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Research Article

Fish farming techniques implemented in the Funa valley in the commune of Mont-Ngafula in Kinshasa (D.R. Congo)

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Abstract

The practice of modern fish farming can help the Congolese population, through intensive supervision, to acquire the basic principles of rational animal husbandry. The aim of this study is to highlight fish farming practices in the Funa valley in the commune of Mont-Ngafula in the city of Kinshasa in the Democratic Republic of Congo and to identify the strengths and weaknesses of fish farming in this part of the city. The data was collected using a survey form and interviews based on direct questioning of fish farmers. The results showed that artificial and natural hand-dug ponds are the most common fish farming systems used in the study area. Monoculture is more practiced than polyculture, with the use of natural feed based on primary production in the pond through biological and chemical fertilisation as opposed to supplementary feed. The fish fauna exploited in the study area is rich and diverse. The systematic inventory shows the presence of eight (8) species of fish divided into four (4) orders (*Cichliformes*, *Anabantiformes*, *Osteoglossiformes* and *Siluriformes*), six (6) families (*Cichlidae*, *Channidae*, *Arapaimidae*, *Clariidae*, *Claroteidae* and *Schilbeidae*) and seven (7) genera (*Oreochromis*, *Tilapia*, *Parachanna*, *Heterotis*, *Clarias*, *Ochenoglanis* and *Schilbe*) which are exploited by fish farmers based in the Funa valley at Mont-Ngafula. The fish farming techniques used by farmers in the Funa valley in Mont-Ngafula are less efficient and less productive.

1. Introduction

Population growth and changing dietary habits, linked in particular to urbanisation, are leading factors to a very sharp increase in the demand for animal proteins in both urban and rural areas [1]. The idea of farming aquatic organisms is not new in the world [2]. Congolese aquaculture is essentially based on subsistence family fish farming, in which fish farming is now predominant despite the potential for farming other aquaculture species [3].

According to FAO [4], fish accounts for between 30% and 40% of animal protein. Whether fresh, smoked or dried. Fish plays a very important role in combating malnutrition and is a major source of animal protein in the human diet [5-7]. Fish flesh contains less saturated fat and more protein [8]. Nowadays, fish farming in ponds has suffered a major decline, due to ecological and socio-economic problems, low production and difficulties in manufacturing feed for fish growth [9]. Fish farmers are still looking for a way to combat famine, and their concern is to make fish

accessible to everyone, regardless of social status. So far, almost no action has been taken [10].

In the Democratic Republic of Congo, lack of experience, absence of knowledge about good fish farming practices, and the difficulties associated with access to good-quality fry and feed have long been obstacles to the development of fish farming [9]. Added to this is the difficulty of acquiring land and space to accommodate rearing ponds in the lowlands that meet fish farming engineering standards [10].

However, there is no tradition of fish farming in the Democratic Republic of Congo. In view of the nutritional and spatial potential of the D.R. Congo, the integration of fish farming into the development programme is a decisive tool in the elaboration of development strategies in general and the fight against malnutrition in particular [11]. Fish are reared by farmers in earthen ponds built in valleys and other wetlands, in extensive and semi-intensive family fish farming systems, with a view to improving the nutrition of indigenous and rural populations [12].

Recent studies on poverty in the Democratic Republic of Congo show that poverty and malnutrition are scourges that affect all the provinces in different ways, and their manifestations vary from one province to another. Whereas in the past, poverty was considered to be a simple lack of income, today it is more than a lack of income [13]. And yet, the DRC, a country rich in watercourses, can develop fish farming to improve the population's level of nutrition. It can also provide work and curb the rural exodus. By introducing fish farming into rural areas, Congolese farmers can acquire the basic principles of rational animal husbandry through intensive training [14].

Given the widespread malnutrition in the country and the advantages offered by fish farming, we wondered whether fish farming could contribute to the fight against malnutrition in the Democratic Republic of Congo in general and in the city of Kinshasa in particular. This is the background to this study, which examines fish farming practices in the Funa valley in the commune of Mont-Ngafula in the city of Kinshasa in the Democratic Republic of Congo. The information provided by this study will help to improve fish production in Kinshasa, which could contribute to the fight against hunger, malnutrition and poverty. The profitability of fish farming will help to increase the income of the various local fish farmers.

2. Materials and methods

2.1 Study area

This study took place in the Funa valley, where pond fish farming is carried out in the commune of Mont-Ngafula in the city of Kinshasa in the Democratic Republic of Congo. A total of four fish farming sites (Fig. 1) with between 6 and 15 ponds were surveyed as part of this study.

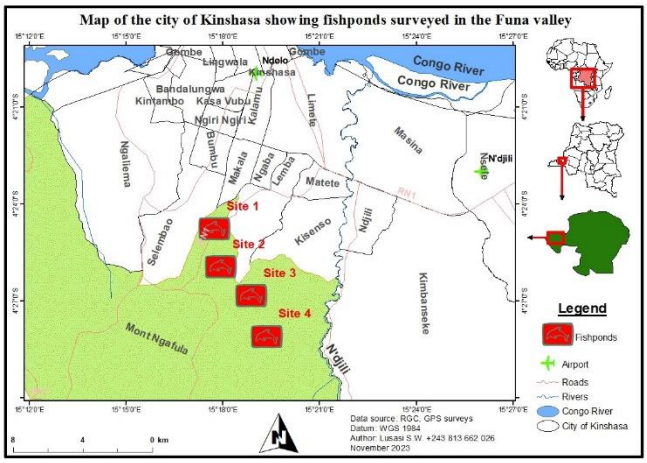

Figure 1. Map of the study area showing the ponds in the Funa valley at Mont-Ngafula

The first site is located at latitude 4° 24' 00.384'' South, longitude 15° 18' 19.589'' East and elevation 318 metres; the second site is located at latitude 4° 25' 3.180'' South, longitude 15° 17' 56.292'' East and elevation 330 metres; the third site located at 4° 23' 1.653'' South latitude, 15° 16' 54.220'' East longitude and 311 metres above sea level and the fourth site located at 4° 27' 6.520'' South latitude, 15° 19' 5.441'' East longitude and 334 metres above sea level.

2.2 Biological material

The biological material used in this study consisted of the various fish species exploited in the fish ponds of the Funa valley in the commune of Mont-Ngafula in the city of Kinshasa.

2.3 Methodologies

2.3.1 Survey of study sites and pre-survey

The presence of functional fish ponds were first ascertained in the study area. This was done by personal interviews with the pond owners.

2.3.2 The survey techniques

The survey was conducted with the aid of a well

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structured questionnaire. The survey questionnaire consists of framed and closed questions. The questionnaire was designed to meet the various objectives defined in this study. The discussions provided information on the socio-demographic profile of the fish farmers interviewed, the various fish farming techniques used, the species of fish raised, the consumer groups for the fish produced, etc. In addition to these exchanges, free interviews lasting a few minutes were conducted with motivated sellers to tell us more.

2.3.3 Survey process and sample size

The survey was conducted over a three-month period from May to September 2022. Data was collected four times a month, i.e. once a week, and a total of 20 field visits were made. The survey was exhaustive in that we interviewed almost all the fish farmers in the Funa valley who own ponds in the area. The criteria for inclusion in the study population were based on age (the respondent must be 18 years and above) and must be a fish farmer in the study area. The exclusion criteria took into account younger people and other categories of people present on the site who do not practise fish farming.

2.3.4 Direct observation and documentary methods

Direct observations were made of the state of the fish farming infrastructure, water inlet and outlet systems, rearing systems and so on. Secondary data was also used for this study like books, dissertations and theses, as well as the contents of libraries and the Internet.

2.3.5 Systematic identification of fish

The systematic identification of fish reared in the Funa valley was based on specimens of fish taken from the fish ponds surveyed. The systematic fish identification keys proposed by Lévêque *et al.* [15, 16]; Mbega and Teugels [17] and the FishBase database were used during fish identification at the Limnology, Hydrobiology and Aquaculture Laboratory of the Life Sciences Department of the Faculty of Science and Technology of the University of Kinshasa.

2.3.6 Data analysis and processing

Following the survey, the various observations made in the field and the information obtained from fish farmers in the Funa valley were analysed and then grouped according to category. The values obtained were taken as absolute frequencies before being encoded in the Excel 2013 spreadsheet. The results are presented as percentages in tables and graphs. Origin version 6.1 was used to draw up the graphs, and the mapping of the study area was generated using ArcGIS 10.8 software based on geographical coordinates recorded with the Garmin Etrex GPS.

3. Results and discussion

3.1 Profile of respondents

The results of the socio-demographic information of the respondents interviewed for this study are shown in Table 1.

Table 1. Socio-demographic profile of respondents

Variable	Number	Percentage (%)
Gender		
Male	18	75
Female	6	25
Total	24	100
Age (year)		
18-25	3	12,5
25-40	11	45.8
40-60	10	41.6
60 and more	0	0
Total	24	99.9
Marital status		
Single	10	41.6
Married	14	58.3
Divorced	0	0
Widowed	0	0
Total	24	99.9
Education level		
Primary	1	4.1
Secondary	18	75.1
University	3	12.5
No education	2	8.3
Total	24	100

The results in Table 1 above show that the majority of fish farmers are men (18 respondents or 75%), followed by women (6 respondents or 25%). This can be explained by the fact that fish farming in shallow ponds requires a great deal of physical effort to set up and maintain the fish farming infrastructure, but it is also linked to the ethnic origins of the farmers, where for the most part, fish farming is reserved for male heads of household and women as housewives. These observations agreed with those raised by Lokinda *et al.* [18]; Kifufu [19] in the provinces of Tshopo and Mai Ndombe in the Democratic Republic of Congo. According to Kifufu [19], pond fish farming requires

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considerable physical effort for pond construction and maintenance, a condition that does not favor women to devote themselves to it. Regarding the age of respondents, it appears that fish farmers in the 25 to 40 age bracket with 11 respondents or 45.8% followed by those in the 40 to 60 age bracket with 10 quotes or 41.6% are more than those in other age brackets; young people are poorly represented with 3 respondents or 12.5%. The findings from this study run counter to the observations made by Nji and Daouda [20] and Hirigoyen *et al.* [21]. In their study of the western region of Cameroon, Nji and Daouda [20] noted a slight increase in the age range of fish farm managers between 50 and 70, and the non-existence of the under-30 age group. On the other hand, Hirigoyen *et al.* [21] carried out a study in central Cameroon, showing that the over-50 age group accounted for 43.2% of all fish farm management. According to Lokinda *et al.* [18], the ageing of fish farm managers in some regions is probably due to the lack of interest shown by young people, who are more interested in immediate-income activities such as fishing, petty trading and small trades in the town center. Concerning marital status, most of the respondents are those with parental responsibilities; married people represent 58.3% of fish farmers, followed by single people with 10 respondents or 46.1%. The high proportion of married people is linked to their responsibility as head of household to create a business that generates the financial means to cover family expenses. According to Kifufu [19], in rural Congo, the majority of children have a secondary education. The majority of fish farmers are those with secondary education (18 respondents or 75.1%), followed by those with university education (3 respondents or 12.5%) and fish farmers with no education (2 respondents or 8.3%). Lokinda *et al.* [18] justify the dominance of fish farmers with a secondary level of education by pointing to the reconversion of former career civil servants to fish farming, and the quest of civil servants and others for additional salary or income, through the development of agriculture as a secondary activity, as factors that would explain the high level of schooling observed among farm managers.

3.2 Fish farming methods

3.2.1 Years of experience in fish farming

The duration of the existence of the fish farming facilities operated in the Funa valley in the commune of Mont-Ngafula in the city of Kinshasa is shown in Table 2.

Table 2. Years of experience fish farming facilities in the Funa valley

Duration (year)	Number	Percentage (%)
0-5	5	20.8
6-10	10	41.6
11-15	9	37.5
16-20	0	0
21-26	0	0
26 and more	0	0
Total	24	99.9

In light of the results shown in the table above, the majority of the fish farming infrastructures in the Funa valley have a duration of between 6 and 10 years with 10 quotations, i.e. 41.6%, followed by fish farming structures set up between 11 and 15 years with 9 quotations, i.e. 37.5%, and the minority of infrastructures have a totalled duration of between 0 and 5 years with 5 quotations, i.e. 20.8%.

3.2.2 Objectives of fish farms

The fish farms installed in the Funa valley in the commune of Mont-Ngafula in Kinshasa have three social objectives: family self-consumption, production and sale of market fish and fry (Fig. 2). Of the three objectives for setting up fish farms, family self-consumption with 14 respondents (58.3%) was the main reason, followed by the production and sale of market fish with 6 respondents (25%) and the production and sale of fingerlings with 4 quotations (16.7%). Most of those working in this sub-sector consider fish farming to be a secondary or leisure activity as supplementary income, family consumption extra activities [22]. For some fish farmers, the fish produced when the pond is emptied are not sold but distributed to family and friends [10]. An exception is made for a small number of people who try to enter this sector to generate income during each fish production [22]. In this study, it was shown that family self-consumption, the production and sale of market fish and fry are the reasons for setting up ponds in the study area. Of the three reasons given, family self-consumption (58.3%) was the main reason, followed by the production and sale of market fish

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(25%). These results corroborate those reported by Kabre [23]; FAO [24]; Micha [25]. The latter report that subsistence fish farming is the most common form of farming in D.R Congo by the majority of Congolese.

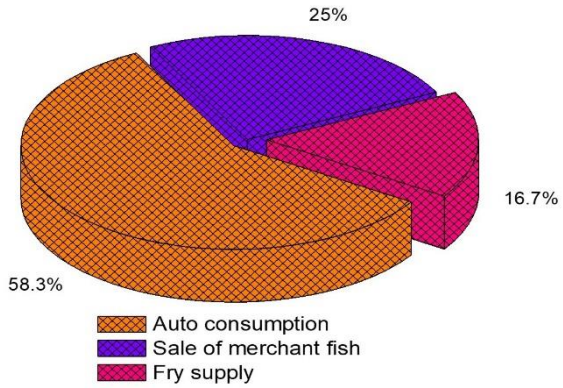

Figure 2. Objectives of farms in the Funa valley at Mont-Ngafula

3.2.3 Types of fish farming infrastructure in place

The different types of infrastructure used for fish production by fish farmers in the Funa valley in the commune of Mont-Ngafula in Kinshasa are shown in Table 3.

Table 3. Types of fish farming infrastructure installed in the Funa valley

Types of infrastructure	Number	Percentage (%)
Naturel pond	7	29.1
Artificiel pond	17	70.8
Total	24	99.9

The results in Table 3 above indicate that two types of fish farming infrastructure, namely natural and artificial ponds, are used by fish farmers in the Funa valley in the commune of Mont-Ngafula. Of the two types of structures, artificial ponds, with 17 respondents (70.8%), are used more often than natural ponds, with 7 respondents (29.1%). These results corroborate those obtained by FAO [24]; Lokinda *et al.* [18]; Kifufu [19]. According to FAO [24], most fish farmers raise fish in small water reservoirs or in hand-dug fishponds. Kifufu [19] notes that digging a pond is done by hand using shovels, spades and hoes after clearing swampy land or land close to a watercourse; this was au si observed in the present study. However, Lusasi *et al.* [22] raise an exception in the provinces of Kinshasa and South Kivu, where semi-intensive fish farming is practiced in shallow ponds, above-ground tanks and floating cages, particularly in Lake Kivu. This confirms the artisanal nature of fish farming in many parts of the D.R Congo.

3.2.4 Fish farming techniques

The different fish farming techniques used by fish farmers in the Funa valley in the commune of Mont-Ngafula are shown in Table 4 below.

Table 4. Fish farming techniques developed in the Funa valley in Mont-Ngafula

Farming system	Number	Percentage (%)
Monoculture	18	75
Multi-crop	6	25
Total	24	100

Fish farmers in the Funa valley practise two fish farming techniques, namely monoculture and polyculture. Of these two fish farming techniques, monoculture, with 18 respondents (75%), is more widely practised than polyculture, with 6 respondents (25%). Natural feed is made available by primary production in the pond through fertilization, in particular: biological fertilization (using plant and animal matter, notably dead leaves, chicken and duck droppings, pig droppings, various biodegradable organic wastes, etc.) as well as chemical fertilization (based on fertilizers, notably NPK). In the case of fish farming in Kinshasa, given that the target selling price of fish is too high [5], it is not possible to make a profit by adopting a fish farming method based on supplying compound feed to imported fish, given the excessively high cost of this form of feed [10]. Fish farming with fertilizer inputs is therefore the preferred method in this context. This method involves depositing livestock droppings and manure in the pond water to increase the quantity of nutrients such as nitrogen and phosphorus, and thus increase the phytoplankton that serve as food for the fish.

3.2.5 Types of fish farming used

All the fish farmers in the Funa valley, i.e. 100%, practise subsistence fish farming. Semi-intensive and intensive fish farming are not practised in the study area (Fig. 3). The research findings of Kifufu [19] show that all fish farmers in his study area have adopted the extensive village farming system. Furthermore, the extensive production of a single species (including mixed farming of tilapia and catfish) integrated with agriculture does not even allow the production of 1 tonne per hectare to be achieved.

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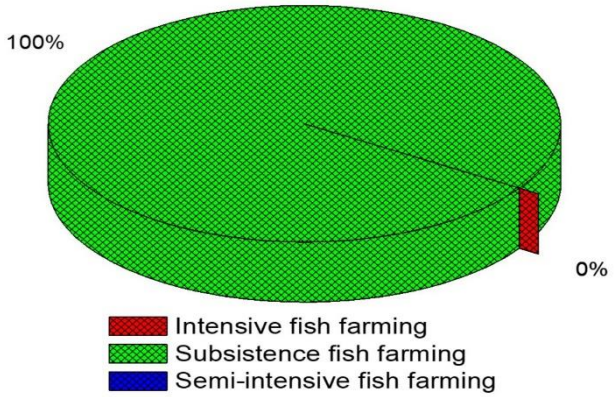

Figure 3. Different types of fish farming developed in the Funa valley at Mont-Ngafula

3.2.6 Types of feed given to fish

The results in Fig. 4 show that the majority of fish farmers use natural feed (79.1%) and supplementary feed (33.3%) to raise fish in the Funa valley at Mont-Ngafula. Artificial feed (manufactured by the fish farmers themselves) is used by a few fish farmers representing 14.8% of respondents (Fig. 4). Under these conditions, fish feed on plankton and other micro-organisms derived from natural fertilization [26]. Household waste and agricultural by-products that can be used in fish farming are used to feed other domestic species, given the distances separating villages from fish farming sites, which can reach over 1.000 m [19]. In the present study, it was found that cassava leaves and the leaves of certain plant species were fed to fish in small quantities.

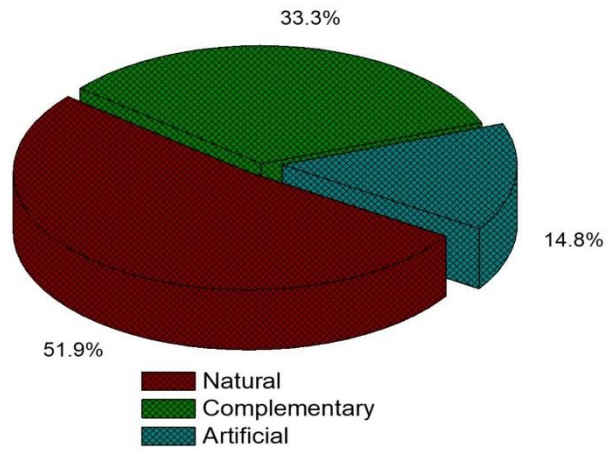

Figure 4. Different types of fish farming developed in the Funa valley at Mont-Ngafula

3.2.7 Places where fish feed is obtained

The places where the various ingredients and feeds used in the feeding of farmed fish in the Funa valley in the commune of Mont-Ngafula are obtained are shown in Table 5.

Table 5. Sources of feed for farmed fish in the Funa valley in Mont-Ngafula

Lieux d'obtention	Number	Percentage (%)
Local market	14	51.85
In the wild	9	33.33
Prepare it yourself	4	14.81
Total	27	99.99

The results shown in Table 5 exbhited that most of the feed used by fish farmers in the Funa valley is bought on the local market (51.85%), other fish farmers obtain their feed from the wild (33.33%), while some fish farmers prepare their own feed (14.81%).

3.2.8 Fertilisation elements

To increase primary production in the pond and make natural food available for farmed fish, fish farmers use two types of fertilisation in particular: biological fertilisation using plant and animal matter and chemical fertilisation based on chemical products (Fig. 5). Most fish farmers (60.6%) use plant matter (dead leaves, various biodegradable organic wastes, etc.), followed by animal waste (27.3%) and chemical fertiliser (12.1%).

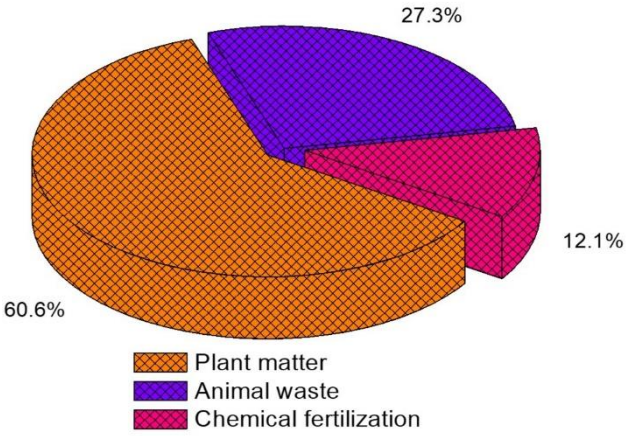

Figure 5. Elements of pond fertilization in the Funa valley at Mont-Ngafula

3.2.9 Fish sales chain

Table 6 shows the results obtained by fish farmers in the Funa valley in the commune of Mont-Ngafula, Kinshasa, on the fish sales chain.

The contribution of fish farming to farm income in the Democratic Republic of Congo is still marginal and almost non-existent due to the small quantities of fish harvested [18, 22]. The information in Table 6 below

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Table 6. Sales chain for fish produced by fish farmers in the Funa valley

Sales chain	Number	Percentage (%)
Wholesale to private companies	1	3.57
Retail to consumers	23	82.14
Local market	4	14.28
Total	28	99,99

expressed that the majority of fish farmers in the Funa valley (82.1%) retail their fish products to consumers, while others (14.2%) sell their products at the local market and a minority (3.57%) sell fish wholesale to private companies in certain restos, supermarkets and fresh food outlets. These results are in line with observations made by Lusasi *et al.* [5, 22]; Masua *et al.* [7]. According to the latter, households as well as restaurant owners are potential consumers of fresh fish sold in Kinshasa markets. Lusasi *et al.* [22] report that in Kinshasa, some fish farmers sell their products in the capital's markets after emptying their ponds, while others supply some of the city's restaurants and supermarkets.

3.2.10 Assistance and technical support for fish farmers

The results of the field surveys revealed that all the fish farmers interviewed in the Funa valley received no financial or technical assistance from the Congolese state, private partners or non-governmental organizations (Fig. 6). The observation made in the present study was also noted by Kifufu [19] where 97.1% of fish farming practitioners claim not to have benefited from technical training. The national aquaculture service of the Ministry of Fisheries and Livestock, which is responsible for providing technical support to fish farmers in the field, is experiencing technical and financial difficulties for several reasons: (1) lack of qualified staff and financial resources, (2) inadequate infrastructure and computer equipment, and (3) difficult access to the Internet and credit [22]. The lack of fish farming instructors, extension services for new fish farming techniques and support organizations throughout the country is partly to blame for the poor performance of fish farming in D.R. Congo. In addition to difficulties in the actual operation of ponds, this lack of technical support structures is also seen in the choice of location as well as pond construction [19].

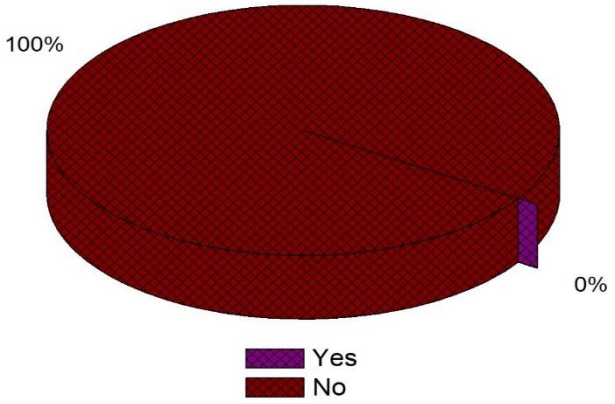

Figure 6. Assistance and technical support for fish farmers

3.2.11 Species of fish raised in the ponds

The list of fish species raised in the fish ponds operated in the Funa valley in the commune of Mont is given in Table 7.

The results shown in Table 7 above reveal eight (8) fish species grouped into four (4) orders (*Cichliformes*, *Anabantiformes*, *Osteoglossiformes* and *Siluriformes*), six (6) families (*Cichlidae*, *Channidae*, *Arapaimidae*, *Clariidae*, *Claroteidae* and *Schilbeidae*) and seven (7) genera (*Oreochromis*, *Tilapia*, *Parachanna*, *Heterotis*, *Clarias*, *Ochenoglanis* and *Schilbe*) are exploited by fish farmers based in the Funa valley at Mont-Ngafula. These results are close to the observations raised by Lusasi *et al.* [22]; FAO [24]; Micha [25] who note the rearing of fish from the *Cichlidae* families (*Tilapia rendalli*, *Oreochromis macrochir* and *O. andersonii* in small reservoirs and ponds; *O. niloticus* in ponds and above-ground tanks), *Clariidae* (*Clarias gariepinus* in ponds and above-ground tanks and *Clarias angolensis* in ponds), *Channidae* (*Parachanna obscura* and *P. insignis* in ponds or large water impoundments) and *Oesteoglossidae* (*Heterotis niloticus* in ponds or large water impoundments).

3.2.11.1 Relative abundance of farmed fish orders

The results visualized in Fig. 7 below show that fish belonging to the *Siluriformes* orders, with three (3) families (50%), are more heavily farmed by fish farmers in the Funa valley at Mont-Ngafula than fish belonging to the *Cichliformes*, *Anabantiformes* and *Osteoglossiformes* orders, with one family (16.7%).

3.2.11.2 Relative abundance of farmed fish families

Of the six (6) families of fish farmed in the Funa valley at Mont-Ngafula, fish belonging to the *Cichlidae* family, with two genera or 28.6%, are farmed by fish

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Table 7. Species of fish farmed in the Funa valley ponds in Mont-Ngafula

Order	Families	Genera	Species	Common names (lingala)
Cichliformes	Cichlidae	Oreochromis	*O. niloticus*	Libundu
		Tilapia	*T. sp*	
Anabantiformes	Channidae	Parachanna	*P. obscura*	Mungusu
Osteoglossiformes	Arapaimidae	Heterotis	*H. niloticus*	Congo ya sika
Siluriformes	Clariidae	Clarias	*C. gariepinus*	Ngolo
			C. spp	Mpiki
	Claroteidae	Ochenoglanis	*O. occidentalis*	Mpoka
	Schilbeidae	Schilbe	*S. grenfelli*	Lilangwa
4	6	7	8	

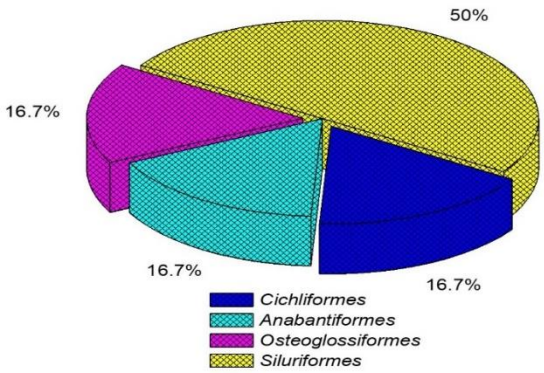

Figure 7. Relative abundance (%) of fish orders reared in surveyed ponds

farmers more than fish from the *Channidae*, *Arapaimidae*, *Clariidae*, *Claroteidae* and *Schilbeidae* families, each with one genus or 14.3% (Fig. 8).

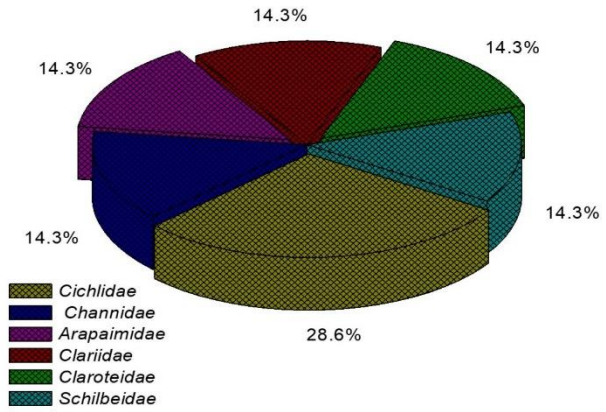

Figure 8. Relative abundance (%) of fish families reared in surveyed ponds

3.2.11.3 Relative abundance of farmed fish genera

The results indicated in Fig. 9 below show that fish of the *Clarias* genus, with two species (25%), are the most widely farmed by fish farmers in the Funa valley at Mont-Ngafula, while fish of the *Oreochromis*, *Tilapia*, *Parachanna*, *Heterotis*, *Ochenoglanis* and *Schilbe* genera, with one species (12.5%), are farmed to a lesser extent by fish farmers (Fig. 9).

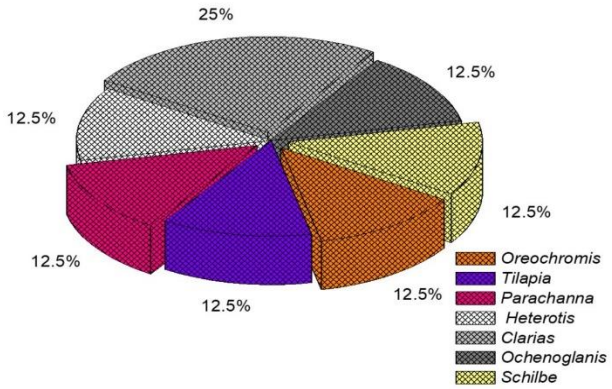

Figure 9. Relative abundance (%) of fish genera reared in surveyed ponds

3.2.11.4 Relative frequency of fish species surveyed

Of the eight (8) fish species farmed in the Funa valley in the Mont-Ngafula commune, *Oreochromis niloticus* with 46 citations or 19%, *Clarias gariepinus* with 42 citations or 17.35%, *Tilapia spp* with 37 citations or 15.28%, *Clarias spp* with 34 citations or 14, 04% and *Parachanna obscura* with 31 quotes or 12.8% are the species most exploited by fish farmers, compared with *Ochenoglanis occidentalis* with 21 quotes or 8.67%, *Heterotis niloticus* with 19 quotes or 7.85% and Schilbe grenfelli with 12 quotes or 4.95% (Fig. 10). Micha [25] notes that *Tilapia* species are the most widely farmed family fish species in tropical Africa. Lokinda *et al.* [18] note that *Tilapia* is the main fish farmed in the Mai Ndombe province in D.R Congo. The predominance of *Tilapia* and *Clarias* fish in Kinshasa is due to the mastery of fish farming by the Congolese population. Lazard [27] reports that African producers have mastered the art of breeding *Oreochromis niloticus*.

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Table 8. Origin of fish fry farmed in the Funa valley ponds in Mont-Ngafula

Fish species	Sources of supply			
	Congo River	Other rivers	Owen production	Other fish farmers
Oreochromis niloticus	0	0	14	32
Clarias gariepinus	9	3	8	20
Tilapia spp	11	9	7	10
Clarias spp	16	7	3	8
Parachanna obscura	13	10	2	6
Ochenoglanis occidentalis	21	0	0	0
Heterotis niloticus	19	0	0	0
Schilbe grenfelli	9	3	0	0
Total	98	32	34	76
Percentage (%)	40.83	13.33	14.16	31.66

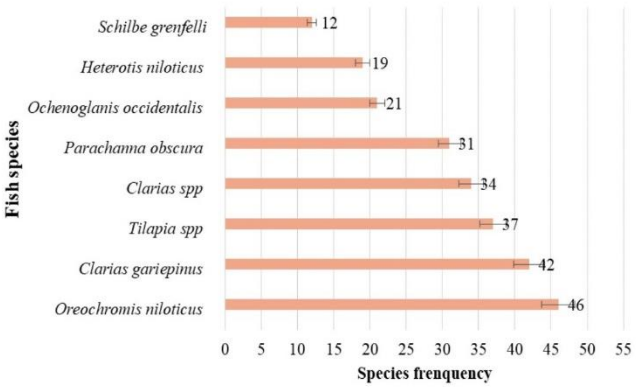

Figure 10. Numerical frequency of fish species reared in surveyed ponds

3.2.12 *Source of farmed fish fry*

The results on the sources of fry of the various fish species farmed in the ponds installed in the Funa valley in the commune of Mont-Ngafula are shown in Table 8.

The fish fry raised in the Funa valley in the Mont-Ngafula commune comes from four different sources. Of all these supply points, fishermen working in the various fishing sites of the Congo River (Malebo Pool) with 98 quotations or 40.83%, followed by supplies from other fish farmers with 76 quotations or 31.66%, supply fish farmers with fry more often than fish caught in other rivers (13.33%) and the own production of certain fish farmers (14.16%). According to Lusasi *et al.* [22], in a bid to diversify Congolese fish farming and thus offer consumers a varied range of good-quality fish in sufficient quantity, some fish farmers are increasingly breeding uncultivated wild species; this justifies the presence of the species *Protopterus doloi* in the fish ponds surveyed in the commune of Mont-Ngafula. Bondombe [28] reports that several attempts to farm wild fish are now being raised artisanally in the city of Kisangani (DR Congo). *Schilbe grenfelli* has also been reported among the fish farmed in the Kisangani region [28]. The presence of wild fish species in the ponds confirms the observations noted on the origin of fish fry collected from the Congo River as well as certain watercourses in the city of Kinshasa.

4. Conclusions

The study revealed that men are more active than women in fish farming. Artificial and natural hand-dug ponds are the rearing systems used in the study area, where monoculture was the more common rearing system than polyculture The fish fauna exploited in the study area is rich and diverse. The wild fish fry raised are taken from the Congo River and some of Kinshasa's rivers. The absence of fish farming instructors, an extension service for new fish farming techniques and support organizations in the study area is partly to blame for the lack of performance in fish farming production in the Funa valley at Mont-Ngafula.

Authors' contributions

Conception, original idea, data collection, writing, analysis and statistical processing of data, W.L.S.; Data collection, data analysis in the laboratory and drafting of the manuscript, B.K.M.; Drafting, correction and revision of the manuscript, C.M.K.; Research orientations and manuscript revision, S.K.M.; Data collection and manuscript revision,

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Availability of data and materials

All data will be made available on request according to the journal policy

Conflicts of interest

The authors declare that they have no conflict of interest in this article. The research was carried out on the researchers' own funds, without any assistance from a third party, whether physical or moral, and the data published are original results of fieldwork.

References

1. Mikobi, M.C., Kusonika, N.A., Tangou, T.T., Mutambwe, S., Mulaji, K.C., Lusasi, S.W., Pwema K.V. Mise au point et évaluation d'un système aquaponique domestique dans la ville province de Kinshasa (République Démocratique Du Congo). Eur. Sci. J., 2020 16(24) : 70 – 87. http://dx.doi.org/10.19044/esj.2020.v16n24p70.
2. Karg, S. Historique de la pisciculture. 2013, 16p.
3. Jassen, J. Search for introduced species fact sheet-Dem. Rep. Of the Congo. Rome: FAO, 1990.
4. FAO. La situation mondiale des pêches et de l'aquaculture: Contribuer à la sécurité alimentaire et à la nutrition de tous. Rome, 2016, 224 p. Disponible sur www.fao.org/publications.
5. Lusasi, S.W., Makiese, M.P., Kununga, N.L., Munganga, K.M., Kavumbu, M.S., Pwema K.V. Proportion de vente des poissons frais locaux et importé dans les marchés de Kinshasa en République Démocratique du Congo (cas des marchés de la liberté de Masina et central de Kinshasa). J. Appl Biosci. 2019a, 141, 1435314363. https: dx.doi.org/10.4314/jab.v14lil.2.
6. Lusasi, S.W., Manza, K.R., Bipendu, M.N., Munganga, K.M., Kavumbu, M.S., Gafuene N.G., Pwema K.V. Analysis of the ichtyological composition of smoked fish sold in the Liberté and Gambela markets in Kinshasa, Democratic Republic of Congo. Agric. Sci. 2020, 2(2), 69-79. https://doi.org/10.30560/as.v2n2p69.
7. Masua, T.B., Lusasi, S.W., Munganga, K.C., Wumba, M.P., Kavumbu, M.S., Pwema K.V. Inventory of fresh fish marketed in the markets of Kinshasa in the Democratic Republic of Congo (case of the Gambela and Matete markets). Int. J. Appl. Res. 2020, 6(4), 102-108.
8. Adouvi, E.C. Effets de la substitution de la farine de poisson par la farine des graines de Néré (Parkia biglobosa) et de la farine du tourteau de soja (*Glycine maxima*) sur la croissance et la survie des juvéniles de *Clarias gariepinus* (Burchell, 1822). Universite d'Abomey Calavi, Benin, 2013, 43p.
9. Pwema, K.V., Mbaki, L.J., Kazaba, K.B., Mayoni, M.A., Yaga, N.C., Lusasi, S.W. Grow-out of *Oreochromis niloticus* (Linnaeus, 1758) fish (*Perciformes*, *Cichlidae*) on local feed in an above-ground tank culture system in Kinshasa, Democratic Republic of Congo. Indonesian J. Agric. Res. 2023, 6(1), 23 – 42. https://doi.org/10.32734/injar.v6i2.9495.
10. Lusasi, S.W., Pwema, K.V., Munganga, K.C., Kavumbu, M.S., Mutambwe, S. Mise au point d'un aliment pour *Distichodus maculatus* Boulenger, 1898 à base des sous-produits agricole disponibles localement. Afr. Sci. 2019b, 15(2), 238-248.
11. Mbele, M.G. Pré grossissement des alevins de poissons *Clarias gariepinus* (Burchell, 1822) (*Siluriformes*, *Clariidae*) dans un système d'élevage hors sol à Kinshasa, R.D Congo. Mémoire de Fin d'Etudes en Sciences Biologiques, Université de Kinshasa, R.D Congo, 2021, 62p.
12. Micha, J.C. Etudes nationales pour le développement de l'aquaculture e Afrique. Rome: FAO. 2005.
13. Mbola, M.D., Ntambwe, M.A. Pauvreté en milieu urbano-rural et conservation environnementale: Paradoxes des dirigeants et des diriges: étude critique sur la production de charbon de bois dans la ville de Kikwit et environs. Int. J.Soc.Dyn. 2021, 118, 42-49.
14. Mayer A. Impact et importance de la pisciculture. Disponible sur http://www.fao.org, 2010.
15. Lévêque, C., Paugy, D., Teugels G.G., Faune des poissons d'eaux douce et saumâtres de l'Afrique de l'Ouest. Edition ORSTM, Tome. 1, 1990, 384p.
16. Lévêque, C., Paugy, D., Teugels, G.G. Faune des poissons d'eaux douce et saumâtres de l'Afrique de l'Ouest. Edition ORSTM, Tome 2, 1992, 518p.

17. Mbega, J.D., Teugels, G.G. Guide de détermination des poissons du bassin inférieur de l'Ogooué. Musée Royal de l'Afrique Centrale (MRAC), Belgique, 2003, 165 p.
18. Lokinda, F., Litemandia, N., Wawana, A., Mbeli, J., Motondo, A., Alongo, S. Caractéristiques de la pisciculture rurale en étang dans la réserve de biosphère de Yangambi en R.D Congo. Rev. Mar. Sci. Argron. Vét., 2018, 6(3), 402-408.
19. Kifufu, G.J. Caractérisation socio-économique et techniques de la pisciculture continentale dans le territoire de Bagata en R.D Congo. Rev. Mar. Sci. Argon. Vét., 2019, 7(4), 557-562.
20. Nji, A., Daouda. Facteurs techniques liés à l'abandon de la pisciculture dans les provinces de l'Ouest et du Nord-ouest Cameroun. Tropicultura. 1990, 8, 189-192.
21. Hirigoyen, J., Manjeli, Y., Mouncharou, G.C. Caractéristique de la pisciculture dans zone forestière du Centre Cameroun. Tropicultura. 1997, 15. 180-185.
22. Lusasi, S.W, Mayoni, M.A., Munganga, K.C., Lundika, N.T., Mogbaka, B.Y., Manikisa, I., Kavumbu, S.M., Pwema, K.V. Synthèse sur l'état de lieu de la pisciculture en République Démocratique du Congo: Enjeux et perspectives. Int. J. Prog. Sci. Technol. 2022, 32(1), 73-91.
23. Kabré, A. Etude de cas d'intégration irrigation et aquaculture (IIA) à la vallée du Kou et au périmètre irrigué de Bagre, Burkina Faso. Land and Water Development Division, FAO, 2000, 50p.
24. FAO. Vue générale du secteur aquacole en République Démocratique du Congo. Département des pêches et de l'aquaculture ? Rome, 2017,10p. http://www.fao.org/fishery/countrysector/naso_congo/fr.
25. Micha, J.C. La pisciculture de la République démocratique du Congo. Unité de Recherche en Biologie Evolutive et Environnementale, Département de Biologie, Faculté de Sciences, Université de Namur, 2013, 43p.
26. Lacroix, E. Pisciculture en zone tropicale. GFA Terra System Eulenkrugstrabe, Hamburg, 2004, 331p.
27. Lazard, J. La pisciculture des Tilapia. Cahiers agricultures, 18, 174-182.
28. Bondombe W.Y.M.G., 2015. Etudes écologiques et biologique de *Schilbe intermedius* Rüppell 1832 (*Schilbeidae*, *Siluriformes*) et tentative de son introduction en pisciculture d'étangs. Thèse en Sciences Biologiques, FGRNR, Université de Kisangani, R.D Congo, 2009, 336 p.

https://doi.org/10.58985/jafsb.2024.v02i02.45