AGRICULTURE AND BIOLOGY JOURNAL OF NORTH AMERICA
ISSN Print: 2151-7517, ISSN Online: 2151-7525, doi:10.5251/abjna.2013.4.5.568.575

Profitability Analysis of all-male Tilapia Farming in Sekyere South and Bosomtwe Districts of Ashanti Region

[*1]Vivian F. Boateng, [2]Elliot H. Alhassan, [1]Saahene Yaw, [1]Emmanuel Nensom and [2]Emmanuel D. Abarike

[1]Department of Agribusiness Management & Finance, University for Development Studies, P. O. Box TL 1882, Tamale-Ghana
[2]Department of Fisheries & Aquatic Resources Management, University for Development Studies, P. O. Box TL 1882, Tamale-Ghana
[*]Corresponding author E-mail: ehalhassan@gmail.com and cell phone: +233 243 567152

ABSTRACT

All-male tilapia production is an emerging market in Ghana and a potential source of employment for the people. Despite the increase in livestock and poultry industries, the problem of protein deficiency continues unabated. The contribution of the fishing industry to solving the protein deficiency problem is important. Using data from eighty randomly sampled fish farmers in the Ashanti Region, the profitability of all-male tilapia farming was assessed and the determinants of all-male tilapia output examined. Gross margin analysis and production functions were estimated. Comparing costs and returns, a gross margin of GH¢ 5,797.56 and profit of GH¢ 2,282.17 were realized per annum. The rate of return on investment of 1.86 implies that for each Ghana cedi invested in this enterprise, a return of GH¢ 1.86 was obtained. Regression analysis revealed that all-male tilapia output was significantly determined by feeding, cost of fingerlings, pond size, sex and experience in fish farming. It is concluded that all-male tilapia production is economically rewarding and capable of creating employment, augmenting income and improving living standards of people. Government participation in all-male tilapia farming can boost the quantity of fish available for consumption in the country.

Key words: all-male tilapia, gross margin analysis, cost of fingerlings, production function and pond size

INTRODUCTION

The Ghanaian fishery industry comprises of three sub-sectors namely the artisanal, industrial and aquaculture. The awareness on the potential of aquaculture to contribute to domestic fish production has continued to increase in the country. This stems from the need to meet the much needed fish for domestic production and export. Fish species which are commonly cultured include *Tilapia zillii, Heterobranchus bidorsalis, Clarias gariepinus and Heterotis niloticus*. Fish culture is mainly done in enclosures such as earthen ponds and concrete tanks. The importance of the fisheries sector in the socio-economic development of the country cannot be overemphasized. The fishery industry plays a major role on sustainable livelihoods and poverty reduction in several households and communities. The sector is estimated to contribute about 3 % of the nation's Gross Domestic Product (GDP) and 5 % of the agriculture GDP of Ghana (FAO, 2006-2011).

Among the various sources of protein, fish is the most important in terms of food security because of its price, relative to the prices of other high quality protein sources such as milk, meat and eggs that are very competitive, it is the only source of protein whose shelf life can be readily enhanced through low cost technologies such as smoking, salting and drying (Aggrey-Fynn, 2001).

Because of the higher demand for tilapia in Ghana and the world as a whole, the all-male tilapia production was introduced to the Ashanti Region by the Fisheries Commission through Pilot Aqua-culture Centre (PAC), a fingerling hatchery unit at Tano-Odumase in 2001, was set-up to produce and supply the all-male tilapia fingerlings to the fish farmers in the region and beyond. The all-male tilapia technology involves feeding the fry with feed mixed with the male hormones (17-alpha methyl

testosterone) to reverse the sex of the female tilapia fish during the fry stage to male since research has proven that the males grow bigger and faster as compared to their female counterparts. This is to increase production level and improve the standard of living of fish farmers in the region and the nation as a whole. Their bigger size leads to the high demand for them in the market.

In previous times, the population of some regions of Ghana relied heavily on fishing to fend for themselves, but such natural fishing potential has largely disappeared due to changes in the ecological status. About 60 % of animal protein in the Ghanaian diet country-wide is said to be from fish, it accounts for 22.4 % of household food expenditures and for a long time, fish has remained the preferred and cheapest source of animal protein with about 75 % of total annual production being consumed locally. Tilapia has become one of the most important and highly demanded seafood in the rural and urban centers of Ghana (Ministry of Fisheries, 2007).

In spite of the apparent potential of the fishing industry, the sector has recorded consistent decline in terms of output over the years. For example, the contribution of the fisheries sector to GDP has declined from around 11 percent in 2008 to 7 percent in 2010 (Directorate of Fisheries, 2011). Currently, Ghana has a deficit of 460,000 tons, which implies fish import is needed to bridge the gap (Kwadjoss, 2009). According to Quagrainie *et al*., (2005) the government of Ghana spends an average of US$ 200 million annually importing fish to supplement local production.

All-male tilapia production is an emerging market in Ghana and a potential source of employment for the people. Despite the increase in livestock and poultry industries, the problem of protein deficiency continues unabated. The contribution of the fishing industry to solving the protein deficiency problem is important. But how can people be attracted into fish farming when returns to this enterprise were unknown? This research was therefore carried out to describe the socio-economic status of all-male fish farmers, determine the profitability of all-male fish farming and examine the determinants of fish output in the study area.

MATERIALS AND METHODS

Study Area: The study was conducted in Sekyere South and Bosomtwe Districts in the Ashanti region of Ghana. Sekyere South District is located in the north eastern part of Ashanti Region, which is located 37 kilometres away from Kumasi. The district has a wide array of resource potential which forms the bedrock of the investment opportunities available for exploitation by investors which includes 53,250 hectares of arable land, sand and clay deposits. The availability of tropical trees coupled with the presence of water bodies such as river Oyon, Betinko, and Offin which help in fishing and aquaculture. Also the Bosomtwe District lies within latitude 6^{o} 43^{1} North and longitude 1^{o} 46^{1}West and it spread over the land area of 718sqkm. The district is bounded on the North by Atwima-Nwabiagya and Kumasi metropolis on the East by Ejisu-Juabeng District. The major occupation in the district is agriculture that employs 62% of the labour force. Crop farming employs 57.4% and 5.2% for fishing.

Selection of Respondents and Data Collection: Sekyere-South and Bosomtwe Districts were purposively sampled for the study, because the two districts are well noted for the all-male tilapia farming. Five communities from each district were randomly selected (Agona, Kona, Tano-Odumase, Asamang and Jamasi from Sekyere-South district and Kuntanase, Abono, Edwenease, Akokofe and Onwe from Bosomtwe district). Eight farmers were also randomly selected from each community, giving a total sample size of eighty (80). The main instrument for collecting primary data was through semi-structured questionnaire. Information were collected on input and output in all-male tilapia farming and socio-economic characteristics of all-male tilapia farmers through personal interview.

Analytical Technique: Descriptive statistics such as frequencies and percentages were used to analyse socio-economic characteristics of the fish farmers. According to Engle and Neira (2005) cost of production is classified into variable and fixed costs. The variable costs include cost of feed, cost of fingerlings, labour, manure, and transportation. The farming enterprise uses both families well as full-time labour. The farmers use family labour based on the availability of the individual while the full-time workers are engaged the whole week. The cost of labour was based on the minimum daily wage of 4.48 Ghana cedis for 2012. The fixed costs include depreciation of pond and equipments. Depreciation was calculated using the line straight line method by dividing the cost by the life span of the equipment/facilities (Cruz *et al*., 2000).

Profitability Analysis: The budgetary technique involves the cost and return analysis. It was used to

determine the profitability of all – male tilapia farming in the study area. The model specified as;

$\prod = TR - TC$ (1)

Where TR is giving by;

$TR = P.Q$ (2)

Where ∏ denoted total profit in Ghana cedis, TR and TC are total revenue and total costs all in Ghana cedis respectively. P is the unit price of fish in Ghana cedis and Q is the quantity of fish output.

Performance Indicators: Performance indicators of interest were gross revenues; rate of returns on investment (ROI) and rate of returns to capital invested (RORCI). Rate of returns to capital invested (RORCI) is the ratio of profit to total cost of production and according to Awotide and Adejobi (2007), RORCI indicates what is earned by the production by capital outlay.

Regression analysis: Some of the factors that influence all- male tilapia output was determined quantitatively using the production function analysis with the use of Ordinary Least Square (OLS) multiple regression analysis under the assumptions that the data collected fulfilled the assumption of multiple regression model. These assumptions include absence of multicollinearity among independent variables, normally distributed error term with zero mean and constant variance and non-autoregression disturbance. The multiple regression analysis postulated for all- male tilapia farmers in the study area is implicitly presented by

$$Y = f(X_1, X_2, X_3, X_3, X_4, X_5, X_6, \mu) \quad (3)$$

Where Y is the value of all-male tilapia output, X_1 is sex of the farmer, X_2 is the educational level, X_3 and X_4 denotes farming experience and pond size (m^2) respectively. X_5 and X_6 are fingerlings and feed costs respectively and μ is it error term.

RESULTS AND DISCUSSION

Socio-demographic Characteristics and Farm Level Information of all-male Tilapia Farmers: The age of the respondents ranged from 20 to more than 65 years. The all-male tilapia farmers whose ages fall between 36 and 50 years constituted the majority as shown in Table 1 below. On the whole, 91.3 % of the farmers fall into the economically active population bracket group of 20 to 65 years. This is consistent with observations made by Addae-Mensah (1981) that economically active age group in Ghana is between 14 and 66 years. This is also collaborate the finding of Aeschiliman (2005) and FAO (2005) who observed that the fish farming in Ghana is clearly for both the older and the middle-aged farmers with very few young people venturing into the fish farming business. A research done by Onumah and Acquah (2010) revealed that older farmers are technically less efficient than the younger ones who are progressive and eager to implement new production methods. Hence, if aquaculture is to survive in Ghana, there is a need to put in place measures that will attract the youth into aquaculture.

The male fish farmer constituted 65 % as compared to the female farmers that represent 35 %. This indicates the dominance of men in fish farming. This agrees favourably with Nunoo *et al*. (2012) and Asmah (2008), who attributed the low number of female ownership of farms to the fact that traditionally men are deemed to be the head of the household unit in Ghana and farms owned and run by a family are likely to be in the name of the head of the family.

Seven nine (79) of fish farmers had formal with large proportions (58.8 %) of them having a tertiary education. According to Onumah and Acquah (2010) reported a positive relationship between households with a high level of formal education and technical efficiency of fish farmers. This implies that level of education of fish farmers is very important to the development of the fish farming industry and also can help in designing appropriate training programs tailored to their levels. It was also evident that most of the farmers (72.5 %) were part time all-male tilapia farmers whilst minority (27.5 %) was engaged full time. This study confirms a study done by Sualih (2000) that fish farmers in Brong Ahafo and Ashanti Regions undertake fish farming to supplement their family income. Also, this is lined with the findings of Aeschliman (2005) who stated that farmers use occupational diversification as a survival strategy as well as a means of spreading risk in case of failure. The distribution of the household size indicates that the household size ranged from 3 to 12 while 43 farmers engaged their family into farming business. The larger household size could be a source of cheap and affordable labour for the farmers. Seventy percent (70 %) of the farmers, reported being in all-male tilapia farming for less than 5 years. The average fish pond size of 947.88m^2 and the majority of the farmers (40 %) owned 3 ponds.

As to the source of water for pond operations, 40 percent used water from nearby river, 36.2 % depended on steam whereas less 10 percent uses

water from dams, lake, and spring. A total of 76 (86.2 %) farmers fed their tilapia three times daily to achieve high yield while majority of farmers (95 %) had formal training in tilapia farming and also received extension services on fish farming.

Table 1: Socioeconomic and Farm Level Information of all-male Tilapia Farmers

Socioeconomic variables	Frequency	Percentage
Age range		
20-35	13	16.3
36-50	34	42.5
51-65	26	32.5
>65	7	8.8
Gender		
Male	52	65
Female	28	35
Education		
No education	1	3
Primary	5	6.3
Secondary	27	34
Tertiary	47	58.8
Mode of farming		
Part time	58	72.5
Full time	22	27.7
Household size		
3-8 person	40	50
9-12	3	3.8
No response	37	46.2
Socioeconomic variables	**Frequency**	**Percentage**
Farming Experience (Years)		
<5	56	70
6-10	22	27.5
11-15	2	2.5
Primary source of water for the pond		
Dam	7	8.8
Lake	8	10
River	32	40
Spring	4	5
Stream	29	36.2
Average pond size (m^2)	**947.88**	
Number of ponds		
2	21	26.2
3	32	40
4	15	18.8
5	7	8.8
6	5	6.2
Source of feeds		
Formulated feed	44	55
Household waste	36	45

Table 1 continued

Socioeconomic variables	Frequency	Percentage
Times of feeding		
Two times	11	13.8
Three times	69	86.2
Training and Access to Extension Service		
Formal training and extension visit	76	95
No formal training and extension visit	4	5
Source of finance		
Friends	4	5
Relatives	4	5
Bank loan	2	2.5
Personal saving	70	87.5

Cost Structure and Profitability: The research examines the profitability of all-male tilapia farming in the Sekyere-South and the Bosomtwe District. To determine the profit level, efforts were made to estimate the cost and return on the all-male tilapia farming. The input used, cost and yield or output data (revenue) generated from the farmers were used to undertake the cost and return analysis and for assessing the profitability of all-male tilapia farming in the study area.

Cost Structure: Costs were categorized into two components; variable cash costs are expenses that are actually paid and vary with the quantity of fish produced, such as fingerlings, feed, labour, transportation, maintenance and organic manure and lime whereas fixed costs which are independent of the production, such as depreciation of the ponds and the equipments (net, pan, containers,) used.

The cost and return analysis is presented in the Table 2. Variable cost accounted for 81.83 percent of the total cost. Among the variable costs, the result revealed that the cost of feeding accounted for the largest proportion (46.08 %) of the total cost of fish production. This was followed by cost of labour (10.2 5%). The cost of fingerlings, organic manure & lime cost and pond maintenance cost accounted for 9.78 % 9.27 % and 6.45 % of the total cost respectively. The average cost and return of all-male Tilapia Production presented in Table 2 shows clearly that the farmers spend large amount of money on feeds and labour in the two districts. A study conducted by Atrill (2003) revealed that the cost of production among others things dependent on the type of culture techniques used and the cost of inputs to the production process. Also, according to Hishamunda (2004), ability to produce at a least cost possible is determined largely by the species, location as well as feed. The fixed cost of production consistent of cost of fixed assets such as pans, nets, pond and containers which accounted for 18.17 % of the total cost of production.

Profitability: Profitability is the principal goal of all business ventures. Without profit, the business will not survive in the long-run. Consequently measuring current and past profitability and projecting future profitability is very important (Hofstrand, 2006). Performance indicators used to assess profitability include net returns, and rate of return to capital invested and rate of return to total investment.

The average total cost of GH¢2,836.71 was incurred per annum by respondent per pond with a gross revenue of GH¢8,118.88 was realized thereby returning gross margin of GH¢ 5,797.56 and giving an average profit of GH¢5,282.17. There is a positive operating profit which indicates that all-male tilapia farming is profitable to operate in the short-term (Table 2). All variable costs of production are covered (Engle & Neira, 2005).

The Rate of Return on Investment (ROI) is 0.91 which implies that for every one Ghana cedi that is invested in the all-male tilapia farming will yield a return of GH¢1.91 and a profit of GH¢0.91. The implication of this is that there is a considerable level of profitability in all-male tilapia farming, as found by Adewuyi *et al*. (2010) and economics viability of fish farming as found by Ashaolu *et al*. (2006). The results also confirm the findings of Nunoo *et al*. (2012) that pen and pond cultured fish production in southern Ghana was profitable. The rate of return per capital invested (RORCI) is the ratio of profit to total cost of production. It indicates what is earned by the business by capital outlay Awotide and Adejobi (2007). The result revealed that the RORCI of 186 % is greater than the prevailing commercial lending rate, implying that fish farming in the study area is profitable.

Determinants of all-Male Tilapia Fish Output: The regression results reported in Table 3 presents determinants of value of fish output in the study area. The F-statistic was statistically significant, implying that all the explanatory variables are related to the value of fish output. The standard error of regression (SER) in the equation predicting the value of fish output was considerably lower than the standard deviation of the sample mean of the value of fish output (Table 3), implying that the estimated model is a better predictor of value of fish output than the sample mean of output. The coefficient of determination adjusted for degrees of freedom is 73 %, which indicates that the variation in all-male tilapia output was explained by changes in the explanatory variables. This shows that 73 percent of the dependent variable (value of output) was explained by total feeding cost, cost of fingerlings, size of pond (m^2), sex of respondent, educational level and years of farming.

This suggested that output was significantly influenced by feeding at 10 % level of significant. The size of pond (m^2) and cost of fingerlings also had positive relationship with all-male tilapia output and was statistically significant. This implies that increasing feeding and fingerlings would leads to an increase in tilapia output. The sex of the farmer had inversely related to the tilapia output and was significant at 10 %, this shows that the production is not male dominated. The signs of the regression coefficients were also in line with the *a priori* expectations, expect for the coefficient of level of education. The results are consistent with the finding of Asmah (2008), Inoni (2007) and Yusuf *et al*. (2002). The result equally suggests the need for all-male tilapia farmers to purchase sufficient amount of inputs to increase their revenue from all-male tilapia production. Similarly, policies that will ensure availability of these inputs to fish farmers at affordable price should be put in place. The positive relationship between value of fish and pond size indicates that with increase in the size of fish pond, more fish will be produced. This is not surprising because *ceteris paribus* the quantity of fish produced is directly proportional to the pond size.

The farming experience coefficient was positive and significant at 10%. This clearly shows that fish farmers who have been in the business for considerable of length of time will enhance their ability to increase output.

Table 2: Average Cost and Return of all-male Tilapia Production

Item	Amount (GH¢)	% Average cost
Net	192.46	6.78
Pond	254.17	8.97
Pans	68.76	2.42
Total Fixed cost	**515.39**	**18.17**
Feeding cost	1307.35	46.08
Cost of Fingerlings	277.50	9.78
Fertilizer and Lime	262.93	9.27
Pond maintenance	182.86	6.45
Cost of Labour	290.68	10.25
Total Variable Cost	**2,321.32**	**81.83**
Total cost	2,836.71	
Total revenue	8,118.88	
Profit	5,282.17	
Return On Investment (ROI)	**0.91**	
Rate of Return per Capital invested (RORCI)	**1.86**	

Table 3: Results of the Multiple Regression of the determinants of fish output.

Variables	Coefficients	t-statistics	Sign. level
Constant	-1204.755	-0.718	0.475
X_1 (Sex)	-0.106	-1.785	0.078*
X_2 $(Educational\ level)$	-0.007	-0.106	0.916
X_3 $(Farming\ experience)$	0.112	1.742	0.086* 0.092*
X_4 $Size\ of\ pond$ (m^2)	0.160	1.707	0.000***
X_5 $Cost\ of\ fingerlings$ (GH¢)	0.613	6.014	0.053*
X_6 $Feeding\ cost$ (GH¢)	0.145	1.963	
Adjusted R^2	0.727		
F-statistics	36.068		0.00***
N	80		

CONCLUSION AND RECOMMENDATIONS:

Based on the value of benefit indicators, it can be concluded that fish production in the study area is economically rewarding and profitable. It is capable of creating employment, augmenting income, reducing malnutrition and improving the living standards of most fish farmers in the area and the country at large. Therefore, it recommended that the Ministry of Fisheries should promote the all-male tilapia farming in order to reduce unemployment. Also effort should be made by the government to take the fish farmers through various rudiments of business management and how to formulate the fish feed to cut down the feeding cost for the farmers engaged in the all-male tilapia farming business

REFERENCES

Addae-Mensah J. (1981) Population Changes and Agricultural Practices in Ghana, pp. 13–34. Land Administration Research Center. Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Adewuji, SA, Phillip, BB,Ayinde, IA and Akerele D (2010). Analysis of Profitability of fish farming in Ogun State, Nigeria. *J. Human Econ* 31(3): 179-184.

Aeschliman, C. (2005) Results of the 2003–2004 Baseline Survey of Ghanaian Fish Farmers. F.A.O. Regional Office for Africa Accra, Ghana.

Aggrey-Fynn (2001). A Practical guide to the Choice of Management of Farmed Project, MoFA, Accra, Ghana.

Ashaolu ,OF, Akinyemi, AA, and Nzekwe LSO (2006). Economic Viability of homestead Fish Production in Abeokuta Metropolis of Ogun State, Nigeria. *Asset Series* A, 6(2): 209-220. Central Bank of Niegria 2004.

Atrill P. (2003) Financial Management for Non Specialists (3rd edn). Pearson Education Limited, London, UK 478 pp.

Awotide, DO and Adejobi AO (2007). Technical Efficiency and Cost of Production among Plantain Farmers in Oyo State Nigeria, *Moor J. Agric Sc,* 7(2): 107-113.

Asmah R. (2008) Development potential and financial viability of fish farming in Ghana. PhD thesis, University of Stirling, Scotland, UK 289pp. Available at: https:// dspace.stir.ac.uk/bitstream/1893/461/1/PhD%20Document.pdf (accessed December 2010).

Cruz E.M., Al-Ameeri A.A., Al-Ahmed A.K. & Ridha M.T. (2000) Partial budget analysis of Nile tilapia, Oreochromis niloticus, Cultured within an existing agricultural farm in Kuwait. *Asian Fish Sc* 13: 297–305.

Engle C.R. & Neira I. (2005) Tilapia farm business management and economics: a training manual. Aquaculture Collaborative Research Support Program. 41pp. Oregon State University, Corvallis, OR, USA.

FAO (2005) Results of the 2003–2004 Baseline Survey of Ghanaian Fish Farmers. FAO Regional Office for Africa, Accra, Ghana 77 pp.

FAO (2006–2011). National Aquaculture Sector Overview. Ghana. National Aquaculture Sector Overview Fact Sheets. Updated 10 October 2005. Available at: http://www.fao.org/fishery/countrysector/naso_ghana/en.

Hishamunda N. (2004) Policies at the farm level to promote commercial aquaculture in sub-Saharan Africa. *Aqua. Econ and Manage* 8: 85– 94.

Hofstrand D (2006). Understanding profitability. Available at: http://www.extension.iastate.edu/agdm/wholefarm/html/c3-24.html (accessed February 2010).

Inoni, O.E. (2007) Allocative efficiency in pond fish production in Delta State, Nigeria: A production function approach. *Agricultura Tropica Et Subtropica* 40(4): 127–134.

Kwadjoss T. (2009). The law of the sea: impacts on the conservation and management of fisheries resources of developing coastal states – the Ghana case study. The United Nations-Nippon Foundation of Japan Fellowship Programme 2008 – 2009. Available at: http://www.un.org/depts/los/nippon/unnff_programme_home/fellows_pages/fellows_papers/kwadjosse_0809_ghana.pdf (accessed March 2010).

Ministry of Fisheries (2007). 'Minister of Fisheries at Meet the Press 1' Series, held on August 28th 2007 in Accra, Ghana.

Nunoo FKE, Asamoah EK and Osei-Asare YB (2012). Economics of aquaculture production: a case study of pond and pen culture in southern Ghana. *Aqua Research* 2: 1-14.

Onumah E.E. & Acquah H.D. (2010) Frontier analysis of aquaculture farms in the Southern sector of Ghana. *World Appl Sc J.* 9: 826–835.

Quagrainie K., Kaliba A., Osewe K., Mnembuka B., Senkondo E., Amisah S., Fosu A.K., Ngugi C.C. & Makambo J. (2005) An economic assessment of aquaculture in rural Africa: the case of Tanzania, Kenya and Ghana. In: Twenty-Third Annual Techical Report. Aquaculture Collaborative Research Support Program (ed. By K. Kosciuch & H. Egna), pp. 73–87. Oregon State University, Corvallis, OR, USA.

Sualih, K. (2000) Economics of Fish Culture in Ghana: A Case Study of the Brong Ahafo and Ashanti Regions. M. Phil. Thesis. Kwame Nkrumah University of Science and Technology, Kumasi.

Yusuf, SA, Ashiru AM, and Adewuyi SA (2002). Economics of fish farming in Ibadan Metropolis. *Trop. J. Animal Sc,* 5(2): 81-88.