Original Research Article

Economic Analysis of Small-scale Aquaculture Enterprise in Ghana; a case study of Sunyani Municipality

ABSTRACT

Aims: This study analyses the economic performance and gender distribution of the small-scale aquaculture of Ghana using Net Present Value (NPV), Internal Rate of Return (IRR), Cash flow as well as gender distribution of the small-scale aquaculture of Ghana.

Study design: This study is exploratory in its design. The study identified certain relationships and associations. Data was gathered from a sample drawn from a population. Questionnaire-based interview was designed and administered to the small scale fish farmers in the Sunyani metropolis. Both quantitative and qualitative research methods will be employed for the study. A case study method will also be used due to the fact that it has the benefit of permitting for an intensive collection of data required to fulfil the goals of the research

Place and Duration of Study: The study was conducted at the Sunyani Municipality in the Brong Ahafo Region of the Republic of Ghana between November 2017 and February 2018.

Methodology: The study randomly selected 20 farms out 40 farms and farmers interviewed using questionnaire. A 600 m2 pond was further selected as a model of the small-scale aquaculture and used to perform the economic analysis.

Results: The total start-up capital for a 600-meter square pond is estimated at GH¢ 12, 119.19. Huge part, 56.9 percent, of the amount goes into fixed investment like pond construction, acquisition of land, and farm buildings. The economic analysis shows a viable industry with an estimated NPV of GH¢2,724.52 and IRR of 24.19 percent.

With gender, the study reveals a huge gap in man-woman distribution in the fish farming trade. Majority of the farms surveyed did not females, with the male having 77 against the female with 23%.

Conclusion: The study has found a viable aquaculture industry with high profitability that can improve the livelihood of fish farming households.

Keywords: Small-scale, Investment cost, operational cost, aquaculture, profitability, gender.

1. INTRODUCTION

Fish is a major component of the human diet. Fish account for up to 20 % of the average per-capita intake of animal protein (FAO, 2014). The usage of fish has increased dramatically due to improved technology, which showcases powerful engines and sonar equipment and led to over fishing, causing a worldwide decrease in wild stock accounting for the decline in the fish population dynamics (FAO, 2005). There is therefore an argent need to increase fish production by fish farming.

Aquaculture can be seen as an aspect of agricultural practices, mainly to increase the production of food above the level that was produced naturally. Today, aquaculture is responsible for an ever-increasing share of global aquatic food production, and accounted for 65% of the increase in fish production in the period 2005–2014. (FAO 2016).

The fisheries resources of Ghana supply 45% of natural animal protein to the people. (MoFAD,2016). Most fish farmers in Ghana use earthen ponds and rely on natural productivity to feed fish, while others supplement feed with agricultural by-products (FAO 2006). The most cultivated species in the country is Oreochromis niloticus (Nile tilapia). Generally, due to health complications associated with consumption of meat, the consumption of aquaculture products is on the increase (Asiedu et al., 2015; FAO, 2016). Moreover, Aquaculture is one of the fastest growing animal foods producing sectors offering employment and food security to the ever-increasing human populace in Ghana (Asiedu et al., 2017). Furthermore, fish have been found to have self-life which is readily enhanced through low-cost sustainable technologies such as smoking, drying and salting (FAO, 2000; 2009). On the other hand, fish is good in terms of gross body weight gain and protein gain per unit of feed intake (Hastings and Dickie, 1972).

Fish farming in Ghana is a profitable venture and it is rapidly expanding and it will continue to be profitable if the planning and management are well taken care of. Fish farming is geared towards the improvement of nutritional standards of the people and to create self-employment opportunities for Ghanaian communities. Secondly, fish farming has become more appropriate to developing countries because of the opportunities for waste recycling and integration with crops and animal farming (Pillay, 1990).

Before starting any activity all likely costs involved in that activity should be taken into consideration. With aquaculture it is important that important technical factors such as water availability throughout the year, quality of water, availability of raw material (fingerlings, feed, etc.) and size of likely market must be taken into consideration as well as the cost and supply of labour and the selling price of the final product.

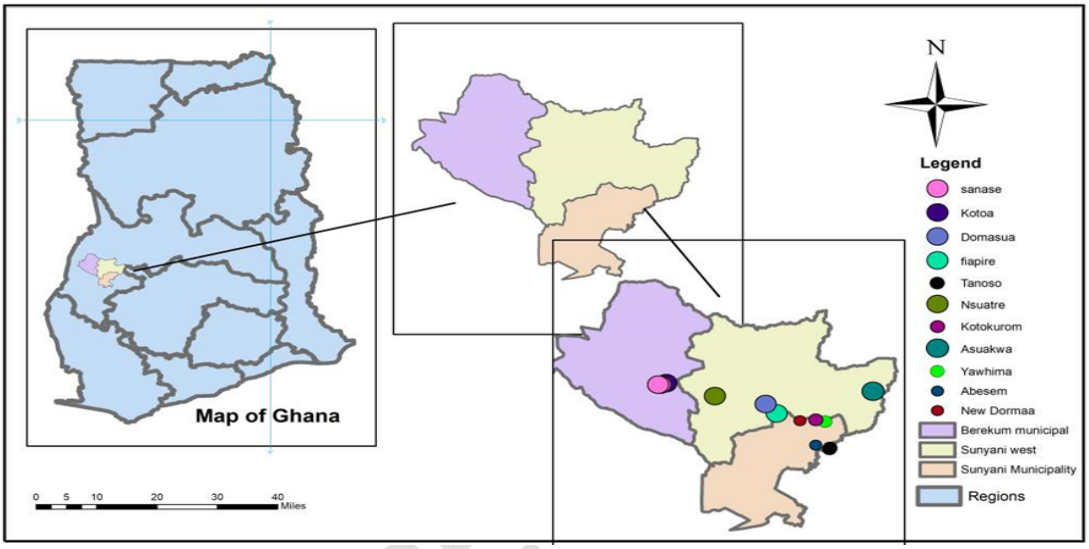
The purpose of every business venture is to generate profits. An enterprise budget is used to examine whether any business is profitable or not. If the total farm revenues from sales generated for the period are greater than the costs, it means profits are generated for that given period (Nandlal and Pickering 2004).

Further studies on aquaculture viability in Sunyani municipality are needed in order to improve the standard of living for people in the area and to help farmers in executing a successful trade. It is an expectation that development of a knowledge base to help the small-scale fish farmers to better understand their business in order to make a significant profit will take place in a short while. This research will contribute to literature and serve as a platform to build upon for future studies. It will also aid small scale fish farmers to know more about aquaculture to improve their economic standards.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

2.1 Study site:

Sunyani is a city in the West African republic of Ghana, and is the capital of the Brong-Ahafo Region. The Municipality covers a total area of 29.3 square kilometers. One third of the total land area is not inhabited or cultivated which provides arable lands for future investment. The Municipality as selected because it has majority of fish farms in the region. Nearly one-half of the region's annual aquaculture production in 2010 was from the Sunyani Municipality. The study area and farms visited are presented Figure 1 below.



2.2 Sampling:

Random sampling was adopted in this study. Simple random sampling technique was employed to select farmers for administering questionnaire. Farm list of the study site was obtained from the Fisheries Commission, and farms assigned with numbers from 1-40. Twenty farmers were interviewed. For profitability analysis 600 m2 pond was used as the basis for analysis because this is the average size used by most fish farmers in the municipality.

2.3 Data analysis:

Data collected was entered into Microsoft Excel (version 2016) and analysed using the descriptive statistic feature to generate tables. Economic analysis was done by using calculating Net Present Value, Internal Rate of Return, Present Value, Net Profit, and production cost, value of harvested stock and market price per unit weight in kilogram using Ms. Excel formulas. Results are presented in tables and bar charts. Gender distribution data was coded and entered, and the percentage of occurrence calculated and chatted with pie chat.

3. RESULTS AND DISCUSSION

3.1 Investment Cost

In the present case study, the building costs were divided into pond construction, fencing and house constructing. The total value of buildings in the present case study, including contingency, was estimated to be about GH¢ 6,902. Regarding equipment needed in the operation such as a pump, vehicle, containers, refrigerator, scales and others, the total value was calculated as GH¢ 4,817.19. The value for other investment costs incurred was about GH¢ 400. The total investment in the farm was GH¢ 12,119.19.

Investment Cost (GHS)						
Equipment	**Quantity**	**Cost**		**Building**		
Pump	1	900		**Item**	**Quantity**	**Cost**
Net	1	1200		Pond	1	1800
Container	2	400		Fence		0
Refrigerator	1	1900		House	1	5000
PVC pipes	4	50		Sub-total		6800
Wheel barrow	2	140		Contingency	1.50%	102
Hoes		0		**Total**	**6, 902**	
Cutlass	2	35				
Scale	2	75				
Test kit		0		Others	Quantity	Value
Shovel	2	46		land		400
Sub-total		**4, 746**		Water		0
Contingency	1.50%	71.19		Total	400	
Total	**4, 817.19**			**Total investment**	**12, 119.19**	

Table 1: Estimation of Investment cost

**Estimation of investment cost for a 600m^2 pond **

Investment cost, coupled with subsequent cash flows, is an essential element to determining the value of a project. This study modelled the establishment and operation of 600m2 fish pond using fish farmers' information as a base data. Investment cost in this study refers to the cost of building, equipment and other investments.

In the case study the total value of buildings in the present case study, including contingency, was estimated to be about GH¢ 6,902.00. Regarding equipment needed in the operation such as a pump, vehicle, containers, refrigerator, scales and others, the total value was calculated as GH¢ 4,817.19. The value for other investment costs obtained was GH¢ 400.00. The total investment in the farm was GH¢ 12,119.19. Out of the start-up cost more than half (56.1%) goes into the fixed cost which involves the cost of land, pond construction and buildings. This shows that high level of investment capital needed as start-up in an aquaculture business usually stems from the high level of the fixed costs. This is in line with Engle, (2010) findings where she found that, the high level of investment capital needed as start-up in an aquaculture business usually stems from the high level of the fixed investment costs.

The study shows that like many business investments, aquaculture is a highly capital-intensive business.

The aquaculture enterprise is capital intensive, characterized with high cost start-up and small-scale fish farmers may require access to funds (Adal 2008). Such huge investment cost affects small-scale aquaculture through perceivably low initial returns. This is inconsistent to the findings of Taabeah et al (2010) who investigated on the constraints of cage culture in Ghana, in which lack of access to funds had the highest mean rankings among the challenges presented. According Nunoo et al., 2012, small-scale fish farmers lack capital to expand and thus, their low investment costs have resulted in low profitability. Farm investment analysis, in contrast, is undertaken to determine the attractiveness of a proposed investment to farmers and to other participants, including the society as a whole.

3.2 Operating cost

Cost of Operation were classified as variable and fixed costs (Table 2). Variable costs include cost of fingerlings, feed, fertilizer, transportation, weeding, machine repairs, erosion checks, harvesting cost, and electricity. The fixed costs considered include the payment of salary, because employees are permanent in the farm.

Table 2: Estimation of Operating cost.

Cash out flows: cost of operating farm/cycle (GH¢)						
Variable items	Quantity	Cost		**Fixed items**	Quantity	Cost/cycle
Fingerlings	2400	480		Employee	1	600
Feed	24 bags	1632		Security	1	240
Transport		500		**Total**	**840**	
Weeding	1	40				
Erosion check	1	30				
Machine repair	1	25				
Electricity		50				
Harvesting cost	5	100				
Miscellaneous		10				
Total	**2, 867**			**Total out flow**	**3, 707**	

**Estimation of operatingt cost for a 600m^2 pond **

Operating cost refers to the cost incurred after farm establishment (equipment and building) for the production of farm produce. The operating cost is made of two cost components; variable cost and fixed cost. Yearly fixed cost component includes security and salary. The total value of fixed cost is estimated to be GH¢240.00 per production cycle. These components remain fixed throughout the production period. Variable cost components are composed of items which market prices can change during the production period. These include feed, fingerlings, weed control, repairs, harvesting costs, and erosion.

The variable costs constituted 55.2% compared to the total start-up cost and this is very close to the range of 33.5% to 55% obtained by Asmah (2008) for commercial operators in the country. This rate, compared to what was obtained by Asmah (2008), is also not surprising looking at the current steps taken to reduce the

operational costs in the form of availability of inputs such as fingerlings at reduced or subsidized cost. It is however very important to note that the variable costs can vary depending on the scale and the level of production that one wants to engage in. Feed is an essential commodity needed in aquaculture operations and the efficiency with which it is utilized for growth depends on its quality and its utilization. In Ghana good quality feed is a major constraint faced by many operators. Since the country has very few producers (example Rannan West Africa Company Limited), majority of the feed used in the country is imported from countries such as Brazil, Netherlands and Israel, resulting in the high cost of feed as seen in this study. Asiedu et al, (2017) shows the main reason for pond abandonment in the Sunyani Municipality is high cost of feed. This is also consistent to Rungwa et al (2015) and Hiheglo (2008) who suggested that high cost of commercial feed is a major constraint to aquaculture in Ghana. In order to obtain bigger sizes of fish, good quality feed with a high feed conversion ratio is needed. Good quality feed may cost more than what was assumed in this study. Increasing the cost of feed by 30% and above will lead to the enterprise making losses. According to Hiheglo (2010), availability quality and affordable fish feed will speed the development of the Ghanaian aquaculture sector.

3.3 Estimation of Profitability

3.3.1. Net Present Value (NPV) and Internal Rate of Return (IRR) –

In Table 3, the net Cash Flow (CF) at year 0 is negative with a negative PV. This because an initial investment (cash outflow) and a zero (0) production (no cash inflow). The PVs are positive for the net cash flows for year 1, 2, 3, 4, and 5. The NPV obtained at a DR of 15% capital is GH¢2, 724.518. This implies that the fish farming enterprise is highly profitable even at a Minimum Attractive Rate of Return (MARR).

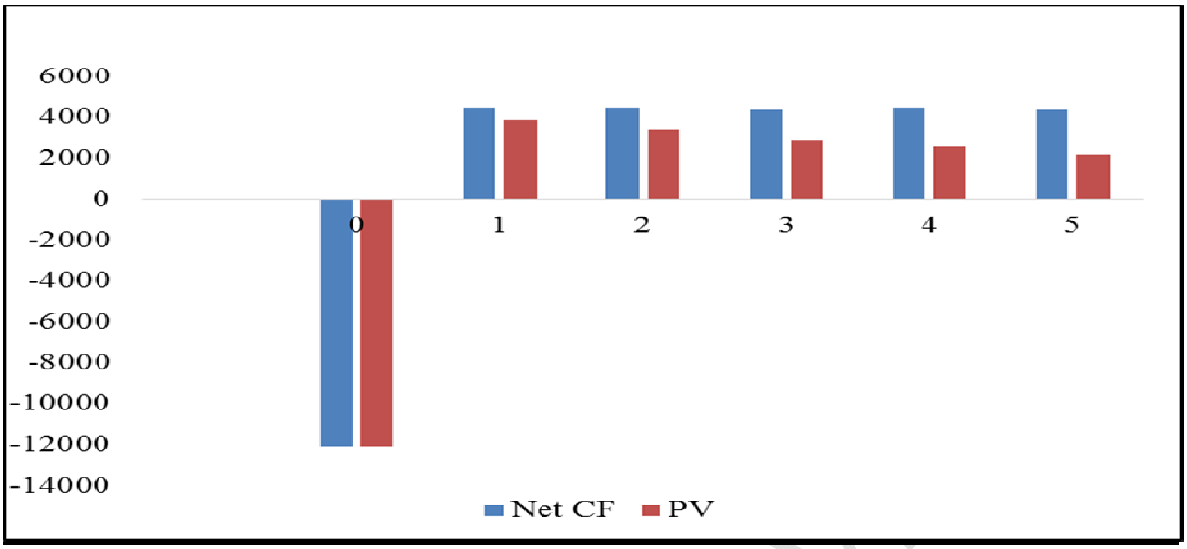
Table 3: computation of NPV and IRR

Year (t)	Net CF	PV	DR (K)	(1+K)^t	NPV
			15%*		$\sum_{t=0}^{n} \frac{CF_t}{(1+k)^t}$
0	-12119.19	-12119.19	DR= discounting rate.	1	**2,724.518**
1	4466	3883.4783		1.15	
2	4466	3376.9376		1.3225	
3	4356	2864.1407		1.520875	
4	4466	2553.449995		1.749006	
5	4356	2165.701859		2.011357	
Total	**9990.81**	**2, 724.52**			
IRR	**24.18503%**				

Note: 15* is the Minimum Attractive Rate of Return (MARR), interest rate with minimum profit to the investor.

3.3.2. Net Cash Flow and Present Value: The results from Figure 2 below indicate a negative net cash flow and present value at year zero (0). This is attributable to the initial investment and in part, a zero production in the setup year (0). Observably, both the net cash flow and present value are both positive in the subsequent years. The net cash flows comparable appear stable whilst present value decline along the years as indicated in Figure 2.

Figure 2: A graph of Net CF and Net PV



Increasing profitability is one of the most important drivers of business managers who continually look for ways to change the business to attain this objective (Engle and Neira 2005). Profitability is the primary goal of all business ventures. Without profit, the business will not survive in the long-run. So, measuring current and past profitability and projecting future profitability is very important (Hofstrand 2006). The profitability was developed based on the results of the 600 m2 pond production model. Performance indicators used to assess profitability include gross revenue, net revenue, total investment, average price, net cash flows, net present value, and internal rate of returns

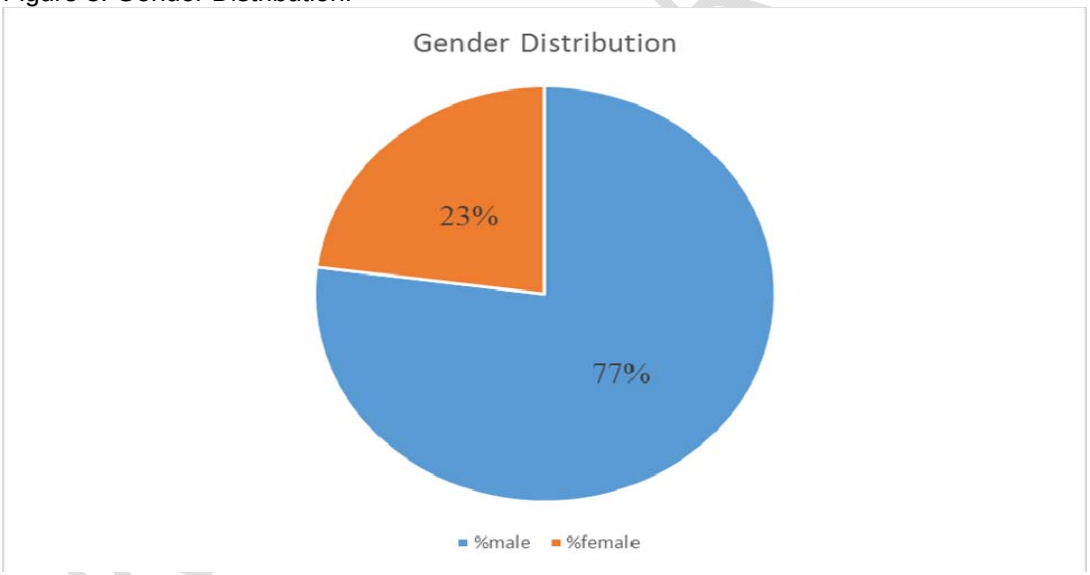
The study found that, investing in aquaculture business in Ghana is a profitable venture and feasible. The NPV was determined using the minimum rate of return (MARR) as a discount rate (DR). Net Present Value (NPV) is a financial function that is calculated for an investment, and it represents the present value of an investment minus the amount of money it cost to buy-in. NPV realistically predicts future cash flows by discounting future cash flows using the projects appropriate discount rate (DR), called opportunity cost. Simply put, NPV is equal to “Present Value (PV) of cash inflows” minus “Present Value of cash outflows”. It can be seen in Table 3, the net Cash Flow (CF) at year 0 is negative with a negative PV. This because an initial investment (cash outflow) and a zero (0) production (no cash inflow). The PVs are positive for the net cash flows for year 1, 2, 3, 4, and 5. The NPV obtained at a DR of 15% capital is GH¢2, 724.518. This implies that the fish farming enterprise is highly profitable even at a Minimum Attractive Rate of Return (MARR). The calculated NPV and IRR values are much higher than zero which indicates that the investment is potentially highly profitable, that is given that the assumptions which the estimates were based on are fairly accurate. The payback period of 5 years obtained in this study is within the10-year period considered for this operation as well as four to five years recommended by Engle (2010) for commercial operations in aquaculture to payback after investment. This is however not surprising looking at the short production cycle (7 month) for tilapia as compared to other species such as salmon culture with production cycle of more than a year (Bjorndal, 1990). Most investors find projects with short payback periods more economically attractive, especially in markets that are lacking in credit facilities. An aquaculture business which takes 10 or more years to payback the cost of investment is considered to be unprofitable (Atrill, 2003). Hence this could serve as an encouragement to investors who normally would prefer a short-term investment as a measure of reducing risk. Risk is time related in the sense that the longer it takes for an investment to recoup its cost of investment, the greater the risk of failure.

Profitability is largely affected by the price at which the fish is sold. The government's policy to ban imports of farmed fish aims at enabling local fish farmers to get better prices and increase their profit margin at the cost of the domestic consumers and foreign producers. Price however is also strongly dependent on the size of fish. This is where good fish production technology is essential. Asmah (2008) goes so far as to imply that the ability of a Ghanaian producer to produce bigger sizes of fish allows him to set the price of his production as opposed the price-taking behavior of those who can only produce smaller sizes of fish. Thus, to be able to produce bigger sizes of fish is an advantage for the producer.

3.5 Gender

Gender distribution in the fish farming enterprise indicates the level of engagement of women and men. Women have played and still playing essential roles in the development of the fish farming subsector. On the other hand, aquaculture presents a development strategy for poor and busy women to combine household chores with farm operations. This present study reveals a huge gap in man-woman distribution in the fish farming trade. It is evident that males dominate the fish farming business in Ghana. With the male having a percentage of 77 against the female with 23%. Majority of the farms surveyed did not females as shown in Figure 3.

Figure 3: Gender Distribution.



Gender distribution in the fish farming enterprise indicates the level of engagement of women and men. Enabling women to fully engage in and benefit from aquaculture and fisheries can boost production reduce poverty and enhance nutrition security for millions of fish-dependent households Women have played and still playing essential roles in the development of the fish farming subsector. This present study reveals a huge gap in man-woman distribution in the fish farming trade. It is evident that males dominate the fish farming business in Ghana.

The findings in this study in in agreement with research works conducted. Aquaculture is therefore principally male-oriented particularly in relation to pond preparation, input procurement (fingerlings, fertilizer and feeds) and application of fertilizer and harvesting Nunoo and Eunice, (2012). Asmah (2008) attributed the low number of female ownership of

farms to the fact that traditionally men are deemed to be the heads 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. Also, the involvement of women in subsistence fish farming activities also remains relatively unchanged and limited to feeding, processing of harvested fish and marketing.

Upcoming evidence reveals that gender equality will play a key role in these sectors' important contributions to achieving the Sustainable Development Goals (SDGs) on poverty reduction and food and nutrition security. In particular, gender equality in fisheries and aquaculture can bring many potential benefits including higher fish productivity and household incomes, as well as positive nutritional outcomes (WorldFish).

To summarize, the discussion above demonstrates that aquaculture in Ghana has a great potential to be highly profitable at the commercial level, depending on the scale of production as well as the size of the fish and the price at which the producer is able to sell the fish at the farm gate. Increasing the scale of production could mean moving from producing on a subsistence basis to a commercial basis by increasing the factors of production such as feed, fingerlings, labour, etc. By increasing the factors of production, the producer however will incur more costs, in absolute terms, than otherwise. If the production exhibits positive returns to scale, the average cost per production unit will however be lower than before. Finally, fish farming in Ghana is male dominated and need more female participation.

dominated and need more female participation.

4. CONCLUSION

In Ghana, aquaculture is a highly profitable venture, depending on the scale of production as well as the size of the fish and the price at which the producer is able to sell the fish at the farm gate. In Ghana, aquaculture is a viable industry with high investment gains. Increasing the scale of production will involve from producing on a subsistence basis to a commercial basis by increasing the factors of production such as feed, fingerlings, labor, etc. The payback period for fish farming is 5 years. Finally, fishing in Ghana is male dominated and with less female participation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Amisah, S. and Quagrainie, K.K. (2007). Opportunities and challenges for sustainable tilapia production and commercialization in Ghana. Paper presented at the World Aquaculture Conference, San Antonio, USA, Feb. 23-28

Asiedu, B., Pierre, F. and Yolaine, B. (2015). Enhancing aquaculture development: Mapping the tilapia aquaculture value chain in Ghana. Reviews in Aquaculture, 7, 1–9.

Asiedu, B., Asase, A., Iddrisu, S., and Ayisi, L. C. (2016). Management, challenges and developments of aquaculture in Ghana, West Africa (pp. 1–28). New York, NY: Nova Science. ISBN: 978-1-63485-563-1.

316 Asiedu, B., Nunoo F.K.E. and Iddrisu, S. (2017). Prospects and sustainability of aquaculture
317 development in Ghana, West Africa. Cogent Food & Agriculture, 3: 1349531.

318 Asmah R. (2008). Development potential and financial viability of fish farming in Ghana.
319 Institute of Aquaculture, University of Sterling.Bjorndal T. 1990. The Economics of Salmon
320 Aquaculture. Blackwell Publications. Oxford, UK.

321 Atrill, P. (2003) Financial Management for Non Specialist. 3rd edition, pp.478. London,
322 Pearson. Education Limited. (Electronic version)

323 Baras E and Jobling M. (2002). "Dynamics of intracohort cannibalism in cultured fish".
324 Aquaculture Research. 33 (7): 461–479.

325 Bryman, A., and Bell, E. (2003). Business research methods: Oxford university press

326 Collaborative Research Support Program. (2006). (edited. by K. Kosciuch and H. Egna), pp.
327 73–87. Oregon State University, Corvallis, OR, USA.

328 Costa-Pierce, B.A., (2002) Ecological Aquaculture, Blackwell Science, Oxford, UK.

329 Dada, B. F. (2004).Fisheries development in Nigeria. The challenges and prospect of
330 assessing fund. The chairman address deminered by Otunbe Bamidele Dada OON at the
331 public lecture organized by FISON in Lagos.

332 Davies, H.S. (1956). Culture and Diseases of Game fishes. University of California Press,
333 Berkeley Directorate of Fisheries (DOF). (2007). Report on pond and reservoir survey in
334 Ghana. Ministry of Fisheries, Ghana.

335 Directorate of Fisheries (DOF). (2008). Annual Report for the Ministry of Fisheries. Ministry
336 of Food and Agriculture, Ghana.

337 Earthtrends (2003). Capture and Aquaculture Production Totals for Marine and Inland
338 Fisheries.

339 Engle, Carole R. and Diego Valderrama. (2001). Economics and management of shrimp
340 farms training manual. In: M.C. Haws and C.E. Boyd (eds). Methods for Improving Shrimp
341 Culture in Central America. Managua, Nicaragua: Editorial-imprenta, Universidad
342 Centroamericana. pp. 231–261.

343 Engle R. C. (2010). Aquaculture Economics and Financing: Management and Analysis.
344 Blackwell Publications. Iowa, USA. (Electronic version)

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

348 E. Rurangwa, S.K. Agyakwah, H. Boon & B.C. Bolman, (2015). Development of Aquaculture
349 in Ghana: Analysis of the fish value chain and potential business cases. IMARES report
350 C021/15

351

FAO. (2005). Aquaculture production, 2004. Year book of Fishery Statistics-Vol.96/2. Food and Agriculture organization of the United Nations, Rome, Italy.

Food and Agriculture Organization (FAO). (2006). The State of World Fisheries and Aquaculture 2006. Food and Agriculture Organization, Rome.

FAO. (2009, History of Aquaculture". United Nations. Retrieved August 23, 2009.

FAO. (2010). Fisheries and Aquaculture Technical Paper N° 580. Rome, Italy: Food and Agriculture Organization of the United Nations. 204 p

FAO, (2012). The state of world fisheries and aquaculture (SOFIA). Rome, Italy: Food and Agriculture Organization of the United Nations. 230 p.

Wikipedia International Incorporated. (2018). Fish farming. In: Wikipedia, the free encyclopedia. [Online] Available at: https://en.wikipedia.org/wiki/Fish_farming (Accessed: 18/06/18).

FAO. (2015), the International Fund for Agricultural Development (IFAD). http://www.fao.org/ghana/news/detail-events/en/c/281948/ (Accessed: 18/06/18)

Fisheries Commission. (2012). Ghana national aquaculture development plan (GNADP), 2012–2016. Accra. (p. 78).

Freeman, P. H. (1974). Environmental aspects of a large tropical reservoir: A case study of the Volta Lake, Ghana (p. 340). Washington, DC: Office of Science and Technology Agency for International Development.

Ghana Investment Promotion Centre (GIPC). (2009). Ghana fish farming: Aquaculture property, blogs, farming. www.farming uk.com/news/Ghana-fish-farming. 14902.

Harrison E. (2001). Gender; rights and poverty issues: Lessons for the sector. Background paper for DFID/FGRP-3/ARP Workshop on practical strategies for poverty targeted research; 7–11 November. Overseas Development Institute. 23 p.

Hastings, W.H. and Dickie L.M. (1972). Feed formulation and evaluation. In: Fish nutrition. Ed. J.E. Halver. Academic Press, New York. pp. 327-74.

Hiheglo, P.K. (2008). Prospects, challenges, antidotes and future prospects of aquaculture in Ghana. Department of Social Science and Marketing Studies, Norwegian College of Fishery Science, University of Tromso, Norway. (November 2010). www.ub.uit.no/munin/bitstream/10037/1431/3/thesis.pdf.

Hofstrand D. (2006) Understanding profitability. Available at: http://www.extension.iastate.edu/agdm/wholefarm/html/c3-24.html (accessed February 2018).

Holme, I. M. and Solvang, B.K. (1997). Research methodology - About qualitative and quantitative methods.Lund: Student literature.

Jhingran, V.G.,(1987) Introduction to aquaculture. United Nations Development Programme, Food and Agriculture Organization of the United Nations, Nigerian Institute for Oceanography and Marine Research.

Kleiber D., Harris L.M. and Vincent A.C.J. (2014). Gender and small-scale fisheries: A case study for counting women and beyond. Fish and Fisheries Vol. 15 Issue 3. doi: 10.1111/faf.12075.

Kronen M. (2012). Social and economic dimensions of carrageenan seaweed farming in Solomon Islands. p. 147–162. In: D. Valderrama,J. Cai, N. Hishamunda and N. Ridler (eds). Social and economic dimensions of carrageenan seaweed farming. Kurlansky (1999). "The form and context of aggressive behaviour in farmed Atlantic halibut (Hippoglossus hippoglossus L.)". Aquaculture. 193 (1–2): 139–147

Ling S.W. (1977). Aquaculture in south East Asia. A Historical Review. University of Washington press, Seattle.

Machena, C. and Moehl, J. (2001). African Aquaculture: A Regional Summary with Emphasis on Sub-Saharan Africa African Aquaculture: A Regional Summary with Emphasis on Sub.[March, 2009].

Manheim and Rich (2011).. Empirical Political Analysis 8th edition. Boston, MA: Longman p. 105

McCann, Anna Marguerite (1979). "The Harbor and Fishery Remains at Cosa, Italy, by Anna Marguerite McCann". Journal of Field Archaeology. 6 (4): 391–411.

Miles M, Huberman A. (1984) Drawing valid meaning from qualitative data: Toward a shared craft. Educational Researcher. 1984; 13:20–30.

Ministry of Food and Agriculture (MoFA) (2010). The fisheries subsector (BA) - Sunyani Municipality. Ministry of Food and Agriculture-Accra, Ghana.

Nandlal, S. and Pickering, T. (2004) Tilapia fish farming in Pacific Island countries. Volume 2. Tilapia grow -out in ponds. Noumea, New Caledonia: Secretariat of the Pacific Community 13 Uganda Ministry of Agriculture, Animal Industry and Fisheries. (2005). Aquaculture Technical manual, Volume 1

Nunoo et al (2012) Economics of aquaculture production: a case study of pond and pen culture in southern Ghana. Aquaculture Research, Volume 1 p 1–14

Ofori J.K. (2000). Status and trends in integrated agriculture-aquaculture in Ghana. In: E.K. Abban, C.M.V. Casal, T.M. Falk and R.S.V. Pullin (eds). Biodiversity and sustainable use of fish in the coastal zone. ICLARM Conf. Proc. 63, p 36- 37; 71 pp.

Phillips, M.J., Boyd, C. and Edwards, P. (2001). Systems approach to aquaculture management. In R.P. Subasinghe, P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery & J.R. Arthur, (eds). Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20-25 February 2000. pp. 239-247. NACA, Bangkok and FAO, Rome.

Pillay, T.V.R., (1990) Basic of Aquaculture, and History of Aquaculture and its Present State. In: Aquaculture Principles and Practice. Fishing News Books. pp. 4, 5, 7, 9, 39-43.

Pullin, R.S.V. and Prein M. (1994). Fishponds facilitate natural resources management on small-scale farms in tropical developing countries. In: J.J. Symoens & J.C. Micha (Eds). Proceedings of 16-19 May 1994. TCA and CTA. Brussels. pp. 169-186 (1995).

Punch, F. K. (2005) Introduction to Social Research: Quantitative and Qualitative Approaches (Second Edition) London: Sage Publication.

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.

Saunders, M., Lewis, P., and Thornhill, A. (2009). Research Methods for Business Students. (Pearson Education Limited, Ed.) (5th ed.). Essex, England.

United Nations Educational, Scientific and Cultural Organization UNESCO. (2015)"Fishpond Network in the Trebon Basin". Retrieved 1 Oct 2015.

Weeratunge N. and Snyder K. (2009). Gleaner, fisher, trader, processor: Understanding gendered employment in the fisheries and aquaculture sector. Paper presented at Workshop on gaps, trends and current research in gender dimensions of agricultural and rural employment: differentiated pathways out of poverty, Rome, 31 March – 2 April 2009.

WorldFish. (2010). Gender in fisheries: Do women support, complement or subsidize men's small-scale fishing activities?

Yin, R. K. (2009). Case Study Research: Design and Methods. (L. Bickman & D. J. Rog, Eds.)Essential guide to qualitative methods in organizational research (Vol. 5). Sage Publications. http://doi.org/10.1097/FCH.0b013e31822dda9eNote: Authors are also encouraged to add other database's unique identifier (like PUBMED ID).

For Articles not in English

Forneau E, Bovet D. Recherches sur l'action sympathicolytique d'un nouveau dérivé du dioxane. Arch Int Pharmacodyn. 1933;46:178-91. French.

Reference to a book:

Personal author(s)

Rang HP, Dale MM, Ritter JM, Moore PK. Pharmacology. 5th ed. Edinburgh: Churchill Livingstone; 2003.

Editor(s) or compiler(s) as authors

Beers MH, Porter RS, Jones TV, Kaplan JL, Berkwits M, editors. The Merck manual of diagnosis and therapy. 18th ed. Whitehouse Station (NJ): Merck Research Laboratories; 2006.

Authored chapter in edited publication

Glennon RA, Dukat M. Serotonin receptors and drugs affecting serotonergic neurotransmission. In: Williams DA, Lemke TL, editors. Foye's principles of medicinal chemistry. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2002.

Reference to Web-resource or Electronic articles.

Hugo JT, Mondal SC. Parallels between tissue repair and embryo morphogenesis: a conceptual framework. Global Health. 2006;16:4. Accessed 29 March 2012. Available: http://www.globalizationandhealth.com/content/1/1/14.

Anonymous. Parallels between tissue repair and embryo morphogenesis: a conceptual framework. Global Health. 2006;16:4. Accessed 29 March 2012. Available: http://www.globalizationandhealth.com/content/1/1/14.

Reference to Organization as author

Diabetes Prevention Program Research Group. A study of digit fusion in the mouse embryo. J Embryol Exp Morphol. 2009;49(2):259–276.

DEFINITIONS, ACRONYMS, ABBREVIATIONS

NPV : Net Present Value

IRR: Internal Rate of Returns

APPENDIX

APPENDIX

UNIVERSITY OF ENERGY AND NATURAL RESOURCES, SUNYANI

DEPARTMENT OF FISHERIES AND WATER RESOURCES.

Dear respondent this questionnaire is designed to be used for academic research on the **"THE ECONOMIC ANALYSIS OF SMALL-SCALE AQUACULTURE ENTERPERISE IN SUNYANI MUNICIPALITY"** The

respondent is assured that all information provided was treated as confidential.

Part I: Personal Characteristics of Respondents

1. Sex: Male [ ] Female [ ]

2. Age:

3. Number of years of doing aquaculture business ?

1 year and less [ ] 2 – 4 years [ ] 5 - 7 years [ ] Above 7 years [ ]

4. Highest academic achievements

Primary [ ] Secondary [ ] 1st Degree [ ] Master's Degree [ ] other (specify)

5. Primary Occupation:……,

Sec. Occupation:……

Part II : Estimation of Investment cost

<u>Equipment</u>

ITEM	**QUANTITY**	**COST GH¢)**
Pump		
Net		
Vehicle		
Container		
Refrigerator		
PVC Pipes		
Wheel barrow		

Hoes		
Cutlass		
Scale		
Test kit		
Shovel		
Sub total		
Contingency		
TOTAL COST		

520

521 **Building**

ITEM	**QUANTITY**	**COST(GH¢)**
Pond		
Fence		
House		
Sub total		
Contingency		
TOTAL COST		

522

Other Investments

ITEM	QUANTITY	COST (GH¢)

Part II : Cash Flow

CASH RECEIVED FROM FARM OPERATIONS

FISH SOLD (Kg) per cycle	VALUE (GH¢)

1. Do you receive income from other farm activities? YES/NO
2. If yes how much? GH¢

CASH PAID FOR FARM OPERATING EXPENSES PER CYCLE

ITEM	QUANTITY	AMOUNT (GH¢)
Fingerlings		
Feed		
Water quality & availability		
Cost of fuel &		

transportation		
Labour		
Repair and maintenance		
Management		
Miscellaneous		

Cash Received From Sales

ITEM	QUANTITY	AMOUNT (GH¢)
Brood stock		
Fingerlings		
Equipment		
Real estate		

CASH FLOW FROM FINANCIAL ACTIVITIES

Operating Loan Received

1. Did you receive any loan for the business? YES/NO
2. If yes, how much? GH¢…….
3. How much of the Loan have you paid? GH¢…….
4. Source of Loan? ……
5. Where you able to pay all operational cost? YES/ NO
6. If no how much did you pay? GH¢……..

Cash Received From Non Farm Activities

1. Did you receive any non farm income for the business? YES/NO
2. If yes, how much? GH¢…….
3. Did you pay for any non farm expenses? YES/ NO
4. If yes, how much?GH¢…….
5. Did you make any withdrawals for family and living activities? YES/NO
6. If yes, how much? GH¢……..

Part II: <u>Gender</u>

1. How many employees do you have? …….
2. Are there males? YES / NO
3. If yes how many males?.....
4. Which activity are the males mostly associated with?

   …….
5. Are there females ? YES/NO
6. If yes how many females?.....
7. Which activity are the females mostly associated with?

   …….
8. Are range of employees.