

## WEALTH CREATION THROUGH EARTHEN FISH PONDS: CASE STUDY OF AIGBE STREAM IN OSOGBO, NIGERIA

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### Abstract

Nigeria is among the largest fish consumers in the continent and the largest producer of African catfish. However, there is a gap in production–consumption which necessitates massive importation of frozen fish. Hence, for this study was carried out. It comprised of six pairs of adjoining ponds to Aigbe stream. Six ponds were dug on each side of the stream's bank to make twelve ponds; each was 9 m × 9 m area. Each pond was stocked with 2,000 fingerlings of *Clarias gariepinus*. The fish were fed with fish pellets ad libitum. Weights of the feed were calculated at each point of feeding to ascertain that all pond have the same amount of feed. Harvested fish were weighed at cropping before sales. The findings of the study showed the profit for all the 12 ponds in the first year which was 140 per cent increase over total cost price of the project and 152 per cent increase over total cost price of the project in the subsequent year. There was an increase of 5.6% in the second year figure of merit over the value for the first year. The accrued profit was ₦4,580,000 which showed an average profit of ₦382,000 per pond. The results revealed higher level of fish productivity of 117,283.95 kg/ha year and fishcop economics of fish productivity value of 11.73 kgm<sup>-3</sup>. It was concluded that a lot of wealth may be created for peri-urban people if they embarked on fish rearing at stream site. The profitability of fish farming along Aigbe stream can be used as a template to advise and encourage intending fish farmers that fish production is profitable at the stream's banks

**Keywords:** Cost-benefit analysis, resource, fish, pond, utilization

### Introduction

Pond could either be earthen or concrete. Although, nowadays fish are raised in plastics, fiber-stars and wooden rafts which are either locally fabricated or imported from developed countries, earthen ponds cannot be ruled out of our local areas. There

are many streams within Osun State where small earthen ponds could be established to rear well-adaptable, environmental friendly fish for wealth creation.

Various species of fish namely: sardines, mackerels, rake etc are imported and very expensive in Nigeria, especially now that

Nigerian currency has been devalued (US dollar \$1 = ₦500), fish is now beyond the reach of the poor people. Because of this, necessary steps need to be taken in rearing local fish species that will be adaptable to Nigerian environment. Nigeria is the largest fish consumer in Africa and among the largest fish consumers in the world (Adelesi 2019; Abegunrin et al., 2019) with about 3.2 million metric tons. Fortunately, Nigeria is the largest producer of African catfish, other countries in Africa namely Mali, Cameroon and South Africa also produce significant quantities (FAO, 2021, Dauda et al., 2018). So what can be produced could as well serve as food. However, the fish produced are not enough for the people's consumption, therefore the need for importation. The failure or success of fish farm enterprise depends on the selection of a good site. The layout and the management of fish farm will largely be influenced by the kind of site selected and other factors. Some of these factors are cost of construction, amount of fish that can be produced, ease of pond management and economics of the enterprise.

### Literature review

African catfish (*Clarias gariepinus*) and Tilapia are the two major fish that can be

reared in the research study site since they are both the common fish in the area, both are important aquacultural species that are cultured in various regions in the world. The top producing country is Nigeria followed by the Netherlands, Brazil, Hungary, Kenya, Syrian Arab Republic, South African, Cameroon, and Mali (FAO, 2016b). The success in Africa catfish farming can be linked to the successful development of artificial propagation protocols in the 1980's and its substantial contribution to aquaculture development can be traced to mid-1990 as it is reflected on the FAO FishStat (FAO, 2016b). Increased production was supported by the acceptability of the fish by consumers as well as by farmers due to beneficial characteristics that included fast growth and high market demands.

Feeding of (catfish) *clarias* with fish pellets has been the best way of increasing their weights within a short period of time both at the growing and finishing stages. A fish will consume a kilogramme of fish pellet in the months of rearing (although, this quantity depends on the number of months the fish are to be reared, if more than four to five months, fish farmers have found out that a fish consume as much as 1.0 – 1.2 kg) before it can attain a weight of 0.9 to 1 kg.

However, the kilogramme of pellet is high and some fish farmers have been using alternatives to reduce cost of production, to increase their weight and to maximize profit. In rearing *Clarias gariepinus* with the mindset to create wealth is to reduce some input costs, cost of feeding can be reduced by using *leucaena* leaf as feed supplement. Amisah *et al.*, (2009) showed that the best inclusion level of *leucaena* in the diet containing the 20% *Leucaena* leaf meal was able to make the fish grow well and was cost effective.

When the fish are sold, to be able to plough back different cost analyses are done by the farmers to find out whether they gain or that they might have lost. Different scholars like Nataliya and David (2010), Harry and David (2010) and Victor *et al.*, (2010) have used different economic cost benefit analysis to examine efficacy of different agricultural projects. They used it to achieve energy, environmental and agricultural policy goals in various countries.

Aigbe stream in Osogbo is a perennial stream and is capable of being a good site because of its topography, the level of the topography is 8% which is good for earthen pond because, water can easily seep into the bank from the channel because of its muddy nature in some of its span. Also, Osogbo and

the adjoining towns are capable of providing good market for fish farmers. Farmers in Osogbo and environs have to produce some food crops for their families, youths who are graduates of the Universities, Polytechnics and Colleges who have turned themselves into commercial motocyclists will have to feed. So also, other categories of people who are living in Osogbo who have no jobs that can feed their families, all these people may be encouraged to take up the challenges of rearing fish along Aigbe stream in Osogbo to reduce poverty among the Nigerian populace. Especially now that farmlands are getting farther away to the people because of the city developmental projects which has made all the arable lands to be developed for buildings of houses and roads and the increase in population the city had witnessed over years, fish farming along Aigbe stream which spans over 15 km from Dagbolu area of Osogbo to Okinni/Ido-osun axis before it tributaries join Erinle river could be a place of sojourn for all who may be jobless or underemployed in the city. Therefore, the objective of the research was to investigate potentials of creating wealth for the peri-urban people on the bank of Aigbe stream of Osogbo, Osun State, Nigeria.

## **Materials and Methods**

Aigbe stream transcends the north-eastern parts of Osogbo (7.54° N; 4.54° E) from Olorunda Local Government Area (LGA) over a length of about 10 km before emptying into Erinle river near Erin-Osun town in Irepodun LGA of Osun State. It is a perennial stream and usually extends to about 100 - 200 ft wide during the peak of rainy season. It has a vast length in some of its lower course in the considered area with moderate slope of between 8 – 10 per cent. Because of its topography, the site is good for earthen pond. Twelve (12) earthen ponds at 9 m x 9 m x 1 m at six per bank were dug with their banks planted with plantain and banana at 3 m spacing to reduce evaporation of water from the pond and to provide shade for the fish for higher and unnecessary temperature that may be beyond their comfort zone range of temperature. This was to prevent banks caving in, it also prevents siltation, which result from erosion and it also provides the aquatic lives with shades. The banks were raised higher to about 2 m design height from the pond's bottom level to prevent flooding and to make adequate provision for any unseen circumstances that may arise from global climatic changes and its flooding effects on the environment and on the pond. Sand-filled sacks were used as

barricades to prevent caving-in, to prevent unnecessary seepage of water to the soil. At the beginning of each month of the year starting from January 2018, each pond was stocked with 2,000 fingerlings. The ponds were staggeringly stocked month by month in order to crop each pond at monthly interval after five good months of rearing. At the end of May 2018, the first pond stocked was cropped. The fish were fed with fish pellets made by Guinea Feeds Nig. Ltd at the average per fish totaling 13.33 kg at both the growing stage of a month and at their finishing stage after a month old till five months old. A total of 2,000kg was used to feed 2000 fish from stocking to harvesting as stated by Dosaraf Multibiz Koncep (2018).

Weights of the feed were calculated at each point of feeding to ascertain that all pond have the same amount of feed. Harvested fish were weighed at cropping before sales.

The water of the stream was subjected to different tests to ascertain the fitness for fish rearing and profitability. With close observation for 15 years now and for over 7 km length of the stream, it has not been utilized for fish pond projects. The reason could be because its vast length/channel are just been exposed to the people of the city. Market prices of fish in kg during the period

under investigation were recorded and used for economic analysis. The present market value of a kilogramme of fish is ₦1,200 (\$2.5); 87.5 – 89 percent of this market price was used in the calculation to make it a reasonable computing amount to leave a room for both unavoidable circumstances and possible uncertainties especially of the global climatic change and the worldwide economic fluctuations that are unpredictable.

The project was evaluated mathematically with the measured parameters namely number of fingerlings stocked, area and volume (of water) of the ponds individually and collectively, feeding, labour costs, advertisement (based on variable and fixed costs), weights of the fish cropped and fish's market price. Some of the tools used were figure of merit, fish productivity or actual fish yield and Fishcop Economic Analysis to investigate the cost-benefit potentials of the project. Figure of merit is defined as the yield in grammes or kilogrammes (BW- Body Weight) per unit total production cost (TPC) evaluated for the ponds. Fish productivity was computed for each pond per annum. It is also called actual fish yield and is defined as the total weight in kilogramme of fish harvested per unit hectare of land per annum, [kg/ha./year] or

expressed in kilocalorie per unit hectare of land per annum, [kcal/ha./year] (Pandey, 2008). This is as the same with the equation of calculating productivity in water and crop which are respectively water productivity and crop productivity (Keller et al., 1996). Fishcop economics of fish productivity is defined as the amount of product harvested (or total body weights of the fish [TBW]) in kilogrammes per unit total volume of their rearing in blue or green water, (Lamidi, 2015). It is expressed in kg/m<sup>3</sup>. This is different from density of object as both have the same units. Fishcop can also be the cost of raising 1 pound of fish per 10 gallons of water

### **Data Analysis**

The detail economic analysis of the project was done using Figure of merit, fish productivity or actual fish yield and Fishcop Economic Analysis. All these were evaluated to investigate the cost and benefit ratio. These ponds are expected to be active for years especially as they are ecologically de-silted annually, costs need to be calculated as salvage cost in subsequent years (Depersio, 2021).

## Results and Discussion

### Costs Estimation

The estimates of the total variable cost (TVC) and total fixed cost (TFC) of construction and installation for the first and second years are summarized in Tables 1-4. The general assumption in the digging of the ponds is that the same set of labourers who have been found to be experts dug all the ponds one after the other. This was to eliminate the probability of human contaminations of the soil and water. Although the water was treated before fish were introduced, it was imperative to reduce the number of men who dug the pond because different men with different contagious diseases. The men were treated with sanitisers (Dettol) and were isolated during the period. It was a precautionary measure for soil health, good water sanitation and healthy fish (Lamidi, 2015).

Tables 1 and 2 reveal the materials that were used for all the ponds altogether including the digging and stocking with fingerlings, the descriptions of the materials and their input cost values and other expenditures. The survival rate was 95%, because 1,900 fish were big enough for market after 5

months of rearing in each of the ponds, regardless of the climatic condition or season of the year, (Tables 2 and 4). The estimated return was ₦7,600,000 (\$15,200) and the fixed and variable costs totaled ₦3,166,000 (\$6,332) in the first year, hence the profit was ₦4,434,000 (\$8,860) Table 2. This profit represents 140 per cent increase over the total costs of the project. The estimates for first year revealed a profit of ₦369,500 per month, it is expected that the second year estimates will be higher since digging of ponds, pipes installations costs were not to be repeated, although desiltation of ponds were done, their cost were relatively less unlike fresh pond's digging.

The 500 g fish weight assumed was reasonable. This could be disadvantageous to the project. Tables 1 and 3 show the estimated values of expenditures in the 12 ponds during the second year including the salvage cost of the pond after a year. There were gains as shown in Tables 2 and 4 in both years, the same results were observed in Oluyole via Ibadan in Oyo State by Adelesi (2019) and Abegunrin et al., (2019), Oluyole, Ibadan is about 80 km to Ejigbo.

**Table 1: Summary of Total cost of Establishment of 12 ponds and their stocking (First year)**

| S/N                   | Materials                           | Unit used     | Unit Price, ₦  | Total (₦)                  |
|-----------------------|-------------------------------------|---------------|----------------|----------------------------|
| <b>Fixed Costs</b>    |                                     |               |                |                            |
| 1                     | 12'' pipe                           | 40            | 1500 (\$3)     | 60,000 (\$64)              |
| 2                     | 12'' control valves                 | 10            | 800 (\$1.6)    | 8,000 (\$6)                |
| 3                     | PVC gum                             | 2             | 1000 (\$2)     | 2,000 (\$4)                |
| 4                     | Digging of ponds                    | 12            | 40,000 ((\$80) | 480,000 (\$1000)           |
| <b>Variable costs</b> |                                     |               |                |                            |
| 5                     | Stocking with fingerlings           | 24,000        | 20             | 480,000 (\$1000)           |
| 6                     | Feeding for 180 days                | 100kg/day     | 100            | 1,800,000 (\$4000)         |
| 7                     | Workmanship for pipes installations | 8             | 2,000 (\$4)    | 16,000 (\$32)              |
| 8                     | Labour/Guard                        | 1             | 15,000/month   | 180,000 (\$360)            |
| 9                     | Total estimated cost of cropping    | 12 ponds/year | 10,000 (\$20)  | 120,000 (\$220)            |
| 10                    | Cost of Advertisement               | 5             | 2,000 (\$4)    | 10,000 (\$20)              |
| 11                    | Transportation                      | -             | -              | 10,000 (\$200)             |
| <b>Total cost</b>     |                                     |               |                | <b>3,166,000 (\$6,332)</b> |

**Table 2: Summary of incomes during cropping in First year**

| S/N | Descriptions                                 | Income (₦)                  |
|-----|----------------------------------------------|-----------------------------|
| 1   | Expected fish per cropping (at 95% survival) | 1,900                       |
| 2   | Total expected fish in a year                | 19,000                      |
| 3   | Estimated average weight per fish in g       | 500                         |
| 4   | Total Yield in kg                            | 11,400                      |
| 5   | Estimated market price in ₦/kg               | 800 (\$1.6)                 |
| 6   | Revenue estimated per cropping in ₦          | 633,333.33 (\$1266.67)      |
| 7   | Total expected income in 12 ponds in ₦       | <b>7,600,000 (\$15,200)</b> |

**Table 3: Summary of Total cost of fish production in 12 earthen ponds in second year**

| S/N                | Materials                        | Unit used | Unit Price (₦) | Total ( ₦)                |
|--------------------|----------------------------------|-----------|----------------|---------------------------|
| 1                  | Stocking with fingerlings        | 24,000    | 20             | 480,000 (\$1,000)         |
| 2                  | Feeding for 180 days             | 100kg/day | 120            | 2,160,000 (\$4320)        |
| 4                  | Labour/Guard                     | 1         | 15,000/month   | 180,000 (\$360)           |
| 5                  | Total estimated cost of cropping | 12 ponds  | 10,000 (\$200) | 120,000 (\$240)           |
| 6                  | Cost of Advertisement            | 5         | 2,000 (\$4)    | 10,000 (\$200)            |
| 7                  | Transportation                   | -         | -              | 10,000 (\$200)            |
| 8                  | Savage cost ( desiltation cost)  | 12 ponds  | 5,000 (\$10)   | 60,000 (\$120)            |
| <b>Total costs</b> |                                  |           |                | <b>3,020,000 (\$6040)</b> |

**Table 4: Summary of incomes during cropping in second year**

| S/N | Descriptions                                 | Income (₦)                  |
|-----|----------------------------------------------|-----------------------------|
| 1   | Expected fish per cropping (at 95% survival) | 1,900                       |
| 2   | Total expected fish in a year                | 19,000                      |
| 3   | Estimated average weight per fish in g       | 500                         |
| 4   | Total Yield in kg                            | 11,400                      |
| 5   | Estimated market price in ₦/kg               | 800 (\$1.6)                 |
| 6   | Revenue estimated per cropping in ₦          | 633,333.33 (\$1266.67)      |
| 7   | Total expected income in 12 ponds in ₦       | <b>7,600,000 (\$15,200)</b> |

The projected revenue and costs were ₦3,020,000 and ₦7,600,000 respectively. Therefore, the accrued profit was ₦4,580,000 which showed an average profit of ₦382,000 per pond. This profit represents 152 per cent increase over the total cost of the project in the second year.

#### Figure of merit and fishcop calculations

The figure of merit is a measure of how well the business progresses, and for this research, as calculated, it increases from the first year to the second. This is good as it gave no room for any alternative because the second year profit increased and could not have been traded for any other business (Lamidi, 2015; Lamidi, 2005, Azogu, 1985)

$$\text{Figure of merit in first year} = \frac{11,400}{3,166,000} = 3.6 \times 10^{-3} \text{ kg/₦}$$

$$\text{Figure of merit in second year} = \frac{11,400}{3,020,000} = 3.8 \times 10^{-3} \text{ kg/₦}$$

The figures of merit calculated were  $3.0 \times 10^{-3}$  and  $3.2 \times 10^{-3}$  in the first and second years respectively. As expected there was an increase of 5.6% in the second year figure of merit over the value for the first year.

#### Fishcop economy

The fishcop economy for a pond was calculated using

$$\frac{\text{Bodyweight}}{\text{volume of water}} = \frac{950}{9 \times 9 \times 1} = 11.73 \text{ kgm}^{-3}$$

the volume of water in a pond was  $9 \text{ m} \times 9 \text{ m} \times 1 \text{ m} = 81 \text{ m}^3$ . Fishcop economy of  $11.73 \text{ kgm}^{-3}$  in the first and second years for each of the pond and was equal for all the ponds. The significance of fishcop economy is that it should not decrease, otherwise, the conditions of the rearing falls short of the fish comfortability and their productivity (Lamidi, 2015; Lamidi, 2005, Azogu, 1985).

The trend in fishcop economy may continue over a very long period of time, year by year except if there is significant change in the price of sale per kilogramme. Since landed

property does not depreciate, it may be surmised that law of diminishing returns may not have significant effect on the total yield in kg.

### Fish Productivity Calculations

Productivity of fish is expressed as weight in kilogramme per unit area in square metre per annual, with unit usually represented mathematically as kg/ha per annual. Higher fish productivity values calculated were 117,283.95 kg/ha per annual in both the first and second years respectively. The reason for these higher values could be because of the land use was 0.0081ha per pond and 0.0972ha altogether (Keller et al., 1996)

### Conclusion and Recommendation

There was annual increment in the profit that was accrued from the fish rearing and law of diminishing returns could not pose a threat. The profitability of fish farming along Aigbe stream at Osogbo and other similar environments can be used as a template to advise and encourage intending fish farmers along Aigbe stream in Osogbo, Osun State of Nigeria, to show them how they can create their wealth at the stream's banks.

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