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**Dugout Farming Of Nile Tilapia,  
Oreochromis Niloticus For School  
Feeding Programme: A Case Study In**

**The Lower Manya Krobo  
District, Eastern Region,  
Ghana**

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# Abstract

Fish farming could provide nutrition and income generation options for institutions, including schools. This study was on Nile tilapia, *Oreochromis niloticus* farming in a dugout of the Legacy Girls' College, a private all girls Senior High School located in Akuse, within the Lower Manya Krobo District, Eastern Region, Ghana. The study aimed at assessing the profitability of a school dugout fish farming and its potential to supplement the nutrition of a school feeding programme. The estimated surface area of the dugout was about 2, 100 m<sup>2</sup>. The main source of water into the system was run-offs from the surrounding areas during rainfalls. Prior to stocking the system with fish, initial water quality parameters relevant to fish farming were measured. The system was stocked with a total of 2, 200 mono-sex male juvenile *O. niloticus* of mean weight  $74.38 \pm 27.86$  g. The fish were manually fed with commercial pelleted-extruded tilapia feed of crude protein contents ranging from 30 to 40%; at a feeding rate of 4.0-3.0% of the biomass at equal portions three times daily. Water quality parameters and fish growth were monitored at three-week time interval for 21 weeks (147 days). The final mean weight of the cultured fish was  $364.44 \pm 57.85$  g and the survival rate was 78.64%. Total harvested biomass was 929.92 kg. The profit index was 2.48 and the incidence cost was 5.37 GHS kg<sup>-1</sup>. The dugout Nile tilapia culture by the Legacy Girls' College was profitable and on daily feeding section, it provided over 85% of the school's protein needs.

**Keywords:** *Moisture content, packaging material, storage condition, Aspergillus spp. Penicillium spp.*

# Introduction

Fish farming is a moderately old business in Ghana and it is widely practised in the Ashanti, Central, Eastern, Volta and Western regions of the country. Freshwater fin fishes constitute the major fish species produced, of which tilapia (mainly the Nile tilapia, *Oreochromis niloticus*) consists of about 80% whilst the remainder consists largely of catfishes (*Clarias* spp., *Heterobranchus* sp.) and the African bony tongue, *Heterotis niloticus* (FAO, 2016).

Fish produced from cages and ponds accounts for about 80% of inland fish production (MoFAD, 2021). Pond culture system is the prevailing production system in most part of the country, which is primarily small-scale and semi-intensive in status. Currently, the bulk of cultured tilapia is produced intensively in cages (Kassam, 2014; MoFAD, 2021).

The Ghana School Feeding Programme was launched in September 2005 following African Union-New Partnership for Africa's Development (AU-NEPAD) recommendation to use home-grown foods, where possible, as one of the "Quick impact initiatives" to achieve the Millennium Development Goals, especially for rural areas facing the dual challenge of high chronic malnutrition and low agricultural productivity. The basic concept of the programme was to provide children in public primary schools and kindergartens in the poorest areas of the country with one hot, nutritious meal per day, using locally grown foodstuffs. The long-term goal is to contribute to poverty reduction and food security in Ghana (NEPAD, 2005; GSFP, 2017). Also, a 2007 review of school feeding programmes throughout the world showed increased school enrolment, decreased truancy, improved educational outcomes and relieve of short- and long-term hunger as well as nutritional deficiencies (Greenhalgh et al, 2009; GoG/WFP/PCD, 2017).

Fish farming is one of the income generating activities that institutions such as schools could engage in. Fish provides valuable nutrients such as high-quality proteins, fats, vitamins and minerals

to the world's population. Fish bones are an excellent source of calcium, phosphorus and fluorides. For optimum human health, about 33% of total protein consumed should come from animal sources (FAO, 2012; Beveridge et. al, 2013). At least a three-fold increase in animal protein supply is required for optimum health of many rural people. However, fish contribution to food and nutrition security depends upon availability, access, cultural and personal preferences (Beveridge et. al, 2013).

Schools can promote small-scale aquaculture by operating school fish farms, which in the long term, could emerge into commercial fish production. Fish has been considered "living cash" and a pond a "savings bank" because fish can usually be harvested throughout the year when needs arise (Bhujel et al, 2008, Shrestha et al., 2012).

Establishment and operating of fish farm may be a very exciting event for the school communities. The development of school fish farm and fish farming would increase awareness of the value of nutrition and fish consumption in rural households. School fish farming would help generate income for schools, and it would also provide teaching material for students. It may also help in capacity building of teachers who could spread the knowledge on the importance of fish in nutrition to parents during teacher-parent interactions. The objectives of this study were to assess the profitability of a school fish farming and its potential to supplement the nutrition of a school feeding programme.



# Materials and Methods

## Study Area

*The study was undertaken at the Legacy Girls' College. The College is a private all girls Senior High School located in Akuse, within the Lower Manya Krobo District in the Eastern Region, Ghana.*

The Ghana Post GPS digital address of the School is EL-0515-4591. It is a boarding school and it offers an enhanced curricula programme in Cambridge A-Level, International General Certificate of Secondary Education (IGCSE) and West African Senior School Certificate Examination (WASSCE) in Science, Business and General Arts.

## Description of the Fish Culture System

The fish culture system was an excavated area (dugout) close to the entrance of the school. It is highly irregular in shape and its estimated surface area is about 2,100 m<sup>2</sup>. Aside, there is an unexcavated landmass "island" occupying a reasonable portion of the system (Plate A).



**Plate A: The dugout for fish farming at Legacy Girls' College, Akuse, Eastern Region, Ghana**

The bottom of the dugout is highly undulating and it lacks the expected gentle slope towards the outlet; with some portions of it being very shallow (< 1 metre in depth) whilst others are relatively deep, over 3 metres when it is filled with water to maximum capacity.

The source of water to the system is surface run-off from the surrounding areas during rainfall. The system lacked a well-designed water exchange structure, although excess water could flow out of it through a drain connected to one end (outlet) of the system. The system has poor embankments and the materials excavated from the system were not well compacted, hence, there is erosion of such material into the system especially when it rains. Due to the rocky and undulating nature of the bottom of the system, total harvesting of culture fish may not be achieved through complete draining by gravity. Harvesting of cultured fish from the system can easily be done by both seining and scooping using a drag and a scoop nets respectively after appreciable volume of the water is pumped out and pockets of it is left in the deeper portions of the system.

### **Water Quality Parameters Analyses of the Dugout**

Water quality analyses were conducted during the same time period (0900-1000 hours) of the day, at three-week time interval. Water quality parameters such as temperature, dissolved oxygen (DO), pH, turbidity and conductivity were measured *in situ* (using Hanna HI 9828 multiparameter probe), whilst nitrite, nitrate, alkalinity, phosphate, ammonia, total alkalinity and total hardness were determined in the laboratory (using spectrophotometer, Hach DR 2800).

All the physico-chemical parameters were measured at a depth of about 0.1 m. The probe of the meter was immersed into the dugout *in situ* and the temperature, DO, pH, turbidity and conductivity were read directly from the meter when equilibrium was achieved. Temperature was measured in degree Celsius ( $^{\circ}\text{C}$ ), DO in milligram per liter ( $\text{mg L}^{-1}$ ), turbidity in NTU and conductivity in microsiemens per centimetre ( $\mu\text{S cm}^{-1}$ ).

For the parameters that were determined in the laboratory, samples of water were taken at the same depth (about 0.1 m) from the upper, middle and lower portions of the dugout into 250 ml plastic bottles which were acid clean and rinsed three times with distilled water and dried in an oven. The samples were immediately stored in an ice-chest, stocked with ice blocks and maintained at a temperature of about 4  $^{\circ}\text{C}$  in the laboratory, the samples were thawed to room temperature and each parameter was determined.

### **Source of Cultured Fish, Conditioning and Transportation**

The cultured fish were juvenile Nile tilapia, *Oreochromis niloticus* obtained from ARDEC, Akosombo. Prior to the transportation of the fish to the culture site, they were conditioned. During the process, the juvenile fish were sustained on maintenance ration. Then the fish were fed at about 2% of their body weight twice a day for about a week. Fish sizes selected for stocking ranged between 60.0 to 80.0 g with an initial mean weight of  $74.38 \pm 27.86$  g. After sorting, the fish were further conditioned in isolated hapas for seven days before they were bagged and transported to the Legacy Girls' College. The bagging was done using aerated closed transparent polyethylene bags. In all, 15 bags

were used, with each containing an average of 146 fish. The transparent bags were put into empty sacks to protect the former from being damaged by sharp objects.

### **Stocking of the Dugout with the Juvenile Nile Tilapia**

On arrival, the sacks were removed and the transparent bags with their contents, without opening them were put into the dugout water for a time period of about 10 to 15 minutes to ensure thermal equilibrium between the water within the bag and that of the dugout. Each bag was slit at one end to allow the fish to swim out voluntarily into the dugout water.

### **Feeding and Monitoring of Fish Growth**

Based on the weights of the sampled individual 50 fish measured, their mean weight was determined and the total weight (biomass) of all the stocked fish was computed. The fish were manually fed with a 35% declared crude protein content commercial pelleted-extruded tilapia feed at 4.0% of their biomass at three equal portions three times daily (between 0800-0830, 1200-1230 and 1600-1630 GMT) throughout the week. The 4.0% rate of feeding was maintained until the fish attained a mean body weight greater than 100.0 g. Then the feeding rate was reduced to 3.0%, but feeding frequency of 3 times per day was maintained throughout the culture period.

Sampling of the cultured fish for growth monitoring was carried out every three weeks. Fifty (50) fish, randomly selected from a group of fish caught from the dugout using a drag net, were put into a large bowl containing dugout water. Each fish was gently mopped on a soft towel to remove excess water from the body. Then the standard and total lengths were measured followed by the weight.

Each fish was then returned into a second bowl containing fresh dugout water. After measurements, the fish were returned to the culture system. The measurements were done between 0630 and 0930 GMT.

The biomass of fish in the culture system was computed and subsequently, the quantity of feed was adjusted accordingly. The fish were not fed on the day they were handled, feeding commenced at 0800 GMT the following day. The fish were cultured for 21 weeks (147 days). Prior to complete harvesting, the lengths and weight of a sample of 50 fish were measured to determine the final mean weight. To facilitate fish harvest, the water level in the dugout was reduced by pumping using a water pumping machine (Antor 4LD 820 LY3; 17HP diesel engine driven). The harvested fish were counted and measured in groups of 25 individuals so as to determine the survival and the total weight of fish produced.

Aside from the stocked fish species, *O. niloticus*, other freshwater fish species were observed in the harvested fish together with juveniles of the stocked species. Species observed in the harvested fish included tiger fish, *Hydrocynus forskalii* and *Tilapia guineensis* of various sizes. These were also weighed and added to the overall yield.

## Determination of Performance Indicators

The specific growth rate (SGR), daily weight gain (DWG), feed intake (FI), feed conversion ratio (FCR), feed efficiency (FE), survival rate (SR) and harvested biomass (HB) were computed as follows

$$\text{i. SGR} = \frac{\ln(\text{final body weight}) - \ln(\text{initial body weight})}{\text{Culture period (in days)}} \times 100\%$$

Where ln = natural logarithm

$$\text{ii. DWG (g)} = \frac{\text{Final mean body weight (g)} - \text{Initial mean body weight (g)}}{\text{Culture period (in days)}}$$

$$\text{iii. FI (g fish}^{-1}\text{)} = \frac{\text{Mean total feed fed (g)}}{\text{Total number of harvested fish}}$$

$$\text{iv. FCR} = \frac{\text{Mean total feed fed (g)}}{\text{Mean live weight gained by fish (g)}}$$

$$\text{v. FE} = \frac{\text{Mean total live weight gain (g)}}{\text{Mean Total feed fed (g)}} \times 100\% = 1/\text{FCR} \times 100\%$$

$$\text{vi. SR (\%)} = \frac{100 \times \text{Final mean total number of fish}}{\text{Initial mean total number of fish}}$$

$$\text{vii. HB (g)} = \text{Total weight of fish harvested from the dugout}$$

## Profitability

The fish production cost was computed using the cost of total feed used and that of the juvenile tilapia stocked. Total revenue was the multiplication of production and price of fish as pertained during the culture period. The economic performance and the profitability of the farmed fish were calculated on the basis of gross profit, profit index and incidence cost. Gross profit is the difference between total revenue and the total variable cost. The profit index is the ratio of the revenue generated to variable input cost, whilst the incidence cost is the ratio of cost of feed used to the weight of fish produced. Labour was not costed, as all activities regarding labour were carried out by the labourers of the school. The following equations were used to analyze the profitability (Anani *et al.*, 2021):

i. Variable input Costs (VIC) = Cost of feed used (GHS) + Cost of juvenile tilapia stocked (GHS)

ii. Production Value (Revenue) PV = Production × Price (GHS)

iii. Gross Profit (GP) = PV (GHS) - VIC (GHS)

iv. Profit Index (PI) = 
$$\frac{PV \text{ (GHS)}}{VIC \text{ (GHS)}}$$

v. Incidence Cost = 
$$\frac{\text{Cost of feed used (GHS)}}{\text{Weight of fish produced (kg)}}$$

## Data Analyses

Data on fish growth, feed used and water quality were entered in a database system using Microsoft Excel software (2016 version). The data was then summarized using descriptive statistics. Results obtained were used to compute the various indices for both performance indicators and the economics of the fish produced.

## Results and Discussion

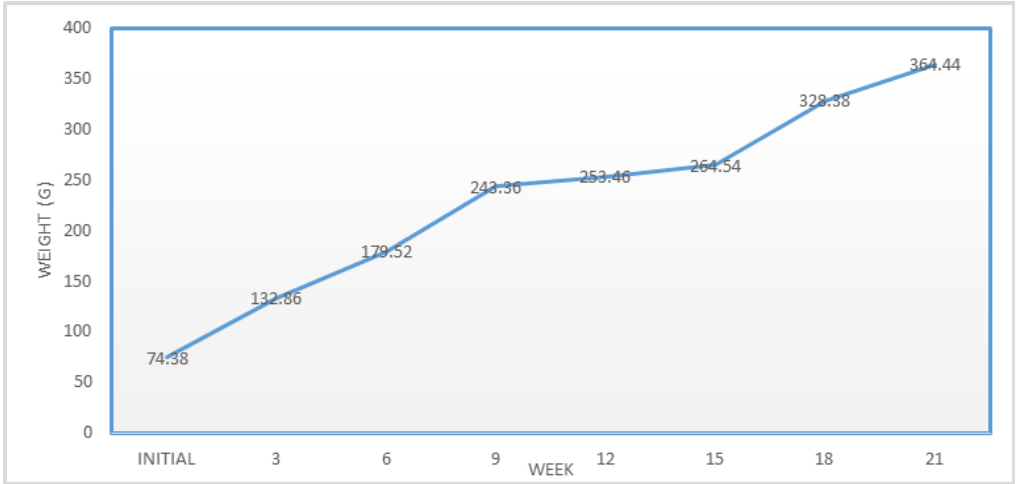
### Water Quality Analyses

The recorded figures for the various water quality parameters monitored during the fish rearing period were within the following ranges: Temperature (29.1-30.8 °C), Dissolved Oxygen (2.1-8.1 mg L<sup>-1</sup>), pH (6.86-8.46), Turbidity (28.9-148 NTU), Conductivity (94-323 μS/cm), Nitrite-Nitrogen (<0.001-0.015 mg L<sup>-1</sup>), Nitrate-Nitrogen (<0.001-0.038 mg L<sup>-1</sup>), Phosphate-Phosphorous (0.017-0.149 mg L<sup>-1</sup>), Ammonium-Nitrogen (0.147-1.211 mg L<sup>-1</sup>), Total Alkalinity (52.5-186.0 mg L<sup>-1</sup>) and Total Hardness (63.0-164.0 mg L<sup>-1</sup>). Water quality parameters play a major role on the maintenance of an aquatic environment and the production of food organisms (Makori *et al.*, 2017; Abu *et al.*, 2021). The recorded parameters in the dugout were within suitable ranges for tilapia grow out production. For better growth and development, optimum temperature is a key factor. The range of temperature recorded in the dugout during the study, fell within 20.20 to 36.50 °C observed in most fish ponds which were favourable for fish culture (Miah *et al.*, 2015; Chakraborty *et al.*, 2017; Kurbah and Bhuyan, 2018; Parvez *et al.*, 2020). Although, some figures of the dissolved oxygen recorded in the dugout was below 3.0 mg L<sup>-1</sup>, most were within the suitable range for fish production (Chakraborty *et al.*, 2017; Kurbah and Bhuyan, 2018). The range of pH figures recorded in this study was within 6.5 to 9.0, considered to be suitable for fish culture (Chakraborty *et al.*, 2010).

## Growth of Cultured Juvenile Nile Tilapia

Figure 1 shows the three-week growth trend of Nile tilapia cultured in the Legacy Girls' College dugout for twenty-one weeks. From the first week up to the ninth week, fish growth was rapid. Growth was generally slow from the ninth to the fifteenth week.

**Figure 1** Growth performance of juvenile Nile tilapia cultured in Legacy Girls' College Dugout for 21 weeks



This was because the cultured fish was not fed with the recommended feeding rate during the said period. However, growth peaked after the fifteenth week till the end of the twenty-first week when the fish were fed with the appropriate feed quantity. At the end of the twenty-first week, the final mean weight was  $364.44 \pm 57.85$  g. The recorded final mean weight would have been higher, if the fish were fed with the required quantity of feed throughout the twenty-one weeks of culture (Ahmed *et al.*, 2012; Workagegn *et al.*, 2014; Opiyo *et al.*, 2014; Anani *et al.*, 2017). No infection or any disease condition was observed among the cultured fish during sampling or at harvest. The growth of the cultured Nile tilapia as indicated by the observed final mean weight and the weight gain suggests that the Legacy Girls' college dugout was suitable for Nile tilapia rearing. The final mean body weight of  $364.44 \pm 57.85$  attained within 21 weeks of culture indicates that the stocking of the system with 2, 200 of the juvenile Nile tilapia was appropriate.

## Growth Performance and Feed Utilizations of the Cultured Nile Tilapia

The figures for growth performance of the cultured juvenile Nile tilapia for 21 weeks are presented as mean ( $\pm$  standard deviation, SD) in Table 1. The mean weight gain by the stocked fish was  $290.06 \pm 30.01$  whilst the specific growth rate (SGR) and the daily weight gain (DWG) were 1.08%

day<sup>-1</sup> and 1.97 g day<sup>-1</sup> respectively. For DWG, the figure recorded in this study was higher than any of those obtained by both Opiyo *et al.* (2014) and by Anani *et al.* (2017), who carried out their studies on Nile tilapia in earthen ponds and in hapa-in-pond systems respectively. Figures recorded by the former ranged from 0.47 to 0.68 g day<sup>-1</sup> whilst those of the latter ranged from 0.84 to 1.18 g day<sup>-1</sup>.

**Table 1 Growth performance and feed utilization of the juvenile Nile tilapia cultured in Legacy Girls’**

College dugout for 21 weeks

Parameter	Figure
Initial mean weight (g)	74.38 ± 27.86
*Final mean weight (g)	364.44 ± 57.85
*Mean weight gain (g)	290.06 ± 30.01
*Specific growth rate (% day <sup>-1</sup> )	1.08
*Mean daily weight gain (g day <sup>-1</sup> )	1.97
*Feed intake (g fish <sup>-1</sup> )	612.72
**Feed conversion ratio	1.38
**Feed efficiency (%)	72.46
*Survival rate (%)	78.64
**Harvested biomass (kg)	929.92

**\*Were computed based on the number of survived stocked fish**

**\*\*Were computed based on stocked fish ( $\geq 224.40$  g) = 705.97 kg and those that invaded the culture system with run-offs ( $\leq 224.40$  g) = 223.95 kg**

Feed intake (FI) was 612.70 g fish<sup>-1</sup> and the computed figure was based on survived stocked fish, whilst the feed conversion ratio (FCR) and the feed efficiency (FE) were computed based on the harvested biomass, and the figures were 1.38 and 72.46% respectively. The relatively high FI was due to the fact that it was only the numbers of the survived harvested stocked fish that were used. Besides, an unknown number of the matured fish escaped from the culture system when it was inundated with excessive rainwater some few days before harvest. The relatively low FCR and the resultant high FE were due to the increase in the biomass of the harvested fish as a result of the other fish species that invaded the culture system during the culture period. The FCR recorded in this study was lower than those recorded by both Opiyo *et al.* (2014) and Anani *et al.* (2017) in their studies. These researchers recorded FCR figures ranging from 1.66 to 2.15 and 2.35 to 2.96 respectively.

The relatively high survival rate (78.64%) recorded was possibly due to the good water quality

recorded throughout the culture period (Makori *et al.*, 2017). The expected impact of uneaten feed and waste from fish excreta caused no noticeable water quality deterioration during the culture period. However, fish survival and the harvested biomass would have been higher if it was not for the escape of matured cultured fish from the culture system when the latter was inundated due to excess water from the rains. Total fish produced (harvested biomass/total fish yield) was 929.92 kg. This consisted of 705.97 kg of originally stocked fish and 223.95 kg of fishes that invaded the culture system during the period. The originally stocked fish ranged from 223.95 to 514.13 g at harvest, whilst the latter group were smaller. Out of the total of 2, 200 juvenile Nile tilapia stocked, 1, 730, constituting about 78.64% were obtained at harvested.

### **Profitability of Producing Nile Tilapia in the Legacy Girls' College Dugout**

Profitability refers to net returns as compared to the cost of production. The figures obtained for the computed economic performance parameters are shown in Table 2 below. The costs of the stocked juvenile tilapia and the feed used throughout the culture period were 2,500.00 and GHS4, 990.00 respectively. The larger amount of money spent by the school on the farm was on purchase of fish feed (66.62%). The result of higher feed cost is in agreement with the findings of other researchers who found out that feed cost was the highest (55 to 60%) among other fish production costs (Okpeke and Akarue, 2015; Md. Abdul and Shishir, 2020). The computed variable cost (VC) was GHS7, 490.00. The estimated cost (production value) of all the fish harvested was GHS18, 598.40. The gross profit was GHS11, 598.40

**Table 2 Economic analyses of Nile tilapia produced in Legacy Girls' College dugout**

<b>Parameter</b>	<b>Value</b>
Fingerlings Cost (GHS)	2, 500.00
Total Feed Input (kg)	1, 060.00
Feed Cost (GHS)	4, 990.00
Variable Cost (GHS)	7, 490.00
Production Value (GHS)	18, 598.40
Gross Profit (GHS)	11, 108.40
Profit Index	2.48
Incidence Cost (GHS kg <sup>-1</sup> )	5.37

**Estimated cost of fish (based on prevailing farm gate price during the production period): 1 kg = GHS 20.00**

**The average exchange rate of the Ghana cedis to the USA dollar in 2021 was: GHS 5.88 = 1.00 USD**

The profit index was 2.48. This suggests that if it were not for the escape of matured fish from the

culture system due to excess rainwater, the recorded gross profit and the profit index would have been higher.

## Conclusion

Fish cultured by the Legacy Girls' College was profitable. If it were not for the inundation of the culture system by excess rains and the subsequent escape of unknown number of fish from the culture system before harvest, the value of fish produced would have been higher than that of the recorded value.

In the context of income generation, fish farming by the school may be an additional source of revenue in meeting the cash needs of the school whilst for food, it would provide school nutrition. The practice of fish farming by the school will enhance the students' practical knowledge in aquaculture and it would afford them the opportunity to acquire the skills for good fish farming practices, which a reasonable number of them may consider as an income generating activity in the future, long after their secondary school education.

### **Recommendations**

For sustainable fish farming and profitability improvements, the outlet of the dugout should be properly designed and constructed to avoid fish escape from the system during excessive inflow of water due mainly by rains. Additionally, the embankment of the dugout should be well-designed (slope/gradient) and compacted to avoid easy movement around the system and avoidance of erosion and siltation of the system.

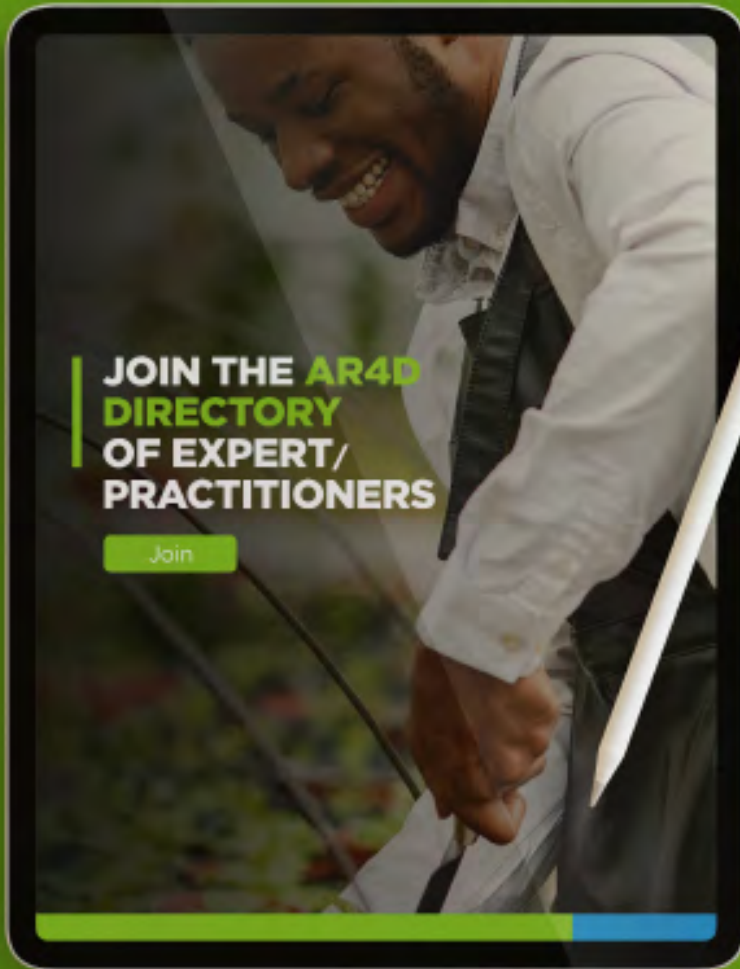
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# References

- Abu, B. S. K., Md. Amirul, I, ASM Tanbirul, H., Md. Anisur R. & Yahia, M. (2021). Growth and yield performance of a sustainable aquaculture of cuchia, *Monopterus cuchia* (Hamilton, 1822) under different type of feeds in Bangladesh. *International Journal of Fisheries and Aquatic Studies*, 9(5): 215–220.
- Ahmed, M. S, Oparah, C. A, & Kiani, M. S. (2012). Growth performance of major carp, *Labeo rohita* fingerlings on commercial feeds. *Journal of Animal and Plant Science*, 22(1): 93–96.
- Anani, F. A., Agbeko, E., Atsakpo, P. D. K., Johnson-Ashun, M., Osei, L. K., Donkor, K. K., Ayarika, A. F., Danquah, E. & Kretsi, E. (2021). Profitability of using commercial tilapia feed to produce three different sizes of Nile tilapia (*Oreochromis niloticus* L.) fingerlings in Ghana. *Asian Journal of Fisheries and Aquatic Research*, 15(3): 10–17. DOI: 10.9734/AJFAR/2021/v15i330328.
- Anani, F. A., Nunoo, F. K. E., Steiner-Asiedu, M., Nortey, T. N. N and Agbo, N. W. (2017). Evaluation of farm-made and commercial tilapia diets for small-scale hapa production of Nile tilapia (*Oreochromis niloticus* L.) in Ghana. *Journal of Applied Life Sciences International*. 10 (3): 1–12. <http://doi.org/10.9734/JALSI/2017/31939>.
- Beveridge, M. C. M., Thilsted, S. H., Phillips, M. J., Metian, M., Troell, M., & Hall, S. J. (2013). Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculture. *Journal of Fish Biology*, 83, 1067–1084.
- Bhujel, R.C., Shrestha, M. K., Pant, J., & Buranrom, S. (2008). Ethnic women in aquaculture in Nepal. *Development*, 51, 259–264.
- Chakraborty, B. K., Azad, S. A., Bormon, B., Ahmed, M. & Faruque, A. M. O. (2010). To investigate the technical and co-management aspects of mud eel (*Monopterus cuchia*) culture by ethnic (Adivasi) communities in the Northern Bangladesh. *Journal of Crop and Weed*, 6(2):19–25.
- Chakraborty, B. K., Haque, S. M., Sarker, S. & Tripura, R. (2017). Growth and yield performance of a sustainable aquaculture of cuchia, *Monopterus cuchia* (Hamilton) under semi-intensive aquaculture in Bangladesh. *Journal of Crop and Weed*, 13(1):34–41. DOI: <https://doi.org/10.22271/fish2021.v9.i5c.2578>
- FAO. (2016). Fishery and Aquaculture Country Profiles. Ghana (2016). Country Profile Fact Sheets. In: FAO Fisheries and Aquaculture Department, Rome. pp 15.
- FAO. (2012). The state of food insecurity in the world. Addressing food insecurity in protracted crises. Rome, FAO. 58 pp.
- GSFP. (2017). Contract for the provisioning of Catering Services under the Ghana School Feeding Programme.
- GoG/WFP/PCD. (2017). Report on joint GoG/WFP/PCD school meals nutrition survey in northern Ghana.
- Greenhalgh, T., Kristjansson, E., & Robinson, V. (2009). Realist review to understand the efficacy of school feeding programmes. *BMJ*, 335 (7625), 858–861.
- Kassam, L. (2014). Aquaculture and food security, poverty alleviation and nutrition in Ghana. Case study prepared for the aquaculture for food security, poverty alleviation and nutrition project. World Fish, Penang, Malaysia. Project Report J 2:1.
- Kurbah, B. M. & Bhuyan, R. N. (2018). Length-weight relationship and relative condition factor (KN) of *Monopterus cuchia* (HAMILTON) in Meghalaya, India. *International Journal of Biology Research*, 3(1):312–318.
- Makori, A. J., Abuom, P. O., Kapiyo, R., Anyona, D. N. & Dida, G. O. (2017). Effects of water physico-chemical parameters on tilapia (*Oreochromis niloticus*) growth in earthen ponds in Teso, North Sub-County, Busia County. *Fisheries and Aquatic Science*, 20:30. DOI: 10.1186/541240-017-0075-7.
- Md. Abdul, Q. & Shishir, K. S. (2020). Leased pond fish farming and livelihood status of farmers in Jamalpur district. *International Journal of Fisheries and Aquatic Studies*, 8(2): 235–240.
- Miah, M. D., Ali, H., Jannat, E., Naser, M. N. & Ahmed, M. K. (2015). Rearing and production performance of freshwater mud eel, *Monopterus cuchia* in different culture regimes. *Advance in Zoology and Botany*, 34–36.
- MoFAD. (2021). Annual Report 2017. Ministry of Fisheries and Aquaculture Development.
- NEPAD. (2005). NEPAD School feeding programme; Annual operating plan. Accra: NEPAD.
- Okpeke, M. Y. & Akarue, B. O. (2015). Analysis of the profitability of fish farming in Warri South Local Government area of Delta State, Nigeria. *Journal of Agriculture and Veterinary Science*, 8(12):45–51.

- Opiyo, M. A., Githukia, C. M., Munguti, J. M. and Charo-Karisa, H. (2014). Growth performance carcass composition and profitability of Nile tilapia (*Oreochromis niloticus* L.) fed commercial and on-farm made fish feed in earthen ponds. *International Journal of Fisheries and Aquatic Studies*, 1(5): 12-17.
- Parvez, C., Shofiquzzoha, A. F. M. & Anuradha, B. (2020). Evaluation trial on production performance of freshwater mud eel (*Monopterus albus*) in farmer's pond. *Asian Journal of Fisheries and Aquatic Research*, 10(2):9-15.
- Shrestha, M. K., Pant, J., & Bhujel, R. C. (2012). Small-scale aquaculture development model for rural Nepal. In: M.K. Shrestha and J. Pant (eds.) *Small-scale aquaculture for rural livelihoods: Proceedings of the National Symposium on Small-scale Aquaculture for Increasing Resilience of Rural Livelihoods in Nepal*. Institute of Agriculture and Animal Science, Tribhuvan University, Rampur, Chitwan, Nepal, and The WorldFish Center, Penang, Malaysia, 71–75 p.
- Workagegn, K. B., Ababbo, E. D., Yimer, G. T. & Amare, T. A. (2014). Growth and performance of the Nile tilapia (*Oreochromis niloticus* L.) fed different types of diets formulated from varieties of feed ingredients. *Journal of Aquaculture and Research Development*, 2014;5:235.



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