THE PAST HISTORY AND PRESENT TRENDS IN THE FISHERIES OF LAKE CHAD

By

Aminu Raji
Federal College of Freshwater Fisheries, Baga
P.M.B. 12, Kukawa, Borno State.

ABSTRACT

Lake Chad is a very large, shallow eutrophic lake shared by four West African Countries i.e. Chad, Nigeria, Niger and Cameroun. It supplies approximately 13% of Nigeria's Inland fish. It however lies in an unstable ecological environment characterised by intermittent period of rainfall and drought. This creates a very large draw down area. Consequently, the fisheries are affected by the oscillation in the size of lake due to the drought. Other factors affecting the volume of water are the numerous dams on the inflow rivers. The fishery is also subjected to intense overfishing and may be affected by pollution and other land use practices.

The paper discusses changes that took place over the years a result of the factors of drought, effect of dams on the inflow rivers. The fishery is also subjected to intense overfishing and may be affected by pollution and other land use practices.

The paper discusses changes that took place over the years as a result of the factors of drought, effects of dams and over-exploitation. Previous records of fish production, species composition and distribution, the status of the fish stocks, their sizes are compared with more recent data. The status of the fishery before and after the contraction of the lake is discussed.

Suggestion for a national exploitation fo the lake based on habitat improvement, increasing the volume of the water in the lake through controlled use of the influent rivers as well as reduction in over fishing are made.

INTRODUCTION

Lake Chad lies between latitude 12°N - 14°20'N and longtitude 13° - 15°30'E South of the Sahara within the Sahel zone of West - Central Africa. It is an inland drainage area with large rivers flowing into the lake from the South and West. Such rivers include the Chari, Lagone, Komadugu - Yoba, Ngada, Yadseram Serbewel and CI - Baid (fig 1). Historically has oscillated in size depending on the rainfall over its catchment are which is about 2,500. There is a 'normal' Chad which has an area of about 20,000km² and a 'little' Chad phase which has an average area of 2000km². The 20,000km² lake in 1968 was reduced to 6,000km² in 1975. In 1988 the lake stabilised to about 10,000km² (LCBC 1989).

The lake has two basins (fig 1) made of a Southern basin whose size is influenced by the flow of the Chari, lagone drainage system (which supplies about 83% of the lake's water). The northern basin is more lacustrine. In 1965 the open water was about 4-7 in depth in the 4,000km² northern basin and 2-4m in the southern basin.

A sahelian drought started in 1968 and after the rivers failed to flow in 1973 the northern basin dried up as in 1907-08. Another drought in 1984 resulted in a similar drying up of the northern basin. The hydrographic system of the present lake and its rivers is the remnant of

what was probably the largest lake in the world (Welcome, 1972). During the 'normal' Chad the area of open water is distributed between the countries sharing the lake as follows: Chad 11,000km² (50%); Nigeria 5,500km² (25%); Niger 3,900km² (17%); Cameroun 1,800km² (8%). During the 'little Chad the open water is shared only between Chad (1200km² or 60%) and Cameroun (800km² or 40%). The Nigerian and Niger portion are liable to complete drying. Some of the physical, chemical and fisheries characteristics of the lake is shown in Table 1.

The lake is far north enough for a 'winter fall in temperature (about 16%) to affect the growth of fish especially in the northern basin (Hopson, 1972). The biology of the fish in the South is affected more by the seasonal flow of the rivers.

Before the drought the lake was divided into three ecological zones (Lowe - Mcconnall, 1987). These are (a) open water, (b) the archipelego of islands along the east and south east coasts and (c) the south coast with its deltas receiving inflow from the Chari - Logone rivers. Many of the fishes migrate long distance ot several hundred kilometres up the rivers to spawn. The young ones feed in the flooded areas and return to the lake to grow and mature. Evaporation in the lake is high and therefore conductivity increases from South to North. This has affect on restricting the distribution of some feona like Oligoheates, benthic snails and some Mormyrid fishes which are not found in the northern basin.

Land use practices in the lake Chad basin area size includes agriculture (rain fed and irrigation), Livetock raising fisheries, Wildlife and forestry as well as mineral exploitation (potash and more recently petroleum prospecting). A detail review of these activities was done by Bolorunduro and Kwari (1992). It is estimated that an average of 10,000 fishermen operate in the lake (Welcome, 1972).

TROPHIC RELATIONSHIP OF LAKE CHAD FISHES

Lauzanne (1976) studied the diets of the most abundant fishes in the Southern archipelago at high and low water levels. The conclusion from such studies was that diets were more diverse in the archipelago than in the open water where food resources were limited. Fishes in the lake fall into four main tropic groups (Lowa - McConnell 1987). There are (a) terminal carnivores feeding mainly on fishes e.g *Hydrocynus forskahlii, H. brevis, Lates niloticus* or predators that scavenge on dead fish e.g *Bagrus bagad. Schilbe mystus* and Eutropius *niloticus* (b) Carnivores, feeding mainly on Zooplankton e.g *Alestes baremose, A. dentex, Synodontis batensoda* and *S. membranaceous,* (c) Carnivores taking mainly benthic inverterbrates like *Hyperopisus bebe. Synodontis scholl* and *Heterotis niloticus;* (d) Detritivores e.g *Citharinus Citharus, Labeo senegalensis Sarotherodon galilaeus.* Changes in fish species composition with regards to trophic levels are discussed elsewhere in the paper.

The shallow depth of the lake and the well oxygenated (due to the Sahel winds) makes the lake one of the most productive in the world with an estimated fish yield potential of 80 - 120 kg/ha/yr fresh weight.

CHANGES IN FISH PRODUCTION, 1969 - 1988

Table 11 show the trend in fish yield production from the Nigerian side and the whole lake from 1969 to 1988. Before 1969 Maschkat and Jensen (1960) observed that the fishing in the lake was very primitive, being done by papyrus and dugout canoes. In 1961 - 62 nylon gill nets

were introduced. The introduction of these nets increased the production from 10,000 tons in 1961 to 15 - 20,000 tons by 1967.

Following the drought of 1972 - 1973, the total catch increased dramatically from an estimated 165,700 tons in 1971 to 191,500 tons in 1973. Wth near drying up of the northern basin in 1974, 220,000 tons were caught in that year. This was due to better accessibility to fish population because of low water level. It therefore led to overfishing as most fish could be removed if they were trapped in shallow pools. The high yield of 1974 also led to the influx of migrant fishermen from areas as far away as Sokoto, Kogi, Niger, Taraba and Kebbi States as well as foreigners from Mali who came with more sophisticated gear. These groups are now the dominant fishermen in the lake. Table II shows that from 1977 onwards relatively low fish tonnage was caught. Since 1982 the total annual catch for the lake is less than 100,000 tons.

CHANGES IN FISH SPECIES DISTRIBUTION 1964 - 1989

At various times, the fish species of the lake were investigated. One of the earliest work was that of Blacha (1964) who recorded 84 species. Hopson (1967) recorded 87 species on the Nigerian side of the lake. Azeza and Gubio (1977) recorded 19 species of commercial importance while Renech et al (1983) recorded in species for the entire lake. Records for the Nigerian side shows that 23 species were present in 1983 (Ajepe, 1983), Askia (1988) recorded 22 species from 13 genera and 13 families Sagua (1990) recorded 14 families comprising of 27 genera of which only six families (Table III) are of commercial importance. The table shows that Claridae, Cichlidae, Characidae, Mormyridae and Synodentidae were very important by 1989. At the present protopteridae and Osteoglossidae are more important specifically than Mormyrids and synodont's. There was therefore a shift from 1989 to the present with the five main important families being Claridae, Osteoglossidae, protopteridae, Cichilidae and Mormyridae in order of importance. The very important synodontidae in 1987 are now insignificant at least on the Nigerian side.

In 1963, the main fish were *Lates niloticus, Synodontis schall Hydrocynus forskahli, Labeo senegalensis, Distichodus* and *Citharinus. Clarias* and *Heterotis* were very insignificant at that time. Hopson (1964) reported that Clarias were very rate from 1963 - 1973 but by 1976, nearly 90% of total landings were of Clarias. The same observation was made by Benech et al (1983). Most of the *Clarias* are *C. gariepinus* and *C. macromystax. C. macromystax* is a stunted Clarias and it accounts for 60 - 65% of the total landings of Clariids. On the whole there is a trend in lake being transformed from a multi species to a single or three species fishery.

THREATS TO THE LAKE FISHERIES

The main threats to the fisheries of the lake are drought, daming of inflow rivers, and over fishing. On a smaller scale may be likely effect of pollution, chanelisation, water obstruction and mineral exploitation.

DROUGHT AND THE EFFECT OF DAMS

Over the years the amount of water discharged into the lake has substantially reduced because of low rainfall over the catchment area and damming of some rivers that contribute water to the lake. Amount of water discharged at Nigerian showed in 1984/85 low discharge of 6.74 x $109m^3$ compared to 15.00 x $109m^3$ in 1987 - 88 (Sagua 1990).

The increase in the Sahehan drought over the last 15 years had a major impact on the lake. The construction of dams in Nigeria mainly on the Hadejia - Jamara rivers and the tributaries has reduced the discharge of the major rivers. One tributary of the Yobe (Durum Gana) which use to flow north of Nguru and Gashua 30 years ago has stopped flowing completely. (Akingbada 1992).

EFFECT OF FISH

Fish production in the lake is related to the available area of water and the flood plains. Hence any reduction in the amount of water will have adverse effect on the fishery. Ostariophysan fishes dominated the catch during the pre-drought period. Catches of Cantropomids, Gymnarchids, Distichodonts, Schilbeids, Characoids, Mockokids and Cyprinids have all declined in favour of Tilapine, cichlids, Clariid catfishes and Protopterids. Other texa that showed increase market presence are *Heterotis niloticus.* Bagrid catfishes, Mormyrids and Synodontids. *Parachanna obscura* (Channidae) which was recorded as only frequent in the Yobe delta by Hopson (1967) are now becoming common in the main lake. Case studies have shown that between 1970 - 1977, the mormyrid *Petrocephalus bana* and *Pollimyrus isidori* disappeared from the South-east of the lake which turned into a swamp (Lek and Lek 1978). They were replaced by *Brienomyrus niger.* Lak and Lak (1978) recorded 18 species of Mormyrids alone in 1978.

The changes in the species composition show an increase of some Piscivores, Zooplanktivores and detritivores e.g Distichodus Labeo and *Gymnarchus* declined in favour of genera higher up in food chain such as Protopterus and Heterotis. There is an overall eco-physicological shift of taxa that are tolerant of reduced water level, high ambient temperature, low dissolved oxygen and capable of prolific precocious breeding like *Tilapia, Heterotis* and *Clarias. Tilapia* and *Clarias* can survive oxygen concentration of 0.3% i.e 0.02 mg/l (Stauch 1977).

The effect of the drought and the dams limit the extent and duration of the flood plain of the lake which can be up 5°, to 70 km. Such flood plain areas are essential to many fish species as spawning, nursery and feeding grounds. Indeed for many fishes in general increase in body length and weight in any year - class depends on the extent of floods (Welcome 1987). Environmental changes that leads to dryness will favour those taxa of fish which are euryoecic and therefore do not depend entirely on flood plain innundation areas dor feeding and reproduction. This may be responsible for the abundance of Tilapine and Clariid fishes. The general increase in the abundance of Protopterus may be related to its ability to aestivate under drought conditions, a lot of them are caught by farmers ploughing the fields as well as by fishermen during the drawdown period.

The drastic decline in *Lates niloticus* (a very important fish before the drought forming 50 - 60% of catches between 1962 - 73 (Table iv) is a result of its high physiological demand and lack of tolerance of high temperature and high turbidity (Bukar and Gubio, 1985). Because it reproduce and matures in deep waters the shallowness of the lake caused by shrinkage affected its abundance. It is now known that *Lates niloticus* exist only on the Chadian and Camerounian part of the Lake which are comparatively deeper (Gubio, Pers Comm.).

Other habitat changes that can affect the fish are pollution, channellization, water abstraction and mineral exploration. Pollution in the lake has not been studied but could be caused by the agricultural activities around the lake. The use of fertilizers; herbicides, pesticides, and arboricides may lead to eutrophication as a result of loading of inorganic materials. Pesticides when used in large quantities poison water bodies and can be lethal on eggs and larvae. This has been noted by Lowe - Mcconnell (1990) elsewhere. Both

channellization (for irrigation) and water abstraction (for irrigation, livestock and domestic use) are major activites in the Chad basin area. The extent to which these affect the fisheries is not yet known.

Exploration of oil in the lake basin and inside the lake area may add additional threat to the fish fauna and the valuable fisheries they support.

OVERFISHING

This is manifested by the reduction in the amount and size of fish harvested annually e.g from about 220,000 tons in 1974 to 31334 tons in 1985 (Sagua 1990). Bolorunduro and Kwari (1992) reported that competitive fishing in the lake promote the caputre of undersized fish. Mesh size regulation exist theoretically but enforcement is almost impossible. Recent observations show that there are few large fish and most are rarely more than 2 kg net weight at the various landing sites.

Over fishing is based on the use of non-selective nylon gill nets, Seines, hooks, baited and unbaited traps. The heavy fishing pressure together with drought conditions are thought to be related to the increasing dominance of *Clarias* and *Tilapia* (Bukar and Gubio, 1985; Welcome, 1987). In addition, the rapid rise in human population around the lake (7.4 million for all four countries sharing the lake (L.C.B.C. 1989) and the demand of fish all over these countries makes fishermen easily sell their entire catch irrespective of species composition or size, all contributes to over fishing. Other causes of over fishing includes a deterioration of the Socio-economic environment, absence of a common fishery policy for the countries controlling the lake as well as post harvest loss which encourage more fishing to offset such losses.

SUGGESTED CONSERVATION MEASURES

1. MEASURE TO ENHANCE MANAGEMENT OF WATER RESOURCES OF THE LAKE

The biodiversity and sustainability of Lake Chad is closely related to the size of the lake. What happens to the influent rivers has a direct effect on the lake. The water resources of the lake should be rationally exploited by the various sectors using it vis - agriculture, livestock, human use, fisheries, forestry and of recent mineral exploitation. This is necessary considering that the lake is located in a very arid environment. There is the need for a much intergrated approach to water management and development. Proper ecological consideration of changes in habitat, dam construction, chanallization, draw down formation etc. should be assessed. The effects of the various irrigation schemes as well as those proposed on the influent river should be carefully studied before implementation.

The idea of transfer of water from the Zaire and other basins into the lake (inter-basin water transfer) should be looked into. Here in Nigeria, a study by Diyam Consultants (1985) proposed that excess water from river Gongola can be transfered into the river Yobe without affecting the water requirements along the Gongola valley. Such a scheme should be implemented because it will increase the discharge of the river Yobe of Malamfatori as well as provide 200,000 ha of irrigation land. Interbasin water transfers have been achieved in other parts of Africa, notably South Africa (Skelton, 1990) and in Libya.

There is an urgent need for inter-governmental agreement on the crucial issue of water use. The Lake Chad Basin Commission (LCBC) formed in 1964 to regulate and ordinate water use wihin the conventional basin should be adequately funded and strengthened. Bileteral agreements concerning water use of the Logone exist between Nigeria and Niger formed in 1969 to share the Komadugu - Yobe water at 75% to Nigeria and 25% to Niger. In 1971, the two countries established a joint commission for cooperation whose mandate include the overall development of the Komadugu-Yobe Basin (UNDP, 1979). Such treatics and joint commission should be encouraged.

2. MEASURE TO REDUCE OVER EXPLOITATION OF THE FISH

Overfishing is generally of a lesser danger than habitat changes because it can be correlated by standard fishery methods once it is detected. Fish populations are also known to be resilient in compensating overfishing by adjusting their reproductive behaviour (Altukhov and Salmenkova 1990). Such a trend may be operating in Lake Chad with respect to *Clarias macromystax*. They, reproduce when about 16cm amd most hardly grow more than 23cm (Odunze, pers).

In most management strategiest proposed e.g. Ita (1982), Ita *et al.* (1982) and elsewhere, reducing fishing pressure is through registration and licencing of fishermen and their gear and crafts, observation of closed seasons, closed areas, mesh size regulation etc. With respect to Lake Chad additional measures to be taken are:

(a) Assess the fishery status of the lake especially as to species composition so as to be able to identify any change in biodiversity over the years.

(b) Identify the spawning, nursery and rearing grounds of the various species so that necessary protection be given to such areas.

(c) Documentation of the species diversity of the lake should emphasise species of commercial importance (food and ornamental fish). Conservation measure should be taken for both commercial and non-commercial fish.

(d) The capabilities of Scientific research should be strengthened through base line studies, applied and multidisciplinary research. Training of fishery officers and fishermen should be encouraged.

(e) The fishery laws of the member countries of the L.C.B.C. should be coordinated and jointly enforced.

(f) Improvement of the living condition of fishermen through reduction in post harvest spoilage by better processing, handling and storage. Also loan scheme to meet up cost of fishing materials should be encouraged. The fishermen and other people involved in the fishery should take part in decision making on the best way of managing the resource. They should be enlightened through campaigns especially in the local language.

(g) Intensive aquaculture to reduce fishing pressure on the lake. Most of the flood plains of the river draining into the lake are suitable for aquacultural production. A few ponds exist around the lake on the Nigerian side at Monguno, Kukawa, Gashua and Nguru. More of

these ponds should be encouraged. Some of the above suggestions are in line with the FAO (1991) recommendation on the lake as well as previous report by Sagua (1990).

CONCLUSION

The Paper highlights some salient points on the fish and fisheries of Lake Chad. It discusses changes in fish production, species composition and distribution as well as problems of the fishery. Factors affecting the lake like drought and dams leading to habitat changes as well as over fishing are discussed. Suggested management proposals are made. On the whole dynamic infer- relationship between fishing patterns, market demand, environmental changes and fish production in the area need to be more fully understood. Such knowledge can help to formulate a more rational fishery management and conservation plan to save the diverse biotic fauna and flora of the area. Such conservation measures should be based on development of the lake for the benefit of the communities of the four countries.

REFERENCES

Ajayi, J. I. O. and Talabi, S. O. (1984)
The potential and strategies for optimum utilization of the fisheries resources of Nigeria. *In. Proc. of Symp.* on *Fisheries Dev.* Sponsored by Almarine.

Akingbade, A. (1992) Farming with Tears, *African Concord* Vol. 7, No. 25, p. 51

Altukhov, Yu P. and Salmenkova, E. A. (1990)
Introductions of distinct stocks of Chum Salmon, *Onchorynchus keta* (Walbaum) into a natural populations of the species. 3. Fish. Biol vol 37, Supplement A, 25 - 34.

Ajepe, G. R. (1983) The Preliminary survey of fishes in Lake Chad, O.N.D. Project Federal Fisheries School, Baga 27 p

Askira, M.M.G. (1988)
An assessment of fish species of Lake Chad in the 1987/88 flood season in the central sector. O.N.D. Project Federal Fisheries School, Baga 74p.

Azeza, N. I. and Gubio, A (1977)
Lake Chad Research Institute, Annual Report.

Benech, V; Durand, J. R. and Quensiere J. (1983)
Fish Communities of Lake Chad, Ecology and *Productivity of a shallow Tropical ecosystem.* Edited by Carmouze, J. P. Durand J. R. Laevque C. Dr. W. Junk Publishers. The haque 293 - 356.

Blache, J. (1964) Les poissons du Bassin de Tchad et du B Bassin adjacent du mayo kabbi. Etude systematique et biologioue, mem. ORSTOM 4, Tome 11 483 p.

Bolorunduro, P. I. and Kwari, I. D. (1992)
The present status, Exploitation patterns, and conservation options of the lake Chad Basin Ecology. Paper presented at the national conference on the conservation of Aquatic Reseources May 11 - 14, 1992 Calabar.

Bukar, T. A. and Gubio, A. K. (1985)
The decline of the commercially important species of fish and predominance of *Clarias lazera* in Lake Chad. A paper presented at the Annual Conference of the Fisheries Society of Nigeria (FISON), Port Harcourt 27 - 29 November 1985.

Diyam Consultants (1985) Dindima Transfer. Planning Report Vol. 2.

Durand, J. R. (1980) Evolution des captures totales (1962 - 1977) et devenir des pecharies de la region du lac Tchad, *Cah ORSTOM Ser Hydrobiol.* 13, 93 - 111.

FAO (1991) Seminar on Fisheries planning and management in the conventional Basin of Lake Chad. Ndjemena, Chad 8 - 12 January 1990. FAO Fisheries Report No 445.

Hopson, A. J. (1964) Federal fisheries of Lake Chad. In fish and fisheries of Northern Nigeria. Gaskiya Corporation Zaria.

Hopson A. J. (1972) A study of the Nile Perch in Lake Chad. Overseas Research Publication No. 19 HMS London.

Ita, E. O. (1982) Biological indices of overfishing in Kainji Lake and the management proposal for the lake fishery. K.L.R.I. Tech. Ser. No 8.

Ita, E. O., Balogun J. K. Adimula, A. (1982)
Report of the impoundment fishery survey of Goronyo Reservoir. Submitted to Sokoto Rima River Basin Development Authority.

Lauzanne, L. (1976). Regimes alimentaires et relations trophiques des poissons du lac bassin du lac Tchad. Cahiers CRSTOM Ser Hydro biologie 11, 225 - 234

L.C.B.C (1989) Lake Chad Basin Commission 25th Anniversary brochure, L.C.B.C. Secretariat N'djamena.

Lek S. and Lak, S. (1979) Etuda de queloues especes de petits, mormyridae du bassin du lac Tchad. *Cahiers ORSTOM Ser, Hydrobiologie* 12, 225 - 236.

Levequa, C. (1987) Bassin Tchadisn: In *African Wetlands ans shallow water Bodies Zone humides at laoc pep profoods di Afrivque Direcotry* (Repertoire). M. J. Burgis and J. J. Symoaus eds. ORSTOM coll. Traaux at documents No 21 Paris 650 p.

Lowe-McConnell, R. H. (1987)
Ecological studies in tropical fish communities. Cambridge University Pres, Cambridge.

Lowe McConnell, R. H. (1990)
Rare fish, Problems, Progress and Prospects for Conservation *J. fish Biol.* 37, (Supplement A) 263 - 269.

Maschkat, A and Jesen, K. W, (1960)
Fisheries Report to FAO/ICA team, unpulished.

Moses, E. S. (1982) Problems and prospects of artisanal fisheries in Nigeria. *Proc. of 2nd Annual Con. of FISON.* Calabar 76 - 90.

Sagua, V. O. (1990) The current status of the fishery Resources of the Lake Chad Basin and a programme for its management and conservation. *In Management Strategies for Inland Fisheries in the Sahel.* FAO Fisheries Report No 445; 42 - 53.

Skelton P. H. (1990) The conservation and status of threatened fishes in Southern Africa. *J Fish Biol.* (Supplement A), 87 - 95.

Stauch, A (1977) What will become of Fisheries in the lake Chad Basin? Report to CIFA, Bujumbura, 21 - 26 Nov., 1977 10 p.

Van den Bossche, J. P. and Bernacsak, G. M. (1990)
Source book for the Inland fishery resources of Africa Vol 2. FAO 240 p.

Van der Meeren, A.G.L. (1980)
A Socio entropelogical analysis of the Fisheries of Lake Chad. FI. DP/NIR/74?001 Field document 1. FAO, Rome.

Welcome, R. L. (1972) The Inland Waters of Africa, *CIFA Tech. papa.* (1): 117 p.

Welcome, R. L. (1987) The effects of the Sahelian drought on the fishery of the central delta of the Niger *Aquaculture and fisheries* Mot. 17, 147 - 154.

U.N.D.P. (1979) Lake Chad Basin Development Study, Intermediate Report, U.N.D.P. Office of Project Execution.

APPENDIX 2

TABLE 1: SOME PHYSICAL, CHEMICAL AND FISHERY DATA ON LAKE CHAD (AFTER VANDEN BOSACHE AND BARNASEK (1990).

Location:	Chad, Cameroun, Nigeria, Niger
Surface Area:	2,000 - 22000km²
Volume:	75km³ for normal Chad
Depth:	9.5m (max), 3.9m (mean)
Max. length:	224km (normal Chad)
Max width:	144km (normal Chad)
Shore line:	100km (normal Chad)
Major inflowing river:	Chari, Vehe, Ngeda, Vadegrom
Annual fluctuation in level:	1m (normal Chad)
Surface Temperature:	18.7 - 32.3°C
Catchment area:	2500000 km²
PH:	7.2 - 8.7
Conductivity:	58 (South basin) - 687 (north basin)ious/cm
Salinity:	77 (South basin) - 695 (north basin)mg/1
Potential Fish yield:	100 - 120 kg/ha (Durand, 1980)
	80 - 100 kg/ha (Van de meeren, 1980)
	70000 t/y lmsy for whole lake (Moses 1982)
	41250 - 55000 t/y (Nigerian waters)
	Ajayi and Talabi 1984
Source:	PH, conductivity) Leveque 1987
	Salinity)

APPENDIX 3

TABLE II FISH PRODUCTION FROM LAKE CHAD 1969 - 1985 (TONS)

Year	Nigeria	Whole lake
1969	20,000	28800
1970	46,000	65500
1971	86,300	115700
1972	123400	165780
1973	153600	191500
1974	172600	220000
1975	84500	128000
1976	68500	108220
1977	37200	52000
1978	70698	100997
1979	67817	96881
1980	64886	92694
1981	58222	83174
1982	15193	21704

1983	21379	30541
1984	28446	40637
1985	21934	31334
1986	19380	77525
1987	8870	35483
1988	12108	55378

Sources: 1969 - 1985 - Federal Department of Fisheries, Lagos
1986 - 1988 - Sagua (1990).

APPENDIX 4

TABLE III **FISH FAMILIES AND GENERAL OF COMMERCIAL IMPORTANCE IN LAKE CHAD (SAGUA 1990)**

Family	General	Commercial Importance
1. Clariidae	*Clarias Heterobranchus*	V. important
2. Cichlidae	*Tilapia, Sarotherodon*	
	Oreochromis	V. important
3. Characidae	*Hydrocynus, Alestes*	
	Micralestes	V. important
4. Mormyride	*Petrocephalus, Gnathonemus*	V. important
5. Synocontidae	*Synodontis, Brachysynodontis*	V. important
6. Bagridae	*Bagrus, Clarotes*	
	Chysichthys, Auchenoglanis	Fairly important
7. Cyprinidae	*Labes*	Fairly important
8. Protopteridae	*Protopterus*	Minor importance
9. Citharinidae	*Citharinus*	" "
10. Schilbeidae	*Schilbe, Eutoropius*	" "
11. Distichodontidae	*Distichodus*	" "
12. Centropomidae	*Lates*	" "
13. Gymnarchidae	*Gymnarchus*	" "
14. Osteoglossidae	*Heterotis*	"

N. B. Observations in 1991 - 1997 shows that Protoptesidae and Ostaoglossidae are now V. importance gradully while Mormyridae and Synodontidae are becoming of minor importance (Raji - Pers. ohs)

APPENDIX 5

TABLE IV CHANGES IN SPECIES COMPOSITION (% OF TOTAL CATCH) OF LAKE CHAD 1962 - 1985.

Year	Species	% Composition
1963 - 1973	*Clarias*	Insignificant
1976	"	89.6[2]
1977	"	85.7[2]
1982	"	38.8[2]
1983	"	43.4[3]
1984	"	50.8[3]
1985	"	56.0[3]
1962 - 1973	*Lates*	50 - 60[1]
"	*Citharinus*	10.4[1]
"	*Baqrus*	4.2[1]
"	*Labeo*	3.5[1]
"	*Heterotii*	3.5[1]

Sources: 1 Hopson (1972)
2 Azeza and Gubio (1977)
3 Bukar and Gubio (1985)

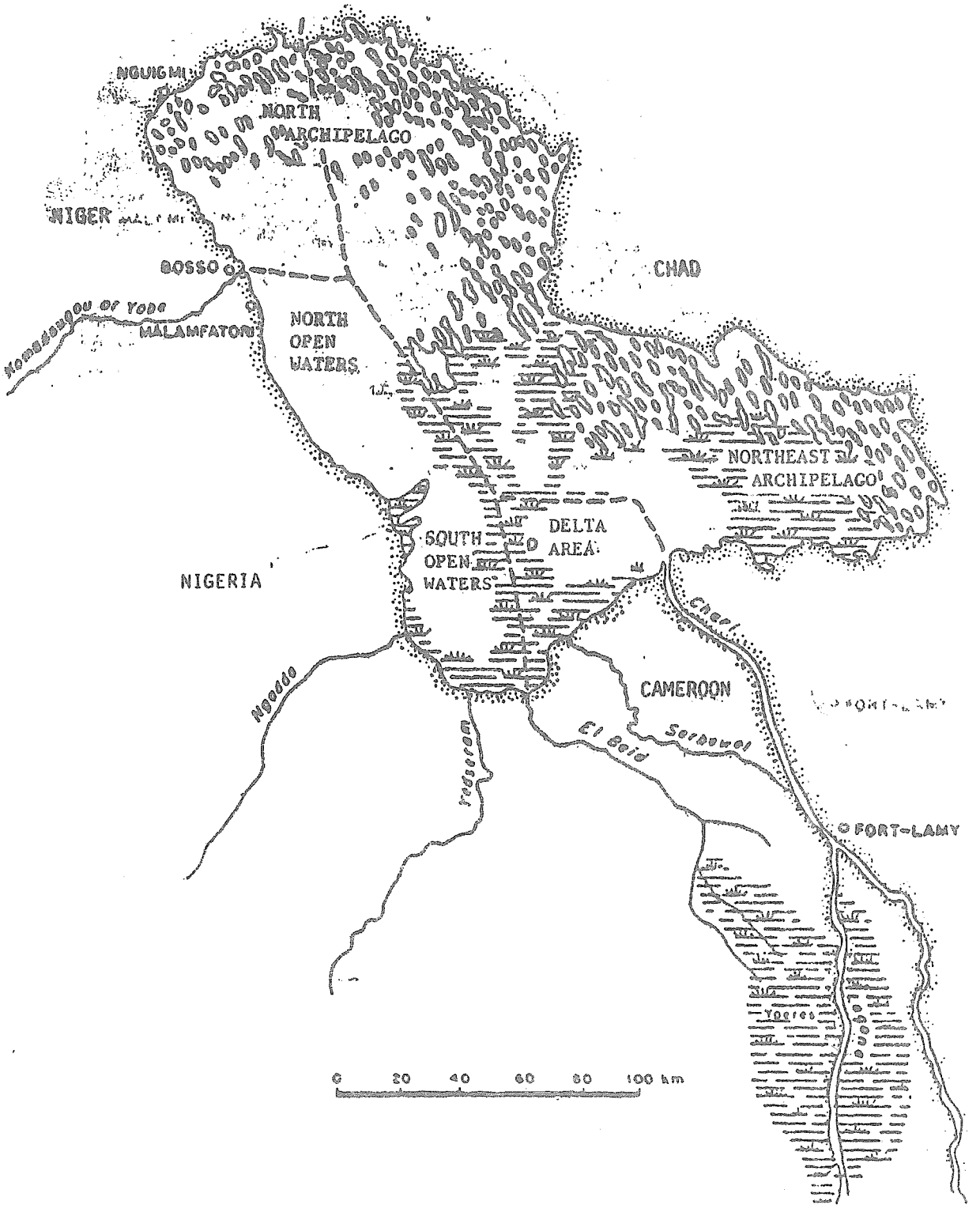

Fig 1. Lake Chad showing the inflow rivers and the main basins. (Adapted from Welcome 1972).