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Reoccurring Constraints in Fish Culture and Fish Nutrition in Nigeria

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Abstract

Aquaculture remains one of the fastest-growing agro-industrial activities in the last four decades and is projected to outpace population growth. Nigeria is the second-largest aquaculture producer in Africa with a production output of about 300, 000 tons annually and largely dominated by catfish culture. Aquaculture development in Nigeria was primarily driven by socio-economic objectives such as supplementary income generation, improvement of nutrition in rural locations and employment creation. Despite the potential impacts of the fisheries and aquaculture resources, the sector is however still confronted with numerous challenges including the high cost of inputs, use of unimproved breeds in aquaculture, need for improved access to finance and most especially, the high cost of feeds amongst others. The aim of this review paper is, therefore, to deepen our understanding of these challenges while also proffering noteworthy recommendations that would leverage aquatic food systems capacity to contribute to the attainment of some sustainable development goals (SDGs) in Nigeria in the coming years. Lack of trained personnel in areas of aquaculture nutrition, feed formulation and processing, and machine operators is among the biggest challenges faced in the aquaculture industry in Nigeria amongst others. And so definite practical steps need to be taken so that the basic needs of the populace for food security and means of poverty alleviation amongst other social development goals can be met.

Keywords: Fish; Culture; Nutrition; Constraints; Recommendations; Nigeria

Introduction

Aquaculture remains one of the fastest-growing agro-industrial activities in the last four decades and is projected to outpace population growth. In the next decade, total output from both capture and aquaculture is envisaged to exceed that of other livestock produce [1, 2]. Aquaculture was developed more than 2,000 years ago in countries such as China, Italy, and Egypt. Not long after, aquaculture practices in Europe, China, and Japan commonly involved stocking wild-caught fingerlings, for example, carp fingerlings (juvenile fish) captured from rivers in ponds or other bodies of water for further growth [3].

Nigeria is the second-largest aquaculture producer in Africa with a production output of about 300, 000 tons annually and largely dominated by catfish culture [4, 5]. Aquaculture production began in Nigeria over five decades ago [6]; however, it has not been able to bridge the gap between domestic consumption and production output [4]. Aquaculture development in Nigeria was primarily driven by socio-economic objectives such as supplementary income generation, improvement of nutrition in rural locations and employment creation, until recently when the perspective of aquaculture was changed and tailored to meet domestic shortfalls in fish supplies to reduce fish importations [4].

According to Digun-Aweto and Oladele [7], aquaculture has shown capacities to serve as means of livelihood, improve living standards, provide employment and generate foreign exchange in many countries and recent investment in Nigerian aquaculture has been targeted towards catfish farming. Fisheries and aquaculture play a significant role in global food supplies, and demand for high-quality aquatic protein is expected to increase substantially as income levels rise and Asia and African populations expand [8]. Fish is very important in the diet of many Nigerians, high in nutritional value with complete array of amino acids, vitamins and minerals [9].

The fisheries sector accounts for about 2% of national G.D.P, 40% of the animal protein intake and a substantial proportion of employment, especially in the rural areas; the sector is .a principal source of livelihood for over three million people in Nigeria [3]. Despite the potential impacts of the fisheries and aquaculture resources, the sector is however confronted with numerous challenges including the high cost of inputs, use of unimproved breeds in aquaculture, need for improved access to finance [10] and most especially, the high cost of feeds amongst others.

The importance of the fisheries sector to individuals and the economy of many developed and developing countries [11] cannot be overemphasized. It is notable that fish provides more than 60.0% of the world's supply of protein, especially in developing countries. Its importance could be felt directly and indirectly among rural and urban residents in Nigeria. The aim of this review paper is, therefore, to deepen our understanding of these challenges while also proffering noteworthy recommendations that would leverage aquatic food systems capacity to contribute to the attainment of sustainable development goals (SDGs) in Nigeria in the coming years.

Water quality

Aquaculture depends predominantly on water and regular monitoring of water quality is a necessity. Fish cultivation also known as aquaculture consists of natural and artificial fish farming carried out in ponds [6]. In addition to the use of ponds [12], fishes are also cultured in various other water holding facilities such as pens, happas, tanks, cages, raceways, etc. Water quality and quantity are critical factors to successful fish production and so water used for fish culture should be void of any chemical harmful to fish and be within acceptable pH range of 6.5-9.0. To a large extent, water temperature

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will determine what species of fish can be grown successfully [9]. Water is the environment for fishes and its quality determines its fitness for use and capacity to sustain the health of farmed aquatic organisms. Environmental pollution is a primary burden of aquaculture as poor water quality in fish ponds will result to deteriorated fish health and eventually low production rate. The status of various water parameters like turbidity, pH, alkalinity, hardness, ammonia, nitrite, nitrate, Biochemical Oxygen Demand (BOD) etc. cannot be overlooked for maintaining a healthy aquatic environment [13]. Water quality is one of the most overlooked aspects of pond management as it affects fish production [12]. If culturists are properly guided and aware about water quality management practices, they can get maximum fish yield in their ponds to a greater extent [13].

Previous research has shown that even the nature of the fish culture receptacle matters with respect to management of water quality. This was seen in the research carried out by Orobator [14] in which the water quality from selected aquaculture ponds in Benin City, Nigeria and its suitability for fish husbandry was evaluated. It revealed that black tarpaulin pond had higher contents of most water quality parameters than deep concrete pond, white plastic tank, black plastic tank, earthen pond and surface concrete pond respectively. This point to the effects of the gradual dissolution of polyvinyl chloride (PVC) from the interior surface of the black tarpaulin into the fish pond water. The study recommended regular monitoring of the conditions of fish culture facilities and pond water to ensure compliance with water quality standards and environmental regulations. This would help to reduce greatly the concentrations of dissolved vinyl chloride in black tarpaulin pond. It also advocates that from amongst the different types of fish ponds in Nigeria, black tarpaulin pond should be least considered when establishing one. Consistent awareness campaigns for fish culturists on the effect of the bio-accumulation of heavy metals on fish pond and application of lime to correct water pH to a more acceptable level for aquaculture use is also advocated.

Market availability

According to Alverson & Paulik, marketing is as old as human beings. It is closely related to all endeavors [15]. Fish marketing in Nigeria is hinged on some basic questions: What do consumers want? Which species? What price, size, form, quality, quantity and grading? Fish marketing is a complex venture to an extent. From harvesting to transportation and processing over a wide geographical range by a large number of traders, the sector needs the support of all. The major constraints facing fish marketing in Nigeria are pronounced in the various pre-harvesting methods of fishery products in Nigeria [15].

According to Agbebi [15], there is a lack of cooperation for the enhancement of a reliable marketing system for the country. Also, is the lack of the development of large scale post-harvest technologies and the improvement of transportation systems that can support the delivery of fish products to the market.

Lack of aquaculture polices and framework

There is no specific legislation on aquaculture nationally in Nigeria [16]; however, the Inland Fisheries Decree (1992) empowers the Minister in charge of fisheries matters to regulate the licensing of enclosures such as pens and cages [17]. The current policy considers aquaculture as an industry in which production at all levels of the value chain is driven by the private sector, while the government creates enabling environments [18]. This issue has made several fish farmers to engage in sharp practices in order to boost their production and profit margin. And this is dangerous to the micro-organisms in the aquatic environment, the fish and most especially the end consumers in the long run.

Production and management of quality of fish seeds

There is a pressing need to address the challenges of inadequate production of high-quality brood-stock and seed encountered by the aquaculture industry in Nigeria [9]. The demand-supply gap for fish seed is considerably huge [19] as Nigeria currently requires at least 1 billion fingerlings/seeds annually to meet market demand for table size fish while it barely produces about 55 million fingerlings from all available sources [20]. Many technical problems arise in the production of fish seed either in the pond or hatchery system. Principal among these are: the lack of and poor management of brood stock, especially feeding and handling; and the poor record keeping of all activities regarding induced spawning, care of eggs, fry, feeding, and general management of fingerlings. Many erstwhile enthusiastic farmers have suffered colossal failures due to poor management skills. Aquaculture involves risk of fish seed loss due to wide pH fluctuations, oxygen depletion, parasites, water pollution, disease, predators, flooding, vandalism etc. [9].

Nigerian aquaculture industry also needs to explore the potentials of genetics and modern technologies in breeding. This will enable the development of high quality fish seed. A number of successful research works has been going on, on the cryopreservation of Clarias sperm and testing of the viability of this cryo-preserved sperm in fertilizing freshly spawned eggs [21-23]. Success of these research and application on a commercial scale will help to conserve male brood stock, which are normally sacrificed for fry production of catfish, and likewise ensure all-year round artificial propagation, helping the fish farmers in overcoming the problem of scarcity of male catfish breeders which are often encountered in the dry season.

Brood stock management through feeding, water source for rearing, stocking capacity, genetic composition and culture are methods of improving the quality of fish seed supply to fish farmers also poor road network, inadequate water supply, scarcity of feed and poor brood stock management are constraints to improving the quality of fish seed supply to fish farmers [23].

Poor extension services and low level of technical know how

Many people who are currently engaged in catfish farming lack management skill [24]. And according to Ajieh [25], the low level of adoption of fishery technology due to lack of extension service as one of the factors that contributes to low productivity in the industry is a major issue in fish culture. In Nigeria, the interaction between the extension agent and the farmers is poor, due to the low level of education of most farmers. To improve the yield of fish production from aquaculture there is need to improve the educational status of most of the farmers. The Government should continually engage farmers in mandatory training sessions to update their knowledge on hands-on skills that will go a long way to improve their output. These steps would lead to enhanced fish production for viable and sustainable aquaculture development in Nigeria.

Lack of trained personnel in areas of aquaculture nutrition, feed formulation and processing, and machine operators is among the biggest challenges faced in the aquaculture industry in Nigeria [26, 27].

Poor aquaculture waste management

Potential pollutants from aqua feed are phosphorous and nitrogenous substances as well as organic matter and these are released to the environment majorly through excretion of fecal wastes, misuse

of medicated feed and uneaten feed. Apart from wastes from feed nutrients, waste waters from aquaculture may also contain residues of some chemicals, such as, medicants, feed additives, antibiotics, fertilizers, disinfectants, hormones, therapeutants and anesthetics commonly applied during farm operations [9].

According to Adewumi [9], the culture system commonly practiced in Nigeria includes stagnant tank, flow through, earthen pond and water recirculation systems. In stagnant and flow-through tank culture systems, all dissolved and suspended solid wastes are released into the environment on continuous basis throughout the production cycle. On the other hand, wastes from earthen ponds are released periodically, in most cases, at the end of production cycle and consist of a mixture of inorganic and organic particulate materials [28]. Gabriel also observed that the waste released in recirculatory systems is low, compared to tanks and earthen pond culture. Akinrotimi [29] reported that effluent from some catfish farms in Port Harcourt metropolis in Rivers State, Nigeria, constantly released into the environment, led to the destruction of the aesthetic value of the surrounding, with putrefying odor emanating from these areas. The release of these wastes on continual basis has led to the buildup of some pathogenic organisms and can result in the outbreak of epidemic diseases. The environmental impact of aquaculture wastes include but are not limited to: Eutrophication, reduction in dissolved oxygen level, production of toxic micro-organisms, direct toxicity on aquatic animals, disruption of fish assemblage in the wild and reduction of aesthetic value of the environment.

Most of these challenges stated can be managed by observing the following recommendations:

There should be proper planning when establishing fish farms by including effluent treatment facilities in order to reduce effluent loads and make treatment more efficient. Farms should also be encouraged to have soak away pits, improve feeding strategy and recycle aquaculture waste from time to time [9].

Lack of modern infrastructure

The lack of capital for investment in modern infrastructure does not encourage fish farming, thereby forcing a huge number of the fish farmers to abandon the enterprise in search of other means of livelihood. Some of the numerous consequences of this include rural urban migration, increase in crime rate and poor income from fishing and poor investment capacity Alhaji [30].

Lack of fishermen cooperatives

ICA [31] and Gábor [32] defines a cooperative as an autonomous association of persons united voluntarily to meet their common economic, social needs and ambitions through a mutually owned and democratically controlled enterprise. Cooperatives all over the world are instruments of social and economic transformation [33]. Cooperatives are established by people of the same mind to jointly pursue beneficial economic interest [34]. The effective mobilization of production resources brought about increase in output and income levels of the cooperative members. Cooperatives are financial organizations that provide savings and loan services to their members in the community [35]. Suffice to say that insufficient funding has continued to be the greatest limiting problem of agricultural production. In consideration of the impact of cooperative society in agricultural production in developed economics, farmers in developing countries had been encouraged to organize themselves into cooperative societies. Observations however, indicated that a good number of them, still do not participate in cooperative societies and the level of livestock production continues to decline as evidenced from the present high cost of meat, which leads to inadequate intake [36].

The Nigerian government has recognized the importance of the fishery sub-sector and it has made several attempts over the years to increase their productivity through institutional reforms and the various economic measures [37]. Some of these measures provided subsidy for inputs and exemption from tax for fishermen. Despite these efforts of government, there is still a deficit in the supply and demand for fish by the population [38].

According to Akerele [37], fish farmers in the study area are members of cooperative society and also have access to cooperative loan thus cooperative formed the main source of finance for their business. Cooperatives have been known for providing technical, educational and financial aid to their members. If well utilized by their members, it would lead to greater profitability in their businesses.

High cost of fish feed and fish feed ingredients

High and soaring cost of fish feed has been a major challenge confronting the economic viability of aquaculture development in Nigeria [39]. The production of high-quality aquaculture feed has also been a major constraint hindering the growth of the aquaculture industry in Nigeria [39]. The cost of feed currently accounts for about 80% of production cost due to currency devaluation, fluctuating exchange rate and inflation; thus increasing the cost of fish production [39]. The aquaculture industry in Nigeria largely depends on the importation of both manufactured feeds and feed ingredients due to insufficient local production and competitive use of ingredients with other livestock feeds [3].

The lack of feed ingredients is the most important challenge in Nigeria's aqua-feed production industry especially being that in fish farming (aquaculture), nutrition is critical because feed typically represents approximately 50 percent of the variable production cost. The indirect depreciation of the naira is believed to have had a serious negative impact on the price of raw materials for aqua-feeds. In addition, the supply of corn and soybeans is insufficient, and they are also contested by people and livestock

The cause of unavailability of feed ingredient is suboptimal production of raw materials, animal and human increase competition for energy sources/conventional feed ingredients. Continuous growths of Nigerian /Global population alongside aquaculture also contribute to lack or shortage of feed ingredients. According to Shepherd and Jackson [40], 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 aqua-feeds 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

Insufficient government funding of the sector

The government of Nigeria pointed out that fish production deficit stands at about 2.5 million tons, hence importation of the commodity continues, which has drained foreign exchange. This is majorly due to the lack or inadequate government funding of the sector. In this regard, the total demand for fish is 3.6 million tons annually while Nigeria is producing 1.1million tons from all sources (Aquaculture, artisanal and Industrial sectors) leaving a deficit of about 2.5 million tons to be supplemented by importation.

According to Ewepu [10], the government has made some efforts through the Federal Ministry of Agriculture and Rural Development to boost the nation's fisheries sub-sector, notably amongst are: backward integration policy of Government to encourage fish importers to go into commercial aquaculture (pond and cage culture) of fish and shrimp farming, establishment of fish farm clusters nationwide, establishment of fish feed mills in each of the six geo-political zones of the country, lake enhancement programs for stock assessment and stocking of water bodies nationwide to increase their productivity. Also is capacity building for farmers, extension workers, women and youth with the provision of starter packs for job and wealth creation, food and nutrition security, the establishment of cottage fish farms in Unity Secondary schools for entrepreneurship development, school feeding programme, targeted at the increase in protein intake to reduce malnutrition among students, issuance of letters of assurance to investors to go into deep sea fisheries exploitation for Tuna and Tuna –like fishes and other pelagic fish species for local consumption and export to an international market, diversification of fish species to provide alternative fish candidates for aquaculture and wide preference for our teeming Nigerians, aquaculture certification and the production systems for local consumption and export to international markets.

Speaking on the way forward to tackle challenges in the fisheries sub-sector, National President of Fish Association of Nigeria and also Regional Vice President for Fisheries and Aquaculture ECOWAS, Dr. Adegoke Agbabiaka, advised the Federal Government to liaise with the private sector across the states to facilitate and coordinate its programs for effective results. However, he pointed out that there are no funds to execute some of these projects and programs in the sub-sector [10].

Conclusion

These constraints in the fish culture industry in Nigeria has been an issue for years and only little progress has been made in recent years as compared to the growing demand for food fish from the teeming Nigeria population. And so definite practical steps need to be taken so that the basic needs of the populace for food security and means of poverty alleviation amongst other social development goals can be met.

Recommendations

Hatchery technologies and inputs needs to be improved by Government intervention programs, in addition to making them available to the farmers. Training and re-training of fish farmers on better and easier ways of using the improved methods should be arranged from time to time. More farmers should be motivated to adopt new technologies through the provision of credit facilities with very low interest rates, incentives, and important inputs. In line with this, research institutes in Nigeria need to be equipped with the necessary state of the art facilities that will help turn out viable fish seeds at faster and much cheaper rates to local farmers

Akerele [17] recommended that cooperatives at all levels should improve in emphasizing their existence and the benefits to farmers so as to help them increase their productivity and profitability. Government at all levels should provide all forms of aid needed by cooperatives to better perform their roles and carry out their activities. Government should try helping the small scale fish farmers by providing them loans with loans that require no collateral and which have little repayment interest rate. Also, the main center of this, which is the farmers, should be sensitive and willing to accept changes and increase their production activities by joining cooperatives. Membership of a fisher cooperative will significantly enhance the income of the fishermen, so cooperative membership should be seen as a major advantage in fish production. It is therefore recommended that fish farmers should form strong Farmer Associations to enable them combat the issues of accessing capital and poor pricing. This will aid in business expansion as the farmers will take advantage of economy of scale.

The best way for Nigeria is to learn and assimilate ways of improving her fish marketing system from advanced fishing Nations like Japan, which has a well-organized and developed central fish wholesale marketing network. The major actors in the enterprise must cooperate for the enhancement of a reliable marketing system for the country. In addition, the development of large-scale post harvests technologies and the improvement of transportation systems that can support the delivery of fish products to market. These are essential if fish will continue to contribute to Nigeria's dietary protein intake, generate more employments and increase the Gross Domestic Product. Fish marketers should form a co-operative society to enable them obtain loan from financial institutions so as to expand their marketing activities. Government and private organization should encourage fish marketers by building an organized market where retailers and wholesalers can off take from.

Finally, with any of the above mentioned recommendations, there should be a body or Federal Government agency or ministry that should be saddled with the responsibility of close monitoring and inspection of projects that have been funded by the government or international bodies so as to ensure total compliance to quality standards and measure the growth rate in the sector from time to time.

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