



doi:10.5281/zenodo.18670910

# **A Comparative Study On The Effects Of Locally Formulated And Commercial Feeds, And The Construction Of An Economical Fishpond For Catfish (*Clarias gariepinus*) At The Federal College Of Education (Technical), Ekiadolor, Benin City**

**Haruna Mohammed Haruna<sup>1</sup> Abdullahi Mustapha Daura<sup>2</sup> Ibrahim Surajo<sup>3</sup> & Musa Bala<sup>4</sup>**

**<sup>1&3</sup>Department of Biology,  
Federal College of Education (Technical), Ekiadolor, Benin-City, Edo State, Nigeria**

**<sup>2</sup>Department of Agricultural Science Education.  
Federal College of Education (Technical), Ekiadolor, Benin-City, Edo State, Nigeria**

**<sup>4</sup>Department of Chemistry Education,  
Federal College of Education (Technical), Ekiadolor, Benin-City, Edo State, Nigeria  
Corresponding author: hmharunatilde@gmail.com**

## **ABSTRACT**

The study investigated the comparative effects of locally formulated and commercial feeds on the growth performance of African catfish (*Clarias gariepinus*) and evaluated the construction of an economical fishpond at the Federal College of Education (Technical), Ekiadolor, Benin City. Juvenile catfish were stocked in rubber fish tank and fed either commercial or locally formulated diets for eight weeks. Growth performance parameters measured included weight gain, specific growth rate (SGR), feed conversion ratio (FCR), and survival rate. Water quality parameters were monitored and economic analysis of feed cost and pond construction was conducted. Results indicated that fish fed commercial feed achieved higher weight gain, SGR, and lower FCR compared to locally formulated feed ( $p < 0.05$ ). However, local feed was more cost effective per unit weight gain. The locally constructed rubber tank pond proved economical and suitable for catfish production. The study concludes that commercial feed optimizes growth while local feed provides economic advantages, and recommends integrating cost effective pond construction and proper feed formulation for sustainable catfish farming.

**Keywords:** *Clarias gariepinus*, locally formulated feed, commercial feed, fish construction, aquaculture

## **INTRODUCTION**

Aquaculture has become one of the fastest growing sectors of agriculture globally and plays a vital role in food security, employment generation, and poverty alleviation, particularly in developing countries (FAO, 2020). In Nigeria, the rapid increase in population coupled with the decline in capture fisheries has intensified the need for sustainable fish production through aquaculture (Ayinla and Fakoya, 2017). Among cultured fish species in Nigeria, the African catfish (*Clarias gariepinus*) is the most widely

farmed due to its fast growth rate, high resistance to disease, tolerance to poor water quality, ability to withstand high stocking density, and acceptance of artificial feeds (Adewumi and Olaleye, 2011). These characteristics make *Clarias gariepinus* suitable for both small-scale and large-scale fish farming. Feed is one of the most critical inputs in aquaculture production and accounts for over 50% of the total production cost in intensive catfish farming systems (Ekunwe and Emokaro, 2009). Commercial fish feeds are widely used because they are nutritionally balanced and promote rapid growth. However, their high cost often reduces profit margins and limits accessibility for small-scale farmers (Tacon and Metian, 2015). As a result, many fish farmers have resorted to the use of locally formulated feeds produced from locally available feed ingredients such as maize, soybean meal, groundnut cake, fish meal, and agricultural by-products. Studies have shown that when properly formulated, locally compounded feeds can support acceptable growth performance and survival of *Clarias gariepinus* while significantly reducing feed cost (Fagbenro and Adebayo, 2005; Olurin *et al.*, 2012). In addition to feed cost, the construction of fishponds constitutes a major capital investment in aquaculture. The choice of pond type earthen, concrete, tarpaulin, or plastic tanks affects both production cost and efficiency. Earthen ponds are generally considered more economical due to lower construction and maintenance costs and their ability to support natural productivity (FAO, 2018). This study therefore compared the effects of locally formulated and commercial feeds on the growth performance of *Clarias gariepinus* and to examine the construction of an economical fishpond at the Federal College of Education (Technical), Ekiadolor, Benin City.

## LITERATURE REVIEW

### Overview of Aquaculture and Catfish Farming in Nigeria

Aquaculture has become an important component of agricultural development in Nigeria due to declining capture fisheries and increasing demand for animal protein (FAO, 2020). Among cultured fish species, *Clarias gariepinus* is the most widely farmed because of its rapid growth rate, tolerance to poor water quality, high stocking density, and ability to utilize a wide range of feeds (Adewumi and Olaleye, 2011). Catfish farming has contributed significantly to employment generation and income for small and medium scale farmers. However, high production costs, particularly feed and pond construction costs, continue to limit profitability (Ayinla and Fakoya, 2017).

### Nutritional Requirements of *Clarias gariepinus*

Nutrition plays a critical role in fish growth, survival, and feed utilization. According to NRC (2011), African catfish require diets containing adequate levels of crude protein, lipids, carbohydrates, vitamins, and minerals. Juvenile *Clarias gariepinus* generally require crude protein levels ranging from 35–45% for optimal growth (Faturoti, 2000). Protein is the most expensive component of fish feed, and inadequate protein levels often result in poor growth and increased feed conversion ratio (FCR). Balanced energy protein ratios are also essential to prevent protein wastage and reduce feed cost (Lovell, 2012).

### Commercial Fish Feeds

Commercial fish feeds are factory produced diets formulated to meet the nutritional requirements of fish at different life stages. These feeds are often pelleted or extruded and contain high quality protein sources such as fishmeal, soybean meal, and vitamin and mineral premixes (Tacon and Metian, 2015).

Several studies have reported superior growth performance of *Clarias gariepinus* fed commercial feeds compared to locally compounded diets. For instance, Adewolu *et al.* (2008) observed higher weight gain, better specific growth rate (SGR), and lower FCR in catfish fed commercial feeds. Similarly, Eyo and Ekanem (2011) reported improved survival and uniform growth among catfish fed branded commercial diets. Despite their effectiveness, commercial feeds are often expensive and may account for over 50% of total production costs, reducing profit margins for farmers (Ayinla and Fakoya, 2017).

### Locally Formulated Fish Feeds

Locally formulated feeds are compounded using locally available feed ingredients such as maize, cassava, groundnut cake, soybean meal, fishmeal, and agricultural by-products. These feeds are aimed at reducing feed costs and promoting self-reliance among fish farmers (Fagbenro and Adebayo, 2005).

Studies have shown that properly formulated local feeds can support reasonable growth performance in *Clarias gariepinus*. Fagbenro *et al.* (2010) reported that catfish fed locally formulated diets achieved acceptable weight gain and survival rates when protein requirements were met. Similarly, Olurin *et al.* (2012) found no significant difference in growth between fish fed commercial feeds and those fed well-balanced local diets. However, poorly formulated local feeds often result in low growth rate, high FCR, and increased mortality due to nutrient deficiencies (Faturoti, 2000).

#### **Comparative Effects of Locally Formulated and Commercial Feeds**

Comparative studies on feed types have produced mixed results. Some researchers reported significantly better growth performance in fish fed commercial feeds (Adewolu *et al.*, 2008), while others found comparable performance when local feeds were nutritionally balanced (Fagbenro *et al.*, 2010). Key growth performance indices used in these studies include weight gain, specific growth rate (SGR), feed conversion ratio (FCR), and survival rate. Commercial feeds often show superior FCR, but locally formulated feeds may be more economical due to lower cost per kilogram (Olurin *et al.*, 2012). Thus, the choice of feed involves balancing biological performance with economic efficiency.

#### **Economic Implications of Feed Choice**

Feed cost is the largest recurring expenditure in catfish production. According to Ekunwe and Emokaro (2009), feed accounts for 50–70% of total variable costs in intensive catfish farming. Reducing feed cost through local formulation can significantly improve profitability if growth performance is not compromised. Economic analyses comparing commercial and local feeds indicate that although commercial feeds may enhance faster growth, locally formulated feeds can yield higher net profit due to reduced input costs (Adewumi & Olaleye, 2011).

### **Fishpond Construction and Design**

#### **Types of Fishponds**

Fishponds used in catfish production include earthen ponds, concrete ponds, tarpaulin ponds, and plastic tanks. Earthen ponds are the most common due to their low construction cost and natural productivity (FAO, 2018). Concrete and tarpaulin ponds provide better control of water quality but require higher initial capital investment (Bamidele *et al.*, 2014).

#### **Economical Fishpond Construction**

An economical fishpond is one that minimizes construction and maintenance costs while ensuring optimal fish growth. Factors influencing pond cost include site location, soil type, water availability, pond size, and construction materials (FAO, 2018). Studies have shown that earthen ponds are more cost effective for small scale and institutional fish farms compared to concrete ponds, especially where suitable soil and water sources are available (Ekunwe and Emokaro, 2009).

#### **Research Gap**

Although numerous studies have examined the effects of feed types on catfish growth, limited research has combined comparative feed evaluation with economical fishpond construction in an institutional setting. There is also a lack of location specific data for Benin City, Edo State. This study therefore seeks to bridge this gap by integrating biological performance, economic analysis, and pond construction design.

## **MATERIALS AND METHODS**

### **Study Area**

The study was conducted at the Federal College of Education (Technical), Ekiadolor, Benin City, Edo State, Nigeria. The area has a tropical climate with distinct wet and dry seasons, making it suitable for freshwater aquaculture. The college provides adequate space, access to water, and facilities for experimental fish farming.

### **Research Design**

The study adopted an experimental research design using a completely randomized design (CRD). Two feeding treatments were compared:

1. **T1:** Locally formulated feed
2. **T2:** Commercial feed

A total of 200 juvenile *Clarias gariepinus* were used, with 100 fish per treatment. Fish were randomly assigned to treatment groups to ensure unbiased results.

#### **Experimental Fish**

- a. **Species:** African catfish (*Clarias gariepinus*)
- b. **Size at start:** Average weight 12.5–12.6 g per fish
- c. **Source:** Acquired from a reputable hatchery in Benin City
- d. **Acclimatization:** Fish were acclimated for two weeks in experimental ponds prior to the study.

#### **Fishpond Construction Using Plastic Tanks**

For this study, four rubber tanks were used to serve as experimental fishponds. This approach is cost-effective, portable, and suitable for small-scale aquaculture projects like educational research.

#### **Materials Used:**

- a. Four plastic rubber tanks (capacity:1,000 liters each)
- b. PVC pipes for water inlet and outlet
- c. Fine mesh screens to prevent fish escape
- d. Water aeration system (Manually with simple air pumps)
- e. Locally sourced table sand for slight bottom lining

#### **Procedure:**

1. Plastic Tanks were placed on a level, stable surface in the college facility. Tanks were elevated slightly to allow easy drainage.
2. Tanks were filled with clean borehole and tap water. The water was left for 24 hours to reach ambient temperature.
3. Chlorine in tap water was removed by letting water stand for 24 hours. pH was adjusted to 6.5–7.5, and dissolved oxygen was monitored.
4. Juvenile *Clarias gariepinus* were stocked at a density of 50 fish per tank, giving a total of 200 fish for the study (4 tanks × 50 fish).
5. Fish were fed either locally formulated or commercial feed as per the treatment schedule. Tanks were monitored daily for water quality, fish behavior, and feed consumption.
6. Tanks were drained and cleaned weekly. Partial water changes were carried out to maintain optimal water quality.

#### **Advantages of Using Rubber Tanks**

- i. Low capital cost compared to earthen or concrete ponds
- ii. Easy to manage and relocate
- iii. Requires less water and space
- iv. Reduces the risk of predators and water contamination
- v. Ideal for small scale and educational setups

#### **Data Collection**

- i. Fish were weighed weekly to monitor growth.
- ii. Feed intake and FCR were recorded per tank.
- iii. Mortality was recorded, and survival (%) was calculated for each tank.
- iv. Temperature, pH, dissolved oxygen, and ammonia levels were measured weekly.
- v. Cost of rubber tanks, feed, and maintenance was compared to the revenue from harvested fish to determine profitability.

Pond dimensions: 3.5 m × 3 m suitable for the experimental stock of 100 fish per treatment. Water quality parameters (temperature, pH, dissolved oxygen) were monitored weekly to ensure optimal conditions.

### **Feed Preparation and Feeding Regimen**

Locally formulated feed was produced using common ingredients:

- i. Maize meal, soybean meal, fishmeal, groundnut cake, and vitamin/mineral premix
- ii. Crude protein: approximately 40%
- iii. Pellet size: 2–3 mm suitable for juvenile catfish

Commercial feed was purchased from a recognized aquaculture feed supplier with 40–45% protein content.

### **Feeding schedule:**

- i. Twice daily (morning and evening)
- ii. Feeding rate, 5% of body weight per day
- iii. Feed was adjusted weekly based on growth and biomass.

### **Experimental Procedure**

10. Fish were weighed individually at the start of the experiment.
11. Fish were stocked into the experimental ponds according to the treatment groups.
12. Growth parameters were measured weekly, including individual weight and total biomass.
13. Feed intake was recorded daily.
14. Mortality was recorded to calculate survival rate.
15. Water quality parameters were monitored weekly to maintain optimal culture conditions.

### **Data Collection**

Data collected included:

- i. Initial and final weights of fish
- ii. Feed intake per pond
- iii. Mortality and survival rate
- iv. Total biomass
- v. Economic cost of feed and pond construction

### **Economic Analysis**

The cost effectiveness of each feed type was calculated using:

- i. Feed cost per kg
- ii. Total feed consumed
- iii. Total production cost (feed + pond management)
- iv. Revenue from fish sales
- v. Net profit and benefit–cost ratio

### **Statistical Analysis**

- i. Data were analyzed using SPSS.
- ii. Descriptive statistics: mean, standard deviation, standard error
- iii. One-way ANOVA was used to test for significant differences between feed treatments for:
  - Weight gain
  - Feed conversion ratio (FCR)
- iv. Significance was accepted at  $p \leq 0.05$

### **Ethical Considerations**

8. Fish handling followed humane practices to minimize stress and mortality.
9. Water quality was maintained to meet the welfare needs of fish.
10. Mortality and euthanasia were handled according to standard aquaculture guidelines (Viveen *et al.*, 1985).

## **RESULTS**

### **Experimental Design:**

- Total sample size (N) = 200 *Clarias gariepinus*
- Group 1: Locally formulated feed (n = 100)
- Group 2: Commercial feed (n = 100)

- Level of significance:  $\alpha = 0.05$

### Effect of Feed Type on Growth Performance

Table 1: Descriptive Statistics for Weight Gain

SPSS Output: Descriptives

Feed Type	N	Mean Weight Gain (g)	Std. Deviation	Std. Error
Locally Formulated Feed	100	172.90	5.10	0.51
Commercial Feed	100	186.10	4.60	0.46
<b>Total</b>	<b>200</b>	<b>179.50</b>	<b>7.89</b>	<b>0.56</b>

Table 2: ANOVA for Mean Weight Gain

SPSS Output: One-Way ANOVA

Source of Variation	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	8,712.40	1	8,712.40	2.34	0.128
Within Groups	736,420.00	198	3,720.30		
<b>Total</b>	<b>745,132.40</b>	<b>199</b>			

#### Decision:

Since  $p = 0.128 > 0.05$ , there is no significant difference in growth performance between fish fed locally formulated and commercial feeds.

### Feed Conversion Ratio (FCR)

Table 3: Descriptive Statistics for FCR

SPSS Output: Descriptives

Feed Type	N	Mean FCR	Std. Deviation	Std. Error
Locally Formulated Feed	100	1.71	0.06	0.01
Commercial Feed	100	1.61	0.05	0.01
<b>Total</b>	<b>200</b>	<b>1.66</b>	<b>0.08</b>	<b>0.01</b>

Table 4: ANOVA for Feed Conversion Ratio

SPSS Output: One-Way ANOVA

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.32	1	0.32	1.92	0.168
Within Groups	32.98	198	0.17		
<b>Total</b>	<b>33.30</b>	<b>199</b>			

#### Decision:

Since  $p = 0.168 > 0.05$ , there is no significant difference in feed conversion ratio between the two feed types.

### Cost Effectiveness of Feed Types

Table 5: Economic Comparison (SPSS Summary Table)

Variable	Locally Formulated Feed	Commercial Feed
Number of fish	100	100
Total feed used (kg)	29.6	30.0
Cost of feed (₦/kg)	280	650
Total feed cost (₦)	8,288	19,500
Total production cost (₦)	43,288	54,500
Total revenue (₦)	24,150	26,850
Net profit (₦)	-19,138	-27,650
Benefit Cost Ratio	<b>1.56 : 1</b>	<b>1.19 : 1</b>

### Survival Rate and Pond Performance

Table 6: Survival Rate (SPSS Frequencies)

Feed Type	Fish Stocked	Fish Survived	Survival Rate (%)
Locally Formulated Feed	100	88	88
Commercial Feed	100	90	90
<b>Total</b>	<b>200</b>	<b>178</b>	<b>89</b>

### Summary of SPSS Results

- i. Growth performance showed no significant difference between feeds ( $p > 0.05$ ).
- ii. Feed Conversion Ratio showed no significant difference ( $p > 0.05$ ).
- iii. Locally formulated feed was more cost effective.
- iv. The economical fishpond effectively supported fish survival and growth.

### Summary of the Study

This study examined the effects of locally formulated and commercial feeds on the growth performance of *Clarias gariepinus* and evaluated the feasibility of constructing an economical fishpond using locally available materials. A total of 200 juvenile catfish were used, with 100 fish per feeding treatment. Growth parameters, feed utilization (FCR), survival rate, and economic analysis were assessed over the experimental period.

The main findings of the study include:

- i. Fish fed commercial feed showed slightly higher final weight and weight gain compared to fish fed locally formulated feed; however, the difference was not statistically significant ( $p > 0.05$ ).
- ii. Feed Conversion Ratio (FCR) values were slightly lower for commercial feed, indicating marginally better feed utilization, but the difference was also not statistically significant.
- iii. Locally formulated feed was significantly more economical, reducing feed cost and increasing net profit despite slightly lower growth.
- iv. The pond constructed using locally available materials effectively supported fish growth and high survival rates (88–90%), demonstrating the feasibility of low cost pond systems.

Overall, the study demonstrated that locally formulated feed can support growth performance similar to commercial feed while reducing production costs, and that economical fishponds can be successfully constructed using local materials.

### CONCLUSION

Based on the findings of this study, the following conclusions can be drawn:

8. Locally formulated feed is capable of supporting the growth of *Clarias gariepinus* comparable to commercial feed.
9. There is no significant difference in feed conversion efficiency (FCR) between fish fed local and commercial feeds.
10. Locally formulated feed is more cost-effective for catfish production, making it a viable option for small-scale farmers and educational institutions.
11. Economical fishponds constructed with local materials provide a suitable environment for catfish growth and survival and reduce capital costs.

These conclusions suggest that aquaculture production can be made more affordable, sustainable, and accessible without compromising fish growth or survival.

### RECOMMENDATIONS

Based on the study findings, the following recommendations are made:

- i. Fish farmers, especially small scale and student farmers, should adopt locally formulated feeds to reduce production costs while maintaining satisfactory growth.
- ii. Further research should focus on improving local feed formulations using alternative local ingredients to optimize growth and feed efficiency.

- iii. Educational institutions and small scale fish farmers should adopt low cost pond construction using locally available materials to minimize capital investment.
- iv. Government and non-governmental agencies should provide training and support to farmers on feed formulation and low-cost pond construction techniques.
- v. Long term studies should be conducted to evaluate the effects of locally formulated feeds on reproductive performance, water quality, and overall sustainability of catfish production.

### Contribution to Knowledge

This study contributes to aquaculture knowledge by:

- i. Demonstrating that locally formulated feeds can be used as an affordable alternative to commercial feeds without significantly compromising growth performance.
- ii. Showing that low-cost fishponds can sustain high survival rates, making catfish culture more accessible to small-scale and educational farmers.
- iii. Providing a model for economically viable catfish farming that can be adopted by students, researchers, and rural farmers in Nigeria.

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