

Nonconvention Feed Practices in Aquaculture: Viability in South-South, Nigeria

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Abstract: Several nonconventional aquafeed sources are currently being adopted in aquaculture business. Of these feeds, the insect-based source particularly reference to the black soldier fly larvae standard out due to its high protein content and several other advantages. This study investigated the viability of inclusion of BSFL in the meal of African catfish (*Clarias gariepinus*) for a period of three months with the objectives of determining the weight, feeding cost, selling price, as well as the compute profits at the different inclusion levels of BSFL using budgeting system. Through four groups A to D, this study showed appreciable growth in weight of the catfish from group C and D. It was revealed that as the quantity of commercial feed reduced the profit from inclusion of BSFL increased and was optimised at the level where the commercial and BSFL feeds were of equal ratio. It is therefore, opined that at equal ratio combining commercial and BSFL meals, farmers should optimise profits.

Keywords: Commercial Feed, Black Soldier Fly Larvae (BSFL), African Catfish, Cost, Selling Price, & Profit.

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I. INTRODUCTION

One of the fastest-growing agricultural productions globally is aquaculture [1]. Fish farming holds great promise for raising the nutritional status of the population. The reason being that its nutritional value (protein content) and importance in enhancing human health is higher than meat. In the face of declining fish supplies from capture sources, fish farming offers a solution to close the supply/demand gap in the face of rising income, shifting dietary habits, and urbanization [2]. Currently, to successfully carry out this economic activity, the use of nonconventional feed sources have become imperative. The incorporation of nonconventional feed practices have therefore evolved over the past few years to reduce the cost of fish feed without compromising fish growth. Some of these fish feed sources do not compete with the human food sources, as they range from animal to plant by-products. The plants and their by-products include, but are not limited to, soybean meal, wheat gluten, peas, and guar corn gluten. Others include locally available raw materials from what is considered waste from yams, plantains, bananas, mucuna, maize, cassava, millets, sorghum, groundnuts, sunhemp seeds, and brewery wastes, etc. [3]. By employing nonconventional feeds in aquaculture, diversified feed sources can minimize waste generation and disposal. Aquaculture is gaining importance in Nigeria, as locally available raw materials from what was considered agricultural and food wastes, are now potential materials for fish feed. Although fish meal is the most suitable feed for

aquaculture business due to its high protein content, it is however out of reach for farmers who are constrained by escalating prices and environmental sustainability issues. The quest for novel substitutes for fish meal have accelerated and become increasingly significant, especially in the aquaculture industry. Fish meal derived from wild fish has been the primary ingredient in farmed fish feed because farmed fish require a high-protein diet. The sustainability of the environment and the profitability of aquaculture are affected by reliance on a fish meal-based diet. Therefore, equivalent-quality protein substitutes are essential. Thus, there has been significant interest in the potential of insect-based protein in animal feed diets [4, 5, 6 & 7]. For instance, a study conducted with a combination of 50% commercial feed and 50% black soldier fly larvae (BSFL) for three months, revealed that proximate protein content in that particular group of catfish was 16.7% while those fed with 100% commercial feed had protein content of 15.3% [8]. This study therefore sought to determine the viability of inclusion of the BSFL in the meal of African catfish (*Clarias gariepinus*) for the period of three months. The objectives were to determine the weight of the catfish; determine the feeding cost; determine the selling price; and compute the profit at the different inclusion levels of BSFL using budgeting system.

II. LITERATURE REVIEW

In various regions across the globe, BSFL have been utilized as a partial substitute for Fish Meal [9,10,11,12].

BSFL have been identified as one of the sustainable ingredients capable of replacing fish meal in aquafeed production. For example, approximately 22.5% of BSFL has been incorporated into the diet of European seabass (*Dicentrarchus labrax*) as a source of dietary protein, resulting in positive growth performance [12]. Additionally, up to 40% of BSFL combined with 60% commercial feed have been successfully used to nourish Rainbow trout (*Oncorhynchus mykiss*) with notable success [13]. Regarding digestibility, a recommendation of 13% BSFL was made for Rainbow trout (*Oncorhynchus mykiss*) [14]. However, caution is advised when combining 50% BSFL with commercial feed for Rainbow trout (*Oncorhynchus mykiss*) [15]. For Eurasian perch (*Perca fluviatilis*), approximately 40% of BSFL can be included in its diet [16]. In the case of Siberian sturgeon fingerlings (*Acipenser baerii*), up to 10% of BSFL has been employed, with potential for further increases [17]. In African Catfish (*Clarias gariepinus*), 75% of partially defatted BSFL effectively replaced fish meal (FM) in commercial feed [13]. Moreover, the oil extracted from BSFL can completely substitute for Soybean in the feed of Juvenile Jian Carp (*Cyprinus carpio* var. *Jian*) without any adverse effects [18]. In one particular study where various inclusion levels of BSFL were substituted as partial meal for Nile tilapia (*Oreochromis niloticus* L.), the results showed 67% inclusion of BSFL does not impact growth quality of the fish [19]. In addition, the unit price of fish meal decreased steadily as the inclusion of BSFL increased [19]. Mineral content was good while heavy metal presence was not found in the catfish fed partially with BSFL at different inclusion levels as all the heavy metal parameters considered were less than 0.01mg/L [20]. A previous study has equally shown that in growing catfish from 780g to about 1kg, farmers using 100% BSFL could still make reasonable profit [21].

III. MATERIAL AND METHODS

A field trial experiment involving African Catfish (*Clarias gariepinus*) was conducted. To allow for comparison, the field study included control and treatment applications in 1 m³ plastic tanks (Figure 1a). We bought melange-sized catfish from a private fish hatchery in Port Harcourt, Rivers State, Nigeria. They weighed an average of 113–315g. Before the experiment began, the fish were allowed to acclimatize to the experimental tank temperatures for a week. The experimental nonconventional diet was then fed to three replicates of each of the four treatment groups of 600 Melange-size catfish. Group A (the control group) and Groups B, C, and D (the treatment groups) were the names given to the schools of fish. Each replicate had 50 melange in a 1 m³ (1 × 1 × 1 m) tank filled with 500–700 L of water. Over the 90-day field trial, their weights were recorded (Figure 1b). In order to arrive at a budget analysis, the current market price for 1kg of catfish NGN3,000 was adopted [21]. The selling price per unit weight of catfish was based on N3 per gram of the commercial feed [9]. In analyzing the profit through budget assessment of catfish production using both commercial and BSFL feeds, the following modified equations were established [22]:

$$\text{Total Revenue (TR)} = \text{Price (P)} \times \text{Quantity (Q)}$$

$$\text{Total Cost (TC)} = \text{Cost of feed} + \alpha$$

Where α represents a constant (with all other expenses such as labor, water, and electricity being held constant).



Fig 1 (A) Research Assistant Feeding Catfish in 1m³ Plastic Tank



Fig 1 (B) Research Assistant Measuring and Weighing Catfish

IV. RESULTS

➤ Fish Weight and Feed Combination

In comparing the weight (g) of catfish trial fed with different inclusion levels of BSFL for the four groups (A, B, C, and D), group A catfish fed with 100% commercial feed grew to an average weight of 278.89g at the end of 1st month (30 days). At the end of the 2nd month (60 days), the group grew to an average weight of 411.03g. By the end of the 3rd month (90 days), the group (A) attained an average weight of 780.83g. With group B, which are catfish fed with 60% commercial feed and 40% BSFL meal grew to an average weight of 274.58g at the end of the 1st month (30 days). By the end of the second month (60 days), the catfish reached an average weight of 400.75g, and at the end of the 3rd month (90 days), the catfish grew to an average weight of 732.79g. Group C which are catfish fed with 55% commercial feed with 45% BSFL meal grew to an average weight of 290.33g at the end of the 1st month (30 days). By the end of the 2nd month (60 days), the catfish reached an average of 405.67g and by the end of the 3rd month (90 days), the catfish grew to an average weight of 895.98g. The catfish fed with 50%

commercial feed with 50% BSFL meal grew to an average weight of 277.46g at the end of the 1st month (30 days). By the end of the 2nd month, the catfish reached an average weigh

of 395.54g. At the end of the 3rd month (90 days), the catfish grew to an average weight of 889.96g. Figure 2 depicts this information.

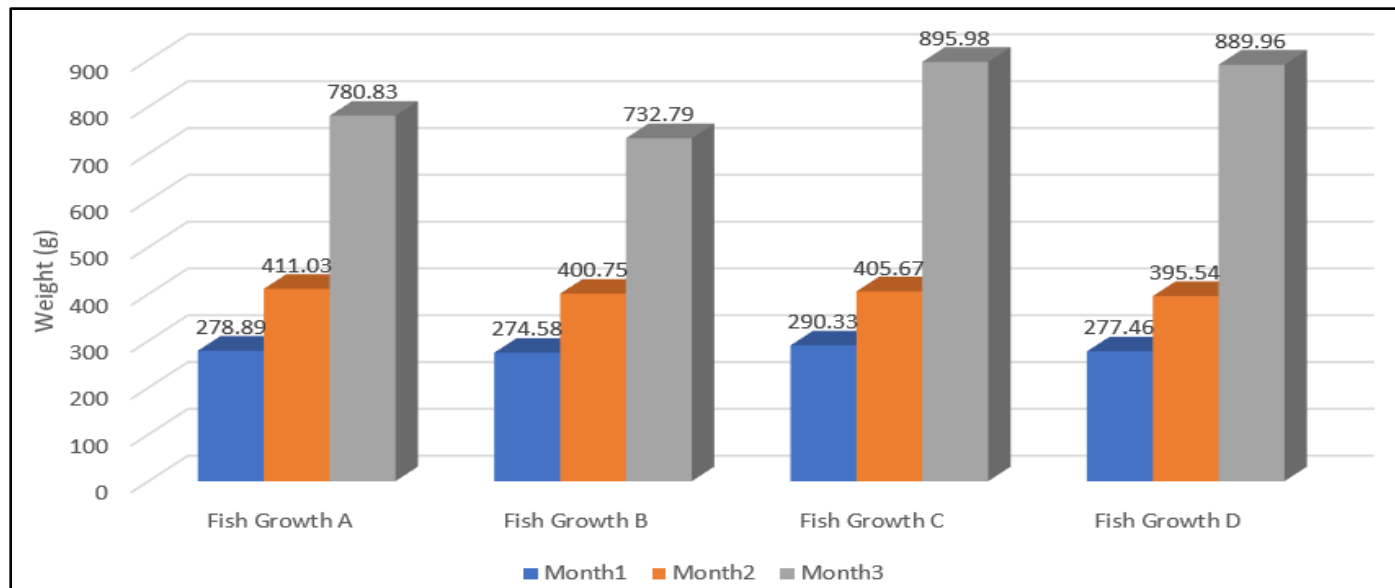


Fig 2 Monthly Catfish Growth

➤ Estimated Cost of Catfish Feeds

This section computed the cost incurred during the feeding of the different groups of the catfish according to the feed source used. Group A catfish fed with 100% commercial feed accumulated a total cost of NGN28,337.78 at the end of the 1st month (30 days). By the end of the 2nd month (60 days), the total cost of feeding group A catfish reached NGN126,000. At the end of the 3rd month (90 days), the total cost incurred was NGN200,662. The group B catfish fed with 60% commercial feed and 40% BSFL meal incurred a total cost of NGN22,465.60 at the end of the 1st month (30 days). At the end of the 2nd month (60 days), the total cost incurred had risen to NGN100,800 and by the end of the 3rd month (90

days), the total cost incurred was NGN152,120. For group C catfish fed with 55% commercial feed with 45% BSFL meal, the total cost of feed at the end of the 1st month was NGN19,966.80. At the end of the 2nd month, the total cost incurred for feeding this group rose to NGN97,650, and at the end of the 3rd month (90 days), the cost rose to NGN148,060. For group D catfish fed with 50% commercial feed and 50% BSFL meal, the total cost incurred on feeding this group at the end of the 1st month (30 days) stood at NGN17,544.80. By the end of the 2nd month the cost rose to NGN94,500. At the of the 3rd month, the total cost incurred reached NGN144,000 (Figure 3).

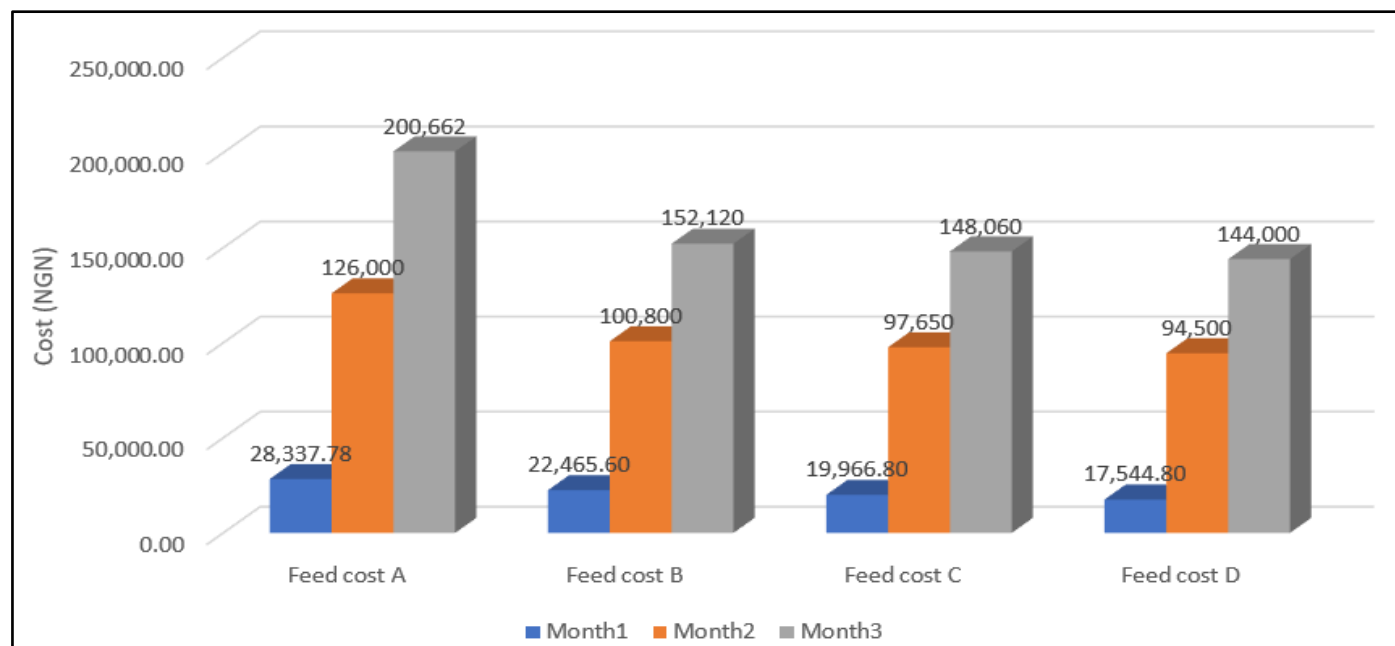


Fig 3 Monthly Catfish Feed Costs

➤ Computed Selling Prices of Catfish

This section computed the selling prices of catfish fed with different combination of feeds. The group A catfish fed with 100% commercial feed were valued at NGN97,890.39 at the end of the 1st month (30 days). By the end of the 2nd month (60 days) the value of the catfish rose to NGN144,271.53 and by the end 3rd month (90 days), the catfish value for this group reached NGN274,071.33. For group B catfish fed with 60% commercial feed with 40% BSFL meal, this group of catfish were valued at NGN98,848.80 at the end of the 1st month (30 days). At the end of the 2nd month (60 days) the value of the catfish rose to NGN144,270 and by the end of the 3rd month, the value of

the catfish reached NGN263,804.40. For group C catfish fed with 55% commercial feed with 45% BSFL meal, the value of catfish in this group at the end of the 1st month (30 days) was NGN101,905.83. At the end of the 2nd month (60 days), the value of catfish in this group rose to NGN142,390.17, and at the end of the 3rd month (90 days), the value of the catfish reached NGN314,488.98. For group D catfish fed with 50% commercial feed and BSFL meal, the value of catfish in this group was NGN98,220.84 at the end of the 1st month (30 days). By the end of the 2nd month (60 days), the catfish value rose to NGN140,021.16, and at the end of the 3rd month (90 days), the value of the catfish reached NGN315,045.84 (Figure 4).

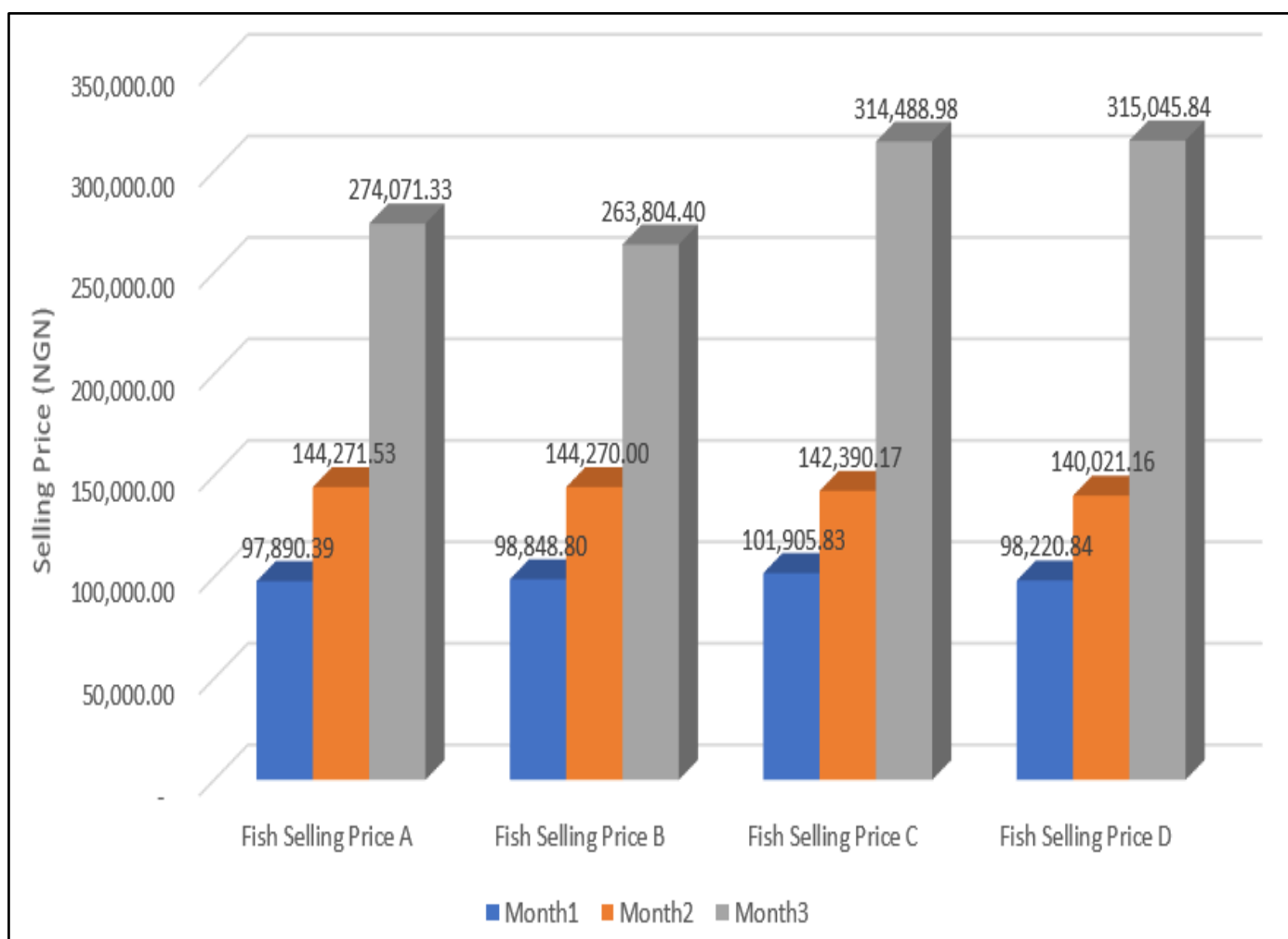


Fig 4 Monthly Catfish Selling Price

➤ Computed Profit from the Sales of Catfish

This section computed the profit from the cost and selling price of the different groups of catfish fed with a combination of feeds. The group A catfish fed with 100% commercial feed, realized a profit of NGN69,552.61 at the end of the 1st month (30 days). At the end of the 2nd month, the profit declined to NGN18,271.53. However, at the end of the 3rd month (90 days), the profit rose to NGN73,409.33. The group B catfish fed with 60% commercial feed with 40% BSFL meal realized the profit of NGN76,383.20 at the end of the 1st month (30 days). At the end of the 2nd month (60 days), the profit declined to NGN43,470.00, and by the 3rd month

(90 days), the profit rose to NGN111,684.40. The group C catfish fed 55% commercial and 45% BSFL meal feeds achieved a profit of NGN101,905.83 at the end of the 1st month (30 days). At the end of the 2nd month (60 days) the profit realized was NGN142,390.17 while at the 3rd month (90 days), the recorded profit from this group of catfish was NGN314,488.98. The group D catfish fed with 50% commercial and 50% BSFL meal realized a profit of NGN98,220.84. At the end of the 2nd month (60 days) the profit attained from this group of catfish rose to NGN140,021.14 while at the end of the 3rd month (90 days), the profit realized was NGN315,045.84 (Figure 5).

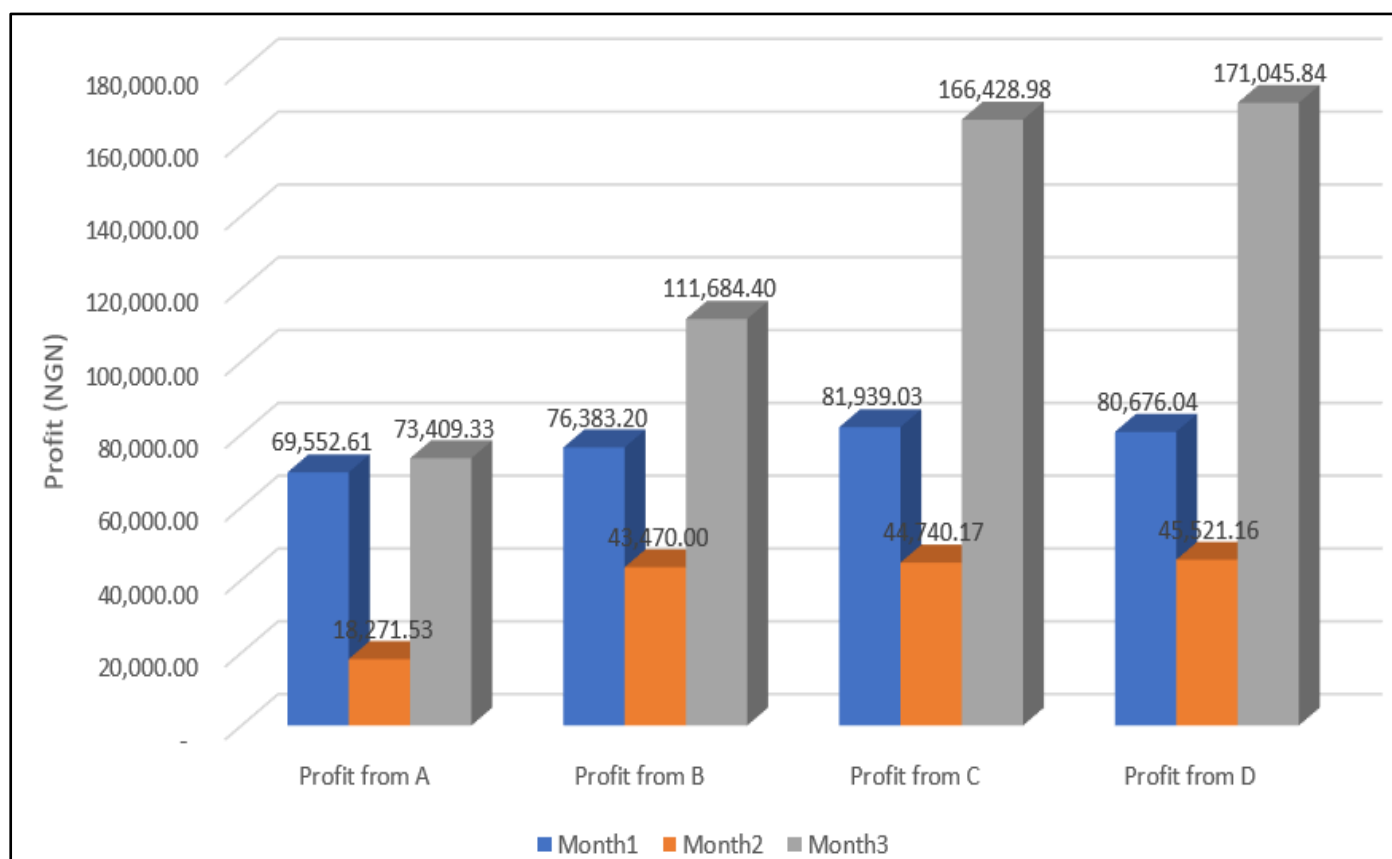


Fig 5 Monthly Catfish Profit

V. DISCUSSION

This study has shown that in the 1st and 2nd months of the field trial, the catfish in group A (100% commercially fed catfish) grew better than those fed with different inclusion levels of the BSFL meal. However, at the end of the third month, it was revealed that catfish in groups C and D recorded better weight gain. The reason could be group C and D had better feed conversion ratio (FCR) [8]. However, there were no statistically significant differences in the weight of the catfish in group A to D [8]. In terms of the cost of the feeds, as that of the commercial feed decreased the cost of BSFL meal increased; but the overall cost of catfish feed decreased with those fed with increased inclusion levels of BSFL meal. This was corroborated as BSFL inclusion reached 67% replacement in fish meal [19]. This study relied on the current sales price of 1kg of catfish from the local markets in Port Harcourt, which to best of the researchers' knowledge have not been reported. Furthermore, the profit realized from each of the catfish groups indicated that optimum profit was achieved with equal ratio of commercial and BSFL feeds.

VI. CONCLUSION AND RECOMMENDATION

This study revealed that as the quantity of the commercial feed reduces the profit from including of BSFL meal increases and was optimal at the level where the commercial feed and BSFL meal were of equal ratio. It is therefore asserted that at equal ratio of combined commercial feed and BSFL meal, farmers should optimize profit.

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