FISH BIODIVERSITY AND WATER QUALITY PARAMETERS OF AGAIE-LAPAI DAM

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ABSTRACT

The research work on fish species, generic, family diversity and abundances of Agaie-Lapia Dam was carried out from May-August 2013. Five stations were located on the Dam (Bakaje landing site, Spill-way, Middle of the dam, River Kari & River Gana) where samples were taken to determine the various physico-chemical parameters concentration. Fish samples were collected from the artisanal fisher men at the landing site bi-weekly. The result revealed that eleven (11) species belonging to nine (9) genera and seven (7) families were identified. Cichlidae and Clariidae families have the highest species diversity having three (3) and two (2) species each respectively which are Tilapia zilli, Tilapia dageti, Oreochromis niloticus, Clarias angullaris, and Clarias gariepinus. The total count of fish samples during the study period was 1,507. Tilapia zillii had the highest population while Gymnarchus niloticus had the lowest population of 22. There was significant difference among the families (P<0.05). Cichlidae recorded the highest mean value of 58.23±5.96 while Cyprindae recorded the lowest mean value of 1.63±1.11. Other families such as Clariidae is second to the highest with mean of 28.22±3.19 followed by Alestidae and Schilbeldae. The physio-chemical parameter of Agaie-Lapia Dam revealed that all the parameters measured (Temperature, Dissolve Oxygen, Biological oxygen Demand, Total hardness, Alkalinity, Nitrate and Phosphorous) fell within the acceptable limit for fish culture and significant difference (P<0.05) were observed among the months.

INTRODUCTION

The riches and variety of nature are essential to the preservation of a healthy environment and its decline reduces the pool of biological resources available to future generation (Unilever, 2008). Aquatic biodiversity can be defined as the variety of life and the ecosystems that make up the fresh water, tidal and marine region of the world and their interactions. Aquatic biodiversity encompasses freshwater ecosystems, including lakes, ponds, reservoirs, rivers, streams, ground water and wetlands. It also consists of marine ecosystem including oceans, estuaries, salt, marshes, sea grass beds, coral reefs, kelps beds, and mangrove forests. It is also the relative number of species, diverse in form and function at generic, organism community and ecosystem level.

Freshwater ecosystem such as rivers, lakes and wetland occupies less than 2% of the earth's total land surface; they provide wide range of habitat for a significant proportion of the world's plants and animal's species. Many species are yet to be discovered, but the number of freshwater fish species worldwide is estimated between 9,000 and 25,000 (Dugeon *et. al.*, 2005). This number is rapidly decreasing due to human interference, physical alterations, habitat degradation, excessive water withdrawal and pollution, which have contributed directly or indirectly to the decline in freshwater species. Today an estimated 20% of the world's freshwater fish is vulnerable, endangered or extinct (Dugeon *et. al.*, 2005).

USEPA (2007) reported 6,650 species of fish are primarily freshwater fishes that can't tolerate salt water, and majority (over 93%) of freshwater fishes are Ostaroprissan Catfish, Crabs and Characins, the remainder including the weakly mormyrids in Africa and Osteoglossids in Australia and African.

MATERIALS AND METHODS

Fish samples were bought from the fishermen at the landing site. Total numbers of fish and numbers of species landed were counted at each sampling period. Samples taken from the field were transported to the laboratory for identification up to specie level using the monograph of Reed *et. al.*; Olaosebikan and Raji, 1998). Species diversity index, generic diversity index, family diversity index, species abundance, generic abundance and family abundance were estimated. The sampling was done twice in a month.

Physico-Chemical Parameters

Five (5) sampling stations were located on Agaie-Lapai dam, and water samples were collected from each of these stations with the aid of a canoe as the means of transportation. Sampling was carried out twice in a month, and it lasted from (May – August, 2013). Temperature of the water was taken insitu. The samples were transported to the laboratory in cooler with ice block for further analysis.

The following parameters were analyzed using the method of APHA, 1995. They are: Dissolved Oxygen, hardness, Biological Oxygen Demand, Alkalinity, phosphate-phosphorus.

RESULTS

Fish Species Composition of Agaie-Lapai Dam

A total of eleven (11) species belonging to nine (9)

generic and seven (7) families were identified (table 1) in Agaie –Lapai Dam. The families are *Alestidae, Bagridae, Cichlidae, Clariidae, Cyprinidae, Schilbeidae, Gymnarchidae. Alestidae* belong to the order *Characiformes, Bagridae, Clariidae* and *Schilbeidae* families belong to the order *Siluriformes* and they belong to the same super order *Ostariophysi. Cichlidae* belong to the order *Perciformes* and super order *Labroidei, Cyprinidae* belong to the order *Cypriniformes* and super order of *Cyprinae. Gymnarchidae* belong to the order *Osteoglossiformes* and the super order of *Osteoglossomorpha.*

All these species belong to same infra *Teleostei*, sub-class *Neopterygii*, class *Actinopterygii* and super-class of *Gnathostomata* except for *Clariidae* which belong to a different super-class *Osteicthyes. Alestidae* family has two (2) species namely. *Hydrocynus forskahlii* and *Brycinus nurse* in the Dam, *Bagridae* family is represented by one (1) specie named, *Bagrus docmak. Clariidae* family is represented by two (2) species namely, *Clarias angullaris* and *Clarias gariepinus.* The *Cichlidae* family had three (3) species namely, *Tilapia Zilli, Oreochromis niloticus* and *Tilapia dageti.* The family *Cyprinidae* is represented with one (1) specie namely, *Barbus bynni occidentalis* The family *Schilbeidae* is represented by one (1) specie named, *Schiibe mystus* while family *Gymnarchidae* is represented by one (1) specie named, *Gymnarchus niloticus..*

Total Count Per Species, Family and Genera.

The total number of various species of fishes found during the sampling period is presented on Table 2. *Tilapia zilli* had the highest population of five hundred and ninety (590), followed by *Clarias anguillaris* with a population of two hundred and twenty (220) and *Clarias gariepinus* with a population of two hundred of fifteen (215). *Oreochromis niloticus, Tilapia dageti, Schilbe mystrus* and *Hydrocynus forskahlii* had population of 152, 79, 62 and 56 respectively while *Brycinus nurse, Babus bynni occidentalis* and *Gymnarchus niloticus* had 47, 36, 28 and 22 respectively.

In terms of occurrence, *Bagrus docmak, Clarias anguilaris, Clarias gariepinus, Schilbe mystrus, Hydrocynus forskahlii, Tilapia zillii, Tilapia dageti* and *Orechromis niloticus*were available and caught throughout the sampling period while *Brycinus nurse, Barbus bynni occidentalis* and *Gymnarchus niloticus* were caught three (3) times in four month of sampling.

The highest catch was in the month of June 2013 (513), followed by May with (482) total number of sample, July (299) and August with a total of (213) sample. This catch trend indicate the increase in catch sample during the early raining season but decrease as the result of increase rainfall intensity which led to increase in water level and decrease in fish catch. The species diversity index, generic diversity index and family diversity index per each sampling period (monthly) are presented on Table 3

Table 1: Fish species composition of Agaie –Lapai Dam

Family	Genera	Species	Order	Super-order	Infra-class	Sub-class	Class	Super-class
Cyprinidae	*Barbus*	*bynni ccidentalis*	*Cypriniformes*	*Cyprinaea*	*Teleostei*	*Neopterygii*	*Actinopterygii*	*Gnathostomata*
Clariidae	*Clarias*	*Anguillaris*	*Siluriformes*	*Ostariophysi*	"	"	"	*Osteicthyes*
Schilbeidae	*Schilbe*	*Mystrus*	"	"	"	"	"	"
Alestidae	*Hydrocynus*	*Forskahlii*	*Characiformes*	"	"	"	"	"
Cichlidae	*Tilapia*	*Zillii*	*Perciformes*	*Labroidei*	"	"	"	"
Clariidae	*Clarias*	*Gariepinus*	*Siluriformes*	*Ostariophysi*	"	"	"	"
Cichlidae	*Oreochromis*	*Niloticus*	*Perciformes*	*Acanthopterygii*	"	"	"	"
Alestiidae	*Brycinus*	*Nurse*	*Characiformes*	*Ostariophysi*	"	"	"	"
Cichlidae	*Tilapia*	*Dageti*	*Perciformes*	*Acanthopterygii*	"	"	"	"
Bagridae	*Bagrus*	*Docmak*	*Siluriformes*	*Ostariophygi*	"	"	"	"
Gymnarchidae	*Gymnarchus*	*Niloticus*	*Osteoglossiformes*	*Osteoglossomorpha*	"	"	"	"

Table 2: Total catch count of fish species per month of Agaie -Lapai Dam.

S/NO	Species	May	June	July	August	Total
1	*Barbus bynni occidenalis*	9	12	7	0	28
2	*Claris anguillaris*	90	60	40	30	220
3	*Schilbe mystrus*	25	18	12	7	62
4	*Hydrocynus forskalii*	26	10	7	13	56
5	*Tilapia zillii*	180	220	100	90	590
6	*Clarias gariepinus*	55	90	50	20	215
7	*Oreochromis niloticus*	60	47	30	15	152
8	*Brycinus nurse*	0	20	17	10	47
9	*Tilapia dageti*	15	30	22	12	79
10	*Bagrus doemak*	12	6	9	9	36
11	*Gymnarchus niloticus*	10	0	5	7	22
	Total	482	513	299	213	1,507

Table 3: Species/ Generic/ Family diversity index of Agaie-Lapai Dam.

S/NO	Family	May	June	July	August
1	Species diversity index	4.564	4.288	7.358	10.329
2	Generic diversity index	3.734	3.509	6.020	8.451
3	Family diversity index	2.905	2.729	4.682	6.573

Species diversity and abundance per total number of fish.

The species diversity and species abundance of Agaie-Lapai Dam is shown on table 3 and 4.

Species diversity of the Dam could be said to be quite low compared to other water bodies in the state such as Lake Shiroro which is within the flood plain of River Niger and has about twenty-eight (28) fish species. Agaie-Lapai had only eleven (11) species found within nine genera and seven families during the sampling period.

Generic diversity and abundance

The generic diversity and abundant of Agaie-Lapia Dam fish species are presented in table 3 and 5. The dam has as of the time of sampling period nine (9) genera in seven (7) families. The families Alestiidae, *Clariidae* and *Cichlidae* was represented by two (2) genera each namely *Clarias* & *Tilapia*. The families *Bagridae, Cichlidae, Cyprinidae, Schilbeidae, Gymnarchidae* were represented by one genera each namely *Brycinus, Hydrocynus, Bagrus, Barbus, Oreochromis, Schilbe* and *Gymnarchus* respectively.

Table 4: Species abundance per total number of fish in month sample of Agaie-Lapai Dam.

S/NO	Species	May	June	July	August
1	*Barbus bynnioccidentalis*	1.867	2.399	2.341	0
2	*Clarias anguillaris*	18.672	11.696	13.378	14.085
3	*Schilbe mystrus*	5.187	3.509	4.013	3.286
4	*Hydrocynus forskahlii*	5.394	1.949	2.341	6.103
5	*Tilapia zillii*	37.344	42.885	33.445	42.254
6	*Clarias gariepiepinus*	11.411	17.544	16.722	9.389
7	*Oreochromis niloticus*	12.448	9.162	10.033	7.042
8	*Brycinus nurse*	0	3.899	5.686	4.695
9	*Tilapia dageti*	3.112	5.848	7.358	5.633
10	*Bagrus doemak*	2.489	1.169	3.010	4.225
11	*Gymnarchus niloticus*	2.075	0	1.672	3.286
	Total	99.999	100	99.999	99.998

Table 5: Generic abundance per total number of fish during sampling period in Agaie-Lapai Dam.

S/NO	Genera	May	June	July	August
1	*Barbus*	1.867	2.339	2.341	0
2	*Clarias*	30.082	29.239	30.100	23.474
3	*Schilbe*	5.187	3.509	4.013	3.286
4	*Hydrocynus*	5.394	1.949	2.341	6.103
5	*Tilapia*	40.456	48.733	40.080	47.887
6	*Oreochromis*	12.448	9.162	10.033	7.042
7	*Brycinus*	0.000	3.899	5.686	4.695
8	*Bagrus*	2.489	1.169	3.010	4.225
9	*Gymnarchus*	2.075	0	1.672	3.286

Table 6: Family abundance per total number of fish of Agaie-Lapai Dam.

S/NO	Family	May	June	July	August
1	*Cyrinidae*	1.867	2.339	2.341	0
2	*Clariidae*	30.083	29.239	30.100	23.474
3	*Schilbeidae*	5.187	3.509	4.013	3.286
4	*Alestidae*	5.394	5.848	2.400	10.798
5	*Cichlidae*	51.867	66.277	57.525	57.277
6	*Bagridae*	2.489	1.169	3.010	4.225
7	*Gymnarchidae*	2.075	0	1.672	3.286

Table 7: Genus abundance per species

Species	Mean±SD
Barbu sbynni occidentalis	1.63^{a}±1.11
Clarias anguillaris	28.22^{c}±3.19
Schilbe	3.99^{a}±0.84
Hydrocynus	3.94^{a}±2.10
Tilapia zilli	44.28^{d}±4.65
Oreochromis niloticus	9.67^{b}±2.23
Brycinus	3.57^{a}±2.48
Bagrus	2.72^{a}±1.26
Gymnarchus	1.75^{a}±1.35

Means in row having same superscript are not statistically significant different (P>0.05)

Table 8: Specie abundance per families.

Family	Species abundance per total number of fish	Mean± SD
Cichlidae	*Tilapia zilli*	38.98^{d}±5.96
	Tilapia dageti	5.48^{a}±5.96
	Oreochromis niloticus	9.67^{b}±5.96
Clariidae	*Clarias angullaris*	14.45^{c}±3.19
	Clarias garepinus	13.76^{c}±3.19
Alestidae	*Hydrocynus forskahlii*	3.94^{a}±3.47
	Brycinusnurse	3.57^{a}±3.47
Schilbeldae	*Schilbemystrus*	3.99^{a}±0.84
Gymnarchidae	*Gymnarchus niloticus*	1.75^{a}±1.35
Balgridea	*Bagrus docmak*	2.72^{a}±1.26
Cyprinidea	*Barbus bynni occidentalis*	1.63^{a}±1.11

Values along the same column carrying same superscript are not significantly different.

Table 9: Genus Abundance per monthly total catch count of fish

Month	Mean±SD
May	11.11[a]±14.38
June	11.11[a]±16.73
July	11.03[a]±14.09
August	11.09[a]±15.33

Values along the same column carrying same superscript are not significantly different.

FAMILY DIVERSITY AND ABUNDANT.

Family diversity and family abundant are presented in Table 3 and 6. The family diversity of Agaie-Lapai Dam can be said to be low compared to other water bodies in the state. The Dam has seven families with nine genera and eleven species during the sampling period.

Table 7 shows statistical significant difference (P<0.05) among species. *Tilapia zilli* has the highest mean value of 44.28±4.65 and *Barbus bynni occidentalis* has the lowest mean value of 1.63±1.11. The second specie in order of decreasing mean is *Clarias anguillaris* with a mean value of 28.22±3.19, followed by *Oreochromis niloticus* 9.67±2.23, then *Schilbe* with a mean value of 3.99±0.84, *Hydrocynus* with a mean value of 3.94±2.10, *Brycinus* with a mean value of 3.57±2.48, *Bagrus* with a mean value of 2.72±1.26, and *Gymnarchus* with a mean value of 1.75±1.35.

Table 9 shows that there is no statistical significant difference across months (P≤0.05). The month of May and June has the highest statistical mean value of 11.11±14.38 and 11.11±16.73 respectively while the month of July has the lowest statistical significant value of 11.03±14.09 from the statistical result, optimum genus abundance in the month of May and June was observed.

Table 8 shows that there is a significant difference among the families (P<0.05). Family *Cichlidae* recorded the highest mean value of 58.23±5.96 while *Cyprindae* recorded the lowest mean value of 6.63±3.47. other species such as *Clariidae* is second to the highest with mean value of 28.22±3.19 followed by *Alestidae* with a mean value of 6.11±3.47, *Schilbedae* with a mean value of 3.99±0.84, *Bagriidae* with a mean value of 2.721±1.26, *Gymnarchidae* with a mean value of 1.75±1.35 from all indications there is a statistical significant differences (P≤0.05).

Physico chemical parameter interpretation of one way Anova.

Table 10 shows that there is significant difference (P<0.05) in the mean values of Temperature (°C) measured at different months in Agaie – Lapai Dam. The highest Temperature was observed in June followed by August, July and the least in the month of May with the mean value of 30.11°C, 30.30°C, 29.9°C and 29.30°C respectively. There is no significant difference (P>0.05) in the mean values of Dissolved Oxygen (D0 (mg/l)) and Biological Dissolved Oxygen (BOD (mg/l)), measured at different months. There is significant difference (p<0.05) in the mean values of Total Hardness (mg/l) measured at different months. The highest Total Hardness (mg/l) was observed in July followed by August, June and the least in the month of May with the mean value of 27.60mg/l, 24.82mg/l, 24.40mg/l and 23.20mg/l respectively. There is significant difference (P<0.05) in the mean values the Alkalinity (mg/l) measured at different months of Agaie – Lapai Dam from May to August, 2013 was observed in August followed by July, June and the least in the month of May with the mean value of 40.00mg/l, 39.00mg/l, 34.80mg/l and 34.40mg/l respectively. There is significant difference (P<0.05) in the mean values the NO_3 (mg/l) measured at different months of Agaie – Lapai Dam from May to August, 2013. The highest was observed in August followed by July, June and the least in the month of May with the mean value of 1.48mg/l, 1.40mg/l, 1.24mg/l and 1.06mg/l respectively. There is significant difference (P<0.05) in the mean values the PO_4 (mg/l) measured at different months of Agaie – Lapai Dam from May to August, 2013. The highest was observed in August followed by July, June and the least in the month of May with the mean value of 0.73mg/l, 0.69mg/l, 0.64mg/l and 0.53mg/l respectively.

Table 11 shows that the means for some physico-chemical parameters measured at different Stations of Agaie-Lapia Dam from May-August, 2013. There is no significant difference in all the parameters ranging from Temperature (°c), DO (mg/l), BOD (mg/l), Total hardness (mg/l), Alkalinity (mg/l) and Nitrate (mg/l) with the exception of phosphorus (mg/l) where there are significant difference across the Station1 to Station5 with Station4 and 5 having the highest

concentration of 0.74mg/l followed by Station3 (0.68), Station2 (0,59) and the least was observed in Station1 (0.56).

Table 12 shows the Correlation Matrix of water quality parameters of Agiae-Lapai Dam from May-August, 2013. Temperature (°c) is positively correlated with Month at (P≥0.05) respectively, BOD is positively correlated with the Month and DO (mg/l) at (P≥0.05) and (P≥0.01) respectively, Total hardness is positively correlated with BOD at (P≥ 0.05), Alkalinity is correlated with Month at (P≥0.01) respectively and Nitrate is positively correlated with Month, Temperature, Total hardness, BOD, Alkalinity at (P≥0.01), (P≥0.01), (P≥0.05), (P≥0.05) and (P≥0.01) respectively and Phosphorus is positively correlated with Stations and Temperature at (P≥0.01) and

Table 10: The mean values for some physico-chemical parameters measured at different months of Agaie-Lapai dam

S/N	Parameters	May	June	July	August
1	Temp (°C)	29.30^{b}±0.70	30.30^{a}±0.50	29.9^{a}±0.60	30.11^{a}±0.60
2	DO (mg/l)	5.20^{a}±1.00	5.90^{a}±1.40	5.90^{a}±1.70	6.20^{a}±1.00
3	BOD (mg/l)	1.80^{a}±1.00	3.50^{a}±0.90	3.50^{a}±1.00	3.40^{a}±1.90
4	T. Hard (mg/l)	23.20^{b}±2.00	24.40^{ab}±2.80	27.60^{a}±4.70	24.80^{ab}±2.00
5	Alk (mg/l)	34.40^{b}±6.00	34.80^{b}±2.70	39.00^{a}±2.40	40.00^{a}±3.00
6	NO_3 (mg/l)	1.06^{d}±0.10	1.24^{c}±0.10	1.40^{b}±0.10	1.48^{a}±0.90
7	PO_4 (mg/l)	0.53^{c}±0.10	0.64^{bc}±0.10	0.69^{b}±0.10	0.73^{b}±0.10

Means in the same row having same superscript are not significantly different from each other (P≤0.05)

Table 11: The mean values for some physico-chemical parameters measured at different Stations of Agaie-Lapai dam from May to August, 2013

S/N	Parameters	ST1	ST2	ST3	ST4	ST5
1	Temp (°C)	29.50^{a}±0.80	30.00^{a}±0.80	29.90^{a}±0.60	30.00^{a}±0.50	30.10^{a}±0.60
2	DO (mg/l)	5.80^{a}±1.70	6.30^{a}±1.60	5.40^{a}±1.40	5.50^{a}±0.90	6.10^{a}±1.30
3	BOD (mg/l)	3.40^{a}±1.40	3.50^{a}±1.50	3.40^{a}±1.40	2.20^{a}±1.50	2.80^{a}±1.50
4	T. Hard (mg/l)	25.00^{a}±3.40	25.50^{a}±5.00	25.50^{a}±1.80	24.30^{a}±4.00	24.80^{a}±2.60
5	Alk (mg/l)	37.80^{a}±3.60	37.80^{a}±4.70	36.80^{a}±4.00	36.25^{a}±5.00	36.80^{a}±6.00
6	NO_3 (mg/l)	1.28^{a}±0.90	1.29^{a}±0.20	1.24^{a}±0.20	1.31^{a}±0.20	1.36^{a}±0.20
7	PO_4 (mg/l)	0.56^{b}±0.60	0.59^{b}±0.60	0.68^{a}±0.70	0.74^{a}±0.70	0.74^{a}±0.70

Means in the same row having same superscript are not significantly different from each other (P≤0.05)

Table 12: Correlation Matrix of Water Quality Parameter of Agaie-Lapai Dam

Month	Week	Station	Temp	DO	BOD	T.Hard	Alk	Nitrate	Phosphorus	
Month	1.000									
Week	0.000	1.000								
Station	0.000	0.000	1.000							
Temp	0.337*	-0.075	0.267	1.000						
DO	0.249	-0.111	0.000	0.146	1.000					
BOD	0.371*	-0.035	-0.244	0.265	0.711**	1.000				
T. Hard	0.263	0.117	-0.073	0.199	0.273	0.385*	1.000			
Alk	0.522**	-0.011	-0.110	0.086	-0.081	0.153	0.147	1.000		
NO_3	0.879**	0.240	0.128	0.403**	0.247	0.369*	0.361*	0.442*	1.000	
PO_4	-0.217	-0.207	0.726**	0.343*	-0.137	-0.148	0.002	-0.214	-0.064	1.000

** Correlation is significant at 1% level (2 tailed)

* Correlation is significant at 5% level (2 tailed)

DISCUSSION

Eleven (11) species belonging to nine (9) genera and seven families (7) were identified during the study period. Abundance of fish families inAgaie-Lapia Dam revealed that Cichlidae has the highest abundance, followed by Clariidae, Schilbeidae, Alestidae, Cyprinidae and Gynarchidae. When compared to the research carried out by Alabi (2011) of Agaie-Lapia Dam, there was decrease in number of species, families and reduction in genera. The species compositions are partially similar to those found in all freshwater bodies in the country and even in West Africa.

The abundance of these species could be attributed to the gears size that were used by the fishermen.

At the beginning of the study it was observed that the catch per unit effort was low, later on a steady increase which then later begins to drop. The increase and decrease in the number of catch of fishes can be attributed to the fact that when the volume of water was average, they were in high number but when the volume increase to a peak the catch was reduced and this was due to the fact fishes now hard deeper depth which aid their ability to escape catch by the fishermen. The result obtained from this research show some variation between month sampling and stations during the high and low tide.

Temperature ranges between 22°C-32°C which is same with all tropical water bodies. Kolo&Oladimeji (2004). The relative low temperature result obtained from all stations in the month of May and June was due to dry season, dry wind and low rainfall. Similar effect had also been observed in some African water bodies (Kolo & Oladimije, 2004). The low concentration of D.O recorded in the month of May could be due to the calmness of the water; e.g. low rainfall, wind and current but it was high in the month of June, July & August which had heavy rainfall, wind, current and human activities which now enable agitation of water which can increase Oxygen content and also it could be because of the cool weather which now makes the water cool because cool water contains more dissolved oxygen APHA (1995). This was in agreement with the work of Kolo & Oladimije, 2004.

Other physic-chemical parameters measured fell within tolerable limit for fish survival and growth.

CONCULISION.

From this study, It could be concluded that Agaie-Lapia Dam although with quite large surface area, harbors only few species of fresh water fishes. Some, occurring in large number while some in few. This is in line with other fresh water habitats and particularly those in tropical Africa where much aquatic biodiversity is concentrated.

Hence the dam serve a great benefit and provides primary needs of man (source of domestic water supply, source of employment, fish production etc.) there will be need to regulate the fishing mesh net size used in fishing.

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