

ALAU RESERVOIR: A MULTI-DIMENSIONAL RESOURCE BASE IN BORNO STATE.

N.O. BANKOLE and A. N. OKAEME.

*National Institute for Freshwater Fisheries Research (NIFFR)
PMB 6006, New Bussa, Niger State, Nigeria*

ABSTRACT

Aspects of the fishery resources of Alau Reservoir in Maiduguri are reported upon in this paper. It focuses attention on the fishery in terms of fish abundance and potential. It also discusses other resources associated with the fish production. Various other uses to which the reservoir is put and to which it could still be put are discussed too. The reservoir is thus revealed to be a most useful and versatile one in terms of fishery resources and fund generation.

INTRODUCTION

The fisheries of the North East Zone which has been dependent majorly on the Lake Chad and which is mainly and predominantly artisanal in nature has been experiencing a downturn. This is due to the recession of the Lake resultant from the droughts that hit the zone in the 1970s and 1980s. (Bankole, 1995). However the creation of the Alau has been a welcome relief to fishermen.

The Alau reservoir was created in 1987 by damming river Ngadda which takes its source from the Mandara Plateau and is one of the three confluent rivers that formed the Sambisa floodplains in the semi-arid North East of Nigeria. The reservoir was formed primarily for the provision of potable water for the Maiduguri Metropolis as well as to irrigate over 8,000 ha of farmlands within and around the reservoir basin (CBDA, 1984). Although no fisheries consideration was given from the onset of its creation, the reservoir contributes immensely to the fisheries of the north-eastern region of the country.

Some of the few information available on the fisheries of the reservoir include those of Odunze *et. al* (1995), Bankoie *et al* (1995) and Bankole and Mbagwu (1996). Odunze *et. al* (1990) gave information on the catch composition abundance and distribution of fish as surveyed in 1990, three years after impoundment. Bankole *et al* (1995) and Bankole and Mbagwu (1996) reported on the fishing, fishing community, catch characteristics, processing and marketing on the lake. All these

information came years after the impoundment of the reservoir. The objective of this paper is to highlight the multiple uses to which the Alau Reservoir could be put for a more effective utilization in the semi-arid zone of Nigeria.

MATERIALS AND METHODS

A Catch Assessment Survey was carried out in September, 1994 using the method of stratified random sampling as in (Ekwemalor, 1977). Three fishing sites were randomly selected out of eight identified. These selected sites were sampled within a 10-day sampling period. Six fishing boats were randomly selected from each fishing site and were sampled for 3 days consecutively. Fish landed by each boat were collected, sorted into species, counted and their weights taken. The weight recorded for each boat and fishing site were then used to estimate the total monthly and annual fish landings for the entire lake. The landing were assessed during the flood season which usually occurs between September and November.

RESULTS AND DISCUSSION

Frame Survey

Fishing Sites

Eight fishing sites were identified along the shores of the reservoir (Fig.1). Of these the Damsite, Laujeri and Alau Ngaufate are located towards the northern shore. Kedari, Aliganari and Kulomari are located towards the southern shore. The remaining sites - Birmari and Burteri - are located to the east

of the reservoir. Due to its overflowing in September, 1994, most of the villages and fishing sites that existed were evacuated and banned from re-establishing in those sites. This accounted for the fewer number of sites identified. Chalmari, a village displaced by the flood on the northern shore had to move to Alau Ngaufate, a resettlement village. Two of the fish landing sites are fishing camps while the remaining five are villages.

Fishermen, Crafts and Gears

One hundred and seventy seven (177) boats were counted. None of these was motorized. About 66% of these were found at the Damsite fishing camp (Table 1). Out of the 177 boats only 30 had assistants; 67% of which came from the Damsite fishing camp.

Due to the general shallowness of the lake a third type of fishermen abound in the reservoir. These are part-time fishermen whose main occupation is arable farming. Their fishing activity is for a short duration within the year. They do not own boats so they set their traps and hooks by wading through the water. They outnumber the fishermen by far; numbering 883 in all during this survey.

Two hundred and seven full-time fishermen were enumerated. These were migrant fishermen comprising Nigerian Nationals such as Kanuris, Marghis, Junkuns and Hausas as well as Nationals of neighbouring countries such as Chadians, Cameroonians and Malians.

Four types of fishing gears were identified on the Lake. These were the Gill-nets, Cast nets, Malian gura traps and Hooks. The commonest of these is the Malian gura trap followed by the Hook and Gill-nets. The gura trap (Fig.2), introduced by the Malians, is extensively used in North East Zone of Nigeria. Its intensive use on the Alau Lake is possible because of the shallowness of the Lake (Mean depth 4.25m). The trap catches fish indiscriminately and juveniles are as susceptible to it as adult fish. Fish caught in gura traps remain alive until they are retrieved unless preyed upon by carnivores. The bait commonly employed for the trap is boiled husk removed from grains in grain mills. After boiling, the husk is shaped into block forms or any other shape suitable to the user and dried. It is placed in the trap when setting to

attract fish into the trap. The trap is particularly efficient in catching *Clarias*.

Hooks are also prominently used on the lake. Gill-nets are used in all the stations except in Laujeri. Cast nets are the least common of the gears and are used only to catch live baits for hooks.

CATCH ASSESSMENT

Species Composition and Distribution

Table 2 shows the distribution of fish species identified in the landings along the Lake Alau shore. Sixteen species belonging to nine families were identified. *Protopterus annectes* and *Polypterus senegalus* were recorded only at the Damsite. *Gnathonemus senegalensis*, *Marcusenius isidori*, *Micralestes acutidens* and *Labeo parvus* were recorded at both damsite and Kedari, but not at Alau Ngaufate. The remaining 11 species were common to all the three landing sites. A comparison of the species diversity with the earlier work of Odunze *et al.*, (1995) showed that more species and fish families were recorded during this survey (Table 2). This is probably because the report of Odunze *et al* (1995) was based on experimental gill-net catches while catches in this report are from assorted gears employed by fishermen.

A further comparison with Tiga, another small reservoir within the same-arid zone shows a closeness in the number of species (Table 3). However there is considerable dissimilarity in the species composition of both reservoirs. This could probably be due to the characteristics of the catchments of both reservoirs which are completely different and widely separated.

Fish Catch

The fish landed by each of six boats for the three consecutive, days and for the three landing sites is shown in Table 4. 81.11% of the fish landed by number were Tilapias. This was followed by *Clarias* spp. (8.41%) and *Schilbe* (5.96%). These three are the most important species to the fishery of this reservoir. The rest are not commercially important. In terms of weight the trend is the same with Tilapias constituting (56.02%) of the catch. *Clarias* spp. formed (32.43%) while *Schilbe* formed 8.87%. In the report of Odunze *et. al*,

Table 1: Distribution of Fishermen, Boats and Gear along the Shores of Alau Reservoir in November 1994

Landing Sites	Type of Fishing Site	Boat owners	Fishermen: Assistants	Fishermen: Part-time	Gill-net	Cast net	Gura trap	Hooks
Laujeri	V	8	-	(150)	-	-	x	x
Dam site	C	116	20	(20)	x	x	x	x
Kedari	C	14	4	12	x	-	x	x
Aliganari	V	10	-	(200)	x	-	x	x
Kulomari	V	5	-	(100)	x	-	x	x
Birmari	V	4	-	(100)	x	-	x	x
Burteri	V	4	-	(120)	x	-	x	x
Alau-Ngaufate	R.V	16	6	(180)	x	-	x	x
		177	30	883				

V = Village; C = Fishing camp RV = Resettled village

1 = All boats are non-motorised and operated by the fishermen owners.

Table 2: Species Occurrence and Distribution among the Sampled Fish Landing Sites along Alau Reservoir in November 1994, and in Experimental Gill-net Catches^(A) in 1990 (Odunze, *et al.*, 1995).

FISH LANDING SITES

SPECIES	Dam Site	Kedari	Alau Ngaufate	(A)
FAMILY LEPIDOSIRENIDAE				
<i>Protopterus annectens</i>	x	-	-	-
FAMILY POLYPTERIDAE				
<i>Polypterus senegalus</i>	x	-	-	-
FAMILY MORMYRIDAE				
<i>Marcusenius isidori</i>	x	-	-	x
FAMILY CHARACIDAE				
<i>Alestes nurse</i>	x	x	x	x
<i>Micralestes acutidens</i>	x	x	-	-
FAMILY CYPRINIDAE				
<i>Labeo parvus</i>	x	x	-	-
FAMILY SCHILBEIDAE				
<i>Schilbe mystus</i>	x	x	x	x
FAMILY CLARIDAE				
<i>Clarias spp.</i>	x	x	x	x
FAMILY MOCHOKIDAE				
<i>Synodontis batensoda</i>	x	x	x	-
<i>Synodontis nigrita</i>	x	x	x	x
<i>Synodontis eupterus</i>	x	x	x	-
FAMILY CHCHLIDAE				
<i>Tilapia zilli</i>	x	x	x	x
<i>Tilapia aurea</i>	x	x	x	-
<i>Oreochromis niloticus</i>	x	x	x	x
<i>Sarotherodon galilaeus</i>	x	x	x	x
<i>Hemichromis bimaculatus</i>	x	x	x	-

Table 3: comparison of the Species Diversity of Alau and Tiga Reservoirs in the Semi-Arid Zone.

SPECIES	ALAU	TIGA*
FAMILY LEPIDOSIRENIDAE		
<i>Protopterus annectens</i>	X	-
FAMILY POLYPTERIDAE		
<i>Polypterus senegalus</i>	X	-
FAMILY MORMYRIDAE		
<i>Marcusenius isidori</i>	X	-
<i>Mormyrops delictosus</i>	-	X
<i>Gnathonenus senegalensis</i>	-	X
FAMILY CHARACIDAE		
<i>Micralestes acuidens</i>	X	-
<i>Alestes nurse</i>	X	X
<i>Alestes denslex</i>	-	X
<i>Alestes baremose</i>	-	X
<i>Hydrocynus forskali</i>	-	X
FAMILY CYPRINIDAE		
<i>Labeo parvus</i>	-	X
<i>Barilius senegalensis</i>	X	-
FAMILY BAGRIDAE		
<i>Chrysichthys auratus</i>	-	X
<i>Auchenoglanis occidentals</i>	-	X
<i>Bagrus bayad</i>	-	X
<i>Bagrus docmac</i>	-	X
FAMILY SCHILBEIDAE		
<i>Schilbe mysus</i>	-	X
FAMILY CLARIDAE		
<i>Clarias lazera</i>	X	X
<i>Clarias sp.</i>	-	-
FAMILY MALAPTERURIDAE		
<i>Malapterurus electricus</i>	-	X
FAMILY MOCHOKIDAE		
<i>Synodontis batensoda</i>	X	-
<i>Synodontis nigrita</i>	X	-
<i>Synodontis eupterus</i>	X	-
<i>Synodontis gambiense</i>	-	-
FAMILY CICLIDAE		
<i>Tilapia zilli</i>	X	X
<i>Tilapia aurea</i>	X	-
<i>Oreochromis niloticus</i>	X	X
<i>Sarotherodon galilaeus</i>	X	X
<i>Hemichromis bimaculatus</i>	X	-

* Source: Ita (1993).

Table 4: Catch by Species for Selected Villages for 3 Days Each in November, 1994.

SPECIES	ALAU DAMSITE		KEDARI		ALAU NGAUFATE		TOTAL				
	NO.	WT(kg)	No	Wt(kg)	No	Wt(kg)	No	%	Wt (kg)	%	Mean Wt (g)
Claris spp	1222	81.95	480	105.81	332	52.55	2034	8.41	240.31	32.43	118.15
Tilapia spp	16193	275.47	128	14.60	3305	125.02	19626	81.11	415.09	56.02	21.15
Synodontis spp											
Alestes spp	747	8.00	2	0.010	8	0.15	757	3.13	8.16	1.10	10.78
Schilbe sp	270	7.66	7	0.12	2	0.11	279	1.15	7.89	1.06	28.28
Mormyrid	1202	55.35	171	7.17	69	3.18	1442	5.96	65.70	8.87	45.56
Protopterus sp	51	2.25	4	0.10	4	0.21	59	0.24	2.56	0.35	43.39
	-	-	1	1.20	-	-	1	0.00	1.20	0.16	1200.00
Total for 3 days	19685	430.68	793	129.01	3720	181.22	24198	100	740.91	100	30.62

% 58.13% 17.41% 24.46%

No of boats sampled per day 6 6 6

Total No of boats sampled for 3 days 18 18 18

Catch per boat (kg) 2393 7.17 10.07

Mean catch per boat (kg) 13.72

1995, the catches were dominated by Tilapias both by number and weight (48.39% and 54.01% respectively) followed by Characids and *Schilbe*. This differs from the present trend where *Clarias* spp. ranks second both in terms of number and weight.

The catch per boat for each of the three landing sites is 23.93kg for Damsite, 10.07 kg for Alau Ngaufate and 7.17kg for Kedari (Table 4). 58% of the fish caught (by weight) comes from the Damsite. This is not unexpected since the highest concentration of fishermen and boats were found here. The sizes of fish caught in all the three landing sites were small (Table 5). The generally small sizes could be attributed to the indiscriminate fish catch of the most popular gear - the Malian gura trap, the shallowness of the reservoir and the gregariousness associated with the breeding activities of most of the species during the floods.

Estimated Landing

The estimated fish landed for the month of November 1994 (coinciding with the flood season) is 72,489kg or 72.49mt (Table 6). This gives an annual production of 869.84 metric tons and a standing stock of 155.33kg ha⁻¹. This figure indicates that the reservoir is highly productive. The production estimate obtained for the Tiga Lake in Kano State ranged between 1526.0 and 1840.8mg yr⁻¹ (Bankole 1988). In comparison with Tiga therefore, (a reservoir which is over 3 times bigger than the Alau) the productivity of the latter is remarkable. The bulk of the fish landed was recorded at the Damsite.

Economic Considerations

With an estimated standing stock of 155.33 ha⁻¹, this reservoir has a great potential for fish production if properly managed. At a modest #50kg⁻¹, the annual fish production of 870mt could fetch over #43.5 million yr⁻¹.

However, the concentration of fishermen in the reservoir at present is 3.70km⁻². This figure is 85% higher than the maximum of two fishermen per square kilometer of reservoir recommended by Henderson and Welcome (1974). It is therefore imperative that management programmes be

introduced to sustain fish production in the reservoir.

MANAGEMENT CONSIDERATIONS

Multi-purpose use of Alau Reservoir

The most effective way of utilizing our water bodies could involve a multi-faceted approach. This could involve utilization of the water body for purposes like irrigation among others. This happens to be one of the major purposes for which the Alau was created apart from potable water supply. This study has revealed that a lot of revenue could be generated by the fisherfolk, operating on this waterbody through artisanal fishing.

One other revelation of great importance in the course of the study is the fact that the reservoir is generally shallow. This holds a good promise for pen, cage, and enclosure fish farming practices. This is worth looking into and is greatly recommended.

All legislation for the management of the fisheries, including regulation of fishermen's numbers and gear should be enforced through the Chief Fisherman of the Lake. These Chiefs are known to command immense authority among the fisherfolk in this region. These measures if implemented could turn this reservoir into an important source of fish and fish products in the North East semi-arid zone of Nigeria especially with the dwindling fortunes of the fishery of Lake Chad. It is also recommended that fish farming in flood ponds around the reservoir be developed and encouraged among the fishermen. This will require some extension work through enlightenment campaigns. The prevailing gear, the Malian gura trap could be of tremendous assistance in cropping fish fingerlings from the lake for stocking the ponds. The water body looks very promising in terms of richness in natural fish food to support fish even without fertilization.

This could have been derived from the fertilizer draining into the reservoir from the adjacent farmlands and from the cattle dungs dropped by cattle that come to drink from the lake from time to time. The zone is big in cattle rearing in the country.

Table 5: Estimated Fish Landing from catch Assessment Survey Conducted along the Shore of Lake Alau in November, 1994*

a	b	c	d	e	f	g	h	i	j	k	l	m n	
Dam site	6 (kg)	116 (kg)	425.18 (kg)	19.33 (mt)	8218.73 (kg h ⁻¹)	1.53	10	12574.66	21746.00	7248.67	72486.7	869.8	155.33
Kedari	6	14	181.37	2.33	422.59	12.64	10	5341.56					
Alau Ngauafate	6	16	129.69	2.67	346.27	11.06	10	3829.77					

a = Name of sampled village

b = No of boats sampled per day

d = Sum of daily catch for 3 days

e = Raising factor (Rfi) = $\frac{\text{No of boats in the village}}{\text{No of selected boats per day}}$

f = d * e

g = Inverse probability raising factor (1/p) = $\frac{\text{Total No of boats in the minor stratum}}{\text{Total No of boats in the selected village}}$
(The entire lake was taken as the minor stratum)

h = Month raising factor = $\frac{\text{Total No of fishing days in the month (Ds)}}{\text{Total No of sampling days in the month (ds)}}$

i = f * g

j = Sum of i

k = Mean of i

l = Catch per annum = l * 12

n = Catch per hectare (56-00 ha)

Water retention in the zone is for a period ranging between 6 - 8 months within which fish would have grown to table size, harvested and sold.

CONCLUSION

The study though brief has shown that the Alau Reservoir was primarily created for the purposes of supplying water and to irrigate surrounding farmlands. The results has further revealed that the lake offers such a great potential for artisanal fisheries with adequate management, as well as pen, cage and enclosure culture practices. The latter has to be introduced and encouraged with inputs and technical know-how.

With the location of the reservoir, it is pertinent to note that water preservation is of paramount importance. Hence with such an appealing potential the reservoir could be put to a multi-purpose use as highlighted. The benefit of combining all these uses will be of tremendous importance towards the improvement of the overall utilization of this reservoir which is located in a semi-arid environment.

REFERENCES

- Bankole N.O. (1995). Fish species diversity and succession in Lake Chad. *Paper presented at the workshop on sustenance and conservation of fisheries and other aquatic resources of Lake Chad and the Arid Zone of Nigeria. Maiduguri 15th - 17th January 1995.*
- Bankole, N.O. *et. al* (1994). Preliminary investigations on the frame and catch assessment survey of Alau Lake, Maiduguri Borno State. *National Institute for Freshwater Fisheries Research Annual Report 1994.* p. 134 - 146.
- Bankole, N.O. and Mbagwu I.G. (1995). Aspects of the fisheries of Lake Alau in the Nigerian North East Arid Zone. *Paper presented at the 9th/10th Annual Conference of the Nigerian Association for Aquatic Sciences. 30th November - 2nd December 1995.*
- Bankole, N.O. (1988). The fish and fisheries of Lake Tiga (a man-made Lake) in Kano State. *NIFFER Ann. Rep.* pp. 12-22.
- CBDA, (1984). A resettlement plan for the Lake Alau Dam and Jere Bowl Scheme Agricultural Survey and Background Studies. Askoning Nigeria LTD. 59 pp.
- Diyam Consultants (1990). Feasibility study of options to improve inflow into Alau Reservoir and preliminary design of the recommended option. Report to Borno State Water Board. 77pp.
- Ekwmalor, A.I. (1977). Catch Assessment Survey of Kainji Lake Nigeria M. Sc. Thesis. University of New South Wales, Sydney. Australia. 49pp.
- Henderson, A.F. and Welcome R. L. (1974). The relationship of yield to Morpho-edaphic Index and numbers of fishermen in African Inland Fisheries. *CIFA Occasional Paper No. 1 FAO, Rome, Italy.* 19pp.
- Ita, E.O. (1993). Inland Fisheries Resources of Nigeria. *CIFA Occasional paper No. 20. FAO, Rome. Italy.* 120p.
- ODNRI (1989) Nigeria: A. Profile of Agricultural Potential. Overseas Development Administration, United Kingdom. 15pp.
- Odunze, F. C., Awojebi, R. and Ntakil, N. (1995). Preliminary fisheries resources survey of Lake Alau Maiduguri. *Paper presented at the workshop on Sustenance, Management and Conservation of Fisheries and Other Aquatic Resources of Lake Chad and the Arid Zone of Nigeria. Held on the 16th - 17th of January, 1995 at Lake Chad Reserch Institute, Maiduguri.* 3