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CAMEROON AQUACULTURE: SITUATION AND CHALLENGES LINKED TO FISH FEED

Tombuh Divine Ngala* et Tangem Lucas Leku

Unit of Aquaculture, Ministry of Livestock, Fisheries and Animal Industries (Minepia), Cameroon

**Correspondence to: Email:dntombuh@yahoo.co.uk; tel: 0023766330000/675730100*

ABSTRACT

The fish feed production sector in the Centre and Littoral Regions of Cameroon faces several challenges that affect the quality of the feed produced and the growth rates of the fish. The drying and storage process of the feed is inadequate, leading to spoilage due to high moisture content. Most of the fish feed production units have a moisture content that ranges between 10.5% and 18.3%, which is higher than the recommended 10% or less. The cost of production has increased due to the high prices of both local and imported raw materials, such as soybean, corn, fishmeal, fish oil, rice, and wheat. The use of well-ground raw materials in fish feed formulation is essential for ensuring the overall quality of the feed and the growth rates of the fish. However, during visits to fish feed production units, it was found that 80% of them did not use well-ground raw materials. The lack of heating units or worn screws in extruders resulted in inadequate temperature control during the extrusion process, which affected the gelatinization of starches and proteins, leading to poor pellet formation, increased feed waste, and reduced feed efficiency. The fish feed produced did not meet the nutritional requirements of the fish, with more than 80% of the local feed analyzed having crude protein levels less than 30%. The local fish feed production sector faces intense competition from imported fish feed, leading to market saturation and reduced profitability for local producers. The lack of low-cost and readily available raw materials was another challenge that the fish feed industry faced. The nutritional composition labeled on fish bags did not match the results of the analysis after assessing some fish feed production units. Additionally, the cost of local or domestic fish feed per kilogram ranges from 1000CFA to 1100CFA, while imported feed costs between 1200CFA and 1400CFA. Despite the higher cost, 70% of fish farmers in Cameroon prefer to use imported fish feed due to its better feed conversion ratio, which they believe promotes the growth of their fish species. The local fish feed production sector faces several challenges that need to be addressed to improve the quality of the feed produced and the growth rates of the fish. Statistical analyses show that the sector needs to focus on improving the drying and storage process, using well-ground raw materials, and ensuring adequate temperature control during the extrusion process. The sector also needs to address the issue of low crude protein content in feed meals, the lack of low-cost and readily available raw materials, and the competition from imported fish feed. The government needs to provide support to the local fish feed production sector to improve its competitiveness and ensure food security.

Keywords: Fish feed production, Cameroon, challenges, quality, and growth rates.

INTRODUCTION

Fish feed plays a crucial role in the aquaculture production chain, as it is the first major step in the growth and development of farmed fish (Abdel-Fattal *et al., 2013*). Feeding fish a balanced diet is essential for their proper growth and well-being, as the diet they consume directly impacts their health and overall performances (Academic Press, 2021). The production of fish feed requires expertise in fish biology, nutrition, and a deep understanding of feed ingredients and their roles. In Europe, fish feed production is primarily focused on highly predatory species. Farmed fish are fed diets specially formulated to meet their nutritional needs, similar to dry dog food in the form of dried pellets (NOAA Fisheries, 2019). These feeds contain all the essential nutrients necessary to keep the fish healthy and promote growth. One of the key challenges in fish feed production is reducing the reliance on wild fish for ingredients such as fishmeal and fish oil. The NOAA-USDA Alternative Feeds

Initiative aims to identify alternative dietary ingredients that can maintain the important human health benefits of farmed seafood while reducing the use of fishmeal and fish oil. Fish feed plays a crucial role in the development of aquaculture, which is the farming of fish, crustaceans, mollusks, and other aquatic organisms (FAO, 2022). As the global demand for fish and seafood continues to rise, the aquaculture industry has become an essential source of food and income for many countries. Fish feed is a vital component of aquaculture, as it provides the necessary nutrients for the growth and development of farmed fish (Hertrampf *et al., 2000*) The percentage of fish feed in the total cost of production varies depending on the type of aquaculture and the specific feed used. In general, fish feed can account for a significant portion of the total production cost. According to a report by the Food and Agriculture Organization of the United Nations (FAO), fish feed can represent approximately 50% of the variable production cost (FAO, 2019).

Aquaculture has experienced significant growth in recent years, particularly in sub-Saharan Africa, where production has been increasing at a rate of 11% annually since 2000 (*Ragasa et al*, *2022*) This growth has been driven by private sector investments and the availability of suitable inland water resources for fish farming. However, one of the main challenges faced by the aquaculture industry in Africa is the high cost of fish feed, which remains prohibitively expensive for small-scale farmers. This is partly due to the fact that many local feed producers in Africa rely on imported raw materials and processing equipment, which incur additional costs.

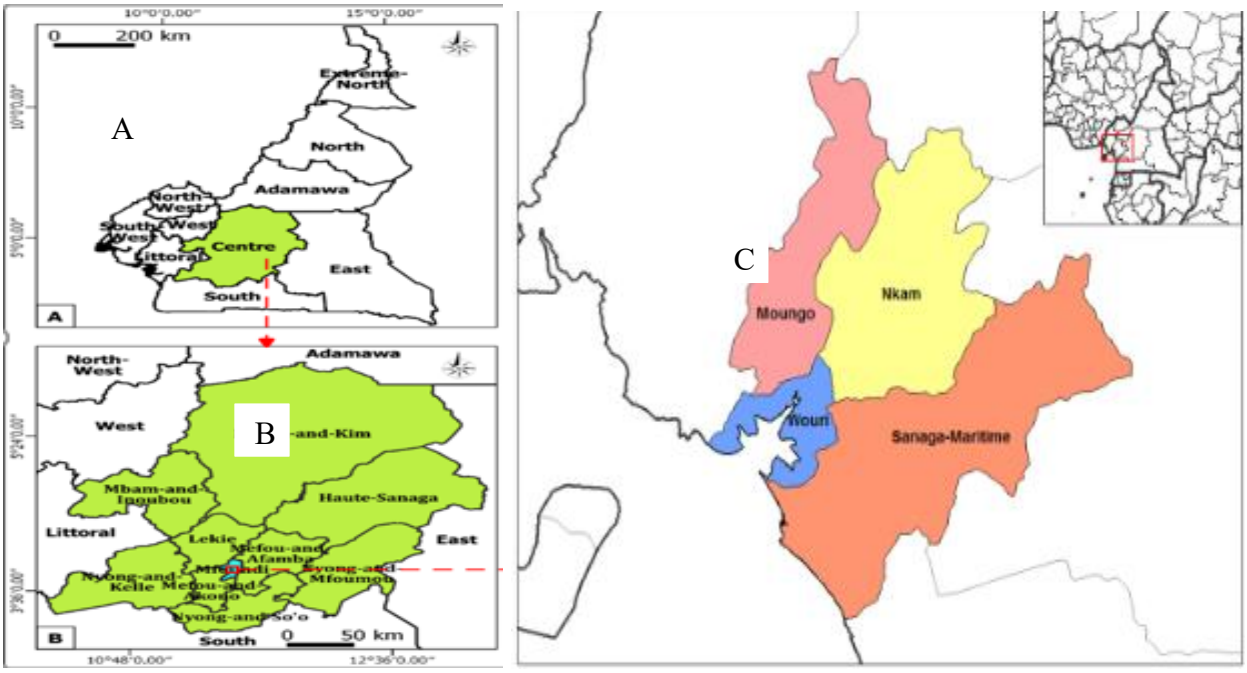
Cameroon, a country in Central Africa, has a growing aquaculture sector, with tilapia, North African catfish, and common carp being the main species contributing to national fish production. However, the fish feed production sector in Cameroon faces several difficulties, which hinder its growth and development. One of the main challenges is the high cost of fish feed, which is a result of the country's reliance on imported raw materials and processing equipment. Additionally, the lack of research on alternative, locally available, and cheaper ingredients for fish feed has further contributed to the high cost of production in the country. The Centre and Littoral Regions of Cameroon are two of the regions where fish feed production is prevalent. The Cameroon Ministry of Livestock, Fisheries and Animal Industries plays a crucial role in promoting fish feed production, but there are still challenges that need to be addressed to ensure sustainable and effective fish feed production practices in the country. To understand the difficulties faced by the fish feed production sector in the Centre and Littoral regions, we conducted site visits to various production units. Addressing these challenges will significantly contribute to enhancing the quality and sustainability of locally produced fish feed in Cameroon.

MATERIALS AND METHODS

Site descriptions

Geographical localization

The Centre and Littoral Regions of Cameroon are located in Central Africa, bordering the Bight of Biafra, between Equatorial Guinea and Nigeria. The Centre Region is bordered to the north by the Adamawa Region, to the south by the South Region, to the east by the East Region, and to the west by the Littoral and West Regions. The Littoral Region bordered by the Southwest Region to the south, the West Region to the northwest, and the Centre Region to the east. The coordinates for the Centre Region are 4°45′N 12°00′E, and it covers an area of 69,000 km2, making it the second largest region in Cameroon The Littoral Region of Cameroon is located on the country's western coast and is known for its proximity to the sea. The region's coordinates are approximately 4°00′N 10°00′E. Figure 1 below shows the map of the Centre, Littoral and map of Cameroon



Source: Geology.com

Figure 1: The map of the Centre, Littoral and map of Cameroon.

HISTORICAL ANALYSIS

State of world aquaculture:

Aquaculture in Cameroon has a long history, dating back to 1948, but the sector is still underdeveloped compared to other farming activities. However, with the assistance of organizations such as the FAO and the WorldFish Center, investor interest in small-scale aquaculture is increasing. Seed and feed have been identified as key constraints for the development of the sector in the newly adopted strategic framework for aquaculture development in Cameroon (Pouomogne, V. 2007). Over 90 percent of fish producers in Cameroon are small, rural, or peri-urban farmers who lack the resources to purchase costly feed ingredients. They rely mostly on nutrients derived from pond fertilization with organic materials of miscellaneous origins. Compounded balanced diets were used only marginally by Cameroonian fish farmers, and more than 90 percent of fish producers in Cameroon knew nothing about compounded fish pellets. In recent years, the compound feed industry has shown tremendous growth, largely as a consequence of the rapidly expanding broiler chicken industry. Many of the ingredients used in the manufacture of chicken feed are also used for making fish pellets.

Despite the challenges facing the industry, investments in Cameroon's aquaculture market are significant in the country's seafood industry. The government has taken measures to support the aquaculture industry, such as knocking out all customs duties on imports of aquaculture equipment since early 2021. Cameroon's aquaculture is mainly practiced in freshwater, in both diversion ponds and dammed ponds. In 2021, Cameroon's fish production was estimated to be slightly more than 230,000 metric tonnes, compared to the annual demand of 450,000 metric tons. The country's aquaculture production was reported at 9,800 metric tons in 2021, according to the World Bank. The majority of fish producers in Cameroon are small, rural, or peri-urban farmers who lack the resources to purchase costly feed. However, the government of Cameroon has recognized the potential of aquaculture and has taken steps to promote its development, including the development of fish feed production in the country.

Current state

With capture fishery production relatively static, aquaculture has been responsible for the continuous impressive growth in the supply of fish for human consumption. Between 1961 to 2016, the average annual increase in global food fish consumption was 3.2% which outpaced the population growth of 1.6%. it is worth noting that, food fish consumption exceeds that of meat 2.8% (from all terrestrial animals combined). Fish provided about 3.2 million people with almost 20% of their average per capital intake of animal proteins, this is particularly true for developing countries (FAO, 2019).

Aquaculture can be defined as the raring of aquatic animals and plants. Fish consumed is obtained from captured fisheries, industrial fishing and aquaculture, Global aquaculture production in 2017 was 1119 million tonnes (MT). this includes 80.1% of aquatic animals of which 53.4MT are finfish ,17.4MT are mollusks, 8.4 MT are crustaceans and 893,900 toonnes of other aquatic animals (FAO, 2019). The proportion of aquaculture to aquatic animals is now 46.4%. in land aquaculture of finfish species is the most important, with a production of 45.6 MT which represents 56.9% of world aquaculture production of aquatic animals (FAO,2019), these shows that fish is the main product of aquaculture. Globally fish farming is mainly carried out in earthen ponds.

The top aquaculture producing countries are: china (46.8MT), India (6.2 MT), Vietnam (3.8 MT), Bangladesh (2.3 MT), Egypt (1.5 MT), Norway, Chile, Myanmar and Thailand. These ten producers collectively produce 71.2 MT contributing to 88.9 % of the world's aquaculture production.

In Africa aquaculture accounts for 17 to 18 percent of total fish. The main aquaculture producers are Egypt in North Africa and Nigeria in sub-Saharan Africa, with a production of 1.7% and 0.4% respectively (FAO, 2019).

METHODOLOGY OF ANALYSIS

The methodology of analysis used in the study involved three main components:

1. **Preliminary survey**
   - Conducted to identify the production sites;
   - 13 fish feed production units were randomly selected and interviewed;
   - A questionnaire was designed to gather information about their operations;
   - 160 fish farmers were also interviewed.

Table 1: Fish feed production units in the Centre and Littoral Regions of Cameroon

Name of fish feed production units	Type of pellets produced	State of activity	Region
Fores Sarl	Floating and Sinking pellets	Functional	Centre
Leofish Farm	-	Not Functional	Centre
Aquaworks	Floating pellet	Functional	Centre
Victory feed	Floating pellet	Functional	Centre
Maboh Farm	-	Not Functional	Centre
Rolas Queen fish Center	Sinking pellet	Not Functional	Centre
Forpet	Floating pellet	Functional	Centre
Agripure	-	Not Functional	Centre
Aquafish Farm	Floating pellets (not for sale)	Functional	Centre
Anthill Farm	Floating pellet	Functional	Centre
Sango Africa	Sinking pellet	Functional	Littoral
Aquafresh Life	Sinking pellet	Functional	Littoral
Mendel Center	Sinking pellet	Functional	Littoral
Aury fish	Floating and Sinking pellets	Functional	Littoral
Aquarin	Floating pellet	Functional	Littoral
IFFA	Floating pellet	Not Functional	Littoral

To assess the current state of fish feed production sector in Cameroon, the following materials and methods were used.

2. Data Collection

- Information was gathered from the 13 fish feed production units that were assessed;
- A questionnaire was designed to gather information about their operations.

3. Laboratory Analysis.

Laboratory analysis was conducted to determine the nutritional composition of the fish feed produced by the fish feed production units. This helped to determine if the fish feed met the nutritional requirements of the fish. The following nutrients were analyzed.

FIELD OBSERVATION

Field observation helped to observe the fish feed production process. This helped to identify the various challenges faced during the production process, such as pulverization of ingredients and drying of fish feed.

INTERVIEWS

Interviews were conducted with fish farmers who use the fish feed produced by the 13 fish feed production units. Among the 160 farmers interviewed, some "use the fish feed regularly," "use the fish feed occasionally," and "do not use the fish feed." This helped to gather information on the quality of the fish feed and any challenges faced in using the fish feed.

DATA ANALYSIS

The data obtained from the survey were analyzed and summarized using simple descriptive statistics.

RESULTS

A recent assessment of the challenges facing the fish feed production sector in the Centre and Littoral Regions of Cameroon has revealed the following:

Feed drying process

Out of the eleven (11) fish feed production units visited, five (5) dried their feeds on the floor, five (5) used dryers, and one (1) dried feed both on the floor and a dryer.. Figure two (2) shows some fish feed drying methods.

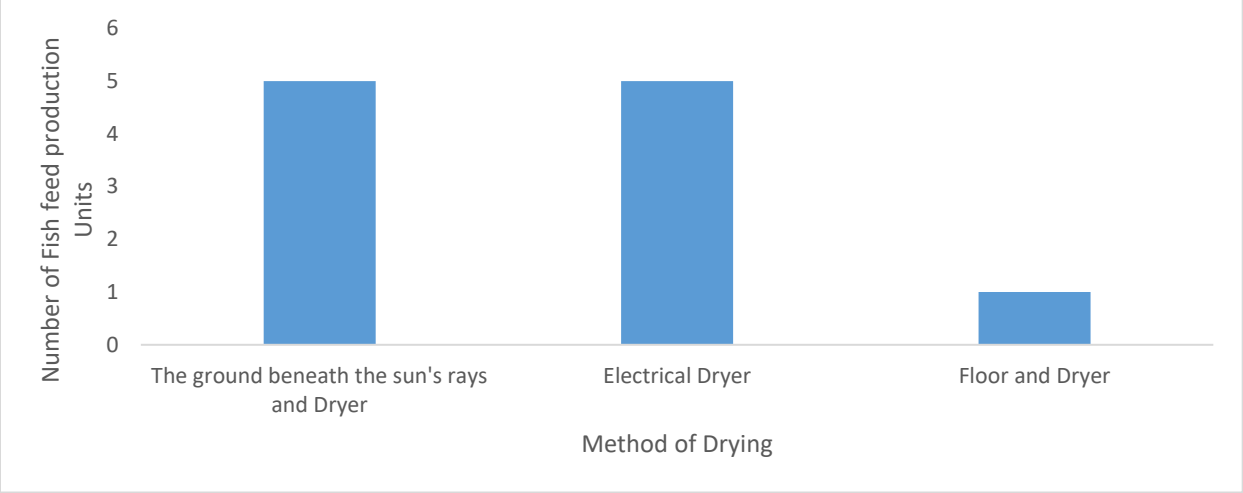


Figure 2: Fish feed drying methods.

Inadequate drying and storage systems led to spoilage due to high Moisture content. Moisture content plays a crucial role in the shelf life of fish feed. Most commercial fish feeds are manufactured as dry pellets, which contain approximately 10% moisture or less. Because of their low moisture content, they can be stored at room temperature for prolonged periods of time, as a general rule, for at least 90 days from manufacture. The moisture content of fish feed from the production units were analysed with the help of an Infrared Moisture Analyzer FD-660 and it was found out that, most of the fish feed production units in the Centre and Littoral regions of Cameroon have a moisture content that ranges between 10.5% and 18.3% as seen in figure four(4).

Figure 3: Infrared Moisture Analyzer FD-660(left) and a poorly dried fish feed (right)

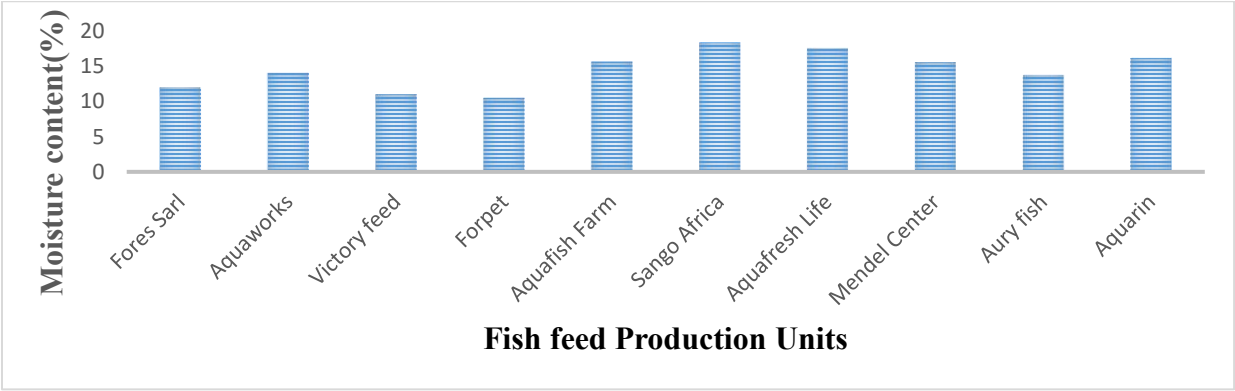


Figure 4: Moisture content of some fish feed production units.

Increased Cost of Production

All the fish feed production units have reported a significant increase in the cost of production due to the high prices of both local and imported raw materials. The cost of key ingredients used in fish feed, such as soybean, corn, fishmeal,

fish oil, rice, and wheat, has been increasing. These prices are closely linked to global commodity and energy prices, which have risen by as much as 50 percent in recent years. The production of floating pellets for fish feed has seen significant growth from 2018 to 2023. Before 2018, many fish feed producers did not have extruders, which are essential for manufacturing floating pellets. Figure five (5) shows the Average cost to produce 100kg of Floating and sinking feeds from 2018-2023 and 2012-2023 respectively.

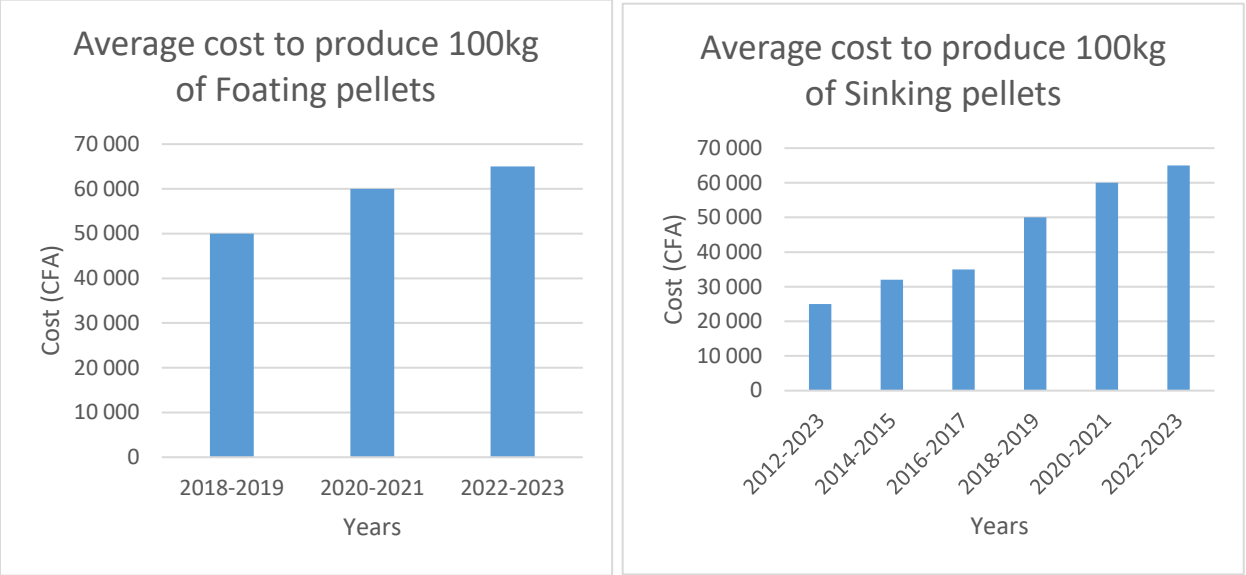


Figure 5: Average cost to produce 100kg of Floating and sinking feeds from 2018-2023 and 2012-2023 respectively.

Pulverization of raw materials

Using well-ground raw materials in fish feed formulation is essential for ensuring the overall quality of the feed and the growth rates of the fish. However, during our visits to fish feed production units, we found that 80% of them did not use well-ground raw materials. This could have a negative impact on the feed quality and, consequently, the growth rates of the fish. In fact, 90% of the fish farmers we surveyed complained about the poor quality of the feed they were using. Figure six(6) shows two cases of raw materials: one from the Littoral region (Douala) and the other from the Centre region (Yaounde). One of the raw materials is well ground, while the other is not.

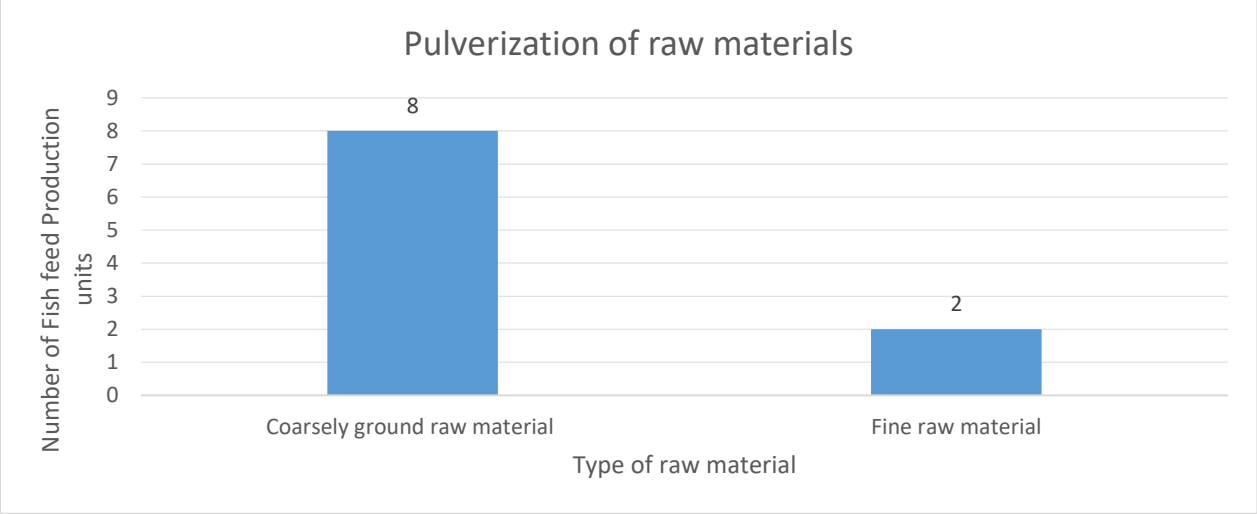


Figure 6: Raw materials at Sango Africa and Fores Sarl

Inappropriate temperature and low pressure treatment during extrusion molding in floating fish feed formulation

During our visits to floating pellet producers, we observed that half of them had extruders with worn screws and no heating units. As a result, the extrusion molding process for floating fish feed formulation was affected by inappropriate temperature and low-pressure treatment. The lack of heating units or worn screws resulted in inadequate temperature control during the extrusion process, which affected the gelatinization of starches and proteins. These are crucial for the formation of a stable and high-quality pellet. The poor pellet formation (Figure 7) led to increased feed waste and reduced feed efficiency.

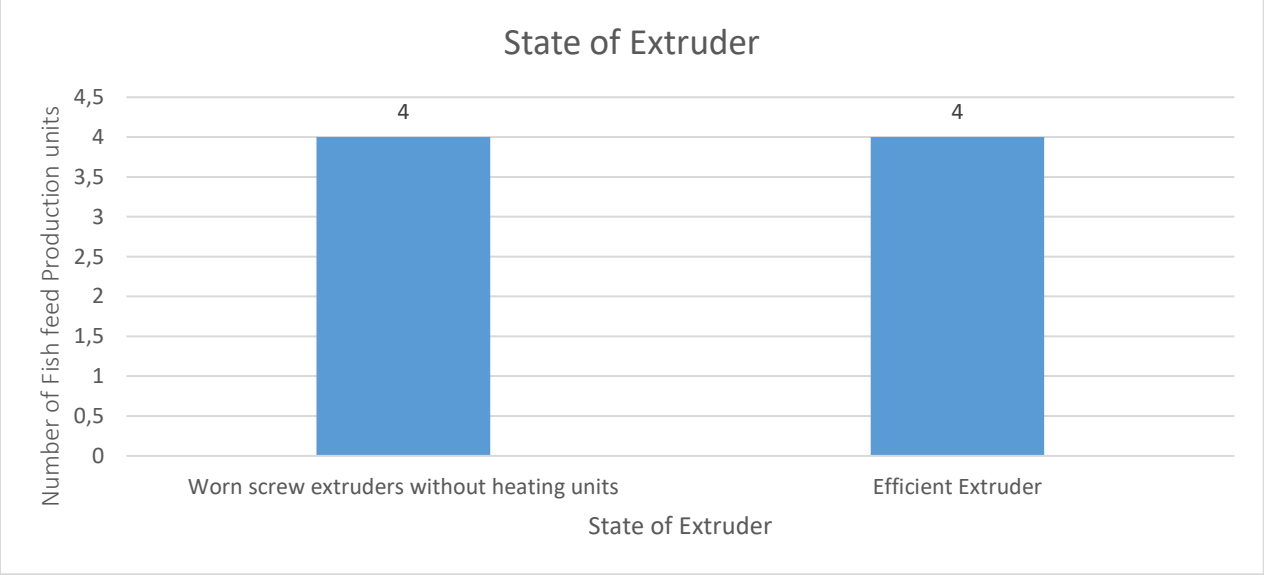


Figure 7: Poor pellet formation

Figure 8: Appropriate and inappropriate temperature and pressure treatment during extrusion molding in floating fish feed formulation.

Nutrients analysis of local fish feed

The fish feed produced by the fish feed production units was analyzed in a laboratory to determine its nutritional composition. However, it was observed that most of the fish feed produced did not meet the nutritional requirements of the fish. Out of the 13 fish feed production units visited, six(6) local feeds were analyzed, and it was noticed that more than 80% of the local feed analyzed had crude protein levels less than 30%. To improve the quality of the fish feed, it is important to consider the chemical and nutrient content of all feed ingredients consumed in the diet. This information is presented in Figure nine (9).

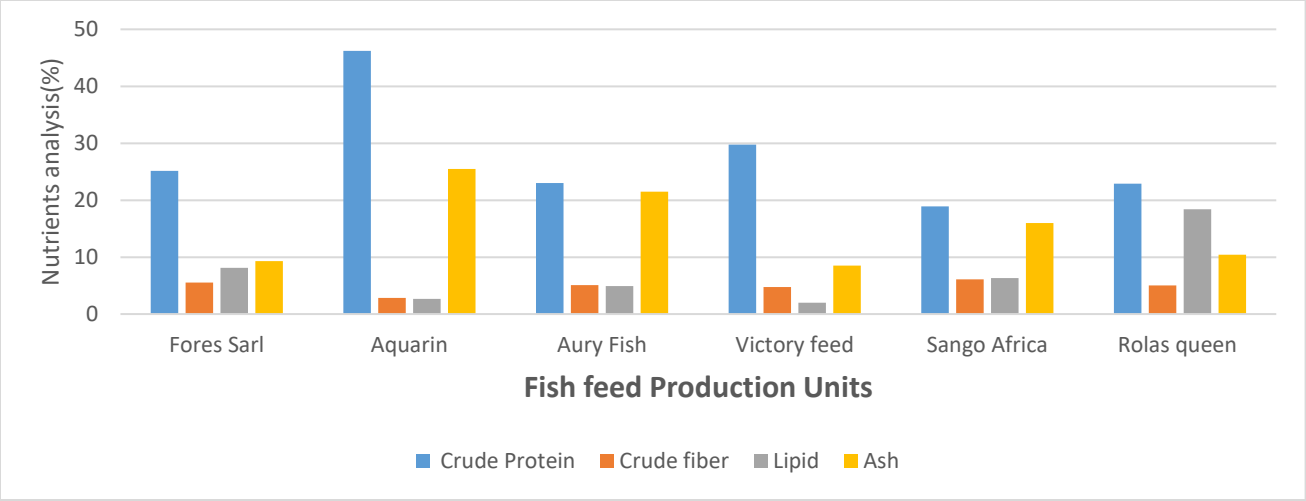


Figure 9: Nutrients analysis of six (6) local fish feed

Crude Protein analysis of fish meals in Cameroon

The results of laboratory analysis conducted in Cameroon showed that only 40% of the fish meals tested had crude protein above 50%, while the remaining 60% had below 21%. This is a significant issue for the fish feed production sector, as low crude protein content in feed meals can negatively impact the growth and health of fish. This information is presented in Figure ten (10).

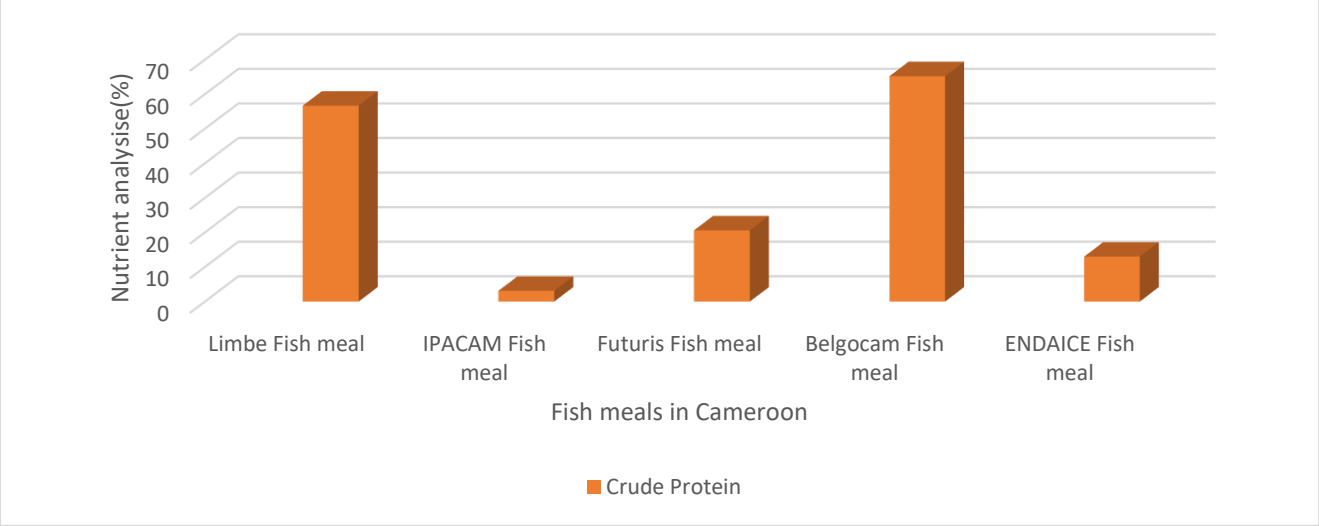
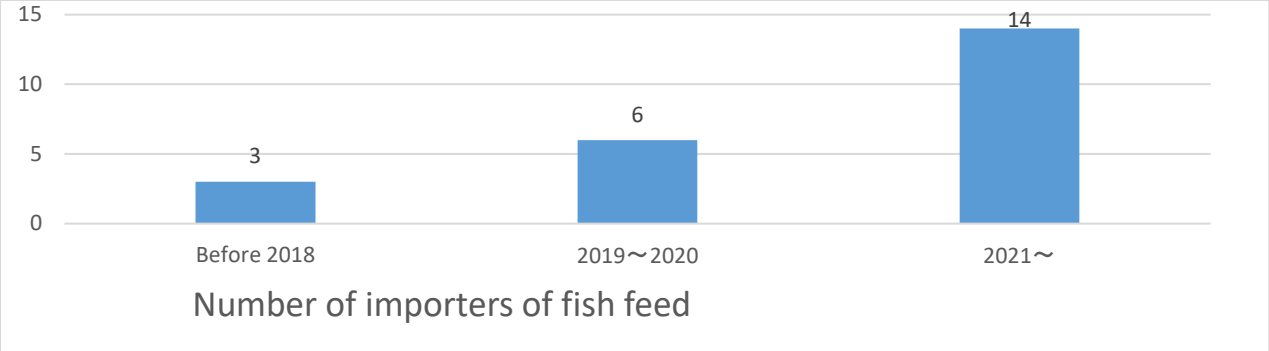


Figure 10: Crude Protein analysis of fish meals in Cameroon

Increased in the number of importers of fish feed

An increase in the number of importers of fish feed have negatively affected the local fish feed production sector. The local fish feed production sector faces intense competition from imported fish feed, leading to market saturation and reduced profitability for local producers. This led to a decline in the local fish feed production sector since some fish feed production units had to abandon. Increased dependence on imported fish feed has posed a threat to food security, as the availability and affordability of fish is compromised, especially for poorer households that rely on fish as a source of protein. Figure 11 shows how the number of importers of fish feed has increased with time.



N°	Manufacturer name	Country	Time of enter
1	GOUESSANT	France	Before 2018
2	SKRETTING	Holland	〃
3	BLUE CROWN	NIgeria	〃
4	ECOFLOAT	NIgeria	2019-2020
5	AQUALIS	NIgeria	〃
6	COPPENS	Holland	〃
7	NATURAL LEVA	Italy	After 2021
8	TOP FEED	Nigeria	〃
9	BIOMAR	Denmark	〃
10	AQUA-BIO	Nigeria	〃
11	BELGOCAM	Belgium	〃
12	ALLER AQUA	Nigeria	〃
13	RANAAN FISH FEED	Ghana	〃
14	CARGIL		〃

Figure 11: Number of importers of fish feed

Feed production equipment

The fish feed production sector faces several challenges, including difficulties in obtaining spare parts for their equipment, such as worn screws in extruders, since all of them are imported from China and it demands much money. This has led to production delays and increased costs for the fish feed manufacturers. The equipment used in fish feed production, such as extruders and heavy dryers, are expensive and difficult to manipulate or repair when they become worn or damaged, which further exacerbates the problem.

Figure 12: Heavy expensive equipment installed but not working

Figure 13: Worn and Damaged equipment

Local feed sales and supplies (Packaging and Labelling)

After analyzing feeds from six fish feed production units, it was found that the nutritional composition labeled on fish bags did not match the actual results of the analysis. Additionally, 70% of the units producing floating pellets ordered their fish bags from outside of Cameroon. A bag of floating fish feed weighing 15kg was being sold for no less than 16,000Frs, which was considered very expensive by fish farmers. This information is presented in Figure 14.

Figure 14: Local feed sales and supplies (Packaging and Labelling)

According to Figure 15, the cost of local or domestic fish feed per kilogram ranges from 1000CFA to 1100CFA, while imported feed costs between 1200CFA and 1400CFA. Despite the higher cost, 70% of fish farmers in Cameroon prefer to use imported fish feed due to its better feed conversion ratio, which they believe promotes the growth of their fish species.

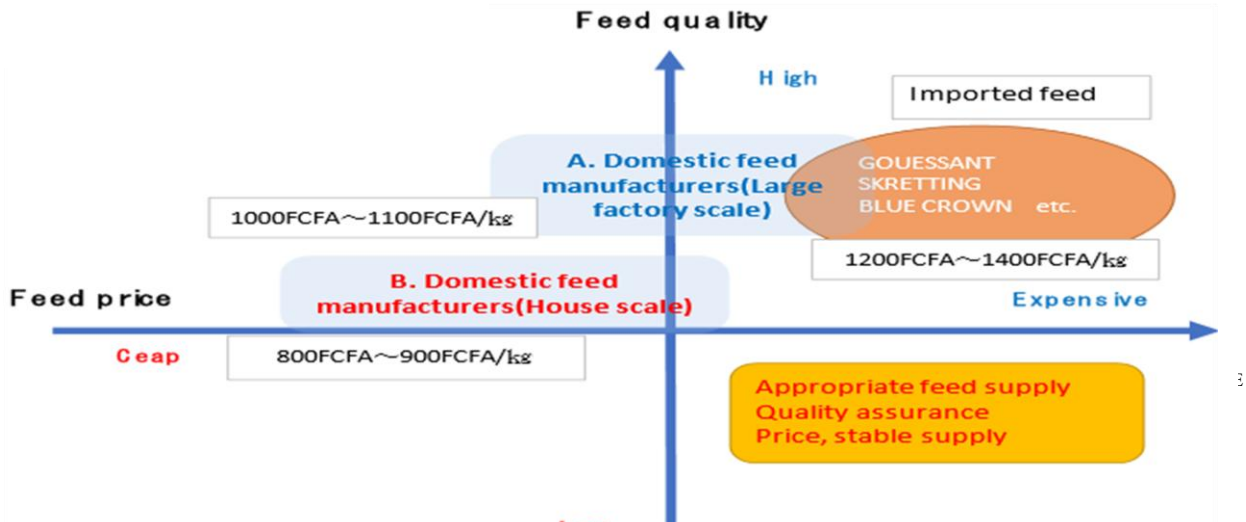


Figure 15: Average cost of local and imported fish feed

Insights from Interviews with 160 Fish Farmers on Fish Feed Quality and Usage.

A survey was conducted on 160 fish farmers who use fish feed produced by fish feed production units. The survey aimed to collect data on the quality of the fish feed and any difficulties encountered while using it. Out of the interviewed farmers, 35 use the fish feed regularly, 30 use it occasionally, and 95 do not use it (figure 16). Most of the farmers who were not using the feed complained that the locally produced feeds are of poor quality. Some of them used the locally imported feed only when they were unable to find imported feed, which they believe is of good quality. Some farmers believe that the difference between the prices of imported and local feed is very small.

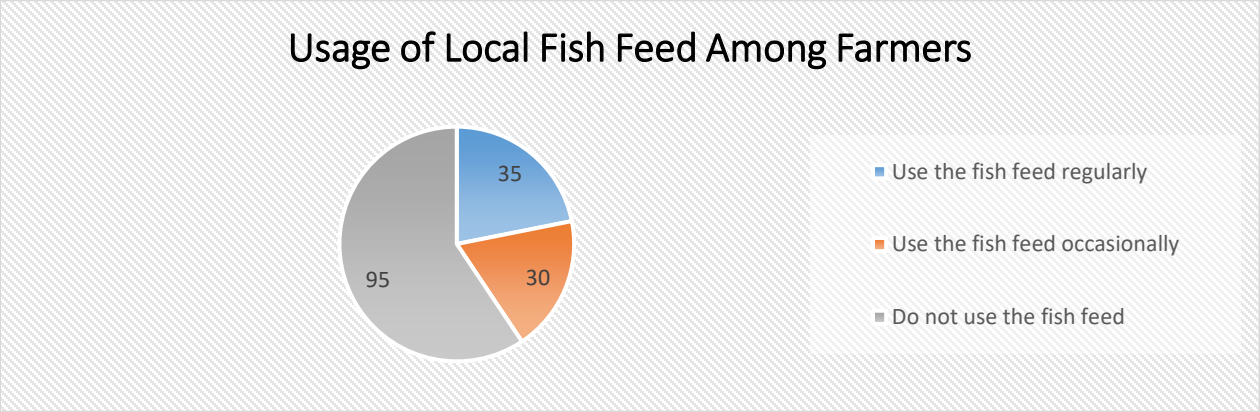


Figure 16: Usage of local fish feed among Farmers

DISCUSSIONS

Nutritionally balanced feeds are prerequisite to cost-effective aquaculture production. Provision of species-specific feeds that address the nutritional requirements of the different life stages of fish is still a formidable challenge for some feed manufacturers.(Oso *et al,* 2006) Most of the feeds formulated by local manufacturers are based on international laboratory analyses of high-quality ingredients in the literature and only a few have been formulated based on analyses locally. In addition, the formulations lack supportive scientific research on their efficiencies in fish production (Nalwanga *et al., 2009*). The situation is exacerbated by feed manufacturers who do not consider the nutritional requirements of their farmed species during feed formulation. (Munguti et *al., 2012*). *Clarias gariepinus* has a relatively high dietary protein requirement, in the order of 40–50 percent of crude protein on a dry weight basis (Van, 1995). High-quality fishmeal normally contains between 60% and 72% crude protein by weight, and it is the preferred animal protein supplement in the diets of farm animals and fish (Miles and Chapman,2000)

Effective drying of fish feed must be properly carried out to enhance the shelf life of the feed and its quality (Adedeji *et al* 2020). The safe moisture content for fish feed for storage is usually 8% to 12% (Adedeji *et al* 2020). This explain why most of the fish feed production units in the Centre and Littoral Regions of Cameroon always find it difficult to conserve their feeds because of moisture content that ranges between 10.5% and 18.3%. If feed is not properly dried, the shelf life will be shortened and it can lead to deterioration of feed. Prolonged storage in unfavourable conditions also may lead to infestation by pests, which negatively impact on feed quality and yield low fish production (Awity, 2013). Using well-ground raw materials in fish feed formulation is essential for ensuring the overall quality of the feed and the growth rates of the fish Because aquatic animals have low food intake, short digestive tract and poor digestion ability, the aquaculture feed requires fine granulation to increase the surface area of the feed and increase the digestive juice of aquatic animals.(Richi M, 2020). Selection of low cost and high-quality ingredients with proper processing into

complete feeds is equally important to the overall profitability of the aquaculture enterprise. Pellet quality and composition is important in improving the digestibility of feed and enhancing the health and disease resistance of fish (Wenwen, *et al*, 2020). Extrusion temperature is an important factor in the production of floating fish feed. During the extrusion process, higher temperatures are utilized to achieve floating ability. However, inappropriate temperature can negatively affect the quality of the feed. A study found that increasing the extrusion temperature from 120°C to 150°C resulted in a decrease in hardness of the feed pellet. Low pressure during extrusion can also affect the quality of the feed. The pressure condition of the extruder directly influences the bulk density and water absorption of the feed, and high water absorption can lead to poor floating ability which is important to carefully control the extrusion temperature and pressure to ensure the quality of the feed. The cost of production in recent years has seen a tremendous increase in the said Regions of Cameroon. The cost of key ingredients in fish feed has increased significantly in recent years due to the rising prices of global commodity and energy prices. In recent years, the cost of fish feed production has skyrocketed and according to Christian *et al 2022,* high energy prices raise fuel and fertilizer prices, boosting food production costs, and that fertilizer prices are double what they were before the pandemic, even after a pullback in recent month. The trade disruption caused by the Ukraine-Russia crisis is leading to a sharp increase in the prices of corn and wheat, which are key ingredients in fish feed. This has resulted in higher feed costs for livestock producers, who are already facing inflationary pressures that may create more headwinds on the demand side. (Tyne M, 2O22).

Indeed, the use of inappropriate feed formulations is a common problem in the Cameroonian fish farming sector (Munguti *et al.,* 2012). According to FAO (2020), the increase in the number of importers of fish feed can be attributed to the growing demand for fish and fish products, the shift from using waste or farm-made feeds to industrially manufactured pellets, and the low volume of domestic fish meal production in some countries.

CONCLUSION

The assessment of the challenges facing the fish feed production sector in the Centre and Littoral Regions of Cameroon has revealed several issues that need to be addressed. The fish feed production units were observed to dry their feeds on the floor and store them improperly, which can lead to deteriorative changes in the quality of both raw materials and finished feeds. Inadequate drying and storage systems led to spoilage due to high moisture content. The cost of key ingredients used in fish feed, such as soybean, corn, fishmeal, fish oil, rice, and wheat, has been increasing, leading to a significant increase in the cost of production. Most of the fish feed production units in the Centre and Littoral regions of Cameroon have a moisture content that ranges between 10.5% and 18.3%, which is higher than the recommended 10% or less. The use of poorly ground raw materials in fish feed formulation is common, which can negatively impact the feed quality and, consequently, the growth rates of the fish. The fish feed produced by the fish feed production units did not meet the nutritional requirements of the fish. The local fish feed production sector faces intense competition from imported fish feed, leading to market saturation and reduced profitability for local producers. The lack of low-cost and readily available raw materials was another challenge that the fish feed industry faced. The equipment used in fish feed production, such as extruders and heavy dryers, were expensive and difficult to manipulate or repair when they became worn or damaged. The nutritional composition labeled on fish bags did not match the results of the analysis after assessing some fish feed production units.

RECOMMENDATIONS

- Fish feed production units should improve their drying and storage systems to prevent spoilage due to high moisture content;
- The use of well-ground raw materials in fish feed formulation should be encouraged to ensure the overall quality of the feed and the growth rates of the fish;
- The nutritional requirements of the fish should be considered when formulating fish feed to improve the quality of the feed;
- The government should provide support to local fish feed production units to reduce their dependence on imported fish feed and improve their competitiveness;
- The government should also provide support to local fish feed production units to improve their equipment and spare parts availability;
- The government should encourage the production of low-cost and readily available raw materials for fish feed production.

PERSPECTIVES

- Improving the quality of fish feed can lead to better growth rates and health of fish, which can increase the profitability of fish farming;
- Reducing the dependence on imported fish feed can improve food security and the availability and affordability of fish, especially for poorer households that rely on fish as a source of protein;

- Improving the competitiveness of local fish feed production units can lead to increased employment and economic growth in the fish feed production sector;
- The government should continue to support the development of aquaculture in Cameroon to reduce the country's surging seafood imports and improve food security.

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