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Evaluation of the economic performance of freshwater fish farming in the wouri division, littoral region of Cameroon

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Abstract
This study on the evaluation of the economic performance of freshwater fish farming in the Wouri division, of the Littoral region, Cameroon has as main objective to evaluate the economic performance of freshwater fish farming. Specifically, to describe the socio-economic characteristics of the fresh water fish farmers; to identify the species of freshwater fishes produced and predominant fish farming practices; to determine the gross margin, net farm income and net return on investment of fish farming and to identify the constraints that affect the fish farming sector in the study area. To achieve these objectives data were collected from 30 freshwater fish farmers and analysed using descriptive statistics and economic analysis tools. The findings revealed that respondents are mostly educated married trained young men with an average family size of five persons. Monoculture of African catfish in concrete ponds is practiced by all the respondents. Calculations of the costs and returns on investment show that this farming practice is highly profitable in the study area with a gross margin of 36,110,163.72 FCFA; a net farm income of 33,979,832.14 FCFA and a net return on investment of 1.68. Constraints faced by these fish farmers include the high cost of feed and fingerlings, lack of adequate funds, and land acquisition. It is therefore recommended that, fish farmers form cooperatives with the assistance of governmental organisations and other organized private sector institutions to establish fish feed mill for quality feeds at affordable price.

Keywords: total revenue, gross margin, net return on investment, fish farming, wouri division

1. Introduction
The increase in human population and reports of large numbers of undernourished or starving people, especially in the developing countries have made the need for food production a major worldwide issue of concern, thus making crop and animal production two major activities for the survival of mankind (FAO) [1]. However, the world's natural stocks of fish and shellfish, though renewable, have finite production limits that cannot be exceeded even under the best management regimes. Moreover, for most lakes, rivers and oceans, the maximum sustainable fishing limit has been exceeded. Therefore, food production depends on fish farming to bridge the gap of food supply (Tacon) [2].

The role of fish farming in food production, economic development and food security is therefore becoming increasingly important in the country and the whole world. Fish farming has primarily been a developing world activity, especially in the Asian countries. Asia accounts for 87% of global aquaculture production by weight, while China alone is responsible for about 68% of the global production. India and Southeast Asia contributed about 15% of production in 1997 (Delgado) [3]. Compared to other continents, this activity in Africa is still insignificant and accounted just for 0.9% (404,571t) of the total global fish production in 2000 (FAO) [4]. Shortcomings of fish farming on the African continent can also be observed at national levels. This study looks at the case of Cameroon, located in West Africa. Although the activity started in Cameroon as far back as the late 1940s, the country currently meets only half of the domestic demand for fish (Kouam *et al.*) [5]. The inability of the country to meet local demand for fish continues to grow each year in spite of the increasing awareness of the role this activity can play on import substitution and the country's balance of trade as well as employment and poverty reduction (Kouam *et al*.) [5].

Since the introduction of aquaculture in Cameroon in 1948, the country has been part of several bilateral projects and a variety of different programs in this sector to encourage the adoption of this new form of fish farming (Kouam *et al*.) [5]. This adoption has been done somewhat timidly and the output has been modest. At the introduction of fish farming, only the farmers were interested but over time, all the social strata considered it as an important nutritional and financial activity (FAO) [4].

The government has gradually set up 22 nurseries, which are extension structures. In the 2003 crop year, there were about 15,000 ponds producing 330 tons worth 748,440,000 franc CFA (MINEPIA) [6]. However, aquaculture in Cameroon is underdeveloped compared to other farming activities and despite a number of aquaculture development projects over 30 years, there were no significant differences in household economics and farming systems between fish farming and non-fish farming families. In rural areas, aquaculture is normally viewed as a secondary activity after staple crop production (plantains, maize, cassava and vegetable production) (Harrison *et.al*.) [7].

Aquaculture in Cameroon is primarily practiced in freshwater ponds. Most of these ponds are located in rural areas. However, aquaculture has developed considerably in terms of production techniques and the species cultivated both in diversion ponds and dammed ponds (FAO) [8]. It is mostly carried out in small ponds with an average size of 350 m^2. The feeding is indirect through compost cribs loaded with organic material (mainly grass and weeds) and kitchen waste. This is the common practice for most small-scale rural fish farmers without supplementary feeding. These cribs occupy an average of 10% of the pond water surface. The emerging commercial fish farmers feed their fish with supplementary feeds (single feed ingredients such as wheat bran and cotton seed oilcake) in fertilized ponds. These ponds are fertilized using organic fertilizer such as chicken manure. Extensive and semi-intensive earthen pond fish farming are the two most common aquaculture systems in Cameroon (Pouomogne) [9].

In many cases and despite years of development, fish farming remains at a subsistence level of production, characterized by low yields. Farmers are poor and their purchasing power is too low to carry out efficient commercial fish farming. Nile tilapia *(Oreochromis niloticus)* is the most commonly farmed species, followed by the African catfish *(Clarias gariepinus).* The most common practice is polyculture of Nile tilapia, either with African catfish where possible, or with other locally available species such as the African bony tongue *(Heterotis niloticus)*, snakehead *(Parachanna obscura)*, banded jewelfish *(Hemichromis fasciatus)*, common carp *(Cyprinus carpio)* or gougeon *(Barbus spp.)* (Pouomogne and Pemsl) [10].

In 2006, 4,200 active fish farmers with 7,500 ponds (average size of 350 m^2) were recorded during a field study of the aquaculture sector. The annual production was estimated at 870 tons divided as follows: 450 tons of tilapia, 350 tons of catfish and 90 tons of other species (Pouomogne and Pemsl) [10]. This production is too low to meet the demand for fish, which is anticipated to increase with the growth of the population. To meet demand, Cameroon has imported more than 100,000 tons/year of frozen fish for the past decade (Pouomogne and Pemsl) [10]; and spends close to 100 billion FCFA each year in imports to address the production deficit, which is estimated to be 230,000 tons (Business in Cameroon) [11]. To reduce this deficiency, in 2014 the government of Cameroon under the Ministry of Fisheries inaugurated an intensive production centre in Meyomessala in the South, with a production capacity of 17 tons of fish (Business in Cameroon) [11].

Fish species that contribute largely to domestic production in Cameroon include tilapia, North African catfish and common carp, (FAO) [4]. Out of 176, 000 tons of fish produced in Cameroon annually, only 1,000 originate from aquaculture (0.1%), which could be attributed to the problems facing fish farming in the African continent (Molua and Oben)[12]. Fishery farms in Cameroon are not only faced with the need to optimize their performance but also to satisfy populations with sufficient and good quality food. This is particularly important as consumption of fish offers unique nutritional and health benefits. Increased attention should be given to fish as a source of essential nutrients in diets, with not only high value proteins, but more importantly as a unique source of micronutrients and long chain omega-3 fatty acids (FAO) [8].

Fish farming is believed to be the way of bridging the gap in the short fall between total domestic fish production and the total domestic demand. Despite this perceived role, there is a low level of fish production, which is due to resource use constraints such as feed supply and low managerial expertise. In addition, low capital has retarded the pace of development in the fish farming subsector. A great deal of opportunity still abounds in small-scale fish farming business (Aregbor) [13]. Taking this situation of low production level into consideration, Cameroon needs to rise beyond the level of subsistence to higher level of profitability through more efficient use of their production resources. Pouomogne *et al.* [14] hold that the fish farming sector is highly productive and commercially profitable at large scale and that freshwater fish demand is rising. Based on this claim, the study questions the performance of freshwater fish farming in the Wouri division of the Littoral region of Cameroon.

2. Methodology

2.1 Presentation of study area

The Littoral region is one of the 10 regions of Cameroon with the highest population density. Wouri is one of the four divisions of the Littoral region with Douala being its capital. The different divisions of the Littoral region include Moungo, Nkam, Sanaga-Maritime and Wouri division. The Wouri division forms the area around the town of Douala, and is named after the Wouri River. This division covers an area of 923 km^2 and as of 2007, its population was estimated at 1, 798, 737 inhabitants with a population density of 157 inabitants per Km^2. The Wouri division usually assimilated to the town of Douala, has seven Sub-divisions namely Douala 1, Douala 2, Douala 3, Douala 4, Douala 5, Douala 6 and Manoka (Essaga) [15]. Wouri is located at latitude 4º05'00'' North, 9º42'00'' East, 4º34'11'' North, 10º09'49"West and 13 meters elevation above the sea level.

The Wouri division due to its river is an ideal place for the development of the fish farming sector. The Wouri (also Vuri or Vouri) is a river in Cameroon which is formed at the confluence of the rivers Nkam and Makombe, 32 kilometres northeast of the town of Yabassi. The Wouri then flows about 160km southeast of the Wouri estuary, the chief port and industrial town in the southwestern part of Cameroon on the Gulf of Guinea.

Douala is the commercial capital of Cameroon and it hosts the international airport and the largest seaport of the country. In

addition to this, Douala is the economic capital of Littoral region of Cameroon and the entire CEMAC region comprising Gabon, Congo, Chad, Equatorial Guinea, Central Africa Republic and Cameroon. The town serves as a gateway to some of the country major exports like coffee, oil, cocoa and fruits. The Douala city is also an important trading centre of Cameroon. Situated on the riverbanks of Wouri, the two ends of the city are connected through Bonaberi bridge. The town of Douala is gradually becoming an important tourist destination. Douala offers a wide variety of accommodation facilities to the visitors due to the location of numerous hotels, restaurants and coffee shops. This town of Cameroon welcomes major attractions in the country (Njoh and Ambe) [16].

Douala is the first city in tropical Africa to have a piped natural gas supply (presently serving only industrial customers). It was ranked in 2015 as the most expensive city in Africa. It has had the highest standard of living among all African cities for the majority of the last 40 years. A very high number of European and American expatriates live in the city due to its highly developed infrastructure and peaceful environment for successful business and goodlife. (Njoh and Ambe) [16]. Some of the export partners of the town of Douala are Spain, Italy, France, South, Korea, UK, Netherlands, Belgium, and United State. (Elate and Som) [17].

Breeding and fishing activities are prosperous and allow thousands of inhabitants to live on it decently as the Wouri division (and specifically the town of Douala) is very rich in fisheries resources. The wouri coast is famous for its concentration of fishes, facilitating the fishing industry as well as the local one. This could explain why foreign fishermen sour regularly the Wouri estuary (Mbog) [18].

Fig 1: Map of Cameroon showing the Littoral region

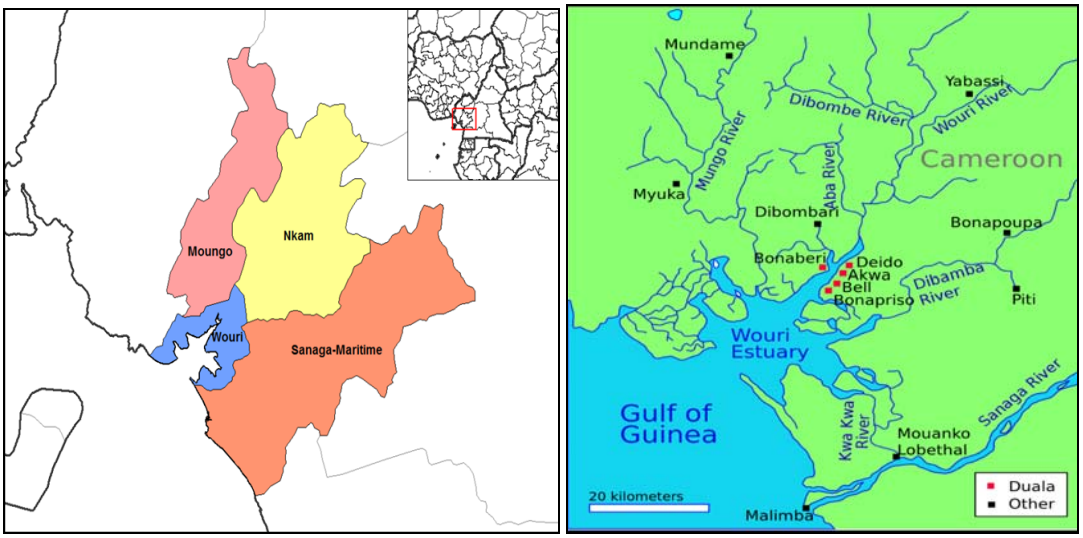

Fig 2: Map of Littoral showing the Wouri division Source: Essaga[15]

2.2 Sampling technique and sample size

This study used the snowball sampling technique. This technique was used to select key informants (resource persons) as well as respondents. This is because the study laid emphasis on the quality of information obtained. Snowball sampling is a special non probability method for getting a research sample where existing study subjects recruit future subjects from among their acquaintances. This sampling technique is often used in hidden populations which are difficult for researchers to access or in case where a sampling frame is hard to establish and it is assumed that cases are affiliated through links that can be exploited to locate other respondents based on existing ones.

On the basis of interviews with resource persons (MINEPIA, Littoral regional delegation), 10 fish farms operating in the study zone were identified and visited. Based on the information given by the owner of these fish farms, 20 other fish farms were identified and visited. Data was therefore collected from 30 freshwater fish farmers in the study area. In the case of this study, due to the small number of freshwater fish farmers identified in the study area, the sample population was equal to the estimated total population of freshwater fish producers of 30 as shown in table 1.

Table 1: Geographical distribution of the respondents

Subdivisions	Frequency	Percentage
Douala 1	3	10.00
Douala 2	4	13.30
Douala 3	3	10.00
Douala 4	8	26.70
Douala 5	6	20.00
Douala 6	2	6.70
Manoka	4	13.30
Total	30	100.00

2.3 Data analysis

Data from the study were analysed with the use of descriptive statistics and economic analysis tools.

2.4 Model specification

Gross margin is the difference between the total revenue and the total variable cost (Olukosi and Erhabor) [19].

Therefore;

GM = TR-TVC---------- (1)

Where GM = Gross margin

TR = Total revenue

TVC = Total variable cost

The net farm income gives an overall level of profitability of an enterprise by taking both fixed and variable costs into consideration and subtracting the total costs from the total revenue (Olukosi and Erhabor) [19].

Therefore,

NFI = TR-TC---------- (2)

Where;

NFI =Net Farm Income,

TR = Total revenue,

TC = Total cost, with TC = TFC + TVC

Net Return on Investment (NROI) is the benefit to an investor resulting from an investment of some resource. A high NROI means the investment's gains compare favourably to its cost, (Olukosi and Erhabor) [19].

Therefore,

NROI =NFI/TC---------- (3)

3. Results and Discussion

The results are presented according to the objectives. These are the socio-economic characteristics of the respondents, freshwater fish species produced and common fish farming practices and, costs and returns of fish farming in the Wouri division and constraints to freshwater fish farming in the study area.

3.1 Socio-economic characteristics of respondents

The distribution of respondents according to some selected socioeconomic characteristics is presented. These include gender, age, and marital status, level of education, family size, professional training and fish farming experience. This is because it helps one to understand the population of interest and their behaviour in the fish farming activities. Table 2 presents the socioeconomic characteristics of the respondents.

Table 2: Distribution of the respondents according to their socioeconomic characteristics

Socioeconomic characteristics	Frequency	Percentage
Sex		
Male	23	76.70
Female	7	23.30
Total	30	100
Age of respondents (years)		
25-30	15	50.00
31-35	7	23.30
36-40	5	16.60
41-45	3	9.90
Total	30	100.00
Marital Status		
Married	18	60
Single	12	40
Total	30	100.0
Level of education		
GCE OL	4	13.30
GCE AL	4	13.30
HND	2	6.70
Bachelor	5	16.70
Engineer	9	30.00
Master	6	20.00
Total	30	100.0
Household size		
1 – 3	13	43.30
4 - 7	10	33.40
8- 12	7	23.40
Total	100	100.0
Professional Training		
Yes	19	63.30
No	11	36.70
Total	30	100.00
Years of fish farming experience		
1 -3	16	53.30
4 - 6	12	39.90
7-10	2	6.70
Total	30	100.00

The results in table 2 show that a majority (76.7%) of the respondents are men. This could be because the fish farming activities requires great physical strength and cannot be easily practiced by women. This dominance of male participation in the fish farming activities is in conformity with the findings of Onzere [20] who indicated that women play a minor role in fish

production in several Sub-Saharan countries.

Age is an important characteristic in the farming context as it affects the producers' physical abilities.The results in table 2 show that, the age of the respondents ranges from 25 to 45 years and that half (50%) of fish farmers surveyed are between 25 to 30 years and 31 to 35 years (23.3%). This implies that the participation of youth in fish farming in the study area is relatively high. It could be because the fish farming activity requires knowledge, strength and great expertise.

The marital status of respondents in this study would have influence on the family size and funding of activities. A majority (60%) of the respondents are married. This greater proportion of the respondents can be attributed to the fact that family charges are great motivations to invest in the farming sector to generate more income. It also could be due to the fact that, the fish farmers could want to reduce labour cost as the larger the family size the larger the labour force hence a fall in the labour cost.

It is important to know the level of education of the freshwater fish farmers because this can shade light on their knowledge of the principles of fish production and available useful technologies. The results (table 2) show that all the respondents had formal education with 66.70% having a first degree. The fact that all the farmers are educated is rather encouraging as educated farmers will easily understand and adopt the fish farming technologies and develop strategies and techniques in order to generate more revenues from this activity. These findings are in conformity with the findings of Wetengere [21] who observed that the adoption of fish farming technologies is influenced by the level of education, knowledge and skills of the farmers.

Approximately, 43 % of the respondents had family sizes varying from 1 to 3 members, 33.4% had 4 to 7 dependents under their care and 23.4% of the respondents had family size varying from 8 to 12 individuals, with an average of five persons (table 2). This implies that the relatively large household size may likely enhance family labour supply on the farms, hence reducing cost of production and increasing yield.

The knowledge and awareness of undertaking any economic activity is a major determinant on the success and sustainability of the enterprise, therefore, fish farming requires that farmers undergo training and seek advice from fisheries experts on where to locate the ponds and about general fish management as reported by the Organic Farmer magazine in 2012. The survey revealed that 63.3% of the respondents are trained while 36.7% of the respondents are not. This could be because since all the respondents are educated, they are receptive to new technologies and have the will power to improve on their fish farming skills.

The number of years of fish farming experience is an important criterion for this study because it determines the farmer's ability to successfully run his or her fish farm, adopt and develop new techniques of fresh fish production. Results in table 2 shows that the years of experience of the respondents in the fish farming sector vary from 1 to 10 years, with majority of the respondents (53.3%) having 1 to 3 years of experience, 39.9% of the respondents had 4 to 6 years of experience and 6.7% had 7 to 10 years of experience. The average years of fish farming experience was 3.80 years. In the light of these results, it can be asserted that the freshwater fish farming activity is an activity that has only been recently introduced in the study area, and that populations, especially young people are taking interest in it.

According to Molua [22] ; Bime and Mbanasor [23]) access to finance appears to be a significant constraint to agricultural production in developing countries in general and in Cameroon in particular. Hence, it is worthwhile to identify the various sources of finance of the respondents. Figure 3 presents the distribution of respondents according to their sources of finance.

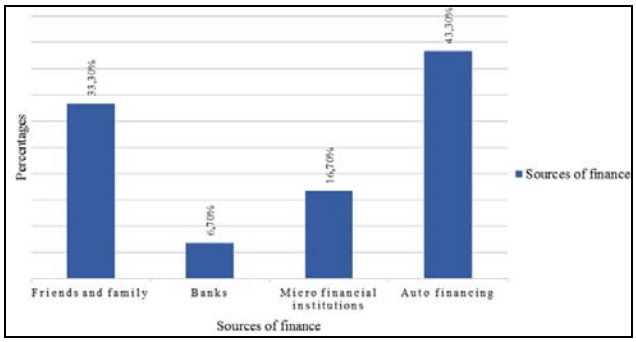

Fig 3: Distribution of fresh water fish farmers surveyed according to sources of finance

Figure 3 shows that the fresh fish water farmers relied on several sources of finance. However, a majority of the respondents (43.30%) do not use any external funding to keep their fish farms afloat. Approximately 33% of the respondents relied on friends and family to help implement their farms, against 16.7% who relied on banks. These findings could be because the respondents are not solely engaged in fish farming activities and therefore they use the income generated from other activities to fund their fish farming activities.

3.2 Freshwater fish produced and predominant fish farming practices

The study identified the African catfish as the main species of freshwater fish produced in the study area. This could be because the culture of the African catfish is very profitable and that the Wouri division meets all the requirements (temperature, climate and water composition) for the production of catfish. These results are consistent with the findings of MINEPIA [6] which asserted that one of the main species of freshwater fishes produced for human consumption in Cameroon is the African catfish.

Fish farming practices highly depend on the species of freshwater fish the farmer is willing to produce whether separately or together with other species. The study identified the monoculture of African catfish as the main fish farming practice prevailing in the study area, as 100% of the respondents practiced the monoculture of African catfish. This could be because the monoculture of African catfish in the study area is more profitable than the polyculture fish farming practice. These results are not consistent with the findings of Pouomogne and Pemsl [10] who argued that the most common fish farming practice in Cameroon is the polyculture of Nile tilapia either with African catfish where possible or with other locally available species such as the African bony tongue (*Heterotis niloticus),* snakehead (*Parachama obscura),* banded jewelfish *(Hemichromis fasciatus),* common carp *(Cyprinus carpio)* or gougeon *(Barbus spp.)* since this practices do not apply in the study area.

Characterization of fish ponds in this section entails the type, number and size of fishponds. The type of fish ponds used in

this sector is of great importance since the survival of freshwater fishes depends on the ponds' quality. The number and size of fishponds in a fish farm are other important aspects in fish production since they determine the quantity of freshwater fishes that can be reared in a single farm. The study revealed that all the respondents in the study area used concrete ponds of size ranging from 1 and 50m^2 and had 3 ponds per fish farm on the average. Table 3 presents the distribution of respondents according to the number and size of fishponds.

Table 3: Distribution of respondents according to the number and size of fishponds used

Number of ponds per fish farm	Average surface area (m^2)	Frequency	Percentages
Equal to or less than 5	50	5	16.66
6-10	15	7	23.33
11-15	10	8	26.66
16-20	18	1	3.33
21-25	14	5	16.66
26-30	12	4	13.33
Total		30	100.00

Table 3 shows on one hand that majority of the respondents (26.66%) had 11 to 15 ponds on their farms with an average size of 10m^2 to produce freshwater fish. Approximately 17 % of the respondents used five or less fish ponds to produce their fish. On the other hand, the study revealed that a low proportion of the respondents had up to 26 to 30 fishponds to produce freshwater fish. This could be because the construction and maintenance of fishponds is costly. The survey also revealed that some respondents built other types of fish ponds that they later abandoned after they found out that it was more difficult to control the production in these ponds and also because these other types of ponds needed greater surface area (above 50m^2). These ponds included the diversion ponds and the dam ponds.

3.3 Cost of production of African Catfish in monoculture

To determine the gross margin, net farm income and net return on investment of freshwater fish farming in the Wouri division, the costs were divided into two types: the variable cost and the fixed costs. The variable costs comprises of cost of fish feeds, cost of African catfish fingerlings, cost of fuel, cost of labour, cost of water treatment, transportation cost and other variable costs (Electricity and communication). The fixed costs comprises of cost of land, cost of pond construction and maintenance, cost of water pump, cost of borehole sinking, cost of generator, plumbing materials' cost, wheelbarrow/shovel and other fixed costs (insurance and depreciation of assets). Table 4 presents the costs incurred in the monoculture of African catfish.

Table 4: Costs incurred in the production of African catfish raised in concrete ponds

Costs	Quantity	Unit costs (FCFA)	Total costs (FCFA)	Percentage in total cost
Variable costs				
Fish feeds (kg)	7,371.44	1,533.00	11,300,417.52	55.99
Fingerlings	28,885.72	150.00	4,332,858.00	21.47
Fuel	/	/	88,571.44	0.43
Labour (per labourer)	2.07	550,000	1,138,500.00	5.64
Water treatment	/	/	314,285.72	1.55
Transportation	/	/	392,857.16	1.94
Other variable costs	/	/	483,071.44	2.39
Total Variable Costs			18,050,561.28	89.44
Fixed costs				
Land (m^2)	500.00	1,500.00	750,000.00	3.71
Pond construction	3.00	303,622.43	910,867.29	4.51
Water pump	1.00	84,642.86	84,642.86	0.41
Bore hole sinking	1.00	138,714.29	138,714.29	0.68
Generator	1.00	19,642.86	19,642.86	0.09
Plumbing materials	/	/	132,857.14	0.65
Wheelbarrow/Shovel	/	/	28,785.71	0.14
Other fixed costs	/	/	64,821.43	0.32
Total Fixed Costs			2,130,331.58	10.55
Total Costs			20,180,892.86	100.00

The table 4 shows that the fresh water fish farmer incurs a total cost of 20,180,892.86 FCFA. Variable cost accounted for 89.44% of this total cost of which the major components were the fish feeds (55.99%), the fingerlings (21.47%), and labour (5.64%). The fixed costs accounted for 10.55% of the total cost of which the major components were pond construction (4.51%) and land (3.71%). Therefore, African catfish farmers spent more in fish feeds (averagely 11,300,417.52 FCFA) and fingerlings (averagely 4,332,858.00 FCFA) while operating their fish farms. Fish feed accounts for more than 50% of the total cost. These results are in conformity with the findings of Ele *et al.*[24] who found out that the cost of feed alone is estimated to represent between 40% and 70% of the cost of producing the fish.

3.4 Returns from the production of African Catfish in monoculture

Returns were derived from economic calculations such as the Total Revenue (TR), Gross Margin (GM), Net Farm Income (NFI) and Net Return on Investment (NROI). The fish farmer in this category buys averagely 28,885.72 fingerlings and produces 21 664.290 juveniles per year, this means that 7 221.430 fishes died during the production process. All African catfishes that completed the production process were sold out to the market. Table 5 presents the TR, GM, NFI, and NROI of the monoculture of African catfish in concrete ponds.

Table 5: TR, GM, NFI, and NROI of the monoculture of African catfish in concrete ponds

Indicators of economic performance	Quantity sold (Kg)	Unit price (FCFA)	Amounts (FCFA)
TR *Clarias gariepinus*	21,664.29	2,500	54,160,725.00
Gross Margin (GM = TR-TVC)			36,110,163.72
Net Farm Income (NFI = TR-TC)			33,979,832.14
Net Return On Investment (NROI = NFI/TC)			1.68

The results in table 5 show that a total revenue (TR) of 54,160,725.00 FCFA was realized per year with a gross margin (GM) of 36,110,163.72 FCFA. When expressed in percentage of sales ({TR-TVC}/TR), the GM is equal to 66.6%, meaning for every FCFA generated in sales, the farmer has 66.6 FCFA to cover basic operating costs and profit. This tells investors how much gross profit (66.6) every FCFA of revenue the fish farming activity generates per year.

The study also revealed that a net farm income of 33,979,832.14 FCFA was realized. This amount refers to the return to fish farms operators for their labour, management and capital, after all production expenses have been paid. A positive NFI implies that the business is profitable. Therefore, the fish farming business in the study area is a profitable business with a yearly NFI of 33,979,832.14 FCFA.

The results further reveals that the monoculture of African catfish generates a net return on investment of 168%. This indicates that monoculture of African catfish in the study area was profitable as for every one FCFA invested; each producer makes a profit of 1.68 FCFA.

3.5 Constraints to fish farming in the study area

The results pertaining to the key constraints to fish farming in the study area are presented in figure 4.

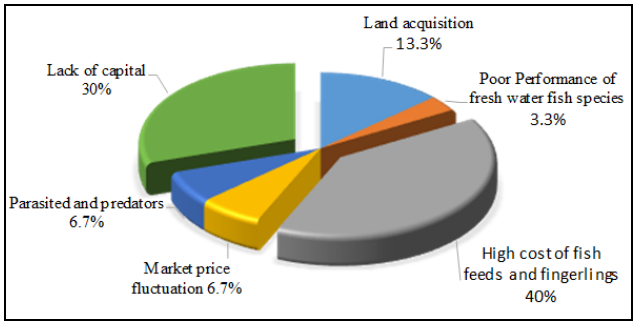

Fig 4: Distribution of respondents according to the constraints faced in fish production

The study identified six major challenges faced by the surveyed freshwater fish farmers in the study area:

The high cost of fish feeds and fingerlings is the top ranking constraint faced by the respondents. Indeed, 40% of the respondents declared that the high cost of fish feeds and fingerlings is the first challenge they face. This could be because of the lack of raw materials and fish feed mill that could be used to produce quality feed and at affordable prices. This is in line with the findings of El-Naggar *et al.* [25]) who examined the economics of fish farming in Behera and found out that high price of fish feeds is one of the top ranking constraints facing fish farmers.

One of the greatest problems facing freshwater fish farmers in the Wouri division is the lack of capital. Thirty percent of the respondents said they do not have enough funds to manage their fish farms, adopt new technologies and purchase feed for their fishes. However, during the field survey it was observed that none of the respondents was subsidised by the Cameroonian government.

Land is one of the most important resources readily made available for production in countries like Cameroon and perhaps it is the most important production inputs. Approximately 13.3% of the respondents said the acquisition of land is the major reason that prevents them from expending their fish farms. This could be due to poor pattern of land distribution, which often favours the rich class. In addition to that, the rich class has the economic resources to purchase and improve the land.

The production of freshwater fish can be a very risky activity for fish farmers due to price fluctuations. The fact that the price of freshwater fishes sometimes fluctuates, pushes some producers (6.7%) to incur losses, especially when there is a drop in price between the buying and delivery periods.

A small proportion of the respondents (6.7%) said parasites and predators affect the profitability of their fish farms. This could be due to high stocking density, the exposure of ponds to birds and snakes, fish seeds and juveniles transportation from other fish farms without adequate precautions and the presence of common water in between ponds

4. Conclusion and Recommendation

The study on the evaluation of the economic performance of freshwater fish farming in the Wouri division, Littoral region of Cameroon aimed specifically at describing the socio-economic characteristics of freshwater fish farmers; identifying the predominant freshwater fish produced and the farming practices used; determining the gross margin, net farm income and net return on investment of freshwater fish farming and identifying the constraints affecting the fish farming sector

A majority of the respondents were educated young married men with an average family size of five persons and farming experience of 3.80 years. The fish farming sector is an important sector in the economic life of the inhabitants of the Wouri division as calculations of the costs and returns on investment show that the farming practice is highly profitable. Most of the fish farmers are motivated to invest for profit making. Majority are trained and although they do not have fish farming as their main occupation they do not rely on external sources of finance to run their fish farms. The study results further reveal that monoculture of African catfish in concrete ponds is practiced by all the respondents Economic analysis revealed that the fish farming activities in the Wouri division is highly profitable, since the gross margin and the net farm income of the identified fish farming practice are positive. Fish farming is therefore a viable activity in the Wouri division as the results revealed a 168%, net return on investment (NROI) that is for 1 franc invested there is return of 168FCFA. The sector faces many constraints including the cost of fish feeds and fingerlings, lack of adequate funds, and land acquisition.

The cost of fish feeds represents the highest proportion to the total cost of production estimated at 55.99% of the total cost. It is therefore recommended that, fish farmers should form cooperatives with the assistance of governmental organisations and other organized private sectors institutions to establish fish feed mill for quality feeds at affordable price.

Government policy to ensure quality feed at affordable prices should be formulated for better harvest and, thus sustain the fish farming sector. Equally, more efforts should be made to organise training sessions during which producers are schooled on the basic principles involved in freshwater fish production. Hence, capacity-building seminars should be organised to train the fish producers.

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