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## **Economics of Fish Production in Amansie-west District of Ghana: Implication for Food Security in West Africa**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Author CC carried out the survey, analysis and reported the results. Author IGU involved in proof-reading, updating the literature, managed the abstract, introduction, tables, references and general structure of the manuscript. Both authors read and approved the final manuscript.*

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### **ABSTRACT**

This study analyzed the economics of fish production in Amansie-West District of Ghana, West Africa. Primary data were collected from 45 fish farmers in the district, in April, 2009. We carried out a descriptive analysis of the inputs used and output obtained by fish farmers in the district. The results show that majority (95.6%) of the fish farmers used the earthen pond type, with a mean pond area of 0.17ha. The mean number of fingerlings stocked by the farmers was 9,331.11 and the mean quantity of fish harvested was 771.96Kg. The results show a wide variation among the farmers in the use of inputs and total quantity of fish harvested, which implies that yields of fish in the area are poor and well below potential yields indicated by field trials. The study recommends changes in public policy to improve yields for existing ponds and to identify circumstances where yields can be improved for future ponds. It also recommends a further research to be carried out to estimate the production and cost functions for the fish production technology used by the fish farmers in the district to help reduce the cost of fish

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production and improve the returns to fish farmers, while helping to increase fish production and promote food security in the country and the West African region.

*Keywords: Fish production; amansie; Ghana; West Africa; small scale farmers.*

## 1. INTRODUCTION

Aquaculture has a long history in Africa, ranging from the regional fish culture development project by FAO which covered the Central Africa countries mainly Cameroon, Congo, Gabon and the Central African Republic [1]. With most of the fish farmers operating on small scale basis, other African countries have also witnessed significant growth in fish production, for instance, Malawi recorded an increase from 5 tonnes in 1996 to 17 tonnes in national catfish production in 2003 [2], and Egypt, which contributes up to 78 percent of the total combined aquaculture production in North Africa, Near East and Sub-Saharan Africa [3, 4]. West African countries for instance, Nigeria also records considerable success in fish production with catfish farmers operating at a profit efficiency of up to 0.84 [5]; catfish production was predicted to increase by 40,000 tonnes before 2010, with the highest concentration of fish farms located in the southern region of the country [6]. Despite the potential for fish farming in Africa, many African countries; including Ghana do not have a quantified long term or even mid-term national plan for their aquaculture sectors [7], making it difficult to develop production targets for the sector. Fish farming in Ghana dates back to the early 1950s, and involves different fish species, mainly the African catfish (*Clarias gariepinus*, *Heterobranchus longifilis* and *Heterobranchus isopterus*) and tilapia, mainly *Oreochromis niloticus* [8]. The estimated domestic supply of fish was about 435,000 Metric Tonnes (MT) and a demand of about 840,000 MT [9]. The national annual deficit is about 405,000 MT, which implies that the nation is able to supply only about 52% of her fish needs. Ghana spends nearly \$100 million a year to import 200,000 MT of fish to supplement domestic production [10], due to a decline in the contribution of the fishing sector to the country's economy [11,12] reported that Ghana's national average fish requirement is approximately 800,000MT annually, while total domestic fish production has been as low as 383,500MT, with limited essential feed ingredients and raw materials necessary to produce nutritionally balanced feeds for the desired fish yield. However, the fisheries sector in Ghana plays an important role in the national economy, although there has been a decline in the contribution of the fisheries sector to the national economy over the years [11]. It contributes about 3 % of the Gross Domestic Product (GDP). Even though in percentage terms 3 % may look small, its significance cannot be over-emphasized taking into consideration the absolute number of people employed in the sector. It is also estimated that, 1.5-2 million people directly or indirectly rely on or support these fishers. These include their wives, children, close relatives, canoe carvers, input suppliers and office workers for industrial fleet [13]. Over the years, the production from capture fisheries in Ghana has peaked, even to a point of decline; on the other hand, demand for fish has been growing due to population increase. Moreover, capture fisheries alone is not enough to meet the demand for fish. This has made the development of aquaculture very important to the Ghana government to serve as one of the ways to bridge the gap between demand and supply of fish and to produce in excess for exports. The Ashanti Region is among the highest producers of farmed fish but not much is known about the production of individual districts that make up the region. Amansie-West is one of the leading districts in Ashanti Region in terms of aquaculture because of its high volume of production. This total volume (90.66 metric tonnes as at 2006) does not come from few farmers but many small subsistence and small scale farms which are located all

over the district. The two percent (2%) increase in production from 2005 to 2006 shows that aquaculture is doing well in the district [14].

Amansie-West has the potential for fish farming and this is found in the nature of terrain, the streams and type of soil, which are inevitable factors in aquaculture. The main local sources of fish are the streams and rivers found in the district. Yet the bulk of their fish has been from Kumasi where much of the fish in the market come from coastal towns like Accra, Takoradi, Tema, Elmina and Yeji [14]. Acknowledged that aquaculture has gained some grounds and has been progressing in Amansie-West District for the last six years since its inception by the Resolute Amansie Mines Company Limited. The adoption of aquaculture in the district is shown in the widespread distribution of earthen ponds. Aquaculture is believed to have helped to mitigate the protein-deficiency of the people. It has also brought employment, especially to the youth as some of the youth are employed as fish pond managers. It was also asserted that there are two categories of fish farmers; individual and cooperative farmers. Most cooperative ponds are abandoned mainly because of lack of commitment and heavy reliance on the mines for resources. There is also a higher preference for individual ponds and farming is at the subsistence and small scale levels. Most of the harvested fish are sold and the rest used in the home. There is more room for improvement in the identified fish pond management practices in Amansie West. However, there are numerous constraints to fish farming in the district and assistance from governmental and non-governmental organizations are needed to sustain interest and improve on production. Moreover, the country's Department of Fisheries is unable to provide all the information and services required for efficient development and management of the fisheries sector, coupled with lack of awareness of current developments in other countries in the West African region which could be relevant to the situation in Ghana [15]. Ghana and other West African countries, including Nigeria and Benin Republic still get higher shipments of fish, mainly Tilapia [16], most of which are exported from the United States of America, and other African countries such as Morocco, Namibia and Angola [12]. This is an indication of insufficient fish production within the West African region. Therefore, improvement in fish production in Ghana will help reduce the growing high demand for fish and food insecurity within the West African region. On the whole, to boost fish production to help promote food security within the country and the West Africa region, it is important that fish farmers are made to share information through an improved mechanism to boost regional and international transfer of information and technology, with reference to efficient fish production [17]. It is against this background that this study was carried out to assess the economics of fish farming in the Amansie-West District of Ghana, with a view to proffering recommendations to help promote small scale farming in Ghana and the West African region. The study identified the various inputs used by the fish farmers in the district and the costs incurred during production and obtained data on the yield and sales of the harvested fish.

## **2. MATERIALS AND METHODS**

This study was conducted in the Amansie-West District of the Ashanti Region of Ghana, West Africa. Amansie-West is a rural farming district in the Ashanti Region of South Ghana, West Africa. The area was chosen because it has the highest number of registered fish farmers in the Ashanti Region [14]. Another reason why the area was chosen was because it was considered a very poor district with high malnutrition status in Ashanti Region which is the highest producer of farmed fish in Ghana. Amansie-West is one of the 21 districts in the Ashanti Region of Ghana with MansoNkwanta as its capital. It was carved out of the Amansie East District in the Ashanti Region in 1989, as part of the government's Decentralization Policy. The district is located in the south-western part of the Ashanti

Region. It shares common boundary on its western part with the Atwima District. On its northern part can be found the Bosomtwe-Atwima Kwanwoma District while a regional boundary separates it from the Western Region on its southern part. The district covers an area of 1,364 square kilometers [18].

The district lies entirely in the rainforest belt of Ghana. It exhibits most semi-deciduous characteristics. The district is very rich in forest resources, such as timber, herbs of medicinal value and fuel wood. It also abounds in different species of tropical hardwood, notably Odum, Mahogany and Sapale. There are four main forest reserves in the district. These are: Oda River Forest Reserve, Apamprama Forest Reserve, Gyeni River Forest Reserve and Jimira Forest Reserve. The soils are mainly ultisols, acid and of low fertility. Amansie-West has a population of 108,726, most of whom are illiterates. It is rural and cocoa farming is the major occupation. Fish farming, a growing business in the district started in 2002 and it was the initiative of the Resolute Amansie Gold Mines. The topography of the district is generally undulating with an elevation of 210 meters above sea level. The most prominent feature is the range of hills, which stretches across the north-western part of the district, especially around Manso-Nkwanta and Abore. These hills have an elevation of between 560 m and 630 m. The district is drained in the north by the Offin and Oda rivers and their tributaries such as Jeni, Pumpin and Emuna. With a mean monthly temperature of 26°C, the district enjoys a mean annual rainfall of 160-180mm, with no strong dry season[19].

Forty five (45) registered fish farmers formed the sample size for the study, selected from the total of seventy (70) registered fish farmers in the District. List of the registered farmers was obtained from the Ashanti Regional Office of the Department of Fisheries. Primary data were obtained from the selected farmers through the use of semi-structured questionnaires and interviews, these included mainly data on farm inputs and types of fish ponds, as well as, yield and sales of the fish. The descriptive analyses were carried out on the socio-economic data using the Statistical Package for Social Science (SPSS). Secondary data used for the study were collected from literature relevant to the research topic, such as serials, FAO publications, books and journals. The secondary data obtained showed that the fish farms in the study area were of three major size distributions: large, medium and small, ranging between 0.01 and 25 hectares. To ensure that each size distribution was fairly represented in the final sample of 45 registered fish farmers in the study area, the researcher categorized the registered fish farmers in the district into groups based on the total area of the ponds on each farm. The categories were: small (0.01-0.10 ha), medium (0.11-0.20 ha) and large (>0.20 ha). There were 39 small-sized farms, 16 medium farms and 15 large farms. With the intended original sample size of fifty (50) and the total population of registered fish farmers of seventy (70) and to obtain a proportionate number of respondents from each stratum, the sample size was divided by the population:  $50/70$ , which gave  $5/7$ . Thus,  $5/7$  of the number of farmers in each stratum was chosen randomly. In other words, twenty-eight (28) small-sized farms were randomly selected from the thirty-eight (38) small-sized farms, eleven (11) from the sixteen (16) medium farms and eleven (11) from the fifteen (15) large-sized farms to taling fifty in all. However, only forty five (45) out of the fifty (50) registered fish farmers selected gave complete information used for this study.

### 3. RESULTS AND DISCUSSION

#### 3.1 Inputs Used by Fish Farmers in the Amansie-West District of Ghana

Data used for this study were obtained from a sample of 45 fish farmers. Of this number of respondents, twenty-two (22) were individuals while twenty-three (23) were cooperative societies. Data was obtained on the total area of functional ponds (ha) used for the 2007/2008 production season, the number of fingerlings stocked, the quantity of fertilizer used (kg), the quantity of feed used (kg) and the number of times per day that the fishes are fed daily and how many months fish are fed before harvesting, and the number of hours or minutes spent working on the fish ponds (man-days). The descriptive statistics of the inputs used by the fish farmers is presented in Table 1.

**Table 1. Descriptive analysis of inputs used by fish farmers in the Amansie-West District of Ghana**

Inputs	Range	Minimum	Maximum	Sum	Mean (N = 45)	Std Dev
Total Pond area (ha)	1.2485	0.0015	1.25	7.413	0.17	0.24
Fingerlings Stocked	70925	75	71000	9331.11	13198.99	13242.68
Quantity of Feeds (Kg)	19215	1260	20475	200313	4451.40	3279.56
Labour (Man-days)	146	4	150	2096	56.58	225.97
Quantity of Fertilizer (Kg)	980	1	981	11732	260.71	210.38

*N = Number of Observations, Source: Field survey data (2009)*

#### 3.2 Total Area of Fish Ponds in Used by Farmers in the Amansie-West District

As shown in Table 2, the distribution of ponds in the district among the forty-five (45) respondents indicates that 27(60%) of the respondents has a total pond area of less than 0.10 ha. This group included both individual farmers and cooperative societies. This is also the modal group in terms of total pond area stocked during the last production season; an indication that most of the farmers operate on the small-scale. As may be seen from Table 1, the least total pond area was 0.0015 ha while the largest total pond area was 1.25 ha. 11(24.44%) of the respondents had pond areas ranging from 0.11 and 0.20ha, while 7(15.56%) of them owned total pond areas larger than 0.20ha Table 2.

**Table 2. Total areas of fish ponds in the Amansie-West District**

Total Pond Area (Ha)	Frequency	Percent
<0.10	27	60.00
0.11-0.20	11	24.44
>0.20	7	15.56
<b>Total</b>	<b>45</b>	<b>100.00</b>

*Source: Field Survey (2009)*

The cost of constructing the highest capital element in the establishment of a fish farm and since majority of the farmers obtained their initial capital from their own savings, it is not surprising therefore that majority of them own pond areas less than 0.11 ha. Most farmers

during the field survey noted that land acquisition was not much of a problem to them, but their major setback had been the construction of the ponds. Among the farmers interviewed, the majority (95.6%) of them had earthen ponds dug out for raising fish while only 2(4.4%) had concrete ponds, as shown in Table 3.

**Table 3. Types of ponds used by fish farmers in Amansie-West District**

Pond type	Frequency	Percent
Concrete	2	4.4
Earthen	43	95.6
<b>Total</b>	<b>45</b>	<b>100</b>

Source: Computed from Field Survey (2009)

### 3.3 Number of Fingerlings used by Fish Farmers in the Amansie-West District

Table 4 presents the descriptive statistics for the number of fingerlings stocked by the farmers. The results show that the minimum quantity of fingerlings stocked by the fish farmers in the Amansie-West District was 75 pieces. The quantity of fingerlings stocked was relative to the total size of the fish pond. Actually, according to the agricultural extension agent (pers.commun) who assisted in this work, the stocking rate per pond was five (5) fingerlings per m<sup>2</sup>. Apart from three (3) farmers who, for their last production season obtained their fingerlings from friends' ponds and the Tropo Farms in the Eastern Region of Ghana, the remaining 42 respondents constituting 93.33% of the total sample obtained their fingerlings from the Department of Fisheries in Kumasi. Fingerlings obtained from the ministries were raised for three months by the ministry and fed on groundnut husk and rice bran. The average price paid for each fingerling was GH¢0.02 (\$0.008) and farmers paid between GH¢ 50(\$20.99) and GH¢ 70(\$29.26) to order and have their ponds stocked by experts. The two major species of fish cultured were tilapia and mudfish. Sixty-nine percent (69%) of the respondents cultured both species, 22.22% cultured not only tilapia and catfish, but also snakehead while 6.67% of the respondents cultured only tilapia and 2.22% cultured only catfish.

**Table 4. Descriptive statistics for number of fingerlings stocked**

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Number of fingerlings stocked	45	70,925	75	71,000	9,331.11	13,198.79

Source: Field Survey (2009)

### 3.4 Feeds and Feeding Regimes

It was discovered that fish farmers in the Amansie-West District fed their fishes with rice bran, corn husks, groundnut husks, and to a lesser degree, pawpaw and kitchen waste and left-over food. The majority of the farmers (77.78%) fed their fish with rice bran and groundnut husks, to provide them with carbohydrates and proteins respectively. These feed materials were obtained from Kumasi. These are the feeds used because according to the farmers they were advised by agricultural extension agents from the Ministry of Fisheries (MOF) to do so because they were affordable and also nutritious. About 18% of the fish farmers also utilized RAANAN feed, which is a formulated feed recently introduced onto the

market, which the MOF is promoting among the fish farmers because it is so nutritious and fortified that it is able to increase the growth rate of the fishes making them reach the market size faster. The remaining 4.1% used some corn husks, pawpaw and kitchen wastes and leftovers.

For the feeding regime only one (1) farmer (2.22%), fed his fishes once daily for twelve months. Five (5) farmers (11.11%), fed their fishes three times daily for the production season which lasted between nine (9) and twelve (12) months. Eighty- seven percent (87%) of the fish farmers fed their fish twice daily over the entire production season. Typically, farmers fed the fingerlings 4kg, the out growers 6kg and the finishers 9kg daily for 3, 3 and 6 months respectively [14]. Reported that groundnut pericarp (husk) is used by almost all the farmers but in combination with cereals or pawpaw leaves or both. The feed is however not compounded but a mixture of the food components. Eighty percent (80%) of the farmers fed their fishes twice daily, 10% fed once daily and another 10% did not have a regular feeding regime. They all fed by hand. This finding was consistent with that observed during this research. This implies that a year after Cobbah's work in 2008, fish farmers in the district still practiced the same technology of feeding their fishes.

### **3.5 Labour (Man-Days)**

Almost all the fish farmers were cocoa farmers at the time of this research and so the fish ponds served as secondary occupation to them. Owing to this they did not spend much time working around the fish ponds except to feed the fishes and periodically weed around the ponds. The least time spent by a respondent at the fish pond is 15 minutes per day, which translates into 4 man-days per season. On the other hand some farmers spent between 5 and 7.5 hours per day at the pond. This group of fish farmers had their ponds situated either on their farms or at their backyards where they easily got access to the ponds.

### **3.6 Quantity of Fertilizer Used by Fish Farmers in Amansie-West District**

The farmers fertilized their ponds at the initial stage of the fish farm and also at the onset of every culture period. Lime was also applied at the bottom of the ponds together with manure before the filling the ponds with water. Organic fertilizer, mostly poultry droppings and compost were used in ponds. The poultry droppings were placed in small heaps in the pond. The quantity of fertilizing material used was based on the farmer's own discretion. As may be seen from the Table 1, the minimum quantity of fertilizer used by the farmers in the district was 1kg whilst the maximum used was 981 kg. The wide variation in fertilizer usage was partly due to the relative sizes of ponds and also the accessibility of fertilizers.

### **3.7 Yield and Sales of Fish in the Amansie-West District**

Table 5 presents the quantity of fish harvested by fish farmers in the Amansie-West District for the 2008/2009 production season. The mean quantity of fish harvested by the farmers was 771.96Kg. The data obtained for the total quantity of fish harvested were for all the species cultured. Data collected did not disaggregate output by these species. The yield reported in table 5 shows that the yield of fish was positively skewed because majority of the farmers obtained less than a tonne during their last harvest except for one commercial farm which obtained 12.2 metric tonnes of fish. Considering the range of 12.15 metric tonnes therefore indicates that there is the potential for the small and medium scale fish farmers to increase their production capacity if they could be assisted to construct more ponds by

making it possible for them to obtain credit from the banks with flexible terms, since many of them already have land readily available for fish cultivation. Twodays before harvest of the fish, a gong is usually beaten in the town and neighbouring towns to alert the people. The harvested fish were sold to the local people and the neighbouring towns soon after they are harvested, in the fresh state, except for two farms which sold their fish to wholesalers in Kumasi. As at the time of this research on the average a kilogram of tilapia was sold for GH¢ 2.50 (\$1.14) while a kilogram of catfish went for GH¢3.00 (\$ 1.37).

**Table 5. Quantity of fish harvested by fish farmers in the Amansie-West District**

Yield	N	Range	Minimum	Maximum	Sum	Mean
Total Quantity Of Fish Harvested (kg)	45	12,150	50	12,200	34738	771.96

*N = Number of observations, Source: Field Survey (2009)*

#### 4. CONCLUSION

With the growing population in the West Africa region coupled with issues of food insecurity in Sub-Saharan Africa, improvement in fish production in Ghana will have positive impact on fish production in the region by helping to make more fish available for people in the country and consumers in other Africa countries. At present, Ghana competes with other West African consumers for the insufficient fish available in the market. This study was limited to a single district by interviewing 45 fish farmers in the Amansie West District of the Ashanti Region of Ghana. This was motivated by the fact that aggregate data could exclude very vital details peculiar to individual districts or firms. The aim was to find out at the micro level, the types and quantities of inputs utilized by fish farmers in their production; to relate this to the yield obtained and to also consider the challenges faced by farmers in their operations.

The results obtained from this study indicated that there is a wide variation among fish farmers even at the district level, and that fish ponds in the district were almost entirely earthen dug out ponds. The wide variation in the inputs used resulted in the corresponding variation in the output. The implication of these findings is that a general intervention for all farmers at a national or even regional level may not adequately address the needs of all farmers, hence the need to conduct series of district-level researches to be able to come up with a much more comprehensive and all-encompassing policy for improving and sustaining subsistence aquaculture.

Based on the results of this analysis, we recommend changes in public policy to improve yields for existing ponds and to identify circumstances where yields can be improved for future ponds. These should include a more focused attention on total pond area, feed and number of fingerlings, subsidizing, improved feed, such as *RAANAN and ProAqua* to ensure that fishes reach market size in time, locating retailing centres for feed at vantage points within the district to cut down the cost of transportation to and from Kumasi and redoubling efforts to construct more fish ponds for the farmers since total pond area was found to be strongly correlated with yields. Finally, it is also recommended that a further research be carried out to estimate the production and cost function for the fish production technology used by the fish farmers in the district to help reduce the cost of fish production. This would help to improve the returns to fish farmers; encourage more people to engage in fish farming, thereby helping to increase fish production and promote food security in the country and the West African sub-region.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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