VOL. 05 NO. 2,
AUGUST, 2024
E-ISSN 3027-1533
P-ISSN 3026-8648

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of African Innovation & Advanced Studies (JAIAS)

Economic, Cultural and Social Impact of Local Fish Feed Production in Borno State, Nigeria

***Babagana Zanna; **Mohammed Musa; & *Ahmed Adam Mohammed**

*Federal College of Freshwater Fisheries Technology Baga, Borno State, Nigeria.
**University of Maiduguri, Borno State, Nigeria.

Abstract

This study was undertaken with main objective of assessment of sustainable aquaculture fish production with reference to local fish feed production. The specific objectives were to determine the economic impact of local fish production, examine the cultural and social impact of local fish feed production in Borno State of Nigeria. Data for the study was obtained through primary and secondary sources from the respondents through survey with the aid of questionnaires. The information obtained through questionnaires were supplemented with information that was collected through individual discussed and focus group discussion. Secondary data was obtained from the farmers book of accounts and other official documents with the aid of discussed with the relevant institution or bodies. Qualitative method of data analysis was applied. The study reveals local fish feed production have developmentally impacted economically, culturally and socially on the economy of the study area. The need for advancement in the technical know-how of the local fish feed producers and transformation of the fish feed industry to technologically advance mode of production that will result to large-scale production with standard quality fish feed. Recommendation were made for the attainment of sustainable large-scale quality fish feed production that will uplift the standard of living of the fishers in the fish production industry and the general public in the study area and world at large through the integration of the traditional ecological knowledge (TEK) of the fishers and modern scientists.

Keywords: Cultural, Economic, Impact, Local Fish Feed, Production, Social

Introduction

One of the important foods for human consumption are fishes. These group of vertebrates are of significant economic, cultural and social values for millions of people globally. In addition, it serves such values as nutritive, medicinal, biological control, sports and games, decorative value, employment opportunity and fish meal, fish flour, fish manure, fish guano, fish silage. Other purposes under fish products category

includes fish oil, fish insulin, fish caviar, fish pearls, isinglass, fish glue, fish fin, fish leather (Lynch, Cooke, Bower, Bunnell, Cowx, Nguyen, Nohner, Phouthavong, Riley, Rogers, Taylor, Woelmer, Youn and Douglas, 2016). The risen state of demand for fish globally as fish and sea food constitutes very important sources of protein and other nutrients in addition to the important role the sub-sector play in promoting food security and economic development. This results to overfishing without corresponding conservation of the fisheries resources which has led to inhabitant degradation and declining fish stocks couples with insecurity problem in most fishing zones in Africa consequently a shift from capture fishery to aquaculture fish production (Nwuba, Ude and Ogbonnaya, 2022).

Aquaculture is the rearing of aquatic organism under controlled conditions. The history of aquaculture has been long in some part of the World as well it has been carried out extensively but yet aquaculture should be viewed as supplementary rather than replacement of fisheries in totality considering the fact that the sea covers 80% of the earth's surface and furthermore fish meal is a major component of fish feeds. Aquaculture in industrialized countries is pursued on financial profits motive basis unlike in developing countries at a subsistence level activity. It is of advantage to culture aquatic organisms biologically as their buoyancy and poikilothermy enable them more efficient users for food than terrestrial warm-blooded animals (Boyd, Aaron and Nevin, 2022).

Feeding fish is to provide nutrient requirement for keeping fish in good health, optimal growth and optimum yield and to minimize the waste brought to the environment in such a way to earn reasonable profit at minimum cost. Good nutritional quality and physical properties of feed determines the production and economic goals of aquaculture production. Aquaculture feeds are formulated with a vast pool of ingredients, when animal is fed, it was intended to supply nutritional requirements so that normal physiological functions is performed such as maintaining immune system, growth and reproduction. Nonnutritive feed additives are being used in aquatic feed so that the dietary nutrients are ingested, digested, absorbed and transported to the cells thus an increasing diversity of non-nutritive feed are being used in aquatic feeds (Merican and Sanchez, 2016).

Fish feed production is the process in which multiple variables such as raw materials, nutritional formulation, transportation, market performance and perhaps climate might be considered as it regulates the agroindustry activities by the way of affecting supply consequently prices of agricultural by-products. In a nutshell, the key factor is the feed mill operation, yet the system could be affected by market policies and others such as adjusting screws considered under simple category. Although, feed mill operations are dynamic systems. Each element of that system and their functions are interrelated to achieve one objective: a safe and well-balanced finished feed (Nates, 2016).

Aquaculture feed producers over the globe are sourcing for the most sustainable ingredients available and devoting substantial resources to the development of alternative ingredient are continuously on the increased. It is important to note that the quality of finished will never improve during storage but can be maintained at the same level at which it was received. In most fish the cost of feed is the largest single expenses item. Thus, a small reduction in feed wastages can significantly affect production and directly influence bottom-line profitability.

Another important aspect to note in terms of feeds and feeding are feed type, pellet size, quantity of feed that should be given, frequency of feeding per day, careful note of any reduction in feeding rate and the possibility of using automatic feeders (Grey Lutz, 2023).

With abundant local input resources for fish feed production in Nigeria, fish farmers may undertake fish feed production at their own level instead of buying from external sources thereby improving the fish farmers profitability level. Under this circumstance all that is required from the fish farmer is to acquire scientific and nutritional knowledge of fish feed formulation, acquire fish feed processing technology skills and finally, possessed and or have adequate access to the use of fish feed making machine (Ogunji and Wuertz, 2023).

The feed developed in Nigeria is mainly sorghum, groundnut cake, flour, maize, cassava, all of which constitute some 38% of the ingredients used and provides between 30% and 50% of the catfish nutrient needs. The ingredients are mixed, oiled and dried to produce floating granules which are then bagged. The nutrient content of the ingredients met the needs for growing species at economical cost. Such ingredients as proteins, carbohydrates, fats, vitamins and minerals necessary for optimal growth and health of fish are all provided. In Nigeria fish feed accounts for 70% of production costs. The local fish feed production technology of Nigeria improves the nutritional quality of fish and facilitates growth of the fish. The use of local fish feed in fish farming significantly constitutes a factor in the increase of fish farmers income (Kolawole and Mustapha 2023).

The required raw materials and ingredients to produce fish feed of high quality already exists in the country Nigeria, such ingredients as viscera, blood, bone and fur of cattle, sheep and chicken produces high quality fish feed after effective collection and proper fish feed production process. Another feasible fish feed ingredient for making fish feed pellets in the country at minimum cost without alteration of the feed quality and nutritional scientific requirement of the feed as fish need protein, carbohydrate, lipids, minerals and vitamins for healthy growth similarly as other animals requires. Ingredients such as protein, fat and mineral substances mainly derivable in straw meal, soybeans cake, peanut cake, corn protein powder, rice bran, wheat bran are fundamental. Other raw materials locally obtainable also considered potential materials for fish feed production includes yam, plantain, banana, cowpea, Macon, maize, cassava, millet, sorghum, groundnut, sun hemp seed, leaf concentrates, kitchen garbage and brewery waste are easily accessible in the country, Nigeria (Sarker, Rahman and Alam (2015).

Raw materials wise the country Nigeria is endowed with substantial inputs in the production of fish feed provided well harnessed in the area of provision for mineral substances, energy source and protein source. Raw materials as shell powder, egg shell powder, calcium phosphate and bone meal can provide mineral substances as calcium, phosphorus, iron, zinc and iodine which plays very important role in fish growth and nutrition. Other raw materials such as the wheat, wheat middling, full cream rice bran, corn and other grains are capable in the provision of energy source. Nevertheless, input materials such as insects, corn gluten, earth worms, maggots, blood meal, silk worm, chrysalis meal, shrimp meal, soybeans, cotton meal, rapeseed meal, peanut meal and sesame meal are sources of protein feed for fish (Udo and Dickson, 2017).

In the Sub-Sahara African, Nigeria had the highest number of animal feed manufacturers (620), producing approximately 3.8 million ton of feed in the year 2000. The domination of the sub-sector by small-scale operators (59 percent of all feed mills produces between 0.5 to 5 ton per hour) thus, large number of the feed mills can be classified as small-scale operators. However, the country installed production capacity was estimated at 7.25 million ton as at the year 2000 having production efficiency of 52 percent only. A significant progress was recorded as the country Nigeria was ranked 40 out of the 130 leading animal feed producing countries in the world (Alltech, 2016).

Problem Setting and Research Objectives

Borno State of Nigeria is one of the states that met environmental requirement for fish production but most of the fish farmers engaged in small-scale fish production regardless of the state natural resources endowment to compete with other leading fish producers in the country, Nigeria. The practice of fish farming in the state is not technologically advanced which contributed for underutilization of the fisheries resources both in term of cultural and modern system of fish production such as aquaculture.

The insecurity in the state resulted to the displacement of many fishing communities in the Lake Chad Basin Area of Borno State and restriction of fishing in many fishing zones in the area as a result of security traits hinders access to the lake for fishing. Consequently, Maiduguri Metropolitan Council, Jere and Konduga Local Government Areas located in Borno Central considered safe for livelihood compared to the insecurity affected zones experienced influx of people thus, the area became densely populated with attendance problems of poverty and lack of adequate government support. This has aggravated to a very serious problem on the level of fish production in the state as the displaced cultural fish farmers from the various fishing communities were primitive culturally conservative fish farmers lacks modern skills of fish production thus the need for transformation of the farmers from cultural mode of fish production to modern aquaculture system of fish farming.

Nevertheless, there exist also the problem of tackling the problems associated with the existing aquaculture system of fish production in the study area among others includes inadequate capital, high costs of inputs, lack of aquaculture fish production awareness, skillfulness and adequate government support.

Furthermore, many research works on fish feed production in Nigeria has been carried out; Udo and Dickson (2017), Obe and Omojola (2015), Begho and Irabor (2024), Kolawole and Mustapha (2023), Agbugu, Emawunegbe and Yaro (2021), Enwemiwe (2018) none of these studies centered in Maiduguri Metropolitan Council (MMC), Jere and Konduga Local Government Areas as a study area. If any? but limited such as Bello (2016). Hence, the need to close the literature gap on fish feed production in the study area.

Thus, considering the important role of fish feed in aquaculture fish production termed as essentially fundamental for aquaculture fish production as natural food nutrient in the pond cannot meet the required rate of growth within the specified economic and scientific anticipated time span. Therefore, this study has been undertaken with the main objective of assessment of sustainable aquaculture fish production with reference to local fish feed

production and identification of problems associated with the system for remedy to ensure sustainable large-scale aquaculture fish production in the study area. The specific objectives are to: -

1. determine the economic impact of local fish production in the study area;
2. examine the cultural impact of local fish feed production in the study area;
3. examine the social impact of local fish feed production in the study area.

The result of this research work may contribute in decision making process regarding development of fish production or in the transformation of fish production stages. Fish feed constitutes one of the most important component of aquaculture fish production. This study may provide insight in to the development of aquaculture fish feed as traditional ecological knowledge (TEK) of the cultural fishers may constitute an important input in the transformation process which may serves as a broad based for modern scientist as well in value addition carried out through integration process.

The outcome of the study may enable the provision of economic benefits derivable such as employment opportunities, contribution to food security, poverty reduction and to serves as an instrument for comparative study analysis, financial benefit analysis and ascertainment of cultural and social benefits derivable as a result of the local fish feed production and overly, it contribution in the aquaculture system of fish production and possibly, identification of grey areas involves in the system for remedy.

Therefore, the study result may serve as a source of information for researchers, government and non-governmental organizations for planning purposes for the development of the sub-sector and the economy in general at local community, state, national and international level.

The aquaculture sub-sector witnessed rapid growth as a result of the used of new intensive cultivation techniques which generally have greater environmental impact than traditional culture technique. Although, the rapid growth occurred in an era in which the generality of the populace has been aware of the environmental effect of human activity and have concern over its effect. Therefore, according to (Houlihan, Bouiard and Jobling, 2001); the production of aquaculture food products continues to be positive but consideration should be given to possible side effects of the increased activity on animal welfare and their impact on the environment. Thus, (Victor Suvesh, 2016) emphasizes on four pillars that will maintain the aquaculture production venture which includes: food safety and quality, health and animal welfare, environmental integrity and social responsibility. Thus, by extension under “fish feed preparation” it should be noted that handling and delivery can as well affect animal performance and nutrient excretion and its resultant effect on the environment.

The empirical findings are in line with the understanding of the concept and theory of sustainable fisheries development which is a process of continuous exploration and improvement. After continues development, the strategy of sustainable development of fisheries has basically reached a consensus, which requires the coordinated development of ecological environment of fisheries waters, fisheries economy, fisheries society, and fisheries resources without jeopardizing the ability of future generation to meet their need (Rosen, 2018).

Methodology and Data

The study was carried out in Jere and Konduga Local Government Area of Borno State of Nigeria. Borno State has an area of 61,43589 km is the largest state in the federation of the Federal Republic of Nigeria in terms of land mass. The state occupies the greatest part of the Lake Chad Basin and shares borders with the Republic of Niger to the North, Chad to the North – East and Cameroon to the East.

Jere Local Government Area of Borno State, Nigeria, has its headquarters in the town of Khaddamari. Jere is one of the twenty-seven local government areas of Borno State, carved out of Maiduguri Metropolitan Council (M.M.C.) in 1996. It lies within latitudes $11^0\,40^1$ E and 12^0 05 N and longitudes $13^0\,50^1$ and $12^0\,20^1$ E; it occupies a total landmass of 160 square kilometers. Within the state, it shares boundaries with Mafa Local Government Area to the east, Maiduguri Metropolitan Council to the north and Konduga Local Government Area to the South. Jere Local Government Area has a projected population of 211, 204 persons with annual growth rate of 2.8%. Majority of the inhabitants are farmers, traders, and civil servants. The major ethnic groups are Kanuri and Shuwa Arab. Others includes Hausa, Bura, and Fulani and many immigrant settlers from within and outside Nigeria (Tijjani, Abubakar, Benisheik and Mustapha, 2010). In Khaddamari, the wet season is hot, oppressive and mostly cloudy and the dry season is sweltering and partly cloudy. Over the course of the year, the temperature typically varies from 58^0 F to 106^0 F and is rarely below 52^0 F or above 110^0 F. The hot season lasts for 2.4 months from March 14th to May 27th with an average daily high temperature above 102^0 F. The hottest month of the year in Khaddamari is May, with an average high of 103^0 F and low of 80^0 F. The cool season lasts for 2.1 months, from July 20th to September 23rd with an average daily high temperature below 92^0 F. The coldest month of the year in Khaddamari is January, with an average low of 59^0 F and high of 92^0 F. The rainy period of the year last for 6.0 months, from April 23rd to October 21st, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Khaddamari is August, with an average rainfall of 5.9 inches. The rainless period of the year lasts for 6.0 months, from October 21st to April 23. The month with least rain in Khaddamari is December, with an average rainfall of 0.0 inches (OCHA, 2018).

Konduga is a community in Borno State, Nigeria and the Centre of a Local Government Area of the same name about 25km to the Southeast of Maiduguri situated on the North bank of Ngadda River. The local government area is shown within Nigeria coordinates: 11^0 39' 6'' N, 13^0 25' 10" E. Konduga Local Government Area have an area of about 6000 square kilometers with a population of 375,000. The ethnic groups in the local government are Kanuri, Shuwa Arab, Marghi, Mulgwai, Wula, Gamargu, Fulani and Hausa. The main occupation of the people is subsistence farming combined with livestock rearing, fishing and trading. The road network in the local government is over 300km mostly (over 90%) untarred bush roads and foot paths with substantial part of the villages living behind a river, which keeps them away from the local government headquarters. Those living behind the rivers use canoes to cross to the local government headquarters. The terrain becomes difficult during the rainy season (Kawuwa, Mairiga and Usman, 2007). In Konduga, the wet season is hot and mostly cloudy and dry season is sweltering and partly cloudy. Over the course of the year, the temperature

typically varies from 58^0 F to 106^0 F and is rarely below 52^0 F or above 110^0 F. The hot season lasts for 2.4 months, from March 11th to May 24th, with an average daily high temperature above 102^0 F. The hottest month of the year in Konduga is April, with an average high of 105^0 F and low of 77^0 F. The cool season lasts for 2.1 months, from July 20th to September 22nd with an average daily high temperature below 92^0 F. The coldest month of the year in Konduga is January, with an average low of 59^0 F and high of 92^0 F. The rainy period of the year last for 6.1 months, from April 20th to October 22nd with a sliding 31- day rainfall of at least 0.5 inches. The month with the most rain in Konduga is August, with an average rainfall of 6.2 inches. The rainless period of the year lasts for 5.9 months, from October 22nd to April 20th. The month with the least rain in Konduga is December, with an average rainfall of 0.0 inches (OCHA, 2018), (Figure 6).

Sources of Data

The study area is Jere and Konduga Local Government Area, Borno State, Nigeria. Forty-five (45) aquaculture fish farmers were selected from each of the two local government areas which made a total of ninety (90) respondents for the study. Local fish feed producers, aquaculture fish farmers and other respondents directly and indirectly associated with fish production were considered for the purpose of this study. Multistage sampling technique with purposive selection was employed for the selection of respondents in the study area. Primary data was collected from the respondents by the way of local feed production industry, farm and market survey method with the used of questionnaires. The questionnaires were completed by interviewing the respondents, the information obtained through the questionnaires were supplemented with information that was collected through individual discussed and focus group discussion. Secondary data was obtained from the farmers book of accounts and other officially documented records with the aid of discussed with officials of fisheries related institutions, local, state and federal government officials, community stakeholders and other non-governmental organizations.

Data collection for the study was carried out within the period from 16th January 2024 to 15th February 2024. The period of first Quatre of most of the year have been a flood season accompanied with intensive fishing activities enables the attraction of high demand for fish warrants high fish feed production consequently high supply of fish feed which metamorphosed to higher harvest of fish for marketing respectively at the period first Quatre of the year. Thus, majority of the fish farmers embarked on harvest at that period as pre-planned on stocking basis. This entails the processes involved in data collection was carried out in a facilitated manner as a result of easy access to local fish feed producers, fish framers and fisheries officials as well the information required was obtained comprehensively.

The study area has a population of 5,86,204 inhabitants. The targeted population for this study has 211,204 and 375,000 persons from Jere Local Government Area and Konduga Local Government Area of Borno State, Nigeria respectively. Forty-five (45) respondents were used from each of the two (2) local government areas, made a total number of ninety (90) respondents for the study. Local fish feed industries, Fish farmers, individuals, stakeholders,

other group of people, governmental and non-governmental organizations that directly and indirectly related to fish production were considered for the purpose of this study.

Sampling Procedure and Sample Size

Survey method of data collection was employed (direct survey) the Local fish feed producers, aquaculture fish farmers, stakeholders and other respondents directly and indirectly associated with fish production were met at the level of community, government organizations, lake site, farm site, local fish feed production industries, workshops for mending (partly) local fish feed production machine, fishing gears, construction of fishing implements, Fish markets, fish packaging sites, fish processing and smoking sites, mats and baskets weaving sites where production occur. This has enabled the acquisition of accurate information on the examination of the economic, cultural and social impact of local fish feed production for sustainable fisheries in Borno State of Nigeria and the level of operation of the cultural transformation system such as the types and the standard of the local fish feed production machine and or implements in used and the associated methods and techniques in practice, fish feed producer output, local fish feed production industry or farm fixed assets capacity and farmers socioeconomic characteristics as applicable in the study area.

Self-reporting through administrative sources (off-site) contact method was also applied for this study as information on the feed producers, fishers, and other relevant individuals and bodies were obtained from the research and consultancy unit, fishing gear unit, workshop unit, fish processing unit and library, information and documentation unit of fisheries institutions and departments in addition to information obtained from officials of local government and state department of fisheries and other stakeholders of the fishing communities such as the traditional rulers and locally recognized heads of fishers and craftsmen in the study area.

The operational system of the survey was segregated in to three and were assigned sub-sample frame primarily constructed for the survey of the fishers on the formulated survey checklists as follows:

1. Identification of facilities from the production site of the farmer (field of operation) and administrative records of fisheries institution, department of fisheries and other local, state federal government organizations and in the markets.
2. Direct enumeration of facilities in the production site (field of operation) in the local fish feed industry, workshops, markets and others not directly specified under a fish farmer, local producer and or a seller.
3. Interviews with the fishers, stake holders and other related members of the fishing industry either directly or indirectly related to matters connected with local fish feed, harvested species, permanence of equipment, the permanence density, the size of operation and on variables connected with environmental and ecological effects of the fishing activities in the study area.

Method of Data Analysis

The information obtained from the sub-set surveys were combined in to an overall procedure after an overall aggregate of thirty (30) fishers were selected from each sub-set survey making a sample frame of ninety (90) fishers for the study and integrated in to a system. The

information obtained through interviews with the application of survey were analyzed with conventional content analysis that discloses result relevant to the assessment of sustainable aquaculture fish production with reference to local fish feed and identification of problems associated with the system for remedy to ensure sustainable large-scale aquaculture fish production in the study area with specific objectives of determining the economic, cultural and social impact of local fish production in the study area.

Results and Discussions

i. Determination of Economic Impact of Local Fish Production in the Study Area

The fish feed produced by local fish feed industries and some fish farmers that engages in feed production are readily marketed in the study area. The feed produced are used for both individual producer application in the farm and for commercial purpose as majority of the local fish feed producers as well as the fish farmers plays a dual role in fish farming and fish feed production in the study area. The local fish feed production is profitable in the study area; a profit of eight thousand naira (₦8000) is derivable per production of fifteen (15kg) of local fish feed. Considering the ready market of the product almost 1500 kg is produced by majority of the producers on monthly basis at production cost of five hundred and ninety-four thousand-naira (₦594,000) one and half (1.5) ton equivalent. Therefore, a local fish feed producer of one thousand five hundred kilograms (1500kg) is in better position to make a profit of eight thousand naira (₦8000 X 100) = ₦800,000 per month.

This result confirmed that of Verdegem, Yossa, Chary, Schrama, Beveridge and Marwaha (2021) aquaculture is the fastest growing food producing sector in the world, providing critical sources of income and nutrition for millions of small-scale fish farmers and their communities. Access to sustainable and affordable fish feed is a key determinant for productive and profitable aquaculture.

Most of the local fish feed producers owns the local fish feed production machine (pelletizing Machine), the few producers that do not possessed the machine do hire the machine but for other ingredients required for the production of the feed are within the reach of the producers as the area is naturally endowed with the materials and financially the producers are better up to cater for the cost of production of the ingredients such as the; wheat offal, maize meal, fish meal, palm oil, premix, salt, binder (starch), soya beans, groundnut cake, lysine, methionine, vitamin C, aqua max, bio vet, bags and other expenses incurred includes; charges for processing, grinding, packaging, consultancy services, workmanship in addition to the cost of diesel, engine oil and transportation.

This result shows consistency with the findings of Fregene, Yossa, Karisa, Olaniyi and Bolorunduro (2020) access to natural resources restricted from competitors, especially foreign feed manufacturers: some feed ingredients that might not be available to foreign fish feed manufacturers could be available locally. If harnessed, these could be a competitive advantage for the locally manufactured feed.

Occupationally, majority of the local fish feed producers are full-time fishers involving in diverse fishing activities in addition to the primary occupation as a fish farmer as well as fish feed producer. Other categories of people that engage in fish feed production as secondary

occupation in the study area are civil servants and businessmen. The feed producers engage in the local feed production industry in form of sole proprietorship and the operation is on small-scale level. Although, the government of Nigeria through the federal ministry of agriculture and rural development in collaboration with Federal College of Freshwater Fisheries Technology, Baga, Borno State of Nigeria has been organizing a short-term empowerment training on annual basis through which the fishers in the study area acquires skills on fisheries technology and other fisheries related disciplines with capital support in form of starter package for a small-scale fish feed production and fish farming entrepreneurship.

Other supports are also accorded to the fish farmers from non-governmental international organizations such as the Food and Agricultural Organization of the United Nation (FAO), United Nation Development Program (UNDP) and at the Borno State Government level Rural Water Supply Agency (RUWASA) Maiduguri. Never the less, support is also accorded to the fish feed producers from philanthropies, relatives, friends and well-wishers. The support accorded to the fish feed producers are of different categories such as capital in form of Machine and or cash and other materials requirement for successful setting up of fish farming entrepreneurship.

Yet the possibility of expansion for the farmers to engage in large-scale production is limited due to the technological backwardness of the country Nigeria to engage on sophisticated machine, more especially in the study area. More so, poor educational background, inadequate capital to engage in capital intensive form of production, inadequate provision of professional consultancy services, lack of close monitoring and evaluation for good planning follow up, lack of identification of lapses for rectification and implementation for rapid transformation are contributory factors.

This result is in line with the finding of Alltech (2016).

The local fish feed production industry has been positively impacting in other form of business endeavors as the local industry has created an avenue for scavengers, agriculturalist, local construction industry to engage in productive activities to transform a by-product to form an ingredient in the production process. Thus, feed production industry has aided the economy of Nigeria in job creation, provision of employment opportunities, source of revenue generation, it has contributed to food security and poverty reduction. It has supported the government of the country by decreasing the rate of importation of foreign fish feed there by increasing the country domestic product (GDP), the industry has supported government in revenue generation and harnessing the natural resources of the state and the nation optimally. Consequently, this will enable the Nigerian nation to have favorable term of trade and balance of payment (Figure 2 and 3).

This result shows consistency with the findings of Ogunji and Wuertz, (2023).

ii. Examination of Cultural Impact of Local Fish Feed Production in the Study Area

Local fish feed production has been positively impacting in the sustenance of culture of fish farming in Borno State of Nigeria known for more than eight thousand five hundred (8500) years ago, since from time immemorial. Its production enables the production of fish through aquaculture as an alternate to cultural fishing which has seized to operates fully in the fishing communities of the Lake Chad Basin area of the state as a result of insecurity situation that

has displaced the fishing communities. Thus, the culture of fish farming has been sustained in the study area through aquaculture fish production as a result of the essential role played by local fish feed production in the study area.

This result confirmed that of Rowan (2023) the sustaining increase in aquaculture has been positively influenced by new technological developments where there is a pressing need to find appropriate solutions to meet growing world population.

The traditional ecological knowledge (TEK) of the cultural fish farmers has been aiding in the formulation of local fish feed production in the study area. It's does not only apply to the formulation of local fish feed production but it has gone a long way in aiding the modern scientist generally in transformation process as the modern scientist lacks adequate ecological knowledge of the fishing communities. Therefore, the cultural fish farmers knowledge has contributed positively in the discovery of additional ingredient needed for the formulation of local fish feed production in the study area and has manifested in the quality of the local fish feed as well as in the growth and dietary need of the fish for human consumption.

This result shows consistency with the findings of Bohensky and Maru (2011) when traditional ecological knowledge is integrated with western science and management knowledge the resulting epistemological pluralism potentially enhances the resilience of social-ecological systems by providing a diversity of knowledge for problem solving.

The local fish feed industry has been providing means of livelihood to the displaced cultural fish farmers from the fishing communities of the Lake Chad Basin area of Borno State of Nigeria. Majority of the displaced cultural fish farmers; if not all? have age long experience in the fishing act as the farmers do not have alternative means of livelihood apart from fish farming. Thus, as they were displaced and moved in to the urban area they were left with no any other source of livelihood except fish production as a result the cultural fish farmer were blended in to the aquaculture system of fish production. This was made possible through the production of local fish feed production as a criterion requirement without which aquaculture fish production might not have been possible in the study area.

Other auxiliaries fishing activities are made possible in a transformed standard to the fishing industry with integration of the traditional ecological knowledge of the cultural fish farmers and that of the aquaculture fish farmers in the study area. Fish production activities such as construction of scoop net, clap net, smoking kiln, mending of fishing implements knife among others, weaving of mat for fish drying, basket and bag for fish packaging, fish feed and fish storage procedures and facilities, collection of garbage and other natural input, transportation and marketing activities of both fish and fish feed and other fisheries value chain related essentials in the study area (Figure 1).

This result is in line with the finding of OECD (2020) the sustainability of traditional management systems in to the future is threatened in all parts of North east Nigeria by the types of factors of change indicated. For the time being, many traditional systems are still in operation and it seem likely that two factors will become increasingly important. Firstly, the rate of change, since community-based systems appear to be highly adaptable if the rate of change is not too great. Secondly, the role of government, since the impact of change might be moderated with appropriate policy and assistance.

There exist cultural constraints of traditional fisheries management systems and community-based fisheries management system in the study area as the system of practice has been modern system of aquaculture fish production under which the jurisdiction is not fully under the traditional rulers such as the Village Head (Bulama), Chief Fishermen (Mai Njiyee) and District Head (Aja) respectively as translated in "kanuri" native language of the study area. Thus, the modern aquaculture fish production in practice in the study area lowered the authority of the traditional rulers in enforcing regulations to control the fishing activities.

This result shows consistency with the finding of Palsson (1988) as a strategy for management in small-scale fishing communities, respect systems work best in culturally homogeneous small-scale fishing communities. Communities whose members share a common ethnicity and cultural background and whose approaches to fishing and individual wealth levels are uniform. Otherwise, respect systems tend to break down when dissimilar and unrelated groups of fishers enter a fishery.

Some of the available ingredients for local fish feed production in the study area contradicts the cultural and religious believers of the inhabitants in the study area such ingredients as the fur pig, blood meal, blood meal and brewery wastes considered potential materials for fish feed production in the study area. Women fishers engagement in fisheries activities has been widen in the modern system of fish production compared to women fisher's participation under cultural system of fish production that regulates women in fishing activities such as fishing in open water or lake as result of religious and cultural believes. However, under the modern system of fish production women fishers freely participates fully in fish feed production, aquaculture fish production, fish processing, fish preservation, fish packaging, marketing and other activities.

This result confirmed that of Thorlindson (1988) certain community-based traditions, customs, religious practices, ritual behaviors and taboos may also influence fishing effort and fishing mortality in small-scale fishing communities. Religious imperatives that prohibit working on certain days may compel a cessation of fishing effort and correspondingly significant reduction of fishing mortality.

Local fish feed production in the study area enables the sustenance of fish production in the study area which has sustained the use of fish and fish product culturally in the study area. Cultural practices as the application of fish liver oil for cold disease medication and other related diseases of infant children below the age of three (3) years. Liver oil has been also considered effective for healing of fracture and dislocation in human body and generally important for human development regardless of age.

This result is in line with the findings of Lynch, Cooke, Bower, Bunnell, Cowx, Nguyen, Nohner, Phouthavong, Riley, Rogers, Taylor, Woelmer, Youn and Douglas (2016).

iii. Examination of Social Impact of Local Fish Feed Production in the Study Area

The production of local fish feed has sustained the culture of fish farming through modern system of farming in the study area. Fish Farmers have achieved social well-being as the farmers have been accommodating transformative changes in line with new technology through the development of aquaculture fish production in the study area. Local fish feed production played a crucial role in aquaculture fish farming thus sustaining the culture of fish

farming in the study area. The local fish feed production enables the fish farmers secure a better livelihood as the fish farmers were able to cope with population increase, urbanization, high demand for essentials goods and services, with an accompanying increase in the general price of goods and services, overstretches on social amenities and other infrastructural facilities in the study area.

This result confirmed that of Lynch, Cooke, Bower, Bunnell, Cowx, Nguyen, Nohner, Phouthavong, Riley, Rogers, Taylor, Woelmer, Youn and Douglas (2016).

The local fish feed producers were able to undergo training in fish feed production technology through which the farmers were able to swung in to full aquaculture fish production and in all fisheries activities such as fingerling production, construction of fishing implements, construction, assembling and repairs of local fish feed production machine, sourcing of fish feed production ingredients, weaving and making of bags and baskets for packaging and transportation among others. Through these activities the fishers generate income and their standard of living has risen as the farmers were able to cater for their educational need through enrolment in to modern system of education. They were able to undergo training and were equipped skill wise in fisheries technology and other fisheries developmental related matters averagely.

The farmers were able to provides for their upkeeps with housing and other provisions with government intervention such as good health care system, electricity supply, pipe bone water, good road system, marketing facilities and security for their life and properties. The present state of social well-being of the fishers might have not been possible without the production of local fish feed which became an instrument in the development of aquaculture fish production and fisheries activities in the study area for the sustenance of the sector (Figure 4 and 5).

This results shows consistency with the findings of Nwuba, Ude and Ogbonnaya,(2022).

Summary and Conclusion

The outcome of the result indicates that local fish feed production in the study area has created employment opportunities through job creation in the value chain of fish production industry. This has led to poverty reduction and improves the food security status of the population in the study area. The local fish feed production has sustained the culture of fish farming in the study area through the transformation and restoration of the culture of fish farming in Borno State of Nigeria known for more than eight thousand five hundred years for its artisanal fish production.

Traditional ecological knowledge (TEK) of the displaced fishers of the rural fishing communities have contributed positively in the transformation and restoration process of the local fish feed by the way of improvement of the quality of the local feed through integration with the low-level scientific mode of production in the study area. The local fish feed production has impacted positively on the social wellbeing of the inhabitants at individual level, household level, community level and at governmental and non-governmental organization levels in meeting the social need of the society such as education, market facilities, skill acquisition, storage facilities, secondary job opportunities, better health status,

improved security for life and properties of the citizenry and access to better infrastructural facilities and social services in the study area. The study recommends: -

1. The fish farmers should own their own initiate ways of improving the general aspects of fish production that will bring rapid development to the people, community, state, nation and the international community consequently for the sector to developed to a greater height.
2. Government and non-governmental organizations should integrate with the fish farmers and community stake holders in decision making process of project plan right from the proposal stage and carry out the project concurrently up to the conclusion stages.
3. Individual, community, state, national and international interest should be eliminated in all matters relating to development based on the project aim and objectives set at the original stage. Any sign of emergence of problem must be curtail before its manifestation.
4. Emphasizes must be given to optimal resource utilization at all level for the attainment of large-scale production that will guarantee the welfare of the public at a sustainable level.
5. The need for standardization of the local fish feed product through formal registration of the local industries with standard organizations and other relevant regulatory bodies.

References

Agbugu M., Emawunegbe LI and Yaro AC (2021) Indigenous Fish Feed Resources in Nigeria (2021) Journal of Biology Innovation 9(6). pp:1339-1353,2020. ISSN 2277 – 8330. https://doi.org/10.46.344 IJBINO.2020.VO9io6.21. agbugui.marian@edouniversity.edu.ng.

Alltech (2016) Altech Global Feed Survey, 2016. http://www.altech.com/feed survey.

Begho T. and Iyabor A. (2024) Fish Feed Formulation: Does Nigerian Farmers Risk and Time Preference Play a Part in Choosing Feed Protein Sources for Intensively Farmed Fish. Aquaculture Vol. 1, 585.

Bello M. M. and Atadiose, J. (2016) Proximate Composition of some Commercial Fish Feeds available in Maiduguri, Borno State Nigeria; 5th Applied Research Conference in Africa,Cape Coast, Ghana 2016. Conference Proceeding Book. mmbello@unimaid.edu.ng

Bohensky, E. L., and Maru, Y. (2011) Indigenous Knowledge, Science and Resilience: What have we Learned from a Decade of International Literature on "Integration"? Ecology and Society 16(4):6. http://dx.doi.org/10.5751/ES-04342-160406.

Boyd, C. E., Aaron, A., and Nevin, M. C. (2022) Overview of Aquaculture Feeds: Global Impacts of Ingredients Production, Manufacturing and use. Feed Feeding Practices in Aquaculture. A Volume in Woodhead Publishing Series in Food Science Technology and Nutrition. Book Second Edition 2022. Edited by: D. Allen Davis. Pp. 445-454. ISBN 978-0-12-821598-2. DOI: https://doi.org/10.1016/c2019-0-03580-7

Enwemiwe V. N. (2018) Methodology in Production of Local Integrated Fish Meal: Our Affordability in Abraka, Delta State, Nigeria. International Journal of Advanced Research and Publications. ISSN: 2456-9992 IJARP. enwemiwevictor@gmail.com

Fregene, BT., Yossa, R., Karisa, HC., Olaniyi A. and Bolorunduro PL. (2020) Extension Manual on Quality Low-Cost Fish Feed Formulation and Production, Ibadan, Nigeria: Technologies for African Agricultural Transformation; Penang, Malaysia: Worldfish. Manual: 2020-34. worldfishcenter@cgiar.org.

Grey Lutz, C. (2023) Aquafeeds, Encyclopedia of Meat Science (Third Edition) Edited by Dikeman M. Kansas State University, Manhattan, KS, United Nations. ISBN:978-0-323- 85198-5. copyright@2023elsevierltd Vol. 2. Aquaculture Feed Producers.

Houlihan, D., Bouiard, T., and Jobling, M. (2001) Food Intake in Fish. Lower State University Press. Black Well Science Ltd. 418 pp.

Kawuwa M. B., Mairiga A. G., and Usman H. A. (2007) Community Perspective of Maternal Mortality: Experience from Konduga Local Government Area, Borno State of Nigeria. Annals of African Medicine, ANNALS OF AFRICAN MEDICINE SOCIETY: ISSN: 1596 – 3519 VOL. 6, NUM 3, 2007. Pp. 109 -144.

Kolawole, A. A. and Mustapha, A.K. (2023) Farmed Fish Feeds: Use of Non-Conventional Feed as Fishmeal Replacement in Nigeria. Journal of Applied Science and Environmental Management Vol. 27 (7) 1387-1398 July 2023. https://www.ajo/.info/index.php/jasem

Lynch, A. J., Cooke, S. J., Denies, A. M., Bower, S. D., Bunnell, D. B., Cowx, L.G., Nguyen, V. M., Nohner, J., Phouthavong, K., Riley, B., Rogers, M.W., Taylor, W.W., Woelmer, W., Youn S. and Douglas, B.T. (2016) The Social Economic and Environmental Importance of Inland Fish and Fisheries. Environmental Reviews. https://doi.org/10.1139/er-2015-0064 Canadian Science Publishing.

Merican Z. and Sanchez, D. (2016) Overview of the Aquaculture Feed Industry: Aquafeed Formulation. Pp. 1-19. https://doi.org/10.1016/8979-0-12-800873-700001-4.

Nates, S. F. (2016) Aquafeed Formulation Sciencedirect.com. ISBN:978-0-12-800873-7. https://doi.org/10.1016/c2013-0-18878-2. PPxiiii-xxii

Nwuba, L. A., Ude E. F. and Ogbonnaya, H. F. (2022) Current Trends in Fisheries and Aquaculture. International Journal of Aquaculture Food and Biodiversity (IJAFAB) VOL. 1, PP.64-69. 1ST December 2022. www.researchgate.net.

OCHA (2018) Office for the Coordination of Humanitarian Affairs (OCHA) United Nations; Nigeria - Administrative Boundaries (Levels 0 – 3). Nigeria – Borno State: Konduga LGA Reference Map as at February 2018.

OECD (2020) Organization for Economic Cooperation and Development: Sustainable Fisheries and Aquaculture Policies for the future: Agriculture and Fisheries; Fisheries and Aquaculture. Organization for Economic Cooperation and Development. https://www.oecd.org.
Ogunji J. and Wuertz, S. (2023) Aquaculture Development in Nigeria: The Second Biggest Aquaculture Producer in Africa. Review Papers of Water, Agriculture and Aquaculture, 2023, 15 (24), 4224; https://doi.org/10.3390/w15244224.
Palsson, G. (1988) "Models for Fishing and Models of Success." Maritime Anthropological Studies (MAST) 1: 15-28.
Rosen, M. A. (2018) Issues, Concepts and Applications for Sustainability. Globalism: Journal of Culture, politics and Innovation 2018, 3, DOI: 1012893/gicpi.2018,3,4. ISSN2283-7949 "Globus at Locus" at www.glocalismjournal.net.
Rowan N. J. (2023) The Role of Digital Technologies in Supporting and Improving Fishery and Aquaculture Across the Supply Chain. Aquaculture and Fisheries Volume 8, Issue 4, pp.365-374. https://doi.org/10.1016/j.aaf.2022.06.003.
Sarker, B., Rahman, M. M. and Alam, M. N. (2015) A Study on Fish Feed Manufacture with its Nutritional Quality and Impacts on Fish Production. Aquaculture, Livestock and Fisheries, Vol.2, No.2 August 2015; 353-362. ISSN: P-2409 – 0603, E-2409-9325. www.agroaid-bd.org/ralf, editor.ralf@gmail.com
Thorlindson, T. (1988) "The Skippers Effect in the Icelandic Herring Fishery, Human Organization 47: 199 – 212.
Tijjani BA., Abubakar M., Benisheik KM and Mustapha AB (2010) Resource Use Efficiency in Rice Production in Jere Local Government Area of Borno State, Nigeria. Nigerian Journal of Basic and Applied Sciences (NJBS) 18(1): 27-37.
Udo, I. U. and Dickson, B. F. (2017) The Nigerian Aquafeed Industry: Potentials for Commercial Feed Production. Nigerian Journal of Fisheries and Aquaculture 5(2): 86 – 95, September 2017. http://www.Unimaid.edu.ng ISSN-2350-1537.
Verdegem, M., Yossa, R., Chary, K., Schrama, JW., Beveridge, MCM and Marwaha, N. (2021) Sustainable and Accessible Fish Feeds for Small-scale Fish Farmers, Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems. Program Brief: FISH-2021-06. @2021 CGIAR Research Program on Fish Agri-Food Systems.
Victor Suvesh A. (2016) Fish Feed Formulation. Aquafeed Formulation. Page 21 – 31. ISBN:978-0 - 12 - 800873 -7. DOI: https://doi.org/10.1016/C2013 – 0 -18878-2.

Appendix

Figure 1: Local Fish Feed Production Machine Workshop in the Study Area



Source: Field Survey, 2024

Figure 2: Local Fish Feed Producers Empowerment Scheme in the Study Area



Source: Field Survey, 2024

Figure 3: Work in Progress in Local Fish Feed Production Industry in the Study Area.



Source: Field Survey, 2024

Figure 4: Sun drying of Local Fish Feed in the Study Area



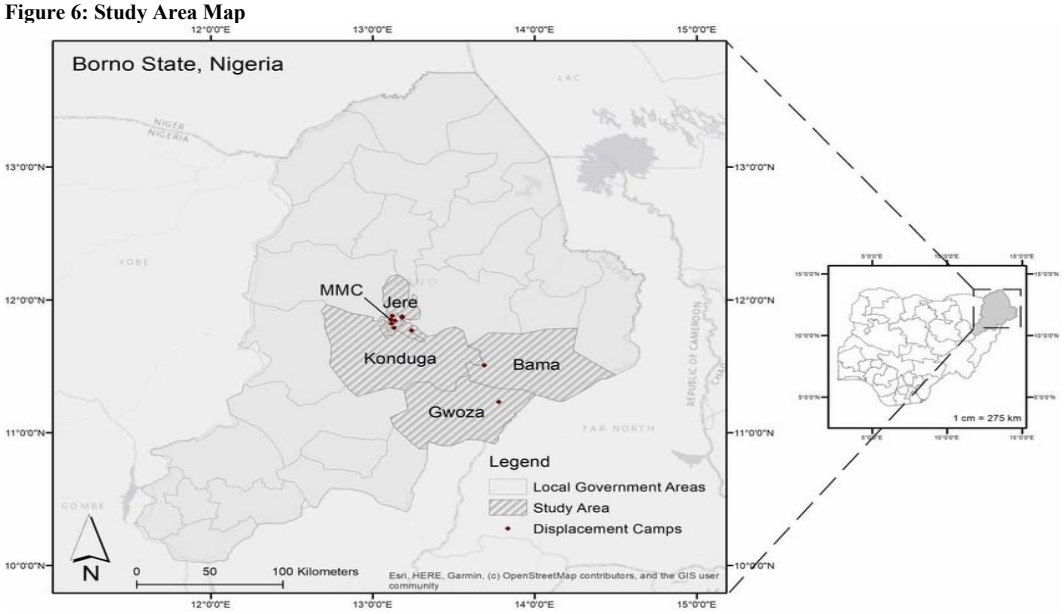
Source: Field Survey, 2024

Figure 5: Local Fish Feed (Finished Product) in the Study Area



Source: Field Survey, 2024

Figure 6: Study Area Map



Source: Field Survey, 2024