

Current Status of the Nigerian Aqua Feeds Industry: A Review

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Abstract: *Nigeria, with a population of about 175,000,000 people is grossly undernourished; lack of adequate protein being the primary factor. Currently, the Nigerian aqua feeds industry is experiencing rapid growth. However, production capacity cannot match the ever increasing aquaculture production thereby resulting in a whopping 75 percent importation of the total aqua feeds required by the fish farmers in Nigeria. Admittedly, this problem needs urgent attention. With this in mind, the authours have reviewed the importance of fish in human nutrition to buttress the superiority of fish protein over all other protein and why fish demand always outpace supply. Overview of the aquaculture production is also presented to compare fish demand and supply alongside the ever increasing population in order to establish deficit. Past and current status of the Nigerian aqua feeds industry is also reviewed and the established trend indicated that while there was a dwindling production capacity in the 1980s, a sharp increase was noticed in 2000 when production capacity of 35,570 tonnes of aqua feeds was recorded while production stood at 10,760 tonnes. In 2015, Nigeria is estimated to have produced 647,750 metric tonnes of aqua feeds. A review of the supply analysis indicated that Nigeria still needs to step up local production in order to reduce importation. The last section of this review deals with the challenges faced by the Nigeria aqua feed industry with lack of feed ingredients taking the lead. Indirect devaluation of naira has been seen to have a serious negative impact on the prices of ingredients used to manufacture these aqua feeds as well as, inadequate supply of maize and soybean, which are also competed for by humans and livestock. From this review, it is seen that there is an urgent need for Nigeria to step up aqua feeds production if Nigeria must attain self-sufficiency in terms of fish production. The solution to it is for government to provide assistance to the agricultural sector by earmarking a better percentage of the country's budget for people to do commercial agriculture. Incentives should also be made available on areas like fish nutrition, processing and feed formulation in order to encourage the youths in becoming experts in this fields.*

Keywords: *aquafeed, feedstuff, fishmeal, maize, soybean, self-sufficiency.*

1. INTRODUCTION

Nigeria, having a population growth rate of 2.38 percent (2008 estimate) and projected population of 206,165,946 in 2025 (2025 estimate) is not adequately supplied with protein, which is one of the basic parts of our daily diet (FAO, 2014). According to Central Bank of Nigeria (CBN, 2016), beef per capita per annum in Nigeria is about two kilogrammes while egg is about four kilogrammes. Local milk production is also inadequate when compared with the current population of about 180 million people. For instance, in 2010, about 0.5 million metric tons of milk were produced in Nigeria, 0.57 in 2013 and since then the production rate has stagnated. Average yield remained at approximately 0.8 litres/cow/day over the past decade. The country therefore is dependent on importation to meet up with the 1.45 billion litres estimated national milk requirement. Egg production of 10.3 billion per annum is not enough when compare with the current population. The same scenario is seen in fish production. According to the Nigeria fishery statistics - 2016 Summary report, the total fish demand for Nigeria calculated on the basis of the current population structure is 3.32 m Mt while domestic production from Aquaculture, Artisanal and Industrial fisheries stood at 1.123m Mt. This shows a deficit of 2.197 m Mt. From all indications, an average Nigerian is malnourished with regards to protein and essential amino acids intake. In order to ameliorate this problem, all hands must be on deck among the stakeholders in term of improved production of all the aforementioned protein based agricultural products so that they will be available and affordable to average Nigerians.

Feed production and quality is considered to be one of the major factors influencing the success of fish production in aquaculture. According to finding, feed constitute up to 60 percent of total operational costs in aquaculture production (Ozigbo, *et al.*, 2014). Unfortunately, this percentage contribution is going higher as aqua feeds industry is hamstrung by many challenges including lack of

feed ingredients and lack of trained personnel. The objective of this work is to present an overview of why fish is needed more than any other protein source by humans and why aquaculture should be given more attention, present useful information on the status of fish production vis-à-vis past and current status of aqua feed production. Supply analysis of aqua feed is also presented while challenges facing the Nigerian aqua feeds industry and the way out are also x-rayed.

2. THE IMPORTANCE OF FISH IN HUMAN NUTRITION

Over the years, humans have used fish protein as a food source. Besides, many health benefits are associated with eating fish. For example, fish and shellfish are rich sources of omega-3 fatty acids Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). These two anti-inflammatory omega-3 fatty acids are readily needed by the body (Ruxton *et al.*, 2004). Any species of wild-caught salmon either fresh or canned, sardines, albacore tuna, trout or mackerel has over 500mg of DHA plus EPA per 3.5 ounce serving. Those with moderate amount (150 mg-500 mg per 3.5 oz serving) include haddock, cod, hake, halibut, shrimp, sole, flounder, perch, bass, oysters, crab and farmed salmon). According to Djoussé *et al.* (2012), intake of marine omega-3 fatty acids is associated with lower risk of heart failure. Research also shows that fish may increase grey matter in the brain and protect it from age-related deterioration (Raji *et al.*, 2014).

Eating of fish can also help humans to overcome depression and become happier persons (Hallahan, 2007). Fish is also a very rich source of vitamin D. Some Fat-loaded fish like salmon and herring contain the highest amounts of vitamin D (Malesa-Ciećwierz and Usyduś 2015). According to these authors, a single 4 ounces which is equivalent to 113 grams serving of cooked salmon has about 100 percent of the recommended intake of vitamin D. Fish is also a very good source of other vitamins such as vitamins A and B complex. Macular degeneration, also known as age-related macular degeneration (AMD or ARMD), a medical condition which may result in blurred or no vision in the center of the visual field is a major cause of blindness globally (Lim *et al.*, 2012). According to Augood *et al.* (2008) consumption of oily fish at least once per week is linked to a 50 percent reduction of the odd ratios for neovascular age-related macular degeneration and therefore protects our vision during old age. Eating fish is also associated with reduced risk of autoimmune diseases, such as type 1 diabetes in both children and adults, rheumatoid arthritis and multiple sclerosis (Löfvenborg, 2014; Bäärnhielm, 2014). According to Yang *et al.* (2013) regular intake of fish and fish oils is related with a 24% lower risk of asthma in children. Research has shown fish may also improve sleep quality and it is delicious and easy to prepare (Hansen *et al.*, 2014). Fish is also rich in fluoride, iodine, zinc, and iron. It is also an excellent source of selenium which is incorporated into a number of enzymes in the body, such as glutathione peroxidase. Glutathione peroxidase plays a significant role in cell membrane protection from damage by free radicals, associated with increased risk of heart disease and cancer. The enzyme binds free radicals, makes them innocuous and thereby helps to protect our body against heart disease and certain cancers of different parts of the body.

2.1. Fish Demand Versus Supply

The awareness that fish is among the healthiest foods around the globe, coupled with the increase in human population has resulted in an increase in demand for fish and fish oil. Report had it that about 40 percent increase in fish demand has been recorded between 2000 and 2015 while about 35 percent increase in deficit over same period was anticipated (FDF, 2008). With the current consumption rate of over 1.5 million tons of fish per annum (CBN 2016) there is still a wide gap between demand and supply which must be filled if Nigeria is to achieve food security. Small and medium scale enterprises (SMEs) when combined with artisanal fisheries contribute about 82 percent of the domestic fish production. However, as catch from the wild is dwindling, aquaculture remains the only alternate source of fish and other aquatic products for human consumption. Globally, the projected fish supply from fish farming stood at 50 percent by 2020. This trend provides an impetus to intensive fish farming in Nigeria strongly supported by a viable aqua feeds industry (EDR, 2014).

3. OVERVIEW OF AQUACULTURE PRODUCTION IN NIGERIA

Notwithstanding that the Nigerian aquaculture industry is about 50 years old (Olagunju, *et al.*, (2007), yet the country has not been able to meet domestic production demand for the populace (Table 1). Regarding her potentials, Ita *et al.*, (1985) in their survey reported that the country has about 13 million hectares of cultivable waters which could be harnessed for aquaculture production. A good number of cultivable fish species both exotic and indigenous have also been documented (Ngueku,

2015). Among the numerous cultivable fish species in Nigeria a significant breakthrough in terms of seed production and new culture technology have been achieved in catfishes of the genera *Clarias* and *Heterobranchus*. They are the most commonly farmed fish (about 90 percent) and most every national investment in aquaculture has been tailored towards its development. According to a recent review by Francis and Davies (2014) some marine species such as *Tilapia guineensis*, *Sarotherodon melanocheilus*, *Pseudotilapia spp.* (the croakers), *Lutjanus spp.* (the snappers) and *Epinephelus* (the groupers) etc. are now good candidates for aquaculture practice in Nigeria. There is no gainsaying the fact that Nigeria is potentially fit to produce fish to meet the rapidly growing population provided that aqua feeds production is given very serious attention. In recent years, a swift growth of this industry has been reported by many researchers (World Bank, 2013; Little *et al.*, 2016). However, Nigeria is now struggling with the obligation of meeting self-sufficiency in terms of fish production.

Ozigbo, *et al.*, (2014) posited that nutrition improvement especially in rural areas, revenue diversification, and employment creation remained the objectives of aquaculture development in Nigeria. In rural communities, where opportunities for economic activities are limited, aquaculture activities are seen as the fulcrum of both youths and women empowerment. Recently, aquaculture has been viewed also as an activity that is very promising in terms of meeting the deficit in fish supplies, thereby curbing importation.

Although aquaculture production in Nigeria has experienced rapid growth in recent years, the industry is still constrained by an inadequate feed supply. The poor quality local feeds currently used by the industry sparks mortalities, exacerbates low productivity and consequently result in low rate of return on investment (ROI). On the other hand, the prices of imported feeds are skyrocketing, fuelled by the current abrupt rise in exchange rate. From the foregoing, a viable aqua feed industry is needed for a sustainable aquaculture production in Nigeria.

Table 1. Aquaculture Production in Nigeria since.

YEAR	Projected Population (Million)	Projected Fish Demand (Tonnes)	Projected Domestic Fish Supply (Tonnes)	Deficit (Tonnes)
2000	114.40	1430.00	467.098	962.902
2001	117.60	1470.00	480.163	984.836
2002	121.00	1412.50	507.928	1004.572
2003	124.40	1555.00	522.628	1063.082
2004	128.00	1600.00	536.917	1063.072
2005	131.50	1643.75	552.433	1091.317
2006	135.30	1691.25	567.948	1123.307
2007	139.10	1732.75	585.872	1154.873
2008	143.00	1782.30	600.612	1186.887
2009	147.10	1838.75	617.353	1221.397
2010	151.20	1810.00	634.500	1255.440
2011	155.50	1943.75	652.606	1291.143
2012	160.00	2000.00	689.958	1328.508
2013	164.00	2113.75	709.683	1365.042
2014	169.10	2175.00	730.248	1404.067
2015	174.00	2055.00	671.493	1444.752

Source: (FDF, 2008) (Tonnes × 1000)

4. STATUS OF NIGERIA AQUA FEEDS INDUSTRY

4.1. Past Status of Aqua Feeds Industry

According to UNCTAD/GATT (1984), total production of compound feed in Nigeria was estimated at around 800,000 tons in 1981, 600,000 tons in 1982 and 400,000 tons in 1983. The decline has been attributed to the serious domestic economic crisis then prevailing and its impact on the livestock sector. The approximate shares by feed type in total output during these years were as follows: Poultry feed, 90 percent, cattle feeds, 7 percent, feed for pigs and other animals, 3 percent. Production was projected at estimated 480,000 tons at end of 1984. By 1986 demand for compound feeds from industrial livestock farms (of which 90 percent will be commercial poultry operation) would climb to about 600,000 tons of poultry feeds and 90,000 tons of feed for pigs and other animals, or a total of 690,000 tons. During these years, the contribution of aqua feed to the total animal feed production

was very negligible. It was grouped among the three percent contribution by pigs and other animals (Figure 1)

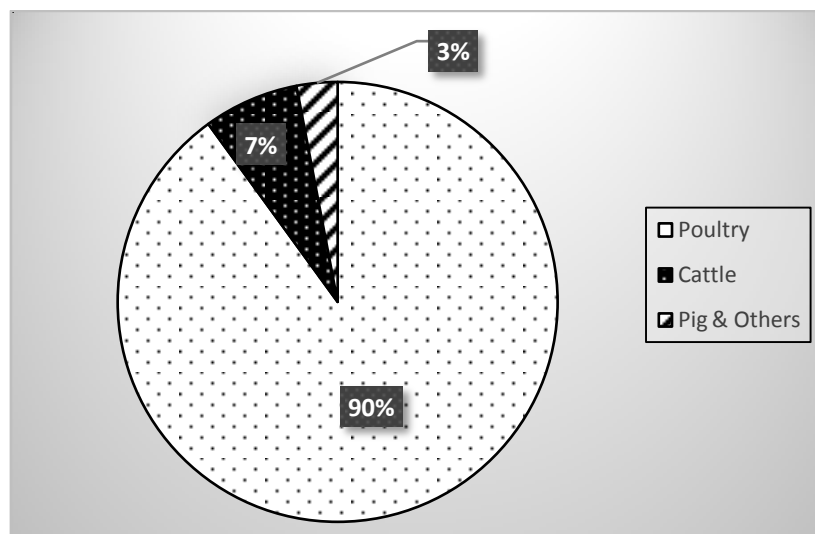


Figure 1. Nigeria's animal feed sector as at 1984 (Source: UNCTAD/GATT (1984))

Of the 350 feed mills registered in 1983, only 185 were operating in mid-1984. Their total production capacity was 1.2 Mt of compound feed annually. Three companies accounted for about 50 percent of total production, plants integrated into large scale poultry production 20 percent and small plants with hourly capacity of up to 2.3 tons 30 percent (ibid.).

In 2000, an estimated 35,570 tonnes of feed were used by the Nigerian aquaculture industry (Fagbenro and Adebayo, 2005). This quantity still represented a negligible proportion (< 1 percent) of the national feed production. However, aquafeeds industry has started to gain recognition. A projection of future aquafeed requirements for 2015 suggests that at an annual growth rate of 10 percent, Nigeria would have the potential to produce sufficient aquafeeds using existing production capacity. The contribution of the Nigerian aquafeeds industry to the national feed production is presented on figure 2.

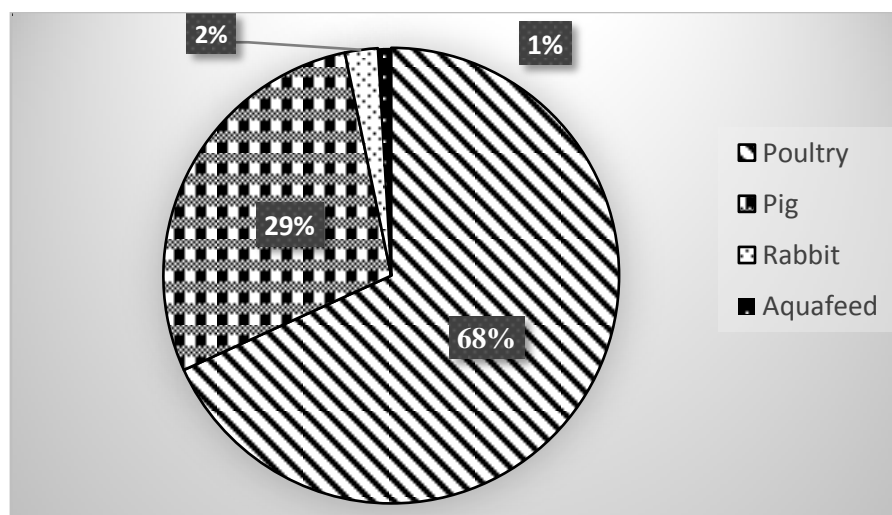


Figure 2. Nigeria's animal feed sector as at 2000 (Source: Fagbenro and Adebayo, 2005)

4.2. Present Status of Aqua Feeds Industry

Nigeria has significantly improved in the area of aqua feeds production between 2014 and 2015. Nigeria is now rated as one of the largest emerging animals feeds producers in the world with the potentials for commercial production. In 2015 the Nigeria's animal feed sector has been rated as number 40th in the world; moving 11 steps forward from its previous ranking of number 51 among the 130 leading animal feeds producing countries in the world. Nigeria is estimated to have produced 3.8 million metric tons (MT) of animal feeds in 2014 and 5.3 million MT of animal feeds in 2015 with aquaculture contributing 12 percent second to poultry production (Figure 3).

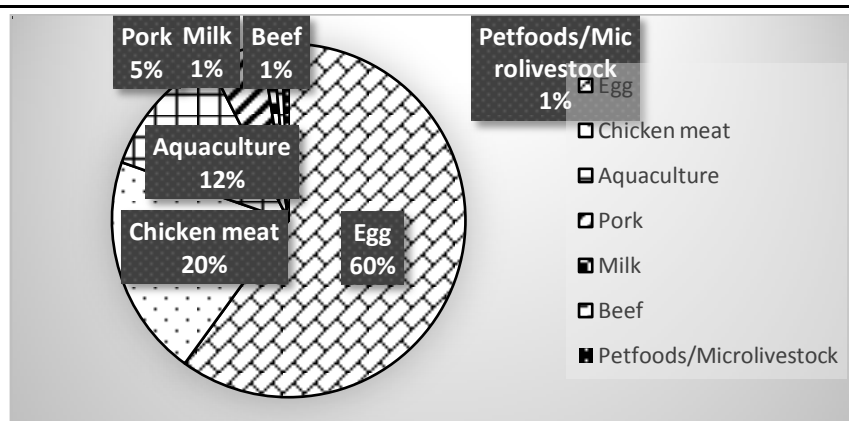


Figure 3. Nigeria's animal feed sector as at 2015 (Source: Alltech, 2016)

5. AQUA FEED SUPPLY ANALYSIS

In Nigeria, the aqua feed industry is dominated by few large commercial feed industries usually based in Europe, Asia or America who run local franchised industries. Currently, emphasis has been placed on encouraging indigenous feed enterprises that make use of local ingredient in formulating feeds for the fish industry. The task of meeting the increasing demand for fish feed can best be realized through increased availability of indigenous feed production. indigenous Feed Enterprises are seen as an honest approach because of ease of availability of raw materials, and access by fish farmers. Several strategies have been adopted such as price policies, input subsidies, production credit and liberalization by governments and individuals to increase the output of these fish feed enterprises, yet their performance is low in terms of meeting the needs of the fish industry. Interestingly, the request for the products of the enterprises is daily on the increase (EDR, 2014). Two types of aquafeeds are used to culture fish in Nigeria. According to Ibiyo and Olowosegun (2005), these are On-farm feed and commercial feed.

5.1. On-Farm Aqua feeds.

These are farm made feeds. According to Ibiyo and Olowosegun (2005), of the estimated total of 35,570 tons of aquafeed produced in year 2000 on-farm feed account for a whopping 70%. On-farm feeds are usually made up of naïve feedstuffs fed as blended, doughs or compressed pellets (Shipton and Hassan, 2013). The quality of farm made aquafeeds depends on the method of formulation, ingredient quality, availability and affordability; and the processes of manufacture. In Nigeria, farm made aqua feeds are cheaper than commercial aquafeeds little wonder local farmers have preference for them. According to these authors, they remain the only option for semi-intensive farmers in Nigeria. Non-conventional feed ingredients are commonly used in on-farm aqua feed production in rural areas in Nigeria among low income group that are actively engaged in fish farming (Abowei and Ekubo, 2011) and most of these non-conventional ingredients have been evaluated (Udo and Umoren, 2011). According to Ogugua and Eyo (2007), the production quantity is not clear since it difficult to quantify.

5.2. Commercial Aqua Feeds

Commercially manufactured aqua feeds are feeds that are wontedly formulated to meet the nutritional requirements of a distinctive fish species and their different life stage. Two forms of commercial aquafeeds have been identified viz. locally manufactured and imported commercial feeds (Shipton and Hassan, 2013).

5.2.1. Locally Manufactured Aqua feeds

Currently, Nigeria is rapidly gaining access to locally manufacturing capacity and consequently, many local feed millers are producing some fish feeds, viz. CHI, Grand Cereals for Vital Feeds and aquamax, Tempo Feed Mill for Fresh line Feeds and Durante (Gabriel *et al.*, 2007) others are: MOSAB, Ideal Fish Feeds, Aqua Vista Feeds, Megatimex, UNIFACO, Aqua Plus, High Yield, Jib Feeds, Darrell Feeds, premier feed etc. (USAID, 2010) These companies offer compounding services (tolling) to farmers willing to self-formulate their feeds. According a survey by Alltech, (2017) Nigeria, among other African countries showed evidence of growth greater than an impressive 30 percent in 2016.

5.2.2. Imported Fish Feeds

According to foraminifera market research, Nigeria import aqua feeds amounting to an estimated 75 percent of the total feed production. In a nutshell, Nigeria imports between 700,000 and 900,000 metric tons of fish annually. Imported feeds are all high quality floating feeds. Admittedly, small fish need high protein (50% CP) and tiny pellets (0.8-1.5 mm) feeds that jumpstarts their growth. As most local aqua feeds only include the larger size pellets that are mostly of low crude protein content, fish farmers resort to imported starter feeds. Many fish farmers prefer using imported starter feeds throughout the nursery stage (1-2 months) before changing to the lower cost feeds (USAID, 2010) which most of the times are locally produced pellets. These imported smaller pellets are very expensive, but the high crude protein content boosts the growth of the young larvae and fry. Some imported aquafeeds used by fish farmers in Nigeria are presented in Table 2.

Nonetheless, current assessment of aquafeeds used by fish farmers in Nigeria showed that 33.3 percent of the fish farmers used both imported and local pelleted feeds, 26.7 percent used locally produced pelleted feeds, merely 20 percent used imported feeds only, 16.7 percent used other Nigerian feeds, while 3.3 percent used locally manufactured powdered feeds in feeding their fish (Obe and Omojola, 2015).

Table 2. Imported aquafeeds used by fish famers in Nigeria

Brand name	Country imported from	Pellet type	Pellets size (mm)
Coppens	Netherlands	Floating	0.2, 0.3, 0.5, 0.8, 1.2, 1.5, 2.0, 3.0, 4.5, 6.0, and 8.0
Sharp	China	Floating	0.2, 0.3, 0.6, 0.85, 1.2, 1.5, 2.0, 3.0, 5.0
Raanan Feed	Isreal	Floating	0.2, 0.3, 0.5, 0.8, 1.2, 1.5, 2.0, 3.0, 4.5, 6.0, and 8.0
Multifeed	Isreal	Floating	0.2, 0.6, 1.1, 1.4, 2.0, 3.0, 4.0, 6.0, and 9.0
Zeigler	USA	Floating	≤ 0.6, 0.85, 1.2, 1.5, 2.0, 3.0, 5.0
SARB Gheerbrant	Germany	Floating	0.2, 0.6, 1.1, 1.4, 2.0, 3.0, 4.0, 6.0, and 9.0
Skretting (France)	France	Floating	0.2, 0.6, 1.1, 1.4, 2.0, 3.0

Source: Authors, USAID 2010

6. CHALLENGES FACING THE NIGERIAN AQUA FEEDS INDUSTRY

The challenges faced by the Nigerian aqua feeds industry are presented in figure 4. Obe and Omojola, (2015) in their assessment posited that main challenge faced by the Nigerian aqua feeds industry is high cost of feed ingredients which constituting about 60 percent of the total challenges. The major ingredients in aqua feeds are fishmeal, soybeans and maize. Major diets ingredients include cereals, fats and oils, which serve as protein and energy sources in the aqua feeds. Indirect devaluation of the naira has also result in hike of raw material prices, particularly fishmeal, maize and soybean. Currently, maize production has been negatively affected by pest. These has resulted in a sudden jump in the prices of aqua feeds. According to Daily Trust of 20 October, 2016 the prices of fish feeds, have risen by up to 80 to 100 percent and many fish farmers have been compelled to leave the business especially in Lagos State.

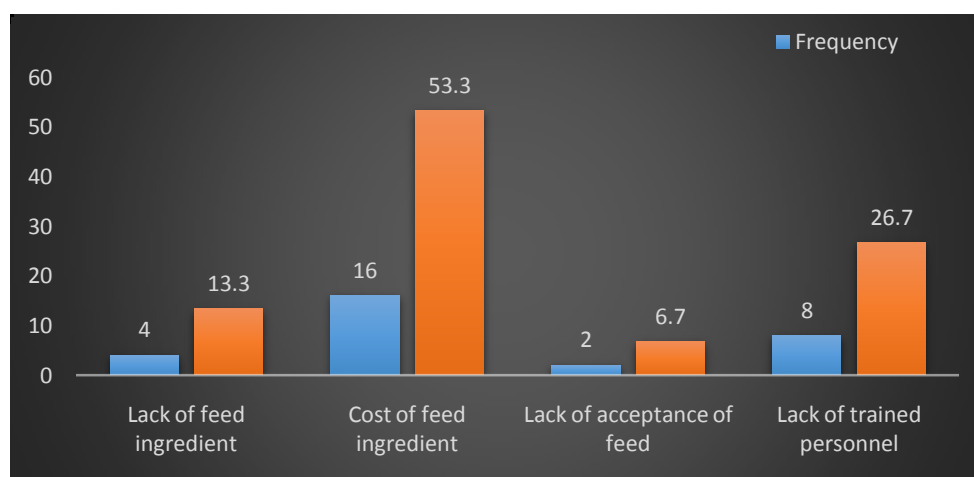


Figure 4. Challenges of the Nigerian Aquafeed Industry

Source: Obe and Omojola, (2015)

Lack of trained personnel in areas of aquaculture nutrition, feed formulation and processing, and machine operators is second among the challenges constituting about 27 percent of the challenges. (Ogugua and Eyo 2007, Obe and Omojola, 2015)). For instance, fish feeds processed by extrusion exhibit floating characteristic of imported floating fish feed. Glaringly, extruded feeds are more cost effective than compressed pellets. It also exhibits improved quality which resulted in increased profitability for both importers and fish farmers.

Lack of feed ingredients is the third in the list constituting about 14 percent of the challenges. The cause of unavailability of feed ingredient are suboptimal production of raw materials, animal and human increase competition for energy sources/conventional feed ingredients. "Poverty Syndrome" has led to unnecessary pressure being directed toward maize and soybean. For instance, maize is consumed by the poor Nigerians as *ogi/akamu*, *tuwo*, *semovita* etc. while soya is consumed as soya milk, soya puff, soya-iru, soya-egusi, soya meat, soya-garri etc. Continuous growth of Nigerian /Global population along side aquaculture also contribute to lack or shortage of feed ingredients. According to Shepherd and Jackson (2013), the estimated use of fishmeal by aquaculture is 75% while crustaceans use the largest portion (29%) as compared to other fish species. Current level of raw materials production does not meet the needs of both animal and aquafeeds industry and the non-conventional ingredients which could be used as substitutes have limitation in commercial quantity as well as localized availability. Seasonality results in inconsistency in availability and quality.

7. CONCLUSION

With the rapid growth of aquaculture, Nigeria has currently improved significantly in the area of aquafeeds production between 2014 and 2015. Nigeria is now rated as one of the world's largest newly independent aquafeeds producers with a better opportunity for commercialization. However, recent statistics show that currently up to 75 percent of the total aquafeeds used by fish farmers in the country is imported. The recent dwindling yield in grains production has also encouraged importation. To meet increasing demand for feeds ingredients, current national production will have to be beefed up and alternative sources exploited and commercialized. New methods of processing and formulation will also go a long way in increasing the chances of inclusion of the non-conventional ingredients into aquafeed. In order for the Nigerian aquafeeds industry to reach self-sufficiency, government should provide assistance for the agricultural sector by setting aside more money for people to do commercial agriculture. New methods of crop production should also be employed as this will go a long way in improving productivity of feed ingredients required to manufacture nutritionally balance and cost effective aquafeeds for great expansion of aquaculture in Nigeria.

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