

Research Trends in Fisheries and Aquatic Sciences

Volume - 15

Chief Editor

Dr. Jitendra Kumar Sundaray

Head, Division of Fish Genetics and Biotechnology at ICAR-Central
Institute of Freshwater Aquaculture, Kauaslayaganga, Bhubaneswar, Odisha,
India

Co-Editor

Dr. Rayees Ahmad Bhat

Department of Zoology, Kurukshetra University, Kurukshetra, Haryana,
India

AkiNik Publications®
New Delhi

Published By: AkiNik Publications

AkiNik Publications

169, C-11, Sector - 3,

Rohini, Delhi-110085, India

Toll Free (India) – 18001234070

Phone No.: 9711224068, 9911215212

Website: www.akinik.com

Email: akinikbooks@gmail.com

Chief Editor: Dr. Jitendra Kumar Sundaray

Co-Editor: Dr. Rayees Ahmad Bhat

The author/publisher has attempted to trace and acknowledge the materials reproduced in this publication and apologize if permission and acknowledgements to publish in this form have not been given. If any material has not been acknowledged please write and let us know so that we may rectify it.

© **AkiNik Publications** TM

Publication Year: 2022

Pages: 132

ISBN: 978-93-5570-161-9

Book DOI: <https://doi.org/10.22271/ed.book.1998>

Price: ₹ 742/-

Registration Details

- Printing Press License No.: F.1 (A-4) press 2016
- Trade Mark Registered Under
 - Class 16 (Regd. No.: 5070429)
 - Class 35 (Regd. No.: 5070426)
 - Class 41 (Regd. No.: 5070427)
 - Class 42 (Regd. No.: 5070428)

Chapter - 7

The Drivers and Impacts of Inflation on Fish Production in Nigeria

Authors

Ochuko Joshua Eriegha

Department of Fisheries and Aquaculture, Nigeria Maritime
University, Okerenkoko, Delta State, Nigeria

Jerimoth Kesena Ekelemu

Department of Fisheries and Aquaculture, Delta State
University, Abraka, Delta State, Nigeria

Victor Oscar Eyo

Department of Fisheries and Aquaculture, Nigeria Maritime
University, Okerenkoko, Delta State, Nigeria

Chapter - 7

The Drivers and Impacts of Inflation on Fish Production in Nigeria

Ochuko Joshua Eriegha, Jerimoth Kesena Ekelemu and Victor Oscar Eyo

Abstract

Generally, inflation has been a major issue in recent times, with reports that inflation in several developing nations, like Nigeria, has reached levels not seen in the last 30-40 years. Fish farmers in Nigeria are contending with rapidly increasing prices for most inputs, such as feed, water supply, energy, and labour. The continual increase in the cost of fish farm inputs has huge implications for fish production. As a result, the purpose of this text is to provide an overall discussion on the trends of inflation as they affect key actors in the fisheries sub-sector, its major drivers and its impact on fish production in Nigeria and then recommend the best possible ways to manage these drivers. With rising production expenses, many fish farmers have resorted to passing these costs on to customers. The challenges of transferring cost increments on to consumers cause difficulties for fish producers, as rising prices of fish tend to reduce the quantity of fish demanded and the envisaged profit margin. Because of Nigeria's economic realities, stagflation (high inflation combined with sluggish demand) cannot be assured. Terrorism, farmers/herders conflict, banditry/kidnapping, the advent of corona virus (COVID 19), high exchange rate, poor government policies such as banning importation, high tax rates, poor infrastructure, an increase in cybercrime rate “yahoo yahoo”, climate change and rapid population growth are identified as some of the drivers of inflation in Nigeria's fisheries sub-sector. The impact of inflation on fish production in Nigeria includes the following: high cost of fish feed (exacerbated by competition for ingredients among fish farmers, other farm animal operators, and human consumption), high cost of fish culturing facilities and other inputs, increase in unit price of table size fish (leading to nutritional deficiency, particularly for low income earners), reduction in demand for fish products, obnoxious feeding practices such as feeding fish with expired and contaminated feed, poor growth rates, prolonged culture duration,

production of malnourished broodstock resulting in poor quality and slow-growing offspring, and moribund farms. What can fish farmers do in Nigeria, where inflation is on the rise? This text recommends a thorough re-evaluation of the business plans of fish farms, with a focus on cash flow in the short term, the use of lean management technology, and the utilization of other fish farming techniques such as intensification of culture-based fisheries, use of non-conventional feed resources, polyculture, and aggressive integration of fish culture. More importantly, government policies that promote robust and viable economies are required. Strong economies have stable, moderate growth, low unemployment and efficient supply chains, which allow aquaculture enterprises to thrive.

Keywords: Food security, aquaculture, inflation, farmers/herders conflict, moribund farms

1. Introduction

Fish continues to play an essential role in the diet of many people in Nigeria which is the most populated country in Africa. The country has the highest fish demand in Africa with a population of over 200 million (Adeleke *et al.*, 2021). Fish has been identified as a low-cost protein source with nutritional benefits (Kaleem and Sabi, 2021). Artisanal fisheries (from coastal and brackish waters and inland lakes, dams and rivers), industrial marine fishing, aquaculture and imported frozen fish are the four main sources of fish for the country. However, supply comes primarily from imports as there is a huge gap between fish demand and local supply. Local fish production has remained insufficient to meet the nation's demand for fish and fisheries products, as the natural fish supplies cannot be overstretched and faces numerous obstacles, one of which is low catch. In 2021 alone, Nigeria spent over N500 billion on fish importation. The National Bureau of Statistics (NBS) reported that N62.4 billion, N35.53 billion and 25.75 billion of blue whiting specie, herrings and mackerel fish respectively were imported in the first half of 2021.

The continuous importation of fish portends a colossal loss of foreign exchange earnings for Nigeria. Nigeria can substitute fish importation with domestic production to create jobs and reduce poverty (Areola, 2007). The opportunity of bridging the widening demand-supply gap of fish in Nigeria through domestic production offers great investment potential for the Nigerian populace and also increases the inflow of foreign direct investment into the country (Oyakhilomen and Zibah, 2013). Fish production can lead to poverty reduction and ensure food security (Kaleem and Sabi, 2021). A good

step towards arresting the demand-supply deficit for fish is aquaculture, which involves raising fish in a controlled environment where their feeding, growth, reproduction, and health can be closely monitored (Omitoyin, 2007). Aquaculture has a great potential to contribute to domestic fish production (Adewuyi *et al.*, 2010). The numerous water bodies in Nigeria like rivers, streams, lakes, reservoirs, flood plains, irrigation canals, and coastal swamps offers great potential for aquaculture production in Nigeria (Oyakhilomen and Zibah, 2013), as it has been projected to overtake capture fisheries in the future (Chan *et al.*, 2019). At the moment, aquaculture is receiving wide participation as a result of the progressive development in most parts of the country. The rise in aquaculture development in Nigeria is attributed to three main factors, namely; increasing demand for fish, an improved environment for investments, and a reduced risk of production (Kaleem and Sabi, 2021). Aquaculture practices as a business venture is capable of bringing significant development in rural and urban areas by improving family income, providing employment opportunities, and reducing problems of food supply and security (Akinrotimi *et al.*, 2009). Production from aquaculture, like the capture fisheries, has, however, not been sustainable due to the numerous challenges and constraints bedeviling them. One of such major challenge is the persistent and appreciable rise in price level of inputs used in both capture fisheries and aquaculture.

Inflation is the persistent and appreciable rise in general price level of goods and services in an economy (Jhingan, 2002). Not every rise in the price level is termed inflation. Therefore, for a rise in the general price level to be considered inflation, such a rise must be constant, enduring and sustained (Bayo, 2015). Nigeria has witnessed high and volatile inflation rates since Independence (Worlddata, 2022). During the period following independence (1965-1975), Nigeria's rate of inflation was about equal to that of its trading partners, averaging 10% annually. In the next decade, (1975-1985), the respective rates of inflation diverged dramatically, as Nigeria's annual rate nearly doubled, to 18% while the other trading partners narrowed significantly, to 4%. These trends continued between 1985 and 1990, as Nigeria's annual average rose to 24% while it's trading partners posted an average of 13% (Moser, 1995). There is no consensus regarding the ultimate source of inflation in Nigeria. However, Masha (2000) and Bawa *et al.* (2016) have reported climatic conditions, flood, wage increment, the structure of production, currency devaluation and changes in terms of trade as the major drivers of inflation in the country. Similarly, Mordi *et al* (2007) also reported excess money supply, political unrest, scarce foreign exchange, and severe shortages in commodity supply as drivers of inflation. Similarly,

Masha (2000) indicated that inflation in Nigeria is driven from both the demand and the supply side. The demand side pressures arise from changes in monetary aggregates, while the supply side pressures arise from the salient characteristics of the economy including climatic conditions, the structure of production, currency devaluations, wage increases and changes in terms of trade.

Inflation increase the cost of goods, deepens poverty and makes life difficult for the vulnerable poor. It also induces uncertainty, discourages savings, promotes consumption, poses serious threat to macroeconomic stability and result in high social costs (Bawa and Abdullahi, 2012; Bawa *et al.*, 2016). In Nigeria, the cost of fresh, smoke and frozen farmed fish is on the rise. This is due to so many factors with rising cost of fish feed as the prominent. This is because, feed costs account for the majority of the total production cost (Ayinla, 2007; Eriegha and Ekokotu, 2017). For example, in Delta State, Nigeria, a bag of 3mm of local floating feed that was selling for N6, 500 as at February 2020 now sells for N10,050 as at February 2022 (Field survey). These sharp increments in cost of input have huge implication on fish production in Nigeria.

2.1 Drivers of inflation on fish production

2.1.1 Terrorism

Terrorism continues to pose a major threat to international peace and security and undermines the core values of the United Nations. Nigeria continues to face multiple challenges posed by various terrorist groups such as *Boko Haram* with devastating human cost, in terms of lives lost or permanently altered, internally displaced persons and immensely negative consequences for economic and social development. Displacement of communities, loss of lives and livelihood (Beetseh *et al.*, 2021).

Nigeria has a long history of conflicts arising from ethnic, religious, political and regional differences, but one of the most recent and ongoing conflicts is the Boko Haram insurgency. The Boko Haram sect was founded around 2002 in Borno State, located in Northeastern Nigeria. It was an Islamist group with the aim of purifying Islam in Northern Nigeria and bringing about regime change. However, following the death of their leader in 2009, there was an uprising leaving their followers, law enforcement officers and civilians dead. Subsequently, from late 2010, Nigeria began to experience an increase in attacks (through bombing, kidnapping, executions) that led to the declaration of a ³State of Emergency in the Northeastern states of Borno, Yobe and Adamawa by 2013. This insurgency has been ongoing to

date with various attacks every now and then (Elden, 2014; Khan and Hamidu, 2015; Dunn, 2018; Beetseh *et al.*, 2021).

Terrorism has impacted negatively to food security in Nigeria (Mukhtar, 2019; 2020). Boko Haram insurgency, has reportedly led to the displacement of about 2 million people in the Northeast region of the country, and in 2019 only, there were over 3,000 confirmed and reported deaths. With the Northern region being largely an agrarian region, this shock has worsened the already existing issue of food security in the country. This has led to a reduction in food production, especially raw materials needed for fish feed production. With dwindling supply, prices of ingredients are expected to rise and ultimately lead to increase in the cost of fish production.

2.1.2 Farmers/herders conflict

Conflict has been defined as a struggle or contest between people with opposing needs, ideas, values and goals (Dietz and Albert, 2016). In Nigeria, crop farming and cattle herding provide a sustainable means of livelihood to majority of the populace. Both form of agricultural operations make significant contribution in meeting the nutritional needs of the country and thus contributing to food security of households (Yakubu *et al.*, 2021).

Herder-Farmer crises in Nigeria occur as a result of resource scarcity; there exists a growing scarcity of arable land and water sources that are equally essential to sustain crop cultivation and cattle herds. Farmers encroach on grazing routes, and have expropriated land designated to grazing reserves, while herders often destroy crops, pollute water sources and trespass on farms to feed their cattle. This is further exacerbated by the growing population of farmers, herders and their herds, increasing scarcity of arable land due to droughts, impending desertification of the Sahel savannah, land degradation and cultural differences among ethnic groups that predominantly farm or graze cattle (Fiki and Lee, 2005). The country has witnessed series of violent communal clashes between crop farmers and cattle herders as a result of the activities of the herders who move about on a daily basis with their cattle in search of water and green pastures. Historically, conflict between farmers and herders existed, but increase in human population and climatic changes, have led to cultivation of more land that is meant for grazing and cattle routes. These clashes has resulted to the loss lives and decline in both crop and cattle production (Suleiman, 2015; Moritz, 2016).

2.1.3 Banditry and Kidnapping

Banditry and kidnapping have become a major house hold name in Nigeria and any part of the world (Beetseh *et al.*, 2021). Banditry is a term

used to refer to acts of robbery and violence in areas where the rule of law has broken down. It consists of the organization of armed bands for the purpose of attacking state or social institutions or enterprises or individual persons (Collins, 2000). Participation in such bands and in the attacks committed by them is equally regarded as banditry. Kidnapping can be defined as the act of seizing and detaining or carrying away a person by unlawful force or by fraud, and often with a demand for ransom. For an act to be deemed kidnapping, it must involve coercive movement of a victim from one place to another, detention or seizure of that person be it a child or an adult. Kidnapping is usually motivated by financial gain or political benefit (Beetseh *et al.*, 2021).

In Nigeria, banditry came as a result of nearly four decades of unresolved conflicts between settled cultivators and nomadic herding communities that wander on the high plains of Northern Nigeria particularly the North West geo-political zone in states such as Zamfara. Banditry in Zamfara State started since around 2009 and increased in 2011 especially after the general elections (Anka, 2017). The banditry has spread to most part of the country (Ladan and Matawalli, 2020). The activities of these armed militia groups has resulted in low farmers' participation in farming activities in recent years. Some raw materials used for fish feed production such as maize and groundnut cake meal are now very scarce and expensive due to the activities of the bandits. This has resulted in the high price of the final product (fish feed) and fish.

2.1.4 Coronavirus disease 2019 (COVID-19)

The advent of Coronavirus disease 2019 (COVID-19) pandemic with associated lockdown, restriction of movement and social distancing rules has resulted in unprecedented shocks in all sectors (Andersen *et al.*, 2020; Erdoğan *et al.*, 2020). Besides, the pandemic caused different and massive uncertainties both in developed and developing countries such as stock market volatility, economic policy uncertainty, uncertainty about employment, and future of GDP growth (Erdoğan *et al.*, 2020) and brought many economies of the world to recession (Brianca *et al.*, 2020). The pandemic, which hit Nigeria in early 2020, has exacerbated poverty and inequality. The country's economy contracted and entered its worst recession in four decades (World Bank 2020). Five million more Nigerians now live in poverty, relative to the pre-COVID-19 economic forecast (World Bank 2020). The growth outlook remains highly uncertain, as it depends on how the world economy and oil prices recover.

In Nigeria, the pandemic induced national lockdown inflicted a huge dent on food production. People lived in palpable fear. Farmers were not tending to their farmland adequately and standard farm practices such as weeding was not in top notch. The result is general low productivity which result in demand and supply shocks. The fact that fish also compete with man for these ingredients exacerbates the situation.

2.1.5 Exchange rate

Exchange rate is a major determinant of inflationary rate in Nigeria. It is the value of the domestic currency in terms of foreign currency. On the other hand, foreign exchange is the actual foreign currency or various claims (bank deposits or promises to pay) on it that are traded for each other (Christal and Lipsey, 1999). Exchange rate changes can affect the relative prices, thereby the competitiveness of domestic and foreign producers. A significant appreciation of the domestic currency makes domestic goods expensive relative to foreign goods resulting in a shift of demand away from domestic to foreign goods. The effect of such a shift on the economy is reduction of demand pull inflation. But depreciation in a country's currency makes the import of necessary productive equipment expensive, leading to high prices of goods and services due to high costs of production (Bayo, 2015). Exchange rate induced kind of inflation is characterized by a fall in the value of the country's currency and a rise in her exchange rate with other nation's currencies. For instance, exchange rate of Naira to Dollar increased from N0.6 in 1981 to N243.49 in 2016 (Ojeyinka, 2019). Presently, the exchange rate stands at N444.81 per dollar and N738.00 per dollar at the official rate and the parallel market respectively. This portrayed a clear evidence of exchange rate volatility in the country, an unwholesome development that has led to the high cost of inputs.

Unstable condition of exchange rate can result in imported inflation. Imported inflation suffered by economies with high reliance on imported goods or services. Such inflation could arise from the dumping of goods in the importing economy either as inputs or final output (Otto and Ukpere, 2016). Major imported inputs used in aquaculture include; micronutrients for feed formulation, feeds (such as Coppens® and Artemia), hormones (such as Ovaprim®, Ovulin®), drugs, nets, water quality test kits, etc. The high prices of these imported goods are transmitted into the local economy which leads to an inflationary tendency.

2.1.6 Government policy banning food export to encourage local farmers

The Central bank forex ban on certain food item and months of border closure has been implicated as a contributory factor to inflation in Nigeria. This is because the Country is yet to produce enough food to match the existing need.

The use of import prohibitions in Nigeria is part of a trade policy regime that seeks to protect existing domestic industries and reduce the country's perceived dependence on imports. The bans are often justified on the grounds of preventing importation of all products that the county is deemed to be capable of producing itself. Those protected by the bans argue that the countries' lack of infrastructure, especially energy, means that they cannot compete effectively with imports without protection. The import bans benefit domestic producers since they reduce the amount of goods that are available on the national market and hence limit competition for domestic firms (Treichel *et al.*, 2012). As a result, prices for these products are higher in the domestic market than they are in the world market. However, this has negative impacts on consumers of these products who have fewer varieties to choose from and have to pay more.

The ban on importation of some animal protein sources such as frozen chicken has increased the demand for fish in Nigeria. Recently (9th to 11th, May 2022), at a three-day hybrid national stakeholders' advocacy and capacity building workshop on the implementation of the Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) in Nigeria, organized by Lagos State University (LASU), in collaboration with the FAO, International Collective in Support of Fish Workers (ICSF) and World-Fish, the director of the Federal Department of Fisheries (FDF), Mr. Umoh Imeh disclosed that the current yearly domestic fish demand of the country is 3.6 million metric tonnes, while the total yearly domestic production from all sources leaves a demand-supply gap of about 2.5 million metric tonnes. This gap made Nigeria the largest importer of frozen fish in Africa and destination for investment (Ibirogbra, 2022). The constant devaluation and fall of the Naira across all FX markets has exacerbated this condition and encouraged inflation.

2.1.7 High tax rates

It is an established fact that import and export taxation could impose substantial influence on fish production decisions. Some countries provide subsidy instead of tax enforcement with the aim of safeguarding national

food security. Analysis conducted by Malan *et al.* (2016) showed that most African countries tax their agricultural sector because of increase in public debt and inflation levels. To encourage the production of fish in Nigeria, instruments of agricultural price policy including taxes, international trade restrictions, subsidies and direct controls were structured (Manyong *et al.*, 2005). However, farmers exporting their fishery products such as smoked fish to other countries pay export tax which will result in the price inflation of the exported products.

2.1.8 Poor infrastructure

Basic social infrastructure such as roads, water supply, power, telecommunication among others are not adequate in Nigeria. In most cases, the fish farmer will need to provide for an alternative source of power as the public supply is unreliable, they may also need to construct and maintain the road to the farm, provide alternative supply of water, security among others.

Poor road network and bad roads also reduce the life span of vehicles and increase maintenance cost. The result is the high cost of transporting fish and other farm input from one location to another. This will summarily increase cost of production and cost of the final product.

2.1.9 Increase in cybercrime rate

The advent of computers and the internet has opened a vast array of possibilities for the young and the old in the international community to have access to the world from their homes, offices, cyber cafes and so on. In recent times, internet or web-enabled phones and other devices like iPods, and Blackberry, have made internet access easier and faster (Adesina, 2017). The cyberspace is said to be overcrowded with cyber activities. This has also attracted cybercriminals or unauthorized intruders of all sort, loitering for vulnerability, waiting to attack their victims. Cybercrime (also known as “Yahoo Yahoo” or “Yahoo Plus”) is a trending issue and remains a source of major concern in many countries. Cybercrime is an offence, with a criminal motive, committed against an individual or group of persons intentionally to harm the reputation of the victims as well as cause irreparable damage to hardware of sensitive infrastructure, including internet and mobile phones (Halder and Jaishankar, 2011). The most important cost of cybercrime, however, comes from its damage to company performance and to national economies (McAfee Inc., 2014). Cybercrime damages trade, competitiveness, innovation, and global economic growth.

In Nigeria, internet penetration has been increasing since the twenty-first century. Internet users as a percentage of the population increased considerably from 3.5 percent in 2005 to 47.4 percent in 2014 (WDI, 2016), and this trend is expected to continue (Asemota *et al.*, 2015). The expansion of the internet has resulted to a rise in cybercrime. Despite increased awareness and attention to the threat in Nigeria, cybercrime has remained a difficult issue. In 2016, for example, cybercrime accounted for almost 43% of all monetary losses related to fraud. People celebrate the fortune of these internet fraudsters without questioning where it came from. This erroneous view of wealth encourages the get-rich-quick mentality, which is usually exploited through cybercrime. The aquaculture sector has not piqued the interest of the vast majority of young people, who see it as labour-intensive and low-return-on-investment. They perceive cybercrime as a simple way to quick make money. Ifeonu (2019) predicted that if the youth got involved in the fish farming business, there would be an increase in fish production and job creation.

2.1.10 Climate change

Climate change is already affecting the natural and managed systems-forests, wetlands, coral reefs, agriculture, and fisheries that society depend on to provide food, fuel, fibre and for many other services. The United Nations Environmental Protection (UNEP) has described climate change as a major challenge of our time as a result of its impacts on our societies and environment (UNEP, 1999). Shifting weather pattern are threatening food production, while rising sea levels are predicted to increase the risk of flooding, especially in low lying regions of the world. Climate change is a serious risk to poverty reduction and sustainable livelihoods (Ovie and Belal, 2019).

The issue of climate change and the threat it poses to small-scale fisheries, commercial fisheries and aquaculture has been acknowledged (Daw *et al.*, 2019). Rising seas, more severe storms, salt water intrusion, and higher temperature are common indicators. Climate change is known to have both direct and indirect impacts on aquaculture operations (De Silva and Soto, 2009). Direct impacts refer to immediate physical, physiological and ecological impacts, whereas indirect impacts relate to associated issues such as feed availability and trade. Direct impacts as a result of changed environmental conditions at the site level include changes in: water temperatures; monsoonal patterns; current and wave action; extreme climatic events; water stress; levels of eutrophication; and stratification in static waters (De Silva and Soto 2009, Handyside *et al.* 2006). Species used in

aquaculture will have similar limitations to those favoured by capture fisheries, with temperature and/or salinity related impacts on physiological functions potentially leading to changes in the optimal locations and/or culturing/containment techniques for aquaculture operations for different species (Sriskanthan and Funge-Smith, 2011).

Most cultured fish species are also likely to suffer physiological challenges because of limited oxygen transport to tissues at high temperatures, and this is likely to have a considerable negative impact on aquaculture operations (Barange and Perry 2009). Warmer temperatures may also result in the increased disease incidence and impacts, non-native species invasions and harmful algal blooms (Ovie and Belal, 2019; De Silva and Soto, 2009; Barange and Perry, 2009; Easterling *et al.* 2007, Handyside *et al.* 2006).

In Nigeria, current environmental problems in most coastal area of the country are flooding which comes from the high rainfall, run off from rivers and urban channels and tidal movement and wind (Okali and Eleri, 2004). Floods have continued to be an annual menace to the sustainability of fish production (Oyebola *et al.*, 2020). Major impacts include loss of tons of fish, change in fish species, erosion of human habitat, and land will have greater impact on the welfare and the livelihood of fishermen most especially in terms of income realized from fishing activities (Chukwu Okeah *et al.*, 2018). As a result of flooding, some species of fishes have migrated to another location while some others died. This leads to low productivity and consequently reduced fish catch/fish production and low standard of living.

2.1.11 Rapid population growth

The relationship between population and economic growth has a long history in economics. With the publishing of the ground-breaking paper titled “An essay on the principle of population” by Thomas Malthus of the classical school of thought in 1798 followed by numerous other publications by notable economics scholars including Pigou, Marshal and Keynes, the entire world became more aware of the need to understand the dynamics of population as a prerequisite to efficient economic planning as well as achieving sustainable economic growth (Aidi *et al.*, 2016). Malthus insisted that more population means more mouths to be fed and that since the population was growing (at geometric progression) at a faster rate than food supply (growing at arithmetic progression), this disequilibrium will adversely affect the economy. This position was corroborated by scholars like Coale and Hoover (1958) and Ehrlich (1968) who observed that rapid

population growth has the tendency to impact negatively on the economy since it will overwhelm any induced response by technological progress and capital accumulation (Pontianus *et al.*, 2021). World population growth has increased by time. There was an increase of 1.08% of the world population from 7.6 billion people in 2018 to 7.7 billion people in 2019. This event caused an increase in world food demand (Muhtar *et al.*, 2021).

Nigerian population has gathered momentum. It will continue to increase for some time even if there is a change favourable towards family planning and birth control. Increasing population at the expense of socio-economic development is inimical to people’s well-being and development. An increasing population has consequences and implications most especially for a country like Nigeria (Okpala, 1990; Odusina, 2011; Pontianus *et al.*, 2021). The rapid population increase in Nigeria without a corresponding increase in local fish production have huge implications on fish supplies (Table 1) and prices.

Table 1: Projected population and fish demand/supply in 2000-2025

Year	Population (Million)	Fish demand (million tonnes)	Fish supply in domestic production (million tonnes)	Short fall (million tonnes)
2000	114.40	0.87	0.53	0.34
2001	117.60	0.89	0.57	0.32
2002	121.00	0.92	0.61	0.31
2003	124.40	0.95	0.65	0.30
2004	127.90	0.97	0.69	0.28
2005	131.50	1.00	0.73	0.27
2006	135.20	1.03	0.77	0.26
2007	139.10	1.06	0.81	0.25
2008	143.00	1.09	0.85	0.24
2009	147.10	1.12	0.89	0.23
2010	151.20	1.15	0.93	0.22
2011	155.50	1.18	0.96	0.21
2012	159.90	1.22	1.00	0.22
2013	164.40	1.25	1.04	0.21
2014	169.10	1.29	1.08	0.21
2015	173.90	1.32	1.12	0.20
2016	178.80	1.36	1.16	0.20
2017	183.30	1.39	1.20	0.19
2018	189.00	1.44	1.24	0.20

2019	194.40	1.48	1.28	0.20
2020	199.90	1.52	1.32	0.20
2021	205.60	1.56	1.36	0.20
2022	211.40	1.61	1.40	0.21
2023	217.40	1.65	1.44	0.21
2024	223.50	1.70	1.48	0.22
2025	229.80	1.75	1.52	0.23

Source: FAO, 2000.

2.2 Implication of inflation on fish production

2.2.1 Food insecurity

Food security is the condition in which all have access to sufficient food to live healthy and productive lives (World Bank, 1986). FAO (2002) defined food security as a situation “When all people at all times have physical, social and economic access to sufficient food to meet their dietary needs for a productive and healthy life”. Food security is dependent on agricultural production, food imports and donations, employment opportunities and income earnings, intra-household decision-making and resource allocation, health care utilization and caring practices (Maxwell and Frankenberger, 1992). According to World Bank (2001), food security is of three folds, these are food availability, food accessibility and food affordability (Eme *et al.*, 2014).

Nigeria is one of the food-deficit countries in Sub-Saharan Africa although it is arguably better in terms of production than the others. It has also not suffered any major catastrophe that could precipitate scourges of famine, mass hunger and therefore food crisis (Ojo and Adebayo, 2012). However, inflation has worsen food insecurity in Nigeria. Soaring food prices in major cities across the Nigerian states are being reported with adverse impact on household budgets and fish consumption. The implication is citizens’ malnutrition and threat to the actualization of the second goal of the sustainable development goals (End hunger, achieve food security and improved nutrition and promote sustainable agriculture).

2.2.2 Poor growth rates, prolonged culture duration and low quality brood stock

Some fish farmers has resulted to obnoxious practices such as feeding fish with expired bread, expired and contaminated feeds, as a coping strategy to the rising cost of fish feed. The implication of these sharp practices are poor growth rates, prolonged culture duration and low quality broodstock.

The importance of feeding fish with the right feed in terms of quality and quantity have been documented by Eriegha and Ekokotu (2017). Feed quality alludes to the dietary efficiency and objective attribute of a feed which make it suitable for feeding and digestion in the typical fish digestive systems. Efficient feeding levels is attained only when the right supply of energy and essential nutrients is available in the proportions that is adequate to the fish for maintenance and growth (Hepher, 2009). For good health and satisfactory growth, a complete feed must meet all the nutritional requirement of the fish (Omitoyin, 2006). Feed quality among other factors have been identified as key influencer broodstock quality (Rurangwaa *et al.*, 2004). In any other animal production system, the technical and economic performance of the hatchery depends in large part on the quantity and quality of gametes and the yield of highly viable fry (Lipton and Gempesaw, 2007).

2.2.3 Moribund farms

Moribund is a term that refers to being in the state of dying or approaching death or something that is coming to an end. In Nigeria, inflation of input has resulted in many moribund farms which are nearly obsolete without any form of vitality or vigour. This has negatively impacted the national fish production. Some fish farmers are currently downscaling why others are shutting down as a result of harsh economic realities occasioned by high cost of fish feed and cost of power supply. Most recently, one of the biggest fish farmer in Benin City that used to run power 24 hours because of the scale of the operation is now forced to cut down and has resorted to petrol generators that can carry one or two boreholes at a time as against the eight boreholes used before now with diesel (Okoro, 2022). According to the Punch Newspapers (2021), 500 fish ponds located in Yenegwe area of Yenegoa in Bayelsa State used for the Presidential Amnesty Programme are moribund. These fish ponds were constructed by Governor Seriake Dickson in November 2016 for the diversification of Bayelsa State economy.

2.3 Adaptation strategies for fish farmers during a period of hyperinflation

2.3.1 Intensification of culture based fisheries

Culture-based fisheries (CBF) are a credible strategy for augmenting fish production in Nigeria (Eriegha *et al.*, 2019). It is a form of extensive aquaculture where suitable seed are stocked in existing water bodies enabling them to feed on the naturally occurring organisms in the water body and attain a marketable size (De Silva *et al.*, 2006). Culture-based fisheries

are comparatively less resource intensive and environmentally less perturbing than most semi-intensive and intensive aquaculture practices, and almost always include community participation (De Silva, 2003). While avoiding waste of scarce water resources, Culture-based fisheries would help in increasing fish production, thereby reducing pressure from the conventional form of fish farming.

Culture-based fisheries (CBF) are a form of stock enhancement bordering on aquaculture. Fisheries enhancement in a broader sense includes, ranching and/or the introduction of a species that is capable of reproducing in the water body and, with time, forms sufficiently large populations that could be exploited commercially (De Silva, 2003). On the other hand, ownership coupled with the need for some level of caring for the stocked fish, makes it a form of aquaculture in accordance with the Food and Agriculture Organization of the United Nations' (FAO) definition of aquaculture. Culture-based fisheries offers advantages over conventional aquaculture practices in that: it is a non-consumptive water use; it is a secondary user of existing water resources and rarely will compete with primary water resource users; its activities require minimal skill levels and capital investment and it does not involve external feed inputs; a communal activity with the potential to generate synergies within and between communities; and attractive to governments and development agencies as a sustainable strategy that will contribute to enhancing fish food supplies at an affordable price to rural communities, thereby providing an additional source of income, and generally contributing to poverty alleviation (De Silva, 2003; De Silva *et al.*, 2006; Wijenayake *et al.*, 2014). CBF is mostly practiced in water bodies that are incapable of sustaining fisheries through natural recruitment (De Silva *et al.*, 2016). The yield from CBF varies between water bodies (Jayasinghe *et al.*, 2005). This variation is related directly to the size (the larger size the lower yield) and productivity of water bodies. An average of about 250 kg/ha ranging from 115 to 429 kg/ha is common. Chinese water bodies have the most developed CBF in the world with an estimated total production of 1,165,075 tons in 1997 from a total area of 1,567,971 ha (yield of about 743 kg/ha annually). A yield of 1800kg/Ha have also been reported (Wijenayake *et al.*, 2014). Ita (1985) has identified numerous water bodies for CBF in Nigeria. Judicious utilization of these water resources would ensure the availability cheap fish products to inland rural population as well as an important source of income for rural people.

2.3.2 Use of non-conventional feeds resources

Non-conventional feed resources (NCFRs) are feeds that are not usually common in the markets and are not the traditional ingredients used for

commercial fish feed production (Madu *et al.*, 2003). NCFRs are credited for being non-competitive in terms of human consumption, very cheap to purchase, byproducts or waste products from agriculture, farm made feeds and processing industries and are able to serve as a form of waste management in enhancing good sanitation (Abowei and Ekubo, 2011). With the rise in the prices of the convention feed ingredient such as fish meal, soyabean meal, groundnut cake meal, the use of non-conventional feed has inevitable. The utilization of nonconventional feedstuffs of plant origin had been previously limited as a result of the presence of alkaloids, glycosides, oxalic acids, phytates, protease inhibitors, haematoglutinin, saponin, momosine, cyanoglycosides, linamarin to mention a few despite their nutrient values and low cost implications (Sogbesan *et al.*, 2006). However, research in aquaculture nutrition have revealed that a number of non-conventional feed can be used at a controlled inclusion. Non-conventional feed include all types of feedstuffs from animal (silkworm, maggot, termite, grub, earthworm, snail, tadpoles etc.), plant wastes (jack bean, cottonseed meal, soybean meal, cajanus, chaya, duckweed, maize bran, rice bran, palm kernel cake, groundnut cake, brewers waste etc.) and wastes from animal sources and processing of food for human consumption such as animal dung, offal, visceral, feathers, fish silage, bone, blood) (Devendra, 1988; Madu *et al.*, 2003; Sogbesan, 2006; Abowei and Ekubo, 2011; Setufe *et al.*, 2018; Irabor *et al.*, 2022). Calculated inclusion if these conventional feed would drastically reduce the cost of fish production.

2.3.3 Polyculture

Polyculture is the practice of culturing more than one species of aquatic organism in the same pond. The motivating principle is that fish production in ponds may be maximized by raising a combination of species having different food habits. The mixture of fish gives better utilization of available natural food produced in a pond (Ovie and Ovie, 2014; Stickney, 2009).

Ponds that have been enriched through chemical fertilization, manuring or feeding practices contain abundant natural fish food organisms living at different depths and locations in the water column. Most fish feed predominantly on selected groups of these organisms. Polyculture should combine fish having different feeding habits in proportions that effectively utilize these natural foods (Figure 1). As a result, higher yields are obtained. Efficient polyculture systems in tropical climates may produce up to 8,000 kg of fish per hectare per year (Singh *et al.*, 2021).

Descriptions of the feeding habit categories and examples of fish from each category include: plankton feeders (Plankton is usually the most

plentiful food in a pond, so it is essential to include a plankton-feeding fish in a polyculture system), Herbivores (This group of fish feeds on aquatic vegetation), Bottom Feeders (Fish in this group feed primarily at the pond bottom and they consume a variety of decaying organic matter, aquatic organisms such as clams, insects, worms, snails, and bacteria living in or on the sediments), Omnivorous Feeder (this type of fish feeds on insect larva, molluscan, snails, worms along with aquatic vegetation. Mrigal is typical example of omnivorous fish) and Carnivorous Fish (This type of fish is used to control unwanted population of carnivorous fish. African catfish is its type).

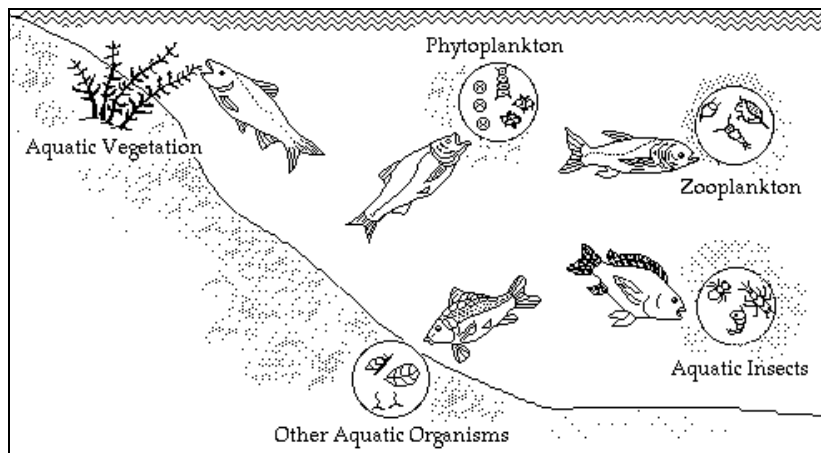


Fig 1: Polyculture utilizes natural foods efficiently (Ovie and Ovie, 2014)

2.3.4 Implementation of lean production system

Lean Production Systems which is a methodology that focuses on minimizing waste while simultaneously maximizing productivity has been successfully applied to aquaculture. The Lean Production Systems or Lean concept was first developed as the “Toyota Production System” and made famous for the monumental competitive advantage it gave to Toyota Manufacturing in car production throughout the latter half of the 20th century (Lewis, 2000; Vikas-Dave, 2015; Melović *et al.*, 2016).

The Lean concept is anchored on the identification and elimination of 8 types of waste. The waste include: Defects/rework, overproduction, waiting, not-utilizing people, transportation, inventory, motion and extra processing. Basic steps of eliminating waste include the identification of the waste, finding the root cause and choosing the appropriate tool of managing the waste. The general objective of Lean is to eliminate what does not add value,

deliver the best possible product to the customer as quickly as possible, remove as many barriers as possible, create a respectful, engaged, and collaborative work environment (Kocakulah *et al.*, 2011; Hofer *et al.*, 2012). The outcome of Lean are both internal [improved productivity and efficiency, reduced costs, increased profits] and external [increased satisfaction, improved quality, consistent product, perceived higher value] (Manea, 2013).

In an era where costs of production inputs are becoming scarcer and more expensive, it is paramount to improve the social and economic efficiency of aquaculture production, processing and marketing systems. Various levels of inefficiencies at every point of the aquaculture value chain have been identified in Nigeria. Waste of raw-material inputs, waste of space, waste of movement, waste of labour, loss of product (fish), and postharvest loss (spoilage) are such inefficiencies, increasing cost of production and reducing profit, which in turn make Nigerian aquaculture less profitable.

Lean Production Systems have been successful in improving operational efficiency, reducing postharvest losses, improving waste management, and decreasing the cost of production of catfish and tilapia in Nigerian aquaculture. At the moment, forty (40) fish farmers have been certified as Lean Subject Matter Experts (LSME) on improving efficiency in the Nigerian aquaculture sector by the *Worldfish* in conjunction with *Feed the Future* and *USAID*. So far, over 1,200 fish farmers and processors have been applying Lean tools and technologies in their production and processing systems across Nigeria. This have been shown to improve health and wealth among Nigerian poor through increased income from better production, processing, and marketing of their products. With the current inflationary trend, the Lean tools and techniques could improve profitability and operational efficiencies of aquaculture, and ultimately make farmed fish more affordable and competitive in the marketplace.

2.3.5 Aggressive integration of fish culture

Integrated fish farming which is the combination of other forms of human activity, especially agriculture, with fish farming with the aim of maximizing production and increasing return per unit area of land has the potential of reducing cost of fish production, and increase profit for the fish farmer. Nnaji *et al.* (2013) have identified four broad groups of integration that are commonly practiced in Nigeria. They are: integrated plant-fish farming, integrated animal-fish farming, integrated animal-plant-fish farming and integrated wastewater-fish farming (Ovie and Ovie, 2014).

The integrated farming system is integrating plants, livestock and fisheries management in a single harvesting cycle. The integrated farming system is one of the solutions to increase the efficiency of food production (Muhtar *et al.*, 2021) Plants are able to become food sources for livestock and fish. In this case, the output from plants turned into input for livestock. Meanwhile, fish and livestock excrement that used as plant fertilizer mean that livestock's output becomes the input for the plants. The major purpose of the integrated farming system is to yield optimization (Gabriel, 2007). Optimization stands for minimizing of feeding and fertilizer cost and to optimize the yield of crops and livestock production. The simulation-based on the secondary data of integrated organic' vegetables and livestock farming that has been demonstrated in some farms including the integrated fish farm unit of the National institute for freshwater fisheries research (NIFFR), New Bussa.

3. Conclusion

The issue of food and nutrition security is one of the top global political agendas, standing as goal number two of the Sustainable Development Goals 2030. The goal aims to end hunger and achieve food security and improve nutrition by 2030. Fish is a rich source of animal protein and valuable micronutrients. It has great potential to address the high levels of under nutrition and malnutrition. Despite being a nutrient treasure store, fish consumption in Nigeria is on the decrease, chiefly due to inflation. Inflation compounds a global food crisis that finds hundreds of millions of people suffering from malnutrition. Where food is most unaffordable, malnutrition is widespread, meaning people are underweight and have vitamin deficiencies, and children aren't growing as tall as they should. Food insecurity not only affects health but also forces people to leave their homes and increases the risk of conflict. Food insecurity is a household measure that reflects limited or uncertain access to adequate food. Declining fish intake can impact food and nutrition security and their ability to meet malnutrition targets of the United Nations' SDG 2. Several causes have been credited as contributing factors to the rising cost of fish in Nigeria. Much of the discussion in the text centered on the impacts of terrorism, farmers/herders conflicts, banditry and kidnapping, COVID-19 pandemic, weak purchasing power of the currency (Naira), government policy banning food export, high tax rates, poor infrastructure, increase in cybercrime rate, climate change and rapid population growth. The ongoing war between Russia and Ukraine has had its own impact on the global market. The two countries are major contributors of goods such as oil, gasoline, metals,

fertilizers, wheat, corn, and soy. This disrupts countless goods and services that require any of those items for production. In addition to problems fueled by conflict, sanctions against Russia by the U.S. and other countries have further complicated matters.

Fish and nutrition insecurity is a complex phenomenon that requires sound policies that promote fish production and trade and exploration of other food production systems that can contribute to the existing food supplies. Notwithstanding the coping strategy recommended by this text, which is geared towards the production of fish at affordable rates, governments and research and development actors need to explicitly encourage the consumption of fish in human diets. The government's effective management of inflation is urgently solicited. Also, as is obtainable for petroleum products, the government should also subsidize inputs such as feeds used for fish production. Government should also invest in fisheries infrastructure, and strengthen governance of fisheries; only then can fish resources be protected and livelihoods and food and nutrition security of fishery-dependent groups secured.

References

1. Abowei JFN, Ekubo AT. Review of Conventional and Unconventional Feeds in Fish Nutrition. *British Journal of Pharmacology and Toxicology*. 2011;2(4):179-191.
2. Adeleke B, Robertson-Andersson D, Moodley G, Taylor S. Aquaculture in Africa: A Comparative Review of Egypt, Nigeria and Uganda Vis-À-Vis South Africa. *Reviews in Fisheries Science and Aquaculture*. 2021;29(2):167-197.
3. Adesina OS. Cybercrime and Poverty in Nigeria. *Canadian Social Science*. 2017;13(4):19-29.
4. Adewuyi SA, Phillip BB, Ayinde IA, Akerele D. Analysis of profitability of fish farming in Ogun State, Nigeria. *J Hum. Ecol*. 2010;31(3):179-184.
5. Aidi HO, Emecheta C, Ngwudiobu IM. Population and Economic Growth in Nigeria: is there an Empirical Evidence of Causality? *International Journal Advances in Social Science and Humanities*. 2016;4(2):59-66.
6. Akinrotimi OA, Abu OMG, Ibemere IF, Opara CA. Economic viability and marketing strategies of periwinkle *Tympanotonus fuscatus* in rivers state, Nigeria. *International Journal of Tropical Agriculture and Food Systems*. 2009;3(3):238-244.

7. Andersen AL, Emil TH, Niels J, Adam S. Consumer Responses to the COVID-19 Crisis: Evidence from Bank Account Transaction Data, 2020. Available at SSRN 3609814.
8. Anka AS. Emerging Issues in Zamfara Armed Banditry and Cattle Rustling: Collapse of the Peace Deal and Resurgence of Fresh Violence. *International Journal of Innovative Research and Development*. 2017;6(12):161-170.
9. Areola FO. Fish marketing and export potentials of fish and fisheries products of Nigeria. A lecture delivered at educative and informative aqua-culture workshop and aqua-exhibitions tagged: sustainable fisheries livelihood, management and food security in Nigeria, 2007, 23.
10. Asemota OJ, Ogujiuba K, Aderemi TA, Mustapha S. Modelling and Forecasting Teledensity using Univariate Time Series Models: Evidence from Nigeria. *International Journal of Statistics and Applications*. 2015;5(6):279-287.
11. Barange M, Perry RI. Physical and ecological impacts of climate change relevant to marine and inland capture fisheries and aquaculture. *FAO Fisheries Technical Paper*. 2009;530:07-95.
12. Bawa S, Abdullahi IS. Threshold Effect of Inflation on Economic Growth in Nigeria *CBN Journal of Applied Statistics*. 2012;3(1):43-63.
13. Bawa S, Abdullahi IS, Ibrahim A. Analysis of Inflation Dynamics in Nigeria (1981-2015). *CBN Journal of Applied Statistics*. 2016;7(1b):255-276.
14. Bayo F. Determinants of Inflation in Nigeria: An Empirical Analysis. *International Journal of Humanities and Social Science*. 2015;1(18):262-271.
15. Beetseh K, Abubakar S, Nongo M. The effect of herdsmen, banditry and kidnapping activities on Food Security in Nigeria. In Ochigbo, Beetseh, and Abubakar ed., *Global Insecurities: Challenges and the ways forward*. 1st ed. Akure: Science and Education Development Inst., Nigeria, 2021, 137-153.
16. Brianca P, Joao D, Miguel F. Is the COVID-19 Pandemic a Supply or a Demand Shock? In: *Economic Synopses*. St. Louis: Federal Reserve Bank of St. Louis, 2020.
17. Chan CY, Tran N, Pethiyagoda S, Crissman CC, Sulser TB, Phillipsa MJ. Prospects and challenges of fish for food security in Africa. *Global Food Security*. 2019;20:17-25.

18. Christal RG, Lipsey KC. Principles of Economics. 9th Edition, Oxford University Press Inc., New York, USA, 1999.
19. Chukwu-Okeah GO, Wekpe VE, Ikebude CF. Impact of Coastal Flooding on Fish Production in Brass, Niger Delta Nigeria, Implication for Coastal Resource Management. *Oceanogr Fish Open Access J.* 2018;6(1):555-678. DOI: 10.19080/OFOAJ.2018.06.555678.
20. Coale AJ, Hoover E. Population growth and economic development in low-income countries. Princeton, New Jersey, Princeton University Press, 1958.
21. Collins H. Social Banditry, 3rd Edition, Harper Collins Publishers, 2000. Retrieved From <https://www.collinsdictionary.com/dictionary/english/banditry>.
22. Daw T, Adger WN, Brown K, Badjeck WC. Climate change and capture fisheries: potentials impacts, adaptations and mitigations. In: Cochrane K, De Young C, Soto D, Bari T (eds.) Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. FAO Fisheries and Aquaculture technical paper no. 530. FAO, Rome, 2009, 109-150.
23. De Silva S, Soto D. Climate change and aquaculture: potential impacts, adaptation and mitigation. Technical paper 530, Food and Agricultural Organization, Rome, 2009.
24. Dietz TSS, Albert M. The European Union and border conflict. The transformation power of integration. *International Journal for United Organizations.* 2016;60(3):563-593.
25. Dunn G. The impact of the Boko Haram insurgency in Northeast Nigeria on childhood wasting: a double-difference study. *Confl. Health.* 2018;12(6):1-12. <https://doi.org/10.1186/s13031-018-0136-2>.
26. Easterling WE, Aggarwal PK, Batima P, Brander KM, Erda L, Howden SM, *et al.* Food, fibre and forest products. In Parry ML, Canziani OF, Palutikof JP, Linden PJVD, Hanson C. eds. Climate change: impacts, adaptation and vulnerability. Contribution of working group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, UK, Cambridge University Press, 2007, 273-313.
27. Elden S. The geopolitics of Boko Haram and Nigeria's 'war on terror'. *The Geographical Journal.* 2014;180(4):414-425.

28. Eme OI, Onyishi AO, Uche OA, Uche IB. Food Insecurity in Nigeria: A Thematic Exposition. *Arabian Journal of Business and Management Review (OMAN Chapter)*. 2014;4(1):1-14.
29. Erdoğan S, Yildirim DC, Gedikli A. Dynamics and Determinants of Inflation during the COVID-19 Pandemic Period in European Countries: A Spatial Panel Data Analysis. *Duzce. Med J*. 2020;22(S1):61-67.
30. Eriegha OJ, Ovie SI, Ovie SO, Aminu AG. Shrinking Lake Chad: Initialization of culture-based fisheries for improved livelihood in Nigeria. *International Journal of Fisheries and Aquatic Studies*. 2019;7(3):14-18.
31. Eriegha OJ, Ekokotu PA. Factors affecting feed intake in cultured fish: A review. *Animal Research International*. 2017;14(2):2697-2709.
32. FAO. *The State of Food Insecurity in the World 2001*. Rome, 2002.
33. Fiki CD, Lee B. Conflict Management, Local Capacity Governance and Inclusive Human Security in North East Nigeria: A case study-Regional Development Dialogue-A journal of UNRISD, Nagoya, Japan, 2005.
34. Food and Agriculture Organization of the United Nations (FAO). *Information on Fisheries Management in the Federal Republic of Nigeria*, 2000. Accessed October, 2022. <http://www.fao.org/fi/oldsite/FCP/en/nga/body.htm>.
35. Gabriel UU, Akinrotimi OA, Bekibele DO, Anyanwu PE, Onunkwo DN. Economic benefit and ecological efficiency of integrated fish farming in Nigeria. *Scientific Research and Essay*. 2007;2(8):302-308.
36. Handyside NT, Ross LG, Badjeck MC, Allison EH. *The Effects of Climate Change on World Aquaculture: A Global Perspective*. London: Department for International Development, 2006, 151.
37. Hepher B. *Nutrition of Pond Fishes*. Cambridge University Press, Cambridge, 2009.
38. Hofer C, Eroglu C, Hofer AR. The effect of lean production on financial performance: The mediating role of inventory leanness. *International Journal of Production Economics*. 2012;138(2):242-253.
39. Ibirogbra F. '2.5 million-tonne fish demand gap to widen without development plans', 2022. Retrieved from <https://guardian.ng/features/agro-care/2-5-million-tonne-fish-demand-gap-to-widen-without-development-plans/>

40. Ifeonu CF, Chukwuemeka V, Agwu EA. Challenges of youths involved in fish farming in the federal capital territory, Abuja, Nigeria. *Journal of Agricultural Extension*. 2019;23(3):156-171.
41. Irabor AE, Obakanurhie O, Nwachi FO, Ekokotu PA, Ekelemu JK, Awhefeada OK, *et al.* Duckweed (*Lemna minor*) meal as partial replacement for fish meal in catfish (*Clarias gariepinus*) juvenile diets. *Livestock Research for Rural Development*, 2022 Oct, 34, Article #6. Retrieved from <http://www.lrrd.org/lrrd34/1/3406irabo.html>.
42. Jhingan ML. *Macroeconomic Theory*. 10th Edition, Vrinda Publications Ltd, New Delhi, 2002.
43. Kaleem O, Sabi ABS. Overview of aquaculture systems in Egypt and Nigeria, prospects, potentials and constraints. *Aquaculture and Fisheries*. 2021;6(6):535-547.
44. Khan A, Hamidu I. Boko Haram and Turmoil in Northern Nigeria. *Jadavpur Journal of International Relations*. 2015;19(1):22-42.
45. Kocakulah MC, Austill DA, Schenk DE. Lean Production practices for efficiency. *Journal of Cost Management*. 2011;25(2):20-28.
46. Ladan SI, Matawalli BU. Impacts of Banditry on Food Security in Katsina State, Nigeria. *Direct Res. J Agric. Food Sci*. 2020;8(12):439-447.
47. Lewis MA. Lean production and sustainable competitive advantage. *International Journal of Operations & Production Management*. 2000;20(8):959-978.
48. Lipton DL, Gempesaw CM. Economics and Marketing. *Developments in Aquaculture and Fisheries Science*. 2007;30:315-328.
49. Madu CT, Sogbesan OA, Ibiyo LMO. Some Non-Conventional Fish Feed Resources in Nigeria. In: Eyo AA. (Ed.), *Proceeding of the Joint Fisheries Society of Nigeria/National Institute For Freshwater Fisheries Research/FAO National Special Programme For Food Security National Workshop on Fish Feed Development and Feeding Practices in Aquaculture Held at National Institute for Freshwater Fisheries Research, New Bussa, 2003 Sept*, 73-82.
50. Malan M, Berkhout E, Bouma J. The impact of taxes and subsidies on crop yields-agricultural price distortions in Africa. *PBL Netherlands Environmental Assessment Agency, The Hague*, 2016.

51. Manea A. Lean production-concept and benefits. *Review of General Management*. 2013;17(1):164-171.
52. Manyong YM, Ikpi A, Olayemi JK, Yusuf SA, Omonona BT, Okoruwa V, *et al.* Agriculture in Nigeria: Identifying Opportunities for increased Commercialization and Investment. IITA, Ibadan, Nigeria, 2005, 26-71.
53. Masha I. New Perspectives on Inflation in Nigeria, CBN Economic and Financial Review, 2000 June, 38(2).
54. Maxwell S, Frankenberger TR. Household Food Security: Concepts, Indicators and Measurement: A Technical Review, New York and Rome: United Nation Children's Fund and International Fund for Agricultural Development, 1992.
55. McAfee Inc. Net losses: Estimating the global cost of cybercrime, 2014. Retrieved from <https://www.mcafee.com/ca/resources/reports/rp-economic-impact-cybercrime2>. Pdf.
56. Melović B, Mitrović S, Zhuravlev A, Braila N. The role of the concept of LEAN management in modern business. *MATEC Web of Conferences*, 2016, 86. DOI: 10.1051/mateconf/20168605029.
57. Mordi CNO, Essien EA, Adenuga AO, Omanukwue PN, Ononugbo MC, Oguntade AA, *et al.* The Dynamics of Inflation in Nigeria, CBN Occasional Paper 32, 2007 Aug.
58. Moritz M. Understanding herder-farmer conflicts in West Africa. Outline of a procession approach. *Journal of Society for Applied Anthropology in Human Organization*. 2016;69(2):765-769.
59. Moser GG. Main determinant of inflation in Nigeria. *IMF Staff Paper*. 1995;42(2):270-289.
60. Muhtar N, Cahyono1 E, Iswandi RM, Arman I. An input-output model of integrated farming system. *Journal of Physics: Conference Series*. 2021;1899:012-102. IOP publishing doi:10.1088/1742-6596/1899/1/012102.
61. Mukhtar M. Impacts of Boko Haram insurgency on households' food security status in Kano metropolitan, Nigeria. In 3rd USM-International Conference on Social Sciences (USM)-ICOSS, 2019, 52.
62. Mukhtar M. Impact of Boko-Haram conflict on food security status among the households in Kano Metropolis. *Lapai Journal of Economics*. 2020;10(1):134-147.

63. Nnaji JC, Okoye FC, Isah J, Ogunseye O. Integrated fish farming. In: Okaeme AN, Nnaji JC, Olufeagba SI and Abubakar I (Eds.) Introduction to freshwater fisheries. National Institute for Freshwater Fisheries Research, New Bussa, 2013.
64. Odusina EK. Implications of a Rapidly Growing Nigerian Population: A Review of Literature, 2011. Retrieved from <https://uaps2011.popconf.org/papers/110048>. Accessed 22 October, 2022.
65. Ojeyinka TA. Exchange Rate Volatility and the Performance of Manufacturing Sector in Nigeria (1981-2016). *African Journal of Economic Review*. 2019;7(2):27-41.
66. Ojo EO, Adebayo PF. Food security in Nigeria: an overview. *European Journal of Sustainable Development*. 2012;1(2):199-222.
67. Okali D, Eleri EO. Climate Change and Nigeria: A Guide for Policy Makers. The publication of the Nigerian Environmental Study Action Team (NEST), Abuja, Nigeria, 2004.
68. Okoro C. Rising cost of inputs crippling catfish farming, 2022. Retrieved from <https://businessday.ng/news/article/rising-cost-of-inputs-crippling-catfish-farming/>. Assessed 21 October, 2022.
69. Okpala AO. Nigerian population growth and its implications for economic development. *Scand. J Dev. Altern*. 1990;9(4):63-77. PMID: 12284704.
70. Omitoyin BO. Introduction to fish farming in Nigeria. Ibadan University Press, 2007.
71. Otto G, Ukpere WI. Inflation in Nigeria: possible determinants and remedies to tackle it in Nigeria. *Risk governance & control: financial markets & institutions*. 2016;6(2):35-43.
72. Ovie SI, Belal E. Climate change and fisheries of the Lake Chad basin, Africa: Analysis of impacts and adaptations. Espatek Nigeria Limited, Ilorin, 2019, 141.
73. Ovie SO, Ovie SI. Aquaculture in focus. NIFFR, New Bussa, 2014.
74. Oyakhilomen O, Zibah RC. Fishery production and economic growth in Nigeria: Pathway for sustainable economic development. *Journal of Sustainable Development in Africa*. 2013;15(2):99-109.

75. Oyebola OO, Efitre J, Falaye AE, Dada TM, Idowu FC. Agriculture in the Face of Climate-Mediated Flooding in Tropical Africa: Technical Innovations of Fish Farmers in Southwestern Nigeria. In: Leal Filho W. (Eds.) Handbook of Climate Change Resilience. Springer, Cham, 2020. https://doi.org/10.1007/978-3-319-93336-8_163.
76. Pontianus VJ, Oruonye ED. The Nigerian population: a treasure for national development or an unsurmountable national challenge. Int. J Sci. Res Arch. 2021;2(1):136-42.
77. Rurangwaa E, Kimeb DE, Olleviera F, Nasha JP. The measurement of sperm motility and factors affecting sperm quality in cultured fish. Aquaculture. 2004;234:1-28.
78. Setufe SB, Ajani EK, Emikpe BO, Ogunbanwo ST. Growth Performance of *Clarias gariepinus* on Diets Fortified with *Lactobacillus plantarum* and *Psidium guajava* Leaf. Journal of the Faculty of Veterinary Medicine. 2018;44(3):105-112.
79. Singh P, Maqsood S, Samoon MH, Verma N, Singh S, Saxena A. Polyculture-A culture practice to utilize all ecological niches of pond ecosystem effectively. Aquatic fish database, 2021. (<http://aquafind.com/articles/Polyculture.php>). Accessed on 11th October, 2022.
80. Sogbesan OA. Effects of different organic substrates on growth and survival of long winged termite (*Macrotermes subhyabrius*) under laboratory conditions. Afr. J Gen. Agric. 2006;2(2):37-44.
81. Sriskanthan G, Funge-Smith SJ. The potential impact of climate change on fisheries and aquaculture in the Asian region. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication, 2011/16, 41.
82. Stickney RR. Aquaculture: an introductory text. CABI, Wallingford, United Kingdom, 2009, 304.
83. Suleiman H. Policy Issues in Pastoral Development in Nigeria. Paper Presented at a Conference on Pastoralism in Nigeria. Zaria, 2015 June.
84. Theohary CA, Finklea K. Cybercrime: Conceptual Issues for Congress and U.S Law Enforcement. Congressional Research Service Report, 2015.
85. Treichel V, Hoppe M, Cadot O, Gourdon J. Import bans in Nigeria increase poverty. Africa Trade Policy Notes No. 28, 2012. Retrieved

- from
<http://documents.worldbank.org/curated/en/435171468078528189/Import-bansin-Nigeria-increase-poverty>.
86. Vikas-Dave AD. Lean Production System: A Future Approach. International Journal of Engineering Sciences & Management Research. 2015;2(6):69-74.
 87. WDI. World Development Indicator (WDI), International Bank for Reconstruction and Development/The World Bank; Washington D.C, USA.
 88. World Bank. Poverty and Hanger: Issues and Options in Developing Countries, A World Bank Policy Study, Washington, D.C: World Bank, 1986.
 89. Yakubu SN, Musa MU, Bamidele TE, Ali MB, Bappah MT, Munir RT, *et al*. Effects of Farmer-Herder Conflicts on Rural Households Food Security in Gombe State, Nigeria. Journal of Agricultural Extension. 2021;25(1):11-20.