanger or negatively affect the structure of the dams. Dams or parts of dams in which angling and/or harvesting is allowed will be zoned and marked accordingly for different purposes.

Such physical zonations will be effected in liaison with the Department of Water Affairs and the planning of zonations for dams in nature reserves, with the co-operation and inputs of the Ministry of Environment and Tourism. For this purpose a small standing committee of nominated members of the three ministries will be formed.

8.9.1.2 Private Dams

The introduction of species into private dams and the transfer of indigenous fish between systems as well as the introduction of alien species will be regulated and controlled by the Ministry.

8.9.2 Cuvelai System

For the Cuvelai System any gear that prevents the natural and even migration of fish during flood events in the system will be prohibited. The system may be harvested as efficiently as possible and the following measures will be implemented:

- (a) all gear that prevents the natural migration of fish by preventing the passage of fish along a waterway during floods will be prohibited,
- (b) all fishing activities that are geared towards harvesting fish, without impeding the general migration, will be allowed,
- (c) the Olushandja Dam will be treated as a river system and not a State Dam, and
- (d) no fishing will be allowed in the Ruacana /Olushandja canal.

Once the floods have subsided, all types of fishing gear, except hook and line, will be regulated. The season for gear and harvesting a particular water body will be set by the Minister or his delegate on advice from local and traditional authorities in whose area of jurisdiction the water body falls. Particulars will be announced by posting a notice, signed by the Minister or his delegate, in the offices of the regional governor of that area and by erecting up a sign in the waterbody itself.

8.9.3 Orange, Kunene, Okavango Rivers and Systems in the Caprivi

For the proper management of shared systems with their upstream areas in neighbouring countries, the Government aims to liaise closely with the governments of these countries through a standing joint commission on fisheries for management purposes.

The following gear restrictions will be implemented in these river systems :-

- (a) no dragnets will be allowed,
- (b) gill net mesh sizes will be regulated,
- (c) all traditional gear will be allowed,
- (d) the establishment of breeding sanctuaries will be considered as a priority to ensure sustainable, unexploited production in these areas. Such sanctuaries, where appropriate, will include the floodplain and riverine vegetation , and
- (e) when the sanctuaries in (d) *supra* are considered, the co-operation of neighbouring countries in appropriate cases will be sought to ensure the establishment of such sanctuaries across the river.

8.10 Actions

Actions which will be pursued are the following:

- (a) the Acts of the relevant Ministries will be co-ordinated,
- (b) the Ministry of Fisheries and Marine Resources will incorporate, as far as practically possible, the ideas voiced by the traditional leaders (chiefs and head men) and the members of the local riparian communities in the northern regions to obtain their full support for this policy and subsequent involvement of the traditional authorities with regard to law enforcement,
- (c) habitat protection through land acquisition and proclamation by the Ministry, will be pursued to enable the Ministry to create the best possible environmental protection for endangered species and representative samples of aquatic biotic elements as well as areas of conservation and scientific importance,
- (d) law enforcement officers will be thoroughly trained to ensure the proper enforcement of all the relevant acts. Such officers will furthermore be appointed to enforce all the relevant acts; such as the Inland Fisheries Act, the Nature Conservation Act, the Forestry Act etc.,
- (e) law enforcement officers will be specifically trained also to act as extension officers in conveying the aims and instructions of acts to local communities to ensure public awareness and co-operation; special care will be taken that the law enforcers are not seen primarily as persecutors but as co-custodians of resources working towards the long term interest of the users of resources,
- (f) only a limited number of law enforcement officers will be appointed and use will also be made of the Ministries of Environment and Tourism and Agriculture, Water and Rural Development, regular police officers as well as members from the traditional systems. The Ministry of Fisheries and Marine Resources will appoint a number of liaison/extension officers. These officers are to be placed in the north in Oshakati to serve the following regions Oshikoto, Omusati Ohangwena and Oshana Regions, in Rundu (Okavango Region) and in Katima Mulilo (Caprivi Region) to act as training, extension and liaison officers,
- (g) communication with neighbouring countries will be initiated as a priority to harmonise legislation applicable to the relevant shared systems. Standing international committees, possibly through SADC, will be established to monitor and liaise on this aspect, and
- (h) future fisheries management courses will have to take into account not only marine aspects. Future management staff will also be afforded the opportunity to become acquainted with management issues by attending courses, seminars, etc., on inland fisheries on the southern African context.

9. POLICY AND LEGISLATION

9.1 Legal Framework

Shortly after Independence the Fresh Water section of the then Ministry of Wildlife, Conservation and Tourism was transferred to the Ministry of Fisheries and Marine Resources. The Ministry of Fisheries and Marine Resources is therefore responsible for the inland fisheries resources as described in Chapter 2. It will need to enact comprehensive legislation which will, *inter alia*, enable it to control fishing operations as well as to introduce appropriate conservation measures for the resources. In spite of the Nature Conservation Act (Act 4 of 1975), the Water Act and a Forestry Act which are in force as an interim measure, there is a general agreement that a new legislation is needed to control fresh water fishing and to ensure the sustainable utilisation and protection of the systems.

The new Act will have to deal specifically with the drafting of fishing agreements along water bodies shared with neighbouring states and other general provisions applying to possible foreign co-operation in the protection and utilisation of the natural resources in the rivers on the borders of Namibia and neighbouring states.

For legislative and administrative purposes, the fauna and area under the jurisdiction/mandate of the Ministry of Fisheries and Marine Resources covered in this policy paper are defined as follows:

Fauna

"All aquatic species, with the exception of amphibians, reptiles, birds and mammals will be governed by this new Act"

Area

"Water and wetland systems (defined as the interface between aquatic and terrestrial ecosystems) above the high water mark of the sea and inside the natural borders of Namibia, whether permanently or ephemerally inundated with fresh or salt water"

Actions

The new legislation will specifically need to address the following issues:

(a) Administration

The Act will accord the necessary powers to the responsible Minister and executive officials. Consideration will be given to the practical implementation of the devolution of powers to regional and traditional levels and to ensure that management decisions can be implemented swiftly.

(b) Management Planning

The Act will specify procedures to be followed by the fisheries administration for fisheries management planning. The management regimes as drafted in this

document for each fishery, will dictate the type of management measures to be implemented by legislation.

(c) **Regional Co-operation**

The legal framework will be established for regional co-operation with respect to the control of cross-border fishing and fisheries management and conservation in general.

(d) **Fisheries Management Measures**

The Act will empower the fisheries administration to implement the appropriate fisheries management measures, including e.g. limitation of effort, fishing gear specifications, minimum sizes of fish to be landed, species limitation, bag limits, closed seasons, etc. to ensure the effective management of the inland fish resources.

(e) **Powers of Enforcement**

The Act will specify the powers of enforcement officers, including halting of boats, search and inspection, seizure and arrest.

(f) **Evidentiary Clauses**

It will be necessary to include certain presumptions in order to ensure that prosecution of illegal fishing activity does not fail on technical grounds.

(g) **Penalties**

The Act will have to specify the penalties to be applied for violations of the Act and Regulations and is to be taken up in regulations or by laws.

(h) **Prohibition of certain fishing methods**

Fishing with or the killing of fish with drag nets, explosives, anaesthetics, poisonous substances and electric shock apparatus and the use of artificial light, except for scientific research purposes, will be prohibited by the Act.

(i) **No one will be allowed to place any modern fishing gear (net) closer than 100 metres from a bridge, culvert or spill way when water is flowing through such a structure.**

9.2 Need for Foreign Assistance

The following areas are identified as likely to require foreign assistance in the development phase of the Namibian inland fisheries:

- a) establishing the infrastructure for fisheries and floodplain research and rendering technical assistance on a regional basis,
- b) training of law enforcement officers to become efficient extension and attitude creating agents,
- c) assisting in putting into practice any production proposals that may flow from the research inputs, and
- d) legal assistance in negotiation with neighbouring countries and in the drafting of treaties with those countries.

9.3 Patrolling and Control : Cost effectiveness considerations

Monitoring the river systems will require strengthening of the present Inspectorate Section of the Ministry of Fisheries and Marine Resources depending, with however, emphasis on the significance of the role that will be played by local and traditional authorities. Careful consideration is to be given to the cost implications before establishing a separate inland fisheries control unit. Likewise consideration should be given to especially accrediting the Police and Environment & Tourism officials, to enforce the Inland Fisheries Act. This will call for well-planned training sessions for these officials to be initiated and organised by the Ministry of Fisheries and Marine Resources, with the consent and co-operation of the Ministry of Environment and Tourism and the Ministry of Home Affairs.

9.4 Socio-economic Considerations

The extent of rural poverty and unemployment which leads to environmental degradation and over-exploitation of natural resource deserves attention. The role fish play in providing food security to subsistence households is recognised and will be protected from uncontrolled commercialisation of the resource by individuals for personal gain.

9.5 Extension Officers

Information concerning the conservation of natural resources as well as the aims and policies of the Ministry with regards to fresh water fisheries needs to be conveyed to rural fishing communities. Equally important is feedback from the rural fishing communities which needs to reach the Ministry. These functions will have to be taken care of by fisheries extension officers, and the personnel identified to act in this capacity should be properly trained. The officers should be co-ordinating the extension function envisaged for the law enforcement personnel as explained elsewhere.

9.6 Legal Framework For Management

The Ministry of Fisheries and Marine Resources will assume responsibility for the initial preparation of drafts of an Inland Fisheries Act and Regulations. It will prepare a draft Act and Regulations based on the policy and principles as set out in this document. In drafting this Act the Ministry of Fisheries and Marine Resources will endeavour to co-ordinate the acts of relevant Ministries, viz. Environment and Tourism and Agriculture, and also Water and Rural Development as far as water of importance to inland fish is concerned.

9.7 Law Enforcement and the Role of Local and Traditional Authorities

Enforcement of the Inland Fisheries Act will be done primarily by traditional and local authorities in the rural communal areas. The devolution of powers to regional and traditional authorities will be spelled out in the Act and implementation of and control over management will be spelled out in the regulations of the Act. These efforts will be backed up by fisheries control personnel and by especially appointed Wildlife and Forestry officials of the Ministries of Environment and Tourism and Agriculture, Water

and Rural Development, as fishery control officers. Liaison to facilitate this will be initiated by the Ministry of Fisheries and Marine Resources.

The traditional as well as official law enforcement officers will be thoroughly trained to ensure the proper enforcement of the Act. The training will be planned and executed by the Ministry of Fisheries and Marine Resources.

Law enforcement officers will be specifically trained to also act as extension officers to convey the aims and instructions of acts to local communities, to cultivate public awareness and foster future good co-operation between local communities and law enforcers.

Communication with neighbouring countries to harmonise legislation applicable to the relevant shared systems is seen as a priority. Namibia will request the formation of standing international committees, if need be through SADC, to monitor and liaise on this aspect. Foreign assistance will be sought in the drafting of treaties to deal with regional, tri- and bi-lateral issues pertaining to shared rivers and water bodies with regards to fishing, conservation and general resource matters.

APPENDIX I

LITERATURE CONSULTED

- ASHLEY, A. 1994. Population Growth and Renewable Resource Management. The challenge of sustaining people and the environment. Research Discussion Paper. No. 1. Ministry of Environment and Tourism.
- ASHLEY, A., BARNES, J. and HEALY, T. 1994. Profits, Equity, Growth and Sustainability. The Potential role of Wildlife Enterprises in Caprivi and Other Communal Areas of Namibia. Research Discussion Paper. No. 2. Ministry of Environment and Tourism.
- BARNARD, K.H. 1948. Report on a collection of fishes from the Okavango river with notes on Zambezi fishes. Ann. S.Afr. Museum 36.
- BELL-CROSS, G. 1982. The biogeography of the Zambezi River fish fauna. M.Sc. thesis, University of Natal, Pietermaritzburg.
- BETHUNE, S. and ROBERTS, K. 1991. Checklist of the fishes of Namibia for each wetlands region. Madoqua 17: 193-199.
- BLOEMHOFF, H.J. 1971. Fishes of the Ekuma River, Etosha Pan and Oponono Lake. Internal report. Dept. of Nature Conservation and Tourism, S.W.A., Windhoek Namibia.
- BREEN, C. and BEGG, G. 1987. Wetlands - a valuable natural resource. Afr. Wildlife 41: 261-263.
- BRUTON, M.N. and JACKSON, P.B.N. 1983. Fish and fisheries of wetlands. J. Limnol. Soc. sth. Afr. 9: 123-133.
- BRUTON M.N., JACKSON, P.B.N. and MERRON, G.S. 1987. Fishes and wetlands. Afr. Wildlife 41: 261-263.
- CAMBRAY, J.A. 1984. Fish populations in the middle and lower Orange River, with special reference to the effects of stream regulation. J. Limnol. Soc. Sth.Afr. 10: 37-49.
- GAIGHER, I.G. and BLOEMHOF, H.J. 1975. Hybrid *Labeo umbratus* X *L. capensis* (Pisces, Cyprinidae) from Hardap Dam, S.W.A. Madoqua 9: 53-55.
- GREENWOOD, P.H. 1984. The haplochromine species (Teleostei, Cichlidae) of the Cunene and certain other Angolan rivers. Bull. Brit. Mus. nat. Hist. (Zool.) 47: 187-239.
- GROBLER, H.J.W. 1987. A fish ecology study of Lake Liambezi in the Caprivi, South-West Africa. M. Sc. thesis, Rand Afrikaans University, Johannesburg. (In Afrikaans).
- HAY, C.J. 1991. The distribution of fish in the Fish River, Namibia. Madoqua 17: 211-215.
- HAY, C.J. and VAN ZYL, B.J. 1992. Fish perspective in Namibia. Contribution to the Namibian biodiversity report for the Rio-Conference. Freshwater Fish Institute, Mariental.

- HAY, C.J., VAN DER BANK, F.H. and FERREIRA, J.T. Aspects on the ecology of *Barbus hospes* from the Fish River, Namibia. (in press).
- HAY, C.J., VAN DER BANK, F.H. and FERREIRA, J.T. The effect of the artificial linkage between the Kunene River and the Cuvelai system on the fish fauna in Ovambo, Namibia. (in press).
- HAY, C.J., VAN ZYL, B.J., VAN DER BANK, F.H., FERREIRA, J.T., and STEYN, G.J. A survey of the fishes of the Kunene River, Namibia. (in press).
- HOLTZHAUSEN, J.A. 1989. The reproduction biology, breeding and hormone induced sex change of four tilapia species. M.Sc. thesis, Rand Afrikaans University, Johannesburg. (In Afrikaans).
- HOLTZHAUSEN, J.A. 1991. Freshwater fishes of Namibian wetlands -a review. *Madoqua* 17: 189-191.
- IRISH, J. 1991. Conservation aspects of karst water in Namibia. *Madoqua* 17: 141-146.
- JACKSON, P.B.N. 1989. Prediction of regulation effect on natural biological rhythms in south-central African freshwater fish. - Regulated Rivers: Research Management 3: 205-220.
- MARSH, A. and SEELY, M. 1992. Oshanas. Sustaining people, environment and development in Central Ovambo, Namibia. National Planning Commission and SIDA, Windhoek. 56 p.
- MERRON, G.S. and BRUTON, M.N. 1988. The response of the fishes of the Okavango delta, Botswana, to the annual flood regime, with special reference to commercially important species. Report commissioned by the Botswana Ministry of Agriculture, Fisheries Division.
- MERRON, G.S. and BRUTON, M.N. 1989. Recent fisheries research in the Okavango Delta. *S. Afr. J. Sci.* 85: 416-417.
- MINISTRY OF FISHERIES AND MARINE RESOURCES 1991. Towards Responsible Development of Fisheries Sector. White Paper presented to the National Assembly by the Minister of Fisheries and Marine Resources..
- MINISTRY OF ENVIRONMENT AND TOURISM. Nature Conservation Ordinance, 1975 (NO. 4 OF 1975).
- MINISTRY OF WILDLIFE, CONSERVATION AND TOURISM 1992. Namibia's Green Plan. Draft compiled and edited by the MWCT (ed. C.J. Brown) in consultation with numerous institutions.
- MINISTRY OF ENVIRONMENT AND TOURISM. 1994. Land-use planning: Towards Sustainable Development. Policy Document.
- MINISTRY OF ENVIRONMENT AND TOURISM. 1994. Conservation of Biotic Diversity and Habitat Protection. Policy Document.

MINISTRY OF ENVIRONMENT AND TOURISM. 1994. Research. Policy Document.

NAMIBIA REVIEW. December 1992. Vol. 1 No.: 1.

PENRITH, M.J. 1978. An annotated checklist of the inshore fishes of southern Angola. Cimbebasia Ser. A 4: 180-190.

REMEDIOS, L. and REGADERA, R. 1991. Preliminar report to the government of Namibia about the possibilities for the development of aquaculture. National Enterprise of Aquaculture of Cuba, Report.

SANDLUND, O.T. AND TVEDTEN, I. 1992. Pre-Feasibility study on Namibian Freshwater fish Management. NORAD.

SCHRADER, H.J. 1986. A survey of the maximum sustainable yield of Hardap Dam and the possible influence of commercial harvesting on angling and fish-eating birds. M.Sc. thesis, Rand Afrikaans University, Johannesburg. (In Afrikaans).

SKELTON, P.H. 1988. The Okavango River - a fish and fishing paradise. Tight Lines January: 42-46.

SKELTON, P.H. and MERRON, G.S. 1984. The fishes of the Okavango River in South West Africa with reference to the possible impact of the Eastern Water Carrier on fish distribution. J.L.B. Smith Institute of Ichthyology, Report no 9: 1-32.

SKELTON, P.H. and MERRON, G.S. 1985. A second survey of the fishes of the Okavango River in South West Africa with reference to the possible impact of the Eastern Water Carrier. J.L.B. Smith Institute of Ichthyology, Report no 14.

SKELTON, P.H. and MERRON, G.S. 1987. A third survey of the fishes of the Okavango River in South West Africa with reference to the possible impact of the Eastern Water Carrier. J.L.B. Smith Institute of Ichthyology, Report no 24.

SKELTON, P.H., BRUTON, M.N., MERRON, G.S. and VAN DER WAAL, B.C.W. 1985. The fishes of the Okavango Drainage System in Angola, South West Africa and Botswana: taxonomy and distribution. Ichthyol. Bull. J.L.B. Smith Inst. Ichthyol. 50: 1-21.

SMIT, P. 1991. The Kavango Area: Resources, population and development. M.Sc. thesis, Stellenbosch University. (In Afrikaans).

TAPSCOTT, C., M. JACOBSON and G. OWEN-SMITH. 1992. Epupa Hydropower scheme - Pre-feasibility Study. Socio-economic Assessment. Windhoek: NISER and Integrated Rural Development and Nature Conservation.

TVEDTEN, I., GIRVAN, L., MASDOORP, M., POMUTI, A. AND VAN ROOY, G. 1994. Freshwater Fisheries and Fish Management in Namibia. Social Science Division. University of Namibia.

VANDEN BOSSCHE, J.-P. AND BERNASCEK, G.M. 1990. Source book for the Inland Fishery Resources of Africa VOL. 1. Cifa Technical Paper 18/1. FAO.

- VAN DER WAAL, B.C.W. 1976. Ecological studies on the fishes of Lake Liambezi in Caprivi, with reference to the utilization of fish by the local population. Ph.D. dissertation. Rand Afrikaans University, Johannesburg. (In Afrikaans).
- VAN DER WAAL, B.C.W. 1980. Aspects of the fisheries of Lake Liambezi Caprivi. J. Limnol. Soc. sth. Afr. 6: 19-31.
- VAN DER WAAL, B.C.W. 1988. Fisheries Development in Owambo. Proceedings of a joint symposium convened by the Foundation for Research Development and the South African Agricultural Union.
- VAN DER WAAL, B.C.W. 1990. Aspects of the Fishery of the Eastern Caprivi, Namibia. Madoqua 17 (1): 1-16.
- VAN DER WAAL, B.C.W. 1991. Fish life of the Oshana delta in Owambo, Namibia, and the translocation of Cunene species. Madoqua 17: 201-209.
- VAN DER WAAL, B.C.W. 1991. A survey of the fisheries in Kavango, Namibia. Madoqua 17: 113-122.
- VAN DER WAAL, B.C.W. 1992. RDC - Fisheries development Annual report 1990 /1991. Unpublished report.
- VAN ZYL, B.J. 1992. A fish ecological study of the Okavango and Kunene Rivers with special reference to the fisheries. Ph.D. dissertation. Rand Afrikaans University. Johannesburg. South Africa. (in Afrikaans).
- WILTON, S. (Undated). A review of Aquaculture in Namibia and the opportunities for Oxfam. Pre-feasibility report commissioned by Oxfam, Windhoek.

APPENDIX II

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Hon. H. Angula	Former Minister of Fisheries and Marine Resources.
Hon. Dr A. Iyambo	Deputy Minister of Fisheries and Marine Resources
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Mr. A.H. Haingura	Governor of Okavango Region

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Chief D. Shooya	Chief of Uukolonkadhi
King J. Taapopi	King of Uukwaluudhi
King I. Elifas	King of Ondonga
Mr. B. Munalye	Private
Mr. J. Martin	Private
Mr. H. Shoombe	Private
Mr. J. Nangula	Private
Mr. A. Ankama	Private
Mr. S. Israel	Private
Mr. G. Mutota	Private
Mr. H. Hidinwa	Private
Mr. E. Shiimi	Businessman
Mr. S. Nambili	Businessman
Mr. S. Kandjala	Businessman
Mr. M. Amutse	NBC
Mr. P. Lungada	NODPH
Mr. R. Kamwi	Medical entomologist
Mr. P. Kapia	Regional Councillor of Okatjali
Mr. S. Kayone	Regional Councillor of Omusati Region
Mr. P. Endjambi	Regional Councillor of Omusati Region
Mr. T. Ainima	Regional Councillor of Omusati Region
Mr. J. Iipinge	Regional Councillor of Omusati Region
Mr. K. Leevi	Regional Councillor of Tsandi
Mr. S. Mukulu	Private, Ombalantu
Mr. P. Aipanda	Private, Ombalantu
Mr. A. Ndakukamo	Representative of King of Ongandjera
Mr. P. Mwanjangapo	Private
Mr. T. Hamuteta	Private
Mr. H. Iipinge	Regional Executive Officer
Mr. T. Salomo	Private
Mr. T. Amupala	Private
Mr. T. Namuro	Private
Mr. D. Shilongo	Headman of Ongandjera
Mr. D. Iha	Headman of Ongandjera
Mr. D. Shikongo	Headman of Ongandjera
Mr. T. Iilonga	Headman of Uukwaluudhi
Mr. E.H. Amuero	Headman of Ondjondjo
Mr. J. Sheehama	Headman of Onawa
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APPENDIX III

INLAND WATERS AND THE LIVING RESOURCE

Zambezi River

Source: North West Zambia and Eastern Angola
Drainage area: 1 300 000 km²
Countries implicated: Angola, Zambia, Namibia, Mozambique, Botswana, Zimbabwe
Major tributaries: Kwando, Kafue, Luangwa, Shire. The Zambezi System is also linked with the Okavango System during high floods.

Geographical data:-

Discharge into: Indian Ocean
Volume of discharge at Katima: 41 000 X 10⁶ m³/ann.
Volume of discharge at mouth: 120 000 x 10⁶ m³/ann.
Flood regime: December to July, maximum in March
Special features: In Namibia an extensive floodplain complex exists that can be divided into five zones :-
(a) Upper Kwando
(b) Lower Kwando and Linyanti swamps
(c) Lake Liambezi
(d) Chobe Marsh
(e) Zambezi and Chobe floodplains. The total area of each wetland including the rivers and their flood plains was 4 680 km² in 1985

Okavango River

Source: Bié plateau, Angola
Drainage area: 115 000 km²
Countries implicated: Angola, Namibia, Botswana
Major tributaries: Quito

Geographical data:-

Discharge into: Okavango swamps in Botswana
Volume of discharge at Rundu: 5 000 x 10⁶ m³/ann.
Volume of discharge: 10 000 x 10⁶ m³/ann.

at Bagani:

Flood regime:

Special features:

December to June, maximum in February / March

Section that borders Namibia is approximately 415 km long. This section meanders through a 2 - 6 km wide valley, 30 - 70 metres below the surroundings. Wetlands vary from 119 km in the dry season to 434 km² during the annual floods.

Kunene River

Source: Bié plateau, Angola

Drainage area: 83 000 km²

Countries Angola and Namibia

implicated:

Major tributaries: Calonga, Cacuvular, Cafu, Calai, Mucopa, Cassava

Geographical data:-

Discharge into: Atlantic Ocean

Volume of discharge 5 500 x 10⁶ m³/ann.

at Ruacana:

Volume of discharge 5 500 x 10⁶ m³/ann.

at mouth:

Flood regime: December to June, maximum in February / March

Special features: Section that borders Namibia is approximately 340 km long. No floodplains occur in this section of the river, except for the Kunene River mouth

Orange River

Source: Lesotho, Drakensberg Mountains

Drainage area: 640 000 km²

Countries Lesotho, South Africa, Namibia

implicated:

Major tributaries: Vaal, Fish

Geographical data:-

Discharge into: Atlantic Ocean

Volume of discharge

at mouth: 150 x 10⁶ m³/ann.

Flood regime: November / March

Special features: No floodplains occur in the section of the river that borders Namibia, except for the Orange River mouth.

Cuvelai System

Source: Cuvelai River
 Drainage area: 23 000 km²
 Countries: Angola and Namibia
 implicated:
 Major tributaries: None

Geographical data:-

Discharge into: Overspilt and seepage to Etosha Pan
 Flood regime: December to June, maximum in February / March
 Special features: Duration of wetland conditions is dependent on the flood

Bondels Dam

Location: 28° 05' S; 18° 37' E
 Altitude: 950,5 m
 Date closed: 1959
 Surface area: 0,770 km²
 Depth: 2,86 m
 Volume: 1 092 951 m³
 Major feeding river: Satco

Daan Viljoen Dam

Location: 22° 26' S; 18° 57' E
 Altitude: 1 432 m
 Date closed: 1957
 Surface area: 0,190 km²
 Depth: 6.22 m
 Volume: 429 085 m³
 Major feeding river: Black Nossob

Dreihuk Dam

Location: 28° 06' S; 18° 37' E
 Altitude: 895
 Date closed: 1977
 Surface area: 3,490 km²
 Depth: 10.87 m
 Volume: 15 493 114 m³
 Major feeding river: Hom

Friedenau Dam

Location:	22° 42' S; 16° 44' E
Altitude:	1 652 m
Date closed:	1970
Surface area:	0,800 km ²
Depth:	15.71 m
Volume:	6 722 659 m ³
Major feeding river:	Kuiseb

Goreangab Dam

Location:	22° 32' S; 17° 01' E
Altitude:	1 588 m
Date closed:	1959
Surface area:	0,960 km ²
Depth:	11.00 m
Volume:	4 191 366 m ³
Major feeding river:	Gammans

Hardap Dam

Location:	24° 52' S; 17° 52' E
Altitude:	1 139 m
Date closed:	1960
Surface area:	28,770 km ²
Depth:	30 m
Volume:	300 157 241 m ³
Major feeding river:	Fish

Merensky Dam

Location:	26° 31' S; 18° 04' E
Date closed:	1987
Surface area:	0,120 km ²
Depth:	5.51 m
Volume:	82 607 m ³
Major feeding river:	Aub

Naute Dam

Location:	26° 56' S; 17° 56' E
Altitude:	735 m
Date closed:	1971
Surface area:	11,550 km ²
Depth:	20.7 m
Volume:	83 580 124 m ³
Major feeding river:	Löwen

Oanob Dam

Location:	23° 20' S; 17° 06' E
Altitude:	1 453
Date closed:	1989
Surface area:	2,650 km ²
Depth:	28.5 m
Volume:	34 505 066 m ³
Major feeding river:	Oanob

Olushandja Dam

Location:	17° 28' S; 14° 37' E
Altitude:	1 106
Date closed:	1971
Surface area:	29 km ²
Depth:	4 m
Volume:	42 331 035 m ³
Major feeding river:	Etaka Oshona

Omatako Dam

Location:	21° 09' S; 17° 10' E
Altitude:	1 359
Date closed:	1981
Surface area:	11,550 km ²
Depth:	5.8 m
Volume:	45 117 612 m ³
Major feeding river:	Omatako

Omatjienne Dam

Location:	20° 25' S; 16° 29' E
Altitude:	1 362.92
Date closed:	1933
Surface area:	2.59 km ²
Depth:	4.8 m
Volume:	5 062 758 m ³
Major feeding river:	Ugab

Otiivero Main Dam

Location:	22° 17' S; 17° 58' E
Altitude:	1 580 m
Date closed:	1984
Surface area:	1,540 km ²
Depth:	14.35 m
Volume:	9 808 408 m ³
Major feeding river:	White Nossob

Otiivero silt Dam

Location:	22° 17' S; 17° 57' E
Altitude:	1 581 m
Date closed:	1984
Surface area:	3,160 km ²
Depth:	7.02 m
Volume:	7 795 450 m ³
Major feeding river:	White Nossob

Swakoppoort Dam

Location:	22° 13' S; 16° 31' E
Altitude:	1 143 m
Date closed:	1979
Surface area:	7,800 km ²
Depth:	20 m
Volume:	69 063 232 m ³
Major feeding river:	Swakop

Tilda Viljoen Dam

Location:	24° 26' S; 18° 57' E
Altitude:	1 436 m

Date closed:	1964
Surface area:	1,900 km ²
Depth:	5 m
Volume:	1 223 980 m ³
Major feeding river:	Black Nossob

Von Bach Dam

Location:	21° 01' S; 16° 57' E
Altitude:	1 353 m
Date closed:	1970
Surface area:	4,890 km ²
Depth:	20 m
Volume:	49 948 799 m ³
Major feeding river:	Swakop

APPENDIX IV

NATURE CONSERVATION ORDINANCE, 1975

(No 4 of 1975)

CHAPTER V

FISH IN INLAND WATERS

65. (1) The Executive Committee may from time to time define the boundaries of any lagoon with reference to physical characteristics, whether natural or artificial.
- (2) Any definition of the boundaries of a lagoon in terms of the provisions of subsection (1) shall be made known by notice in the Official Gazette.
66. No person shall, without the written permission of the Executive Committee, place or release any fish in inland waters (excluding aquariums and ornamental dams).
67. (1) No person other than the holder of a permit granted by the Cabinet shall angle in inland waters : Provided that-
- (a) the owner or lessee of land, or the parents of children of such owner or lessee, or any person permanently employed by him and resident on such land, may angle in waters situated on such land; and
- (b) any member of a particular population group may angle in waters situated on the communal land of the population group concerned, without such permit.
- (2) Any person who angles in inland waters under any permit granted in terms of this section shall at all times have such permit in his possession while he is so angling.
68. (1) Subject to the provisions of subsections (3) and (4), no person shall, without the written permission of the Cabinet, catch fish in inland waters in any other manner than with a line and fish-hook: Provided that a set line shall for the purposes of this section be deemed not to be a line.
- (2) No person shall use more than two lines at the same time when angling in inland waters.
- (3) No person shall -
- (a) use any other fish-hook than a single fish-hook when angling in inland waters;
- (b) use more than two single fish-hooks on any line when angling in inland waters: Provided that one artificial spoon, artificial fly or other artificial

lure approved by the Cabinet may be used instead of one single fish-hook.

- (4) The provisions of this section shall not apply to any member of a particular population group who catches fish in inland waters situated on the communal land of the population group concerned.
69. (1) the Executive Committee may at any time prohibit or restrict the angling of fish in general or the angling of any species of fish determined by it in any inland waters or in those inland waters determined by it on the conditions and for the period which it may deem necessary.
- (2) Any prohibition or restriction imposed by the executive Committee in terms of this section shall be made known by notice in the Official Gazette.
 - (3) Any person who contravenes or fails to comply with any provision or condition of any prohibition or restriction imposed in terms of this section shall be guilty of an offence.
70. No person shall place in, or cause or allow to be dropped into, any inland waters in which fish are or might presumably be present any explosive, poisonous or intoxicating materials.
71. Any person who contravenes or fails to comply with any provision of this chapter, or any condition, requirement or restriction of any permit or permission granted thereunder, shall be guilty of an offence."

