

COST- BENEFIT ANALYSIS OF INVESTING IN LOCALLY PELLETIZED FISH FEED PRODUCTION IN NIGER STATE, NIGERIA

¹Umar Jummai Khadijat,² Ifejica Philip ³Aliyu Rilwan ⁴Ibeu Dele, ⁵Ebenezer Landu and

⁶Garba Abubakar Usman

^{1, 2, 4, 5 & 6}Socio -Ecos and Extension Services Division, National Institute for Freshwater Fisheries Research New- Bussa Niger State Nigeria.

³Product Development and engineering department, National Institute for Freshwater Fisheries Research New- Bussa Niger State Nigeria.

umarjummaikhadijah@gmail.com

+2347060452957.

Abstract

The study assessed the profitability and economic viability of investing in locally pelletized fish feed production in Niger State, Nigeria. The research was motivated by the rising cost of fish feed, which significantly affects the profitability of fish farmers and limits the growth of aquaculture in the country. Primary data were collected from 215 locally pelletized fish feed producers using structured questionnaires and analysed using farm budgeting techniques, including net farm income, gross margin, and profitability ratios. The findings revealed that total variable costs accounted for 70.48% of the total production cost, while fixed costs constituted 29.52%. The estimated gross margin and net farm income were ₦233,425 and ₦122,425 respectively, indicating strong profitability. The rate of return on investment (RRI) was 0.33, the operating ratio 0.84, and the gross ratio 0.75, all of which confirm the economic viability of local feed production. The study concludes that locally pelletized fish feed production offers a profitable and sustainable agribusiness opportunity capable of enhancing rural employment, reducing production costs for fish farmers and supporting Nigeria's food security goals. Therefore, it is recommended that government and development agencies promote the establishment of small and medium-scale local fish feed enterprises through targeted credit schemes, subsidized equipment, and technical training for producers

KEYWORDS: Aquaculture, investment, Profitability, Pelletized Fish Feed, Production, Niger state.

JEL Code: O40, H56, E60, E63

1. INTRODUCTION

Aquaculture is widely acknowledged for its pivotal role in supplying both food and income to numerous developing nations. It involves the controlled cultivation of fish and various aquatic organisms in environments such as pens, ponds, tanks, cages, and raceways, commonly referred to as fish farming. Aquaculture is rapidly expanding across the world, with the potential to providing significant proteins for human consumption (Boyd, McNevin, & Davis 2022). The

volume of global fish production grew from 184.6 million metric tons in 2022 to 186.6 million metric tons in 2023 (Al-Wakeel, Elbahnaswy, Risha & Zahran 2024). In Africa, freshwater fish production has steadily increased significantly than the previous years. In the North Africa for instance, the most raised production levels are found in Egypt, Morocco, Algeria and Libya (Mehrim & Refaey, 2023). Expansive structures are depicted by stacking of juvenile fish in storehouses as practiced in Egypt. Egypt's aquaculture output increased from 139,389 tons in 1998 to 1,561,457 tons in 2018, accounting for 71% of Africa's total aquaculture production (Elsheikh, Uçak&Bağdatlı 2024). Egypt occupied the first rank among African countries and the ninth position globally in the field of fish farming production. This achievement aimed to link up the disparity between fish production and consumption in Egypt (Mohammed, Ebrahim, Youssef, Saleem&Abdelkhalek 2024).

Fish farming in South Africa has also grown from 2819 tons in 2000 to 9753 tons in 2020 (Life & Potgieter 2024). The country was the 12th largest fish producer in Africa. Similarly, In East Africa fish farming increased from 68351 tons in 2000 to 379778 tons in 2020. Tanzania is the major fish producing country of the region with a production of close to 400000 tons. In value terms and based on ex vessel price, the total fish production is estimated at close to US 400million. Similarly, In West Africa, fish production surged from 32146 tons in 2000 to 388375 tons in 2021, with a remarkable annual growth rate of 2.37 percent, surpassing regional and global averages.

Aquaculture production in Nigeria rose from about 2000 tons in 1960 to more than 300,000 tons in 2015. This rate dropped in 2019 to 290,000 tons and 260,000 tons in 2020 because of the COVID-19 impact (Ogunji & Wuertz 2023). The last production figures revealed 275,645 tons. According to the Central Bank of Nigeria (CBN) and the Food and Agriculture Organization (FAO), the average Nigerian eats less than 2kg of beef a year. The figures also show that the average Nigerian receives a paltry 4kg of eggs a year. This has led to a lot of people getting involved in fish farming, which has created a very good market for people who produce fish feed in Nigeria. Nigeria has a growing fish farming industry and the demand for fish feed is high. The high cost of fish feed affects profitability margin of fish farmers, thereby driving some of them out of the business, particularly the small-scale fish farmers. The high cost of the feed also affects the price of fish products thereby undermining welfare of Nigerians. Therefore, there is the need to determine the cost and the benefits of investing in locally pelletized fish feed, with a view to providing fish feed at an affordable price to fish farmers and also generating employment and income to fish feed producers. Fish culture is gaining importance in Nigeria as locally available raw materials are considered as potential materials for fish feed. (Audu & Yola, 2021).

The global rise in demand for fish has increased the need for sustainable, affordable feed solutions. In Nigeria, However, variability in feed quality, lack of standardized quality controls, and logistical issues such as poor infrastructure hinder widespread adoption (Nwachukwu et al 2017). Farmers' perceptions and skepticism about the nutritional value of local feeds further limit their reliance on imported fish feeds perceived as higher quality creates economic challenges and market fluctuations (Ogunleye et al 2018) Dada et al 2019). There is growing interest in producing local feeds using readily available raw materials like maize and soybeans, which could lower costs and generate employment (Adewumi et al., 2019). (Eze & Nwachukwu, 2019). Addressing quality standards, improving distribution, and understanding farmers' preferences are key to promoting the use of locally pelletized fish feed.

Literature Review

Several studies have explored the production and utilization of local fish feeds in Nigeria and other developing countries, offering insights relevant to this research. Dada and Olaleye (2019) examined distribution networks for aquaculture inputs and reported that inadequate transportation infrastructure and limited market linkages restricted access to local feeds, especially in rural areas. These logistical challenges increased costs and reduced availability, limiting adoption among smallholder farmers.

(Ogunleye and 2018) surveyed fish farmers in Ogun State, revealing that while farmers valued the low cost of local feeds, concerns about their quality and nutritional effectiveness hindered widespread adoption. Farmers preferred feeds with proven nutritional content and consistent pellet quality, emphasizing the importance of quality assurance and farmer education.

(Ogunleye and Ayodele 2020) surveyed small-scale feed producers in southwestern Nigeria and found that they mainly relied on readily available raw materials such as maize, soybean, and rice bran. Their study highlighted the absence of standardized processing techniques, which compromised the consistency and nutritional quality of the feeds. Similarly, Ibrahim and Musa (2020) observed that limited access to modern pelletizing equipment resulted in variable pellet quality and weight among local producers. While Adegbite et al. (2021) assessed the nutritional composition of locally produced fish feeds in Nigeria and found that many samples failed to meet recommended protein and energy levels, primarily due to poor ingredient mixing and processing methods. This inconsistency negatively impacted fish growth and feed efficiency, underscoring the need for establishing quality control protocols.

Recent growth in Nigeria's aquaculture industry, especially in Niger State, highlights its potential for economic development and food security due to abundant natural resources. However, the sector faces significant challenges, primarily the heavy reliance on expensive imported fish feed over 80% of Nigeria's feed, costing around \$600 million annually which raises operational costs and limits industry expansion. Developing local fish feed production could reduce costs, create jobs, and support rural development, but obstacles such as high investment requirements, quality control, raw material fluctuations, and weak distribution networks hinder progress. Existing research lacks region-specific data for Niger State, making it difficult for policymakers to expertise targeted strategies. Addressing this gap through focused studies on cost benefit analysis could promote sustainable growth, attract investment, and enhance food security by establishing a competitive local fish feed industry modified to Niger State's unique socio-economic background. Historically reliant on costly imports feeding, Nigeria and other African countries have shifted toward locally producing fish feed using available raw materials like maize and soybean. This approach aims to reduce costs, improve feed availability, and support local economies. Today, pelletized fish feed is seen as essential for making aquaculture more sustainable and profitable, despite challenges in scaling up, ensuring quality, and establishing distribution. Largely, it is a transformative solution, especially in resource-rich regions like Niger State.

Currently, Nigeria's pelletized fish feed industry is expanding due to government policies and aquaculture growth. Modern technology has improved feed quality, and local ingredients are now widely used, reducing reliance on imports. Investment by SMEs and larger companies has increased production capacity. Support from government and NGOs, along with rising demand from expanding aquaculture, has led to greater production volumes and diverse feed formulations. At this time, there is limited specific scholarly work focusing exclusively on locally pelletized fish feed production in Niger. However, related research and conceptual frameworks can be drawn

from broader studies on aquaculture feed production in West Africa, small-scale fish farming, and local feed manufacturing practices. The key conceptual themes surrounding locally pelletized fish feed production in Niger focus on promoting sustainable aquaculture by developing affordable, locally sourced feed options that reduce reliance on imports. These themes emphasize the adaptation of low-cost pelletization technologies suitable for small-scale producers, utilizing readily available agro-industrial by-products such: maize bran, millet, sorghum, and fish waste to formulate nutritionally balanced feeds modified to regional fish species. The approach aims to improve fish growth performance, lower production costs, and enhance food security. Additionally, it recognizes existing challenges like limited technical capacity and market access, while highlighting opportunities for technology transfer, capacity building, and supportive policies to foster industry development.

The cost related to fish feed remains a major issue, especially among small-scale fish farmers in the aquaculture industry. This is because feed accounts for over 70% cost of producing a table-size fishes. However, to maximize profit through cost minimization, there has been a substantial improvement in the technology of processing locally pelleted fish feeds in recent years. The use of hand mixing has been replaced with a well-modernized model of indigenous machinery comprising a crusher, pelletizer, mixer and the like Omeje et al (2023). This technology can be set up at the fish farm sites, while the composition of the mixed ingredients and the size of the pelleted feed can be changed considerably depending on the age and specie of farmed fish.

In light of these considerations, this study focuses on Niger State to explore the cost benefit analysis of investing in locally pelletize fish feed production. Related empirical and literature reviews such as: Nwabeze et al (2017). Examined information needs of fish-feed entrepreneurs in the Kainji Lake Basin, Nigeria. On the other hand, Opong et al (2017) The study found that producing fish feed from Black Soldier Fly Larvae is a financially viable and promising alternative to traditional fishmeal, which is expected to become scarce. It the assessed profitability using Net Present Value (NPV), Benefit Cost Ratio (BCR), and Internal Rate of Return (IRR), finding that both BSFL meal and BSFL-based fish feed are financially attractive. Ajani et al (2020). Examined the differences in quality between locally pelletized fish feed and the imported one. The study found that local diet if well formulated has the potential for being profitable. Ifejica et al (2020). Analysed the economic return among different low-cost feed types while, Adeoti et al. (2021) found that fish feed enterprises in Osun State, Nigeria, are highly profitable, but farmers face challenges like limited funding, high equipment costs, market instability, and poor feed quality. Similarly, Sogbesan, et al (2021) investigated the hike in the price of fishmeal, which is the major source of animal protein in fish diet, and suggested the need for alternative sources. Their study found that fresh chicken intestine could be used as an alternative for fishmeal in order to reduce the cost of raw materials for making fish feed. Hence, Studies on the marketability of the locally pelletized fish feed point the price of the feed, its aroma and quality as its barriers in the market place (Adeoti et al., 2021).

The cost of raw materials often makes the price of locally pelletized fish feed to be high and put it at a competitive disadvantage (Audu, et al 2021). Omeje et al. (2023). stated that fish feed production profitability depends on factors like stable electricity, affordable equipment, demand, and ingredient availability, and they advise regular maintenance and timely machine replacement to boost productivity and profits. Hence, this research aims to generate targeted insights into the economic and social impacts of establishing a regionally adapted fish feed industry. By doing so, the study seeks to inform local policy decisions, attract investment, and contribute to the development of a sustainable, competitive aquaculture sector that can drive economic growth,

improve food security, and create livelihoods for local populations within Niger State. Specifically, the study aim to:

- i. Determine the profitability of investing in locally pelletized fish feed in Niger State.
- ii. Examine the marketability of locally pelletized fish feed in Niger State

2. METHODOLOGY

2.1. Study Area

The study was conducted in Niger State, Nigeria, which is geographically situated between latitudes 8°22'N and 11°30'N and longitudes 3°30'E and 7°20'E. It borders several states—Zamfara, Kebbi, Kogi, Kwara, Kaduna, and Abuja (FCT) and shares an international border with the Republic of Benin at Babanna in Borgu Local Government Area. Covering approximately 76,470 square kilometers, about 9.3% of Nigeria's land area, Niger State has a population of around 3.95 million. Its favorable environment for studying locally produced fish feed stems from its high fish production, abundant raw materials such as fishmeal, soybeans, maize, and other agricultural products, which reduce transportation costs and enhance efficiency. Additionally, the presence of existing fish feed facilities provides a strong infrastructure base for further research and development in the region.

2.1.2 Sampling techniques and sample size

The population for this study consists of locally pelletized fish feed producers in Niger State. A three-stage sampling procedure was employed to select locally pelletized fish feed producers in the study area. The first stage involved purposive selection of three (3) local government areas associated with locally pelletized fish feed producers from each of the three (3) Agricultural zones in the Niger State. Bida in Agricultural Zone (I). Chanchaga in Agricultural Zone (II) and Borgu in Agricultural Zone (III). The second stage involved random selection of two (2) villages from each of the selected local govt. The final stage involved selection of 50% percent of total fish feed producer in the villages. Upon discussion with Niger State Agricultural Mechanization and Development Authority (NAMDA), Community heads and extension agents from each zone, the Sampling frame of 450 of locally pelletized fish feed producers was obtained.

A total number of 215 respondents were used for the study. This approach was adopted because NAMDA, community leaders and extension agents are familiar with all registered and active locally pelletized fish feed producers within their jurisdictions, which help ensure that the list is accurate and comprehensive.

Table 2.1 Sampling outlay of the study.

Agricultural Zone	Local Govt Areas	Villages	Sample Frame	Sampled size (50%)
Zone I	Bida	Kutigi	76	38
		Lemu	62	31
Zone II	Chanchaga	Lapaigwari	76	38
		Gbako	78	39
Zone III	Borgu	New Bussa	94	47
		(Agwara)Babanna	44	22
Total	6	6	430	215

2.1.3 Method of Data Collection

Primary data were used for the study. A structured questionnaire complemented with interview schedule was used to elicit the necessary information from respondents in the study area. Data were collected on the socio-economic characteristics of the respondents; source and frequency of information; cost of input utilized and return was collected. More so, data on marketing margin and marketing efficiency of locally pelletized fish feed were collected.

2.1.4 Method of Data Analysis

Descriptive and inferential statistics were used in analyzing the collected data. Descriptive analytical techniques used compose of means, frequencies and percentages. However, budgetary technique and marketing margin were used to specify the model: The justification for using budgetary techniques and marketing margin analysis lies in their effectiveness for assessing the financial viability and profitability of fish feed production and marketing. Budgetary techniques help estimate costs and revenues, aiding in decision-making and resource planning. Market margin analysis evaluates the profitability at different distribution stages and the competitiveness of local feeds. Together, these methods provide a comprehensive financial overview; budgetary techniques specify costs and income, while market margins highlight economic efficiency and market sustainability.

The net farm income model is specified as equation 1:

$$NFI = GR - (TFC+TVC) \quad (1)$$

Where:

NFI = Net farm income (₦);

GR = Gross revenue (₦);

TFC = Total fixed costs (₦); and

TVC = Total variable costs (₦).

$$GM = GFI - TVC \quad (2)$$

$$RRI = \frac{GM}{TVC} \quad (3)$$

Where:

GM= Gross margin (₦);

TVC = Total variable cost (₦).

$$OR = \frac{TVC}{GI} \quad (4)$$

Where:

OR is the operating ratio;

TVC is total variable cost; and

GI is the gross income.

Gross ratio: It measures the ultimate solvency of the farm business. Equation 5:

$$GR = \frac{TFE}{GI} \quad (5)$$

Where:

GR is the gross ratio;

TFE is the total farm expenses; and

GI is the gross income. A lower and less than one ratio are preferable.

$$\text{Marketing margin} = \frac{\text{selling price} - \text{purchasing price}}{\text{Selling price}} \times 100 \quad (6)$$

3. RESULT AND DISCUSSION

3.1 Socioeconomic characteristics of respondents

The finding on the age distribution of respondent in **Table 3.1** show that majority (60%) of the respondents are within 20–39 age bracket, with an average age of 37years, indicating that young and middle-aged individuals predominantly engage in locally pelletized fish feed production. Their openness to innovation and technological adaptation bodes well for the sector's sustainability. Additionally, most respondents (45.1%) have 21–30 years of fish farming experience, averaging 23 years, which provides them with substantial practical knowledge. This experience enhances their appreciation of locally produced feeds, especially for reducing costs compared to imported options. This aligns with findings by Oyesola et al (2022) and Boyd et al (2022).who noted that experienced fish farmers are more likely to adopt cost-effective technologies and improve productivity, feed quality, input costs, and management practices.

Table 3.1: Socioeconomic characteristics of respondents

Variable	Frequency	Percentage (%)	Mean
Age			
20–39	129	60.0	37
40–59	75	34.9	
60 and above	11	5.1	
Years of experience			
1–10	32	14.9	
11 – 20	54	25.1	23
21 – 30	97	45.1	
31 – 40	32	14.9	
Gender			
Female	50	23.3	
Male	165	76.7	
Marital Status			
Married	198	92.1	
Single	13	6.0	
Widowed	4	1.9	
Level of Formal Education			
Non-formal	95	44.2	
Primary	29	13.5	
Secondary	52	24.2	
Tertiary	39	18.1	
Contact with Extension Agent (Last Season)			
Yes	120	55.8	6
No	95	44.2	
Secondary occupation			
Fish farming		81	37.7
Fish feed retailer		80	37.2
Wage labourer		23	10.7
Access to credit in the last farming season		77	35.8

Belong to any association/cooperative societies	138	64.2
Sources of information		
Family and friends	215	100.0
Producers group	122	56.7
Radio	174	80.9
Television	34	15.8
Newspaper	1	0.5
Extension agent	118	54.9
Social media	50	23.3

The respondents in the study area are predominantly male (76.7%), reflecting gender disparities in Nigerian aquaculture, where women face limited access to land, credit, and training, restricting their participation mainly to supportive roles (Nwuba et al., 2022; Ogunji et al., 2023). Most are married (92.1%), which likely supports sustained engagement through family labor and shared resources (Audu et al. 2021). Educational levels vary, with 42.8% having no formal education, indicating reliance on indigenous knowledge, though some have higher education to facilitate modern practices (Mehrim et al., 2023). About 55.8% had contact with extension agents, suggesting moderate access to knowledge that can enhance productivity (Boyd et al., 2022; Ogunji et al., 2023). Fish farming and feed retailing are main secondary occupations, highlighting sector growth and diversification (Ashaolu et al., 2020; Olasunkanmi et al., 2023). However, only 35.8% accessed credit recently, with most relying on informal sources due to limited formal credit access (Osondu et al., 2021; Obasi et al., 2023). Additionally, 64.2% are members of cooperatives, which improve access to resources and markets (Adekoya et al., 2024). Information about feed production mainly comes from family, friends, and producer groups, with radio being the most accessible mass media, facilitating knowledge transfer in this rural setting (Ajayi et al., 2023).

3.2 Profitability of investing in locally pelletized fish feed production

Table 3.2 presents the profitability of investing in locally pelletized fish feed production, indicating the total variable cost (TVC), total fixed cost (TFC), total cost (TC), Gross margin, net farm income and other ratios. The finding reveals that variable costs accounted for 70.48% of the total cost of production. This dominance is typical in agro-processing ventures like feed production where input prices, particularly feed ingredients, drive overall cost structure. In the study area, most of the ingredients are locally available but their prices can be volatile due to seasonal fluctuations, transportation bottlenecks or inflation. Labour, though often informal, still contributes significantly since most of their operation is still manual. The high variable cost also signals that the enterprise is resource-intensive at the operational level. However, this is a manageable challenge, if input supply chains are stabilized or cooperative purchasing is adopted, the cost burden can be reduced. This dominance of variable cost is in line with Fagbenro and Arowosoge (2021) and Adebayo and Daramola (2023), who both found that feed ingredients and operational expenses consistently form over 65% of total costs in smallholder fish, feed enterprises. **Table 3.2** also reveals that fixed cost accounted for 29.52% of total production cost, which is relatively modest and expected for a small-to-medium scale feed enterprise. The moderate fixed cost ratio implies that after the initial investment, producers can scale production with minimal additional fixed cost.

Table 3.2: profitability of investing in locally pelletized fish feed production

Variable	Cost	Percentage of TC
Total variable cost	265000	70.47872
Total fixed cost	111000	29.52128
Total cost	376000	100
Total return	498425	
Gross margin	233425	
NFI	122425	
RRI	0.33	
OR	0.84	
GR	0.75	
MM	133.4699	

The study's findings reveal that locally pelletized fish feed production is highly profitable, with a gross margin of ₦233,425 and a net farm income of ₦122,425, indicating substantial earnings after covering operational costs. The return on investment (ROI) of 33% demonstrates that producers earn an additional ₦0.33 for every ₦1 invested, making it more advantageous than alternative rural income sources such as rain-fed farming or retail trade (Inoni, 2017; Akinbile et al., 2011). The operating ratio of 0.84 suggests that 84% of revenue is used for operating expenses, leaving 16% as profit, while the gross ratio of 0.75 indicates that 75% of income covers production costs with 25% remaining as profit. These ratios align with existing literature, confirming that profitable small-scale feed enterprises typically maintain gross ratios below 1, ensuring operational sustainability and room for margin improvement (Inoni, 2017; Akinbile et al., 2011).

4. Marketability of Locally Pelletized Fish Feed

Table 4.1 presents the findings on the marketability of locally pelletized fish feed production. It reveals that majority of respondents reported selling directly to fish farmers (80.5%) and in local markets (72.6%). This pattern suggests that the supply chain for pelletized feed is still relatively informal and community-driven. Selling directly to fish farmers allows producers to build trust, receive direct feedback and reduce transaction costs associated with middlemen. The presence of wholesalers (45.1%) and retail shops (37.7%) as sales channels indicates an emerging semi-structured market. These middle actors help in scaling distribution but may also reduce producers' profit margins due to bulk pricing. That 10.7% still resort to hawking (roadside selling) highlights a segment of producers who lack market access, are trying to reach customers in remote areas, or operate at a very small scale. **Olaoye et al. (2023)** found in their study of smallholder catfish farmers in Ogun State that over 70% of fish feed is procured directly from local processors or fellow farmers rather than large-scale feed companies. This direct interaction supports relationship-based transactions and trust building.

Table 4.1 Marketability of locally pelletized fish feed production

Variable	Frequency*	Percentage	Mean
Where sold			
Local market	156	72.6	
Direct to fish farmers	173	80.5	
Wholesalers	97	45.1	
Retail shops	81	37.7	
Others(hawking)	23	10.7	
Quantity produced			
< 500 kg	38	17.7	1,014 kg
500–999 kg	67	31.2	
1,000–1,499 kg	69	32.1	
1,500 kg and above	41	19.1	
Quantity sold			
<500 kg	44	20.5	962 kg
500–799 kg	61	28.4	
800–1,099 kg	79	36.7	
1,100 kg+	31	14.4	

Multiple responses were recorded

The study indicates that most producers operate at small to medium scales, with 17.7% producing less than 500 kg per cycle and 32.1% producing between 1,000 and 1,499 kg, with an average of approximately 1,014 kg (Tiamiyu et al., 2023). The average quantity sold (962 kg) is close to the amount produced, with the largest group (36.7%) selling between 800–1,099 kg, reflecting steady market demand. The small discrepancy between production and sales suggests that some feed may be stored for future use or retained for personal consumption, a common practice among small fish feed producers in the area (Tiamiyu et al., 2023).

5. CONCLUSION

The study concludes that investment in locally pelletized fish feed production in Niger State is economically viable and market-responsive, especially when based on the use of local raw materials and sold through informal but effective distribution channels. It supports smallholder aquaculture by improving access to affordable feed, and contributes modestly to employment, especially among youth and women. However, the sector still faces challenges related to scale, formal market penetration, and limited institutional support, which constrain its broader socio-economic impact.

5.1 RECOMMENDATIONS

- i. The government and developmental agencies should implement targeted support programs such as input subsidies, tax incentives, and training initiatives to increase employment opportunities and reduce reliance on imported fish feed that can be produced locally.
- ii. To broaden market access, authorities and development partners should establish structured market linkages by creating digital trading platforms, setting up fish feed marketplaces, and supporting contract arrangements between feed producers and large-scale aquaculture operations. This will help reduce market uncertainties and improve profitability.

iii. Although the profitability indicators (Gross Margin, Rate of Return on Investment, and Operating Ratio) show that the business is viable, efficiency can be enhanced through capacity building. Training on improved pelletizing technologies, feed formulation, quality control, and packaging should be institutionalized, with a focus on youth and women who have already found employment in the sector. This will equip them with advanced entrepreneurial and technical skills necessary for sustained competitiveness.

Based on the findings, the following recommendations are proposed:

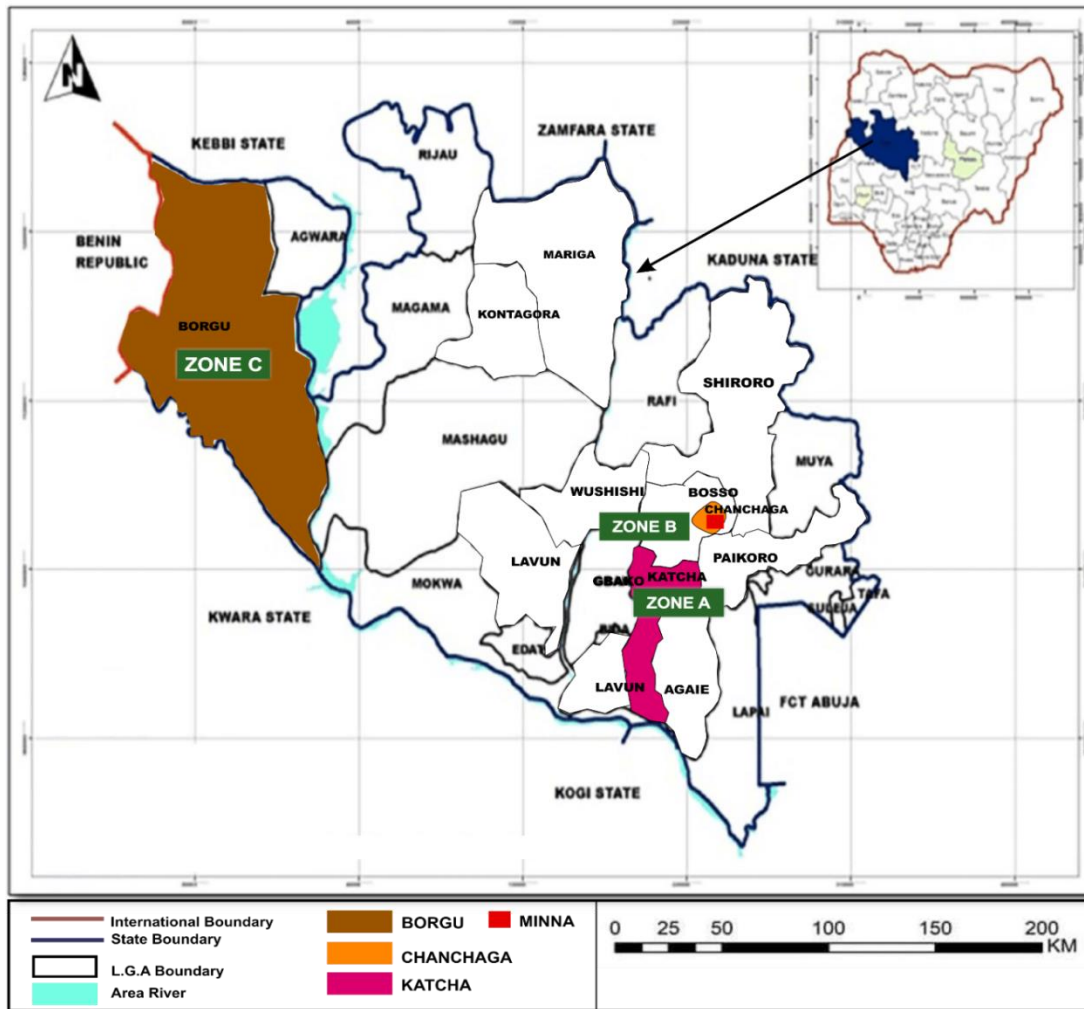


Figure 2.2: Map showing the study areas

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