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Characterization of the fishing in Lake Ndjale in Kibombo territory, Maniema DRC

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ABSTRACT

This paper analyzes the current state of fishing in Lake Ndjale in order to point out positive and negative aspects that can permit different actors intervening in this sector to get useful information to improve this economical channel. According to the fishing and agriculture code in DRC, the document produced by FAO on fishing in Lake Ndjale by local fishers and the fishing gears used, it appears that the State is deficient, the management of the lake is not transparent. Lake Ndjale is managed by the customary authority according to which only natives can have access. Moreover, captured fish are neither weighed nor monitored, resulting in that the price varies according to customer's social rank and no regulation is cared for. Fishing is practiced both for subsistence and for commerce. Men are the main actors. Various nets, pirogues and fishing line are the most used tools. Bicycles and motorbikes are used for transportation, involving many intermediaries between fishermen and consumers. Therefore, it is necessary to organize this channel to make this activity more profitable.

1. Introduction

In DRC, meticulous observation on food consumption proved that products of animal origin (frozen beef and pork, chicken and fish), are imported come largely from the imports at a large extent.

The country imports 150 tons of fish every year, yet the Congo River, lakes and streams in RDC constitute invaluable fishing reserves. In this regard, the RDC ranks among basic food importers such as sea fish despite their importance in the Congolese people's welfare. Other imported products are: beef, pork, chicken and other poultry, eggs, sugar, rice, wheat flour and many other foods. This trade costs the country almost two billion dollars every year.

Despite the bulk of those imports, specialists say that 70% of the Congolese people still live in food insecurity and currently the DRC ranks among countries where food security is not ensured yet. Therefore, it has the highest malnutrition rate worldwide to date. However, there is no reason for the DRC to pay such sums for food import because the country is able to produce enough food for its population and truly ensure its food security with its natural potentialities.

The DRC has an exceptional fish potentiality extending from the Atlantic Ocean to Moanda in Central Congo. Even one fishing company could assure enough fish supply. More, the country is crossed by the majestic and big Congo River that is one of the longest and most powerful rivers in the world, with several tributaries hosting innumerable and various aquatic species.

The national government through the Ministry of Agriculture can organize the fishing, aquaculture, even fish farming to provide the population with enough fresh fish since the fishing practiced currently is very far from meeting national needs and demands.

The DRC has a hundred lakes of which ten rank among the vastest and full of fish like Lake Tanganyika. The government could also organize and develop industrial fishing (Bitkuela, 2019).

However, in spite of all these imports, food conditions are still fragile in the country.

In Kindu and its surroundings (in Maniema Province), salty and smoked fish come either from outside of the province such as Tanganyika, Tshopo, Mongala Provinces, either from the inner part of the province especially form Kibombo, Kailo, Kabambare and Pangi territories.

It should be noted that these products are often carried with small crafts (whaleboats), vehicles, trains, airplanes, motorcycles and bicycles – which has an impact on the quality, the quantity and the price of the products.

Yet Maniema is also crossed by the majestic Congo River and hosts several aquatic ecosystems (streams, Lake Ndjale) and wetlands.

However, till now, the operating mode of these fish resources has never followed a good model to allow fishermen to improve their socio-economic conditions and the State to draw dividends from the exploitation of these resources.

In this study on the characterization of the fishing in Lake Ndjale, we asked the following questions:

- What characterizes the fishing practiced in Lake Ndjale ?

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- What are likely reasons for the low impact of the fishing on the improvement of the socio-economic conditions of Lake Ndjale fishermen?

From these questions, we can admit that:

- The fishing in Lake Ndjale is on a law scale, to commercial tendency,

- The likely reasons for the low impact of the fishing on the socio-economic level could be poverty of the fishers, bad management of the lake by the customary authority, weakness of the State in regulating, bad roads, and absence of technical and financial support to fishermen.

1.1 Objective

The objective of this study is to provide a database on the exploitation of Lake Ndjale in order to suggest possible solutions for the improvement of socioeconomic conditions of fishermen, consumers and environmental conditions of aquatic organisms in this lake.

Specific objectives:

- To characterize the fishing practiced in Lake Ndjale;
- To value fishing gears and practice used as well as environmental aspects.

2. Study area and method

2.1. Study area

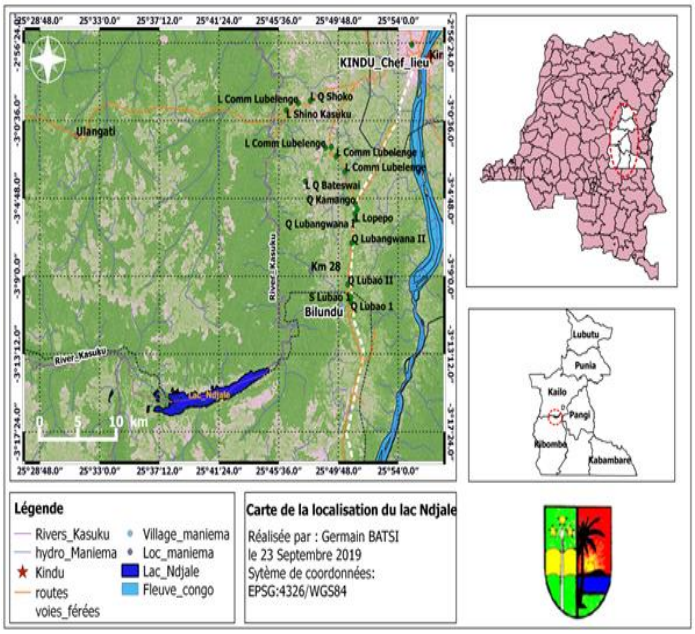

Figure 1. Location of Lake Ndjale in Kibombo territory, Maniema Province

Lake Ndjale is located in Matapa chieftaincy at 42 km away from Kindu city, Kibombo road, at an altitude of 472 m at 35M 0357259 and UTM: 9640173.

3. Method

We interviewed 40 fishermen, distributed into two stations (Dongo and Gabon), two fishermen's villages and 20 fishermen by station. We surveyed and the socioeconomic and environmental data on the fishing.

Besides the investigation, we used other collection techniques namely: guided interview, free observation, documentation, focus group. We used Excel software to treat data presented in percentage.

The selection of fishermen was made on basis of the following criteria:

- To be a fishermen and be known by other fishermen of the area;
- To live on the fishing essentially;
- To accept to answer the researcher's questions;
- To be available and live in the area.

The survey questionnaire contained:

- Fishermen's identification (age, sex, education, civil status, tribe, secondary activities, and experience in fishing);
- Types of fishing and gears used;
- Fish caught, destination and income;
- Conservation and price;
- Environmental impact of gears used on aquatic biodiversity of Lake Ndjale.

4. Results and discussion

Analysis of the results revealed that the age of the majority of fishermen of Lake Ndjale is between 31 - 35, and 97.5% are of those who practice the fishing are men, a low representation of women is rarely observed 2.5%, 85% are household heads (married), 12.5% are bachelors and 2.5% widows. They are all (100%) from the same tribe (Kusu) and fishing is the main activity of the area. However agriculture and breeding are considered as secondary activities.

As for seniority in fishing is 11 years on average and the fishing is exclusively practised for subsistence and for commerce.

The species caught are from Mormyridaes (39.4%), Claroteidae (18.5%), Mockokidae (16.9%), Clariidae (8.3%), Cannidae(4.6%), Osteoglossidae (3.6%) Cichlidae (1.9%) and Notopteridae families. Other rarely caught species are from Alestidae and Hepsetidae families.

As for the size, it varies from one species to another. However, the small size observed could be due to the type of the nets used. Mesh size of most of the nests is <5 cm. The pirogues used are too small to support 10 cm mesh nets.

This same tendency is also observed for the weight of the species captured, that requires fishing with a larger pirogue that can support heavier nets and catch bigger individuals.

While comparing the size and weight of individuals we observe that fish caught with a pirogue and longlines are bigger than the ones caught with light nets. However, the number of fish caught with different nets was superior to the ones caught with hooks (pirogue and longlines). In other words, the catching capacity of net is superior to the one of a hook in the lake. The average observed by net of 50 m was between 200 and 250 individuals by fishing effort.

As for the destination of fish, about 75% are intended for sale, and 25% for self-consumption. Also fish are sold fresh (70%), which is women's main activity. A small quantity is smoked (30%) especially there no customers to take fish to urban markets in Kindu or surrounding villages.

However, there is an income from that permit fishermen's children's schooling (65%) and the other part is destined either to health care, clothing and other expenses.

As we emphasized in the introduction, the management of this lake is very opaque, and so is in way fishermen manage their income, that is, in spite of the income generated by this activity, their social conditions are too low. This calamitous management cannot enable the actors (fishermen) to improve their social conditions.

Some fishermen proudly argue that Lake Ndjale belongs to them and fish are so abundant that they can go fishing, earn and spend money on beer and women.

The same tendency is observed as for the species preferred by consumers and fishermen. In general, all species of Ndjale are preferred given their taste is different from the ones captured in the Congo River, such as: *Mochokidae, Mormyridae, Claroteidae, Clariidae, Citharinudae* ,

Cichlidae and *Cannidae* (singa), and many customers come to buy fish of this lake.

Among endangered species are *Hepsetidae* and *Characidae* families which are rare.

Currently two new species are present *Polypterus spps* and *Bricaenitiops ssp* in the lake. Since the lake comes from the breaking of Kasuku stream, these species can come from Kasuku stream where they are endemic.

No fish disease has been reported by fishermen in Lake Ndjale. This proves that the quality of water and the area are still good because no anthropic activity is observed on the banks of the lake.

The most used gears are various gillnets (87%), the longlines (11%) and hand lines 2%; fish-traps are no longer used. 100% gears belong to fishermen individually. Fishermen are not organized. There are no collective or hired gears. They hardly renew their gears, and have often to barter (nets, hooks).

When comparing the income and the price of gears, we noticed that fishermen do not manage their income appropriately. This requires a supervision so that the activity can be more profitable to them.

There is discipline in using forbidden gears such as toxic products, mosquito nets. But small fish are still caught with <5cm mesh nets. This denotes that they ignorance fishing regulations, State's weakness in controlling and monitoring.

Results obtained by Dialla, Tossembeko and Micha in 2016 in Burkinafaso on fishing durability of *Oreochromis nuliticus* (Cuvier 1829) (Linnaeus, 1758), *Clarias gariepinus* (Burchell, 1822) and *Gymnarchus niloticus* (Cuvier,1829) in Sourou dam lake, clearly show that the majority of gears remain passive, that mesh nets varying between 27mm and 30mm or even between 35 and 40mm, longlines and fish-traps are generally set put in the afternoon in a specific place, and that they are removed the following morning.

The comparison of their results with ours show that the fishing in Lake Ndjale and in Burkinafaso is similar as (in Sourou dam lake, sleeping net predominates followed by longlines and hand line).

As far as fishing management is concerned, State is weak to organize and regulate the fishing. That's why the customary authority is the efficient organ to manage this lake and its fish resources. This authority is the only one to regulate and monitor the fishing activities.

Although this regulation is limited, it forbids night fishing, use of toxic plants and mosquito nets in Lake Ndjale. Each chief of the clan legislates the fishing on the area of the lake under his/ authority.

From the results presented above, it appears that the management of Lake Ndjale is almost the same as of Lake May-Ndombe. As for the types of fishing practiced on both lakes, we observe that the fishing is almost exclusively practiced by male adult, that is 97.5%, whereas women and children under 15 years of age are not almost concerned; to apart from 2.5% widows. The same situation is observed among fishermen of Lake May-Ndombe where only adult men practice fishing, and women and children under 15 years practice leisure fishing (training) in the swamps of the lake and its tributaries during the long dry season. (Bongeba, C. and Micha 2013).

As for the type of fishing, in Lake May-Ndombe either active or passive fishing is practice. Since active fishing make a big pressure on available fish stock, stable mesh nets, moving mesh nets, hawk nets and harpoons are used. On the other hand, passive fishing makes weak pressure on fish resources and fish-traps, sleeping mesh nets surface drifting nets and hand longlines, Luchaka (in liana) and Conon are used. Conon is a current fishing practice in Lake Ndjale, but the gears used are: sleeping nets, longlines, cannon and handline. Fish traps and Luchaka, mosquito nets poisoning use to be used by the fishermen of Ndjale Lake, but today are less used because of the additional work that they impose and also of scarceness of the materials to make them (lianas and other plant fibers).

In addition, the fishing technique is related to the type of species as well as to its biologic living environment. In deep zones, sleeping nets, longlines and cannon are used, whereas line fishing and fish-trap are used in less deep areas.

As for the organization of fishermen, compared to those Lake May-Ndombe, fishermen of Lake Ndjale are almost not well organized. There is no official structure of Ndjale fishermen. They do not receive any support from the government or organisms, nor any gears or technical support project.

The same issue is observed for fishers of Lake May-Ndombe as Bongeba and Micha (2013) underline with the difference that in Mayi-Ndombe there are two fish related active projects (Djambandjale funded by World Wildlife Fund and EPEFE). Although associations do not receive any support of the government, the projects provide fishermen in Mayi-Ndombe with sustainable technical support such as the use of rational Chrochor ovens for fish smoking, the use of salt for dried salty fish and the management of local fishing organizations.

The creation of microcredits by the projects permitted to support these associations and to fund fishermen to buy gears and salt.

The only common point with fishermen of Lake Ndjale remains the absence of the State in supporting fish activity. Lack of grouping fishermen into association not only influences the activity, but also this population's living conditions. This situation does not enable development and modernization of the fishing in Lake May-Ndombe, Lake Ndjale and other areas in the region.

Results descended of our survey on the conservation of fish of Lake Ndjale, we observed that most of fish are not kept due to lack of conservation infrastructures, the only conservation means being smoking. Fish are shipped or sold there sold locally fresh for direct consumption. Smoking is related to the size of the individuals captured.

Unlike fishermen in May-Ndombe, Ndjale fishermen use two conservation methods: smoking in drying apparatus and a "Nsakala", a tool made of liana, to keep fish alive before shipping (Bongeba and Micha, 2013).

The other method not used by fishermen of Ndjale is salting technique used at 30% in May-Ndombe because of the high cost and scarceness of salt in the region. Salting lasts 3 days. These techniques permit fishermen not only conservation of their products but also maximization of the income in case there is a delay between sale and consumption.

The comparison of the results of this survey in Lake Ndjale with those in Basoko, Isangi, Ubundu territories, in Tshopo Province conducted by Ngoy and al. (2010), it appears that 98.3% fishermen are male, 89.3% married, 53.7% went to primary school, 43.7% practice agriculture as a secondary activity. Fishermen's average age is 40 years, the

average household size is 9 persons, seniority in fishing is 22 years and gears used (pirogue, net, fish-trap, hook) are bought by fishermen themselves. The most net technique used are Chachas/Kumba-kumba (30.6%) and Bindo (28.1%). *Clarias* is the most captured species in Tshopo with 43.0%, followed by *Tilapia* (8.3%), *Chrisichthys w* (6.6%), and *Distichodus fasciolactu*s (6.6%). 80.8% production costs are related to gears purchase (pirogue, net, fish-trap, hook, …) and 19% are related to functioning (food, taxes, conservation cost, ...).

Fishermen mainly use smoking (68.6%) and salting (19.8%) as means of conservation. The activity is profitable and procure to fishermen (individually/in group) a raw profit of 4.92 US$ to 366.58$ US$. Fish selling is an activity practiced mostly by women (89.7%) among whom 83.8% are married.

The average age is 38 years, 63.2% saleswomen have a clean capital in Tshopo Province, and 3.4% of the respondents affirmed to have access to credits for the activity of selling fish.

These results show that the channel of fishing in Lake Ndjale in Maniema and Tshopo Provinces is quite the same from the social point of view, but there are some remarkable differences at the level of household size in majority 6 persons for Lake Ndjale against 9 for Tshopo, education level in Ndjale is nearly null against 53.7% in Tshopo with a longer experience in fishing.

As for the distribution of fish from Lake Ndjale, we noted that due to transportation difficulties in DRC in general and in Maniema in particular, distribution of fish among consumers is patchy. So a larger part fish products is consumed in Kindu, capital city of the province. Fish are shipped only either by bicycle or by motorbike. Products are sold in detail (parcel or per unit) and the price varies according to fish size and specimen. There are disorganization of fishermen and bad road leading to Ndjale Lake. More, the presence of several intermediaries between fishermen and consumers raises the price higher than the one of sea fish (called Tomson or "mpiodi") in the region. The situation in May-Ndombe is similar to the one in Ndjale.

As far as environmental impact of gears used in Lake Ndjale is concerned, we observed that <5 cm mesh nets are the most, inducing high capacity to catch more small fish.

While comparing this situation to the current regulation, we notice that those nets are not appropriate for responsible fishing since they threat the stock of adults able to repopulate the lake. This situation can have serious consequences at the environment and socioeconomic levels and even scarceness of fish biodiversity of this ecosystem and the income and the nutritional state of fishermen as well as the population concerned.

With regards to the environmental aspect on the management of fishing gears, it is reported that 55% are abandoned in the lake and 25% along the lake on the outskirts and driven into the lake by flood. These gears continue to catch fish without a fisherman. This type of fishing called fathom fishing is a serious danger to fish population and other aquatic organizations in Ndjale.

At the environmental level, these two situations can be explained by fishermen unawareness of norms or regulations of fishing, poverty and bad income use and weakness of the State on fishing monitoring.

We present fishing assessment in Lake Ndjale in the table below.

Table 1. MOFF analysis of fishing in Lake Ndjale

Analysis	Positive	Negative
	Strengths	**Weaknesses**
Internal	- High presence of fish in the lake - Mastery of fishing technique by fishermen of the lake - Proximity of the lake to the center of consumption (Kindu city) and its surroundings - Preference of fishy taste of the lake by the local population	-Proliferation of aquatic plants in the lake -Bad road state to the lake -Insufficiency or absence of basic infrastructures and gears - absence of reliable statistical data on fish potential - Absence of technical coaching in the domain of fishing -Opaque management and control of the customary power on the lake
External	**Opportunities** - Income source for the province - Valorization of the lake as touristic site - Existence of many permanent fish consumers	**Threats** Absence of microcredits to fund fishing activities -Weakness of State's services in monitoring fishing activities -Bad organization of fish commercialization channel -Rivalry among fishing site chiefs -Difficulties of transportation - Administrative annoyances and illegal taxes.

MOFF analysis reveals that fishing channel in Lake Ndjale causes serious social, administrative, economic and environmental problems. Consequently, each stakeholder (fisherman, customary authority, the State) should get efficiently involved through popularization of legal texts on the regulation of fishing and fishermen capacity building.

5. Conclusion and Suggestions

The analysis of the results on the characterization of fish channel in Lake Ndjale shows that fishermen of the survey area are men aged between 31 and 35 years, from Kusu tribe Kibombo territory.

The most caught fish belong to *Marmyridae*, *Mockokidaes*, *Clariidaes*, *Claroteidaes*, *Cychlidaes* and *Cannidaes* families. Light nets are the most used, followed by longlines and cannons. However, the two latter are more efficient in capturing of big fish, while light nets are efficient capture more in terms of number.

At least 75% fish products are destined to direct sale or after smoking. The lake is managed by a customary authority and the majority of fishermen are uneducated.

Families of *Mockokidae*; *Mormyridaes*, *Cannidae*, *Clariidae*, and *Citharinudae* are the most preferred by consumers and fishermen.

Different gears used for fishing belong to fishermen individually. There is no fish organization for Lake Ndjale, and fishing is practiced all the year, without closing period.

There is State's weakness to regulate fishing activities. Though fishing seems to be profitable to fishermen, their living conditions are very low.

Given problems faced for fishing in Lake Ndjale, we suggest:

- To regulate the closing and the opening of fishing activities, in Lake Ndjale;

- To sensitize fishermen on protection of aquatic fauna, and on fishing gears;
- To regulate intermediate saleswomen's activities and access to credits;
- To standardize fish sale measures in Kg and improve fish conservation and conditioning until the sale;
- To renew road infrastructures and reinforce administration capacities on fishing regulation;
- To assure security and stop administrative annoyances and illegal taxes.

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