



International Journal of Fisheries and Aquatic Studies

ISSN: 2347-5129

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.352

IJFAS 2016; 4(4): 24-30

© 2016 IJFAS

www.fisheriesjournal.com

Received: 06-05-2016

Accepted: 07-06-2016

Christian Larbi Ayisi

College of Fisheries and Life
Sciences, Shanghai Ocean
University, Shanghai 201306,
PR China.

Elliot Haruna Alhassan

Department of Fisheries and
Aquatic Resources Management,
University for Development
Studies, P. O. Box TL 1882,
Tamale, Ghana.

Doreas Addo

College of Public Administration,
Department of Sociology, Hohai
University, Nanjing, PR China

Benjamin Osae Agyei

Department of Horticulture,
North East Agricultural
University, Harbin 150030, PR
China.

Andrews Apraku

College of Fisheries and Life
Sciences, Shanghai Ocean
University, Shanghai 201306,
PR China.

Correspondence

Christian Larbi Ayisi

College of Fisheries and Life
Sciences, Shanghai Ocean
University, Shanghai 201306,
PR China.

Aquaculture extension services: A case study of fish farms in the eastern region of Ghana

Christian Larbi Ayisi, Elliot Haruna Alhassan, Doreas Addo, Benjamin Osae Agyei and Andrews Apraku

Abstract

Extension services plays an important role in the development of aquaculture. Present study assessed the status of aquaculture extension services in the Eastern Region of Ghana. The study examined the socio-economic characteristics of fish farmers (specifically managers and owners of fish farms), the respondent's assessment of extension services available to them and their general expectation from extension workers.

Fifty farms were selected for this study, with either the farm owner or manager being the respondent. The findings of the study indicate that a large number of the respondents (48%) find the extension services unavailable. The farmers prioritize feed preparation and production as their top most need. The study concludes that although the extension service is not available to a large number of farmers (48%), the socio-economic characteristics of farmers indicates that new technologies are likely to be accepted at a higher rate by the farmers. The best of extension services could be achieved through public-private partnership as the aquaculture farmers seems to have great appetite and trust in them.

Keywords: Extension services; Eastern Region; Socio-Economics; Status; Ghana.

1. Introduction

Aquaculture is the beneficial and sustainable use of water as a medium to farm organisms, such as finfish, shellfish and aquatic plants ^[1,2] and serve as a means of efficiently increasing food production in food-deficit countries ^[2,3] and improving livelihood and poverty status among farming households ^[2]. It also serves as a weapon to fight malnutrition ^[4]. Aquaculture contribute close to half of total world fisheries output in 2011 ^[5] and is widely heralded as the world's fastest growing food production sector ^[6].

Fish production contributes substantially to Ghana's economy through employment, Gross Domestic Product (GDP), foreign exchange earnings, food security and poverty reduction. The fishery sector contributes between 3% and 4.5% of the national Gross Domestic Product and generates US\$ 80 billion through export income annually ^[7].

The contribution of aquaculture to the Ghanaian economy has not been disaggregated from the overall contribution of fisheries, so its importance is not fully recognized ^[8]. In recent years production from aquaculture appears to be growing at a near exponential rate. The total production has increased from 950 tonnes in 2003 to 3,257 tonnes in 2007; 5600 tonnes in 2008, 7203 tonnes in 2009, 10200 tonnes in 2010 and 19,092 tonnes in 2011 ^[9]. It has been estimated that the production from ponds and culture-based fisheries is worth about US\$ 1.5 million per annum ^[8].

Fish contributes over 60% of the Ghanaian protein intake ^[10]. In Ghana, demand for fish as a source of food, nutrition, raw material for the poultry industry and income, among others, far exceeds supply ^[11]. It is estimated that fish provides about 19% of the protein intake in developing countries ^[12] hence the need to boost aquaculture production.

Ghana is one of the countries in the sub-Saharan Africa region with the potential to dramatically increase its fish production through aquaculture ^[13]. This is the result of a high fish demand, and the combination of a stable political environment and its commissioning of the only commercial fish feed mill in West Africa ^[14,15].

Extension services or agents contribute to food security by taking farmers through learning experience to overcome production problems, act on relevant information in order to attain a high level of satisfaction.

By this extension agents actually influence the innovation and decision making process in a direction deemed desirable to enhance farmers' economic and social status^[16]. Agricultural extension has long been seen as a key element for enabling farmers to obtain information and technologies that can improve their livelihoods^[17] and is recognised as an important factor in promoting agricultural development^[18,19]. Hence, from a development policy perspective, investments in extension services are considered as potentially important tools for improving agricultural productivity and increasing farmers' income^[20]. Extension service promulgates development because it provides opportunities for agricultural professionals to make expert contribution in identifying, adopting and sharing technology in a way suited to diverse ecological and socioeconomic conditions^[21]. Agricultural technologies and techniques are constantly changing and farmers need to be made aware of the inherent yield potentials^[22]. Access to adequate, accuracy, timeliness and relevant information is very essential to increase agricultural productivity^[23-25].

The purpose of this study was to assess the current state of extension services rendered to fish farmers and analyze the farmers demand for extension services in the Eastern Region of Ghana. This will provide indications to initiate attempts to streamline aquaculture extension departments for an effective extension service.

2. Methodology

2.1 Study area

The study was conducted in the eastern region of Ghana (Figure 1) that occupies 19,323 kilometers (Km) and constitutes 8.1% of the total land area of Ghana. It is the sixth largest region in terms of land area. It lies between latitudes 6° and 7°North and between longitudes 1°30' West and 0° 30'

East. The region shares common boundaries with the Greater Accra, Central, Ashanti, Brong-Ahafo and Volta Regions^[26]. Nine (9) towns where fish farming are dominant were used for this study (Table 1).

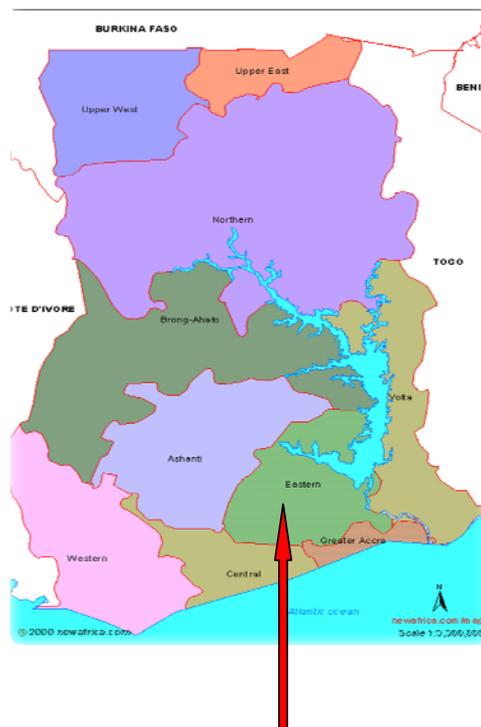


Fig 1: Map of Ghana showing Eastern Region

Table 1: List of farms used for study

S/N	Town	Farms	Total number
1	Atimpoku	Desmond's Fish Farm, Dey Farms, Safohene Fish Ltd, Shehu Fish Farm, Siphons Farm, Issah Yirekyi Fish Farm, Gabriel Fish Farm, Kobby Farms, Leticia Otubea's Fish Farm, K.C.Y.O. niloticus	10
2	Akwamufie	Cee & Max Farms, Danas Fish Farm, His Grace Farms, Nii & Francis Fish Farm, Volta Rapid Tilapia Ltd	5
3	Adome	Christian Martey farm, Adome Biakoye Farm, F. A. F. F (NGO), Opoku's Fish Farm, Natgold Fish Farm, Paradise Ventures, From Grace to Glory	7
4	Senchi (including south)	Amebor Farms and Works, Ansong's Farm, Ayensu Farms, Chally Tilapia Farms, C & J, S/Hoint Ltd., South Senchi Fish Farmers Assoc., Dakey Farm, Gadason Fish Farm, Blue Leaf Farm	10
5	Akrade (Old and New)	First Fresh Water, Godson Fish Farm, Jassa Farms, Mahara Fish Farms, Data stream Farms, Paniel Farms	6
6	Small London	Elorm Fish Farm, Dawufre Fish Farm, Appiah Farm	3
7	Adjena	Sun Woo Culturing System, Lee's Farm, Tilafish Ltd.	3
8	Dodi	Crystal Lake Fish Ltd, Reeba Farms, Triton Aquaculture Africa Ltd, Nahim Farms	4
9	Abotia	Aqua Consult Farms, Dieu D'Abord	2

2.2 Data Collection

Primary data were generated through the use of semi-structured questionnaires administered to the farm managers and owners. Secondary data were obtained from ministry of fisheries and aquaculture development, Accra, Ghana. In total 50 fish farms/farmers were used for this study.

2.3 Data analysis

All analysis was performed using Microsoft Excel (2010) and results presented in the form of tables and figures.

Table 2: Employment capacity of selected farms in the Eastern Region of Ghana

Employment capacity	Frequency	Percentage (%)
1-5	26	52
6-10	8	16
11-15	5	10
16-20	4	8
21-25	1	2
26+	6	12
Total	50	100

3. Results

3.1 Summary of socio-economic characteristics of farmers

The socio-economic characteristics of the respondents (farm managers and farm owners) are presented in figures 2, 3, 4 and 5 based on the frequency analysis.

As shown in figure 2, 40% of the respondents fall within the age class of 30-35, with 36% being in the class of 36 or more years. Those within the age group of 18-23 and 24-29 accounted for 4% and 20% respectively.

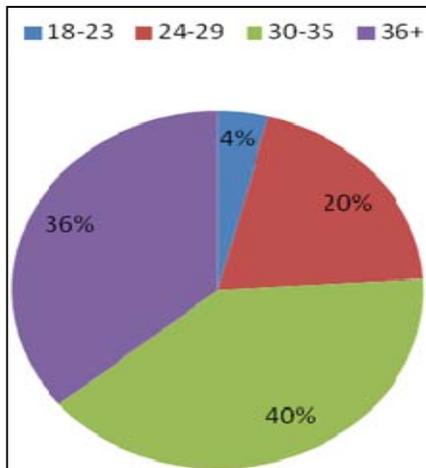


Fig 2: Age of respondents (Source: Field survey, August, 2015)

The study showed that 8% of the respondents had no formal education. 30% of the respondents, being it managers or farm owners had education up to the tertiary level. Those who have education up to the primary level accounted for 10% with 28% being Junior High School (J.H.S) graduates and 24% having education up to the Senior High School (S.H.S level) (Figure 3).

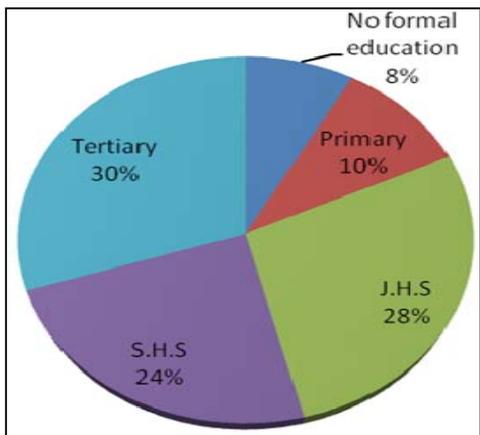


Fig 3: Educational level of respondents (Source: Field survey, August, 2015)

The study revealed that 30% of the respondents had their farms existing for three (3) years, whiles 26%, 14%, 12%, 10% and 8% had their farms existing for 5 years, 2years, 1 year, 4 years and 6 or more years respectively (figure 4).

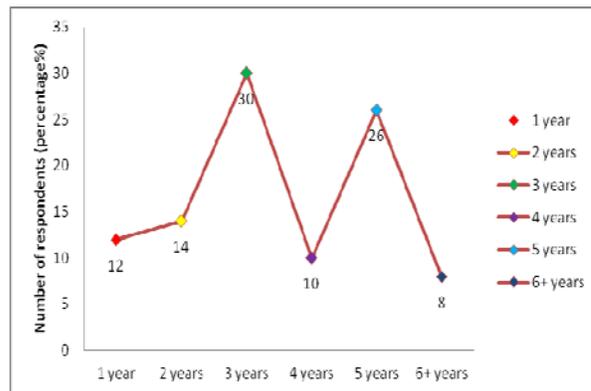


Fig 4: Years of Existence of Farms (Source: Field survey, August, 2015)

90% out of the total respondents were males and were either owner or managers of the farms visited whiles 10% were females.

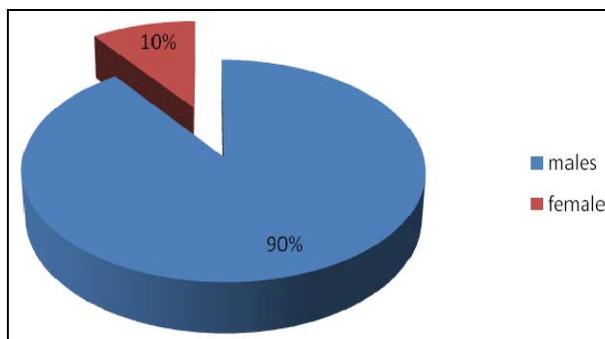


Fig 5: Gender of respondents (Source: Field survey, August, 2015)

3.2 Employment capacity of farms in study area

Table 2 shows that 52% of the farms in the eastern region employ 1-5 workers with 16% having employment capacity of 6-10 workers. Also those who are able to employ 10-15, 16-20, 21-25 and 26+ workers accounts for 10%, 8%, 2% and 12% respectively.

3.3 Extension Workers and Extension Service Delivery

The dynamics of extension workers to farms are presented in table 3. The total number of extension workers stationed in the eastern region of Ghana at the time of this study (August, 2015) stood at 12. The extension worker to farm ratio was also 1:17. The minimum qualification to be extension service personnel has been pegged at Agric college certificate. The extension service workers are supposed to visit the farms at least each month (Table 3).

52% of the respondents indicated that they have had extension workers visiting their farms while the remaining 48% have no extension workers visiting their farms (figure 6). 65% of those who have extension workers visiting them indicated that their farms are visited on monthly basis; whiles 31% and 4% are visited by the extension worker on quarterly and yearly respectively. None are visited on weekly basis.

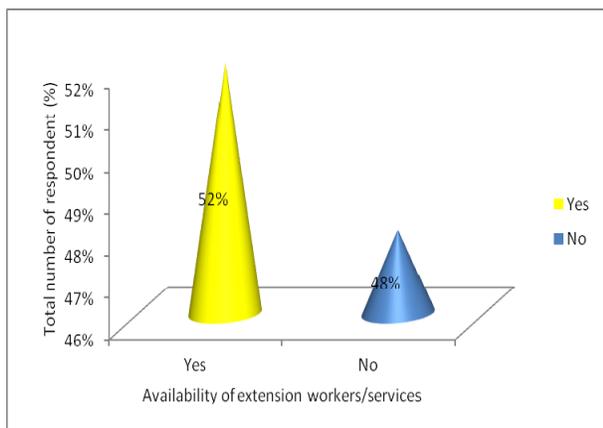


Fig 6: Source: Field survey, August, 2015

Table 3: Dynamics of extension workers to farms

Parameter	Frequency
Aquaculture farms in study Area	204
Total number of Extension Officers in Study Area	12
Extension worker to farm ratio	1:17

Source: Ministry of Fisheries and Aquaculture Development, August, 2015

3.4 General Extension Service Ratings

Whereas 23% of the respondents rated extension services provided to them as excellent, 31% rated the services as good. The services provided were on the other hand rated to be good, fair and poor by 19%, 15% and 12% of the respondents respectively.

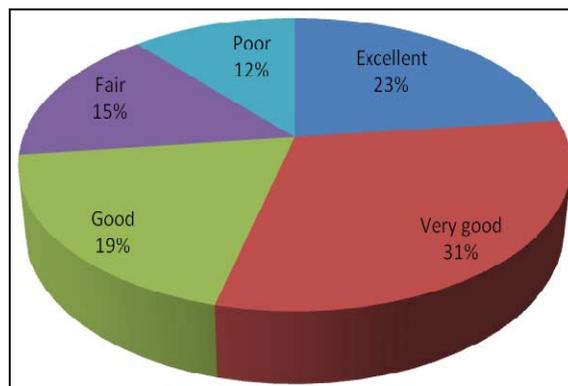


Fig 7: Ratings of extension service delivery by respondents

3.5 Acceptability of privately trained Extension Officers

The readiness of respondents to accept or reject extension services provided by private organizations is shown in Table 4. Forty seven (47) of the respondents representing 94% indicated their willingness to accept extension services from private organizations or people whiles 3 of the respondents representing 6% indicated their unwillingness to accept services from private organizations or people.

3.6 Expectation from farmers

The farmers indicated that they expect extension worker to help them in areas such as; water quality assessment and management, feed preparation and production, use of inputs, identification of diseases and control as well as reminding them of permit renewal. Out of these needs, the respondents prioritized feed preparation, seed/fingerling production and water quality management as the three most pressing needs (Table 5).

Table 4: Acceptability of privately trained Extension Officers by Respondents

Parameter	Frequency	Percentage (%)
Yes	47	94
No	3	6
Total	50	100

Table 5: Ranking information/services expected from extension service providers

S/n	Information required	Frequency	Percentage	Cum percentage	Rank
1	Feed preparation/production	20	40.00	40.00	1
2	Seed/fingerlings production	16	32.00	72.00	2
3	Water quality management	7	14.00	86.00	3
4	Disease identification and control	5	10.00	96.00	4
5	Fish processing, packaging and marketing	2	4.00	100.00	5
	Total	50		100	

The ranking of the services required by the fifty respondents is presented in Table 5. From the table, the most pressing service required by the farmers is about how to produce farm based feed. 40% of the respondents indicated feed preparation and production as their most important need. This was followed by 32% of the respondents indicating seed of fingerling production as their most pressing need. On the other needs required by the respondents, 14%, 10% and 4% indicated water quality management, disease identification and fish processing, packaging and marketing respectively as their most pressing need.

4. Discussions

Agricultural extension services typically include capacity development through training, strengthening innovation processes, building linkages between farmers and other

agencies, and helping to strengthen farmers' bargaining position through appropriate institutional and organizational development^[27, 28]. The quality of extension services provided by the Community and the State to support the farmer is important if the farmer is to use these services to improve the levels of his/ her incomes and reduce his/her poverty^[29]. In this study we assessed aquaculture extension services in the Eastern Region of Ghana focusing on the current state of extension services rendered to fish farmers.

Extension and Education enhances the ability to derive, decode and evaluate useful information for agricultural production^[30]. The basic idea is that an appropriate response to technological change in agriculture requires the collection and processing of new information, and educated farmers would be expected to respond more quickly than others^[31]. In this study, only 8% had no formal education with 82% having

at least education to the J.H.S level. This is an indication that the respondents stand a greater chance of being able to assimilate and idealize any new technology from the extension workers as the rate at which one can assimilate and idealize new knowledge and technology could depend on the educational level of the individual^[32]. The study revealed there is a fertile ground for the dissemination and adoption of new technologies due to the educational background of the respondents. This is because, generally, education is thought to create a favorable mental attitude for the acceptance of new practices, especially information-intensive and management-intensive practices^[33, 34, 35].

Extension service is important to increase in aquaculture and agriculture as a whole. Aquaculture extension services are expected to facilitate the farming community to access backward and forward inputs and services, educate the farmers on better farm management practices, food safety guidelines and enforce regulatory guidelines for the planned aquaculture growth^[36]. This study revealed that 48% of the respondent had no extension services available to them. This is slightly lower than the value reported in a study that 69% of the respondent having no access to extension service^[37]. This implies that availability of extension services to aquaculture farmers in the Eastern Region of Ghana is not adequate and unavailable to some farmers.

Age is an important factor that influences the probability of adoption of new technologies because it is said to be a primary latent characteristic in adoption decisions^[35].

Age was found to positively influence adoption of sorghum in Burkina Faso^[38], Integrated pest management on peanuts in Georgia^[39], and chemical control of rice stink bug in Texas^[40]. This study revealed 64% of the respondents are aged between 18-35 years indicating that there are quite a larger proportion of young people engaged in the management of aquaculture in the Eastern Region of Ghana. This revelation of young people being involved in the management of the aquaculture industry is an advantage to the industry as their technology adoption behaviours are crucial to improvement in agricultural productivity^[35].

This study revealed that only 8% of the farms surveyed had been in existence for 6 or more years with the remaining 92% being in existence from 1-5 years as at the time of this study. This goes to confirm the assertion that Aquaculture (fish farming) is relatively new to Ghanaians compared to most Asian countries^[9]. Its practice is however becoming widespread in many parts of the country especially in the Ashanti, Central, Eastern, Volta and Western regions.

The agricultural and/aquacultural extension service operates from the backdrop belief that increased agricultural/aquacultural productivity depends primarily upon the acceptance of improved cultural and technological change at the rural farm level and that peasant farmers can achieve higher farm yields only if they adopt recommended scientific farming techniques in place of their traditional practices^[41]. Perception plays an important role if one is to accept services being rendered. This study revealed that majority of the respondents (94%) are willing to accept extension services from private organizations or people while a fraction of the respondents (6%) are unwilling to accept service from private organizations or people. The minority that are unwilling are of the view that services provided by private organizations are expensive and wouldn't be able to pay while the majority believe the services from such groups or individuals are usually of high quality, delivered on time and have proper regulatory system.

Feed accounts for at least 60% of the total cost of fish

production in Africa, which to a large extent determines the viability and profitability of fish farming enterprise^[42]. The study revealed that 40% of the respondents have feed preparation and production as their most pressing need. This could be attributed to the fact that aquaculture production in the developing world is greatly constrained by undersupply, scarcity and high cost of conventional fish feed^[43, 44] of which Ghana is not an exception. This could also be attributed to the fact that development and management of fish feed, play very vital role in aquaculture growth and expansion^[45].

5. Conclusion and Recommendation

This study documents that, there is fertile grounds for extension services to be made available to fish farmers in the Eastern Region of Ghana due to the favourable age and education of respondents in connection with ability to adopt to new technologies. However, there is a perception against the services rendered by the extension officers in the study area. It would be therefore prudent if the regulatory body does streamline the services rendered to ensure extension workers reach all farmers at the right time. In addition since the respondent are inclined to accept services from private organizations, there is therefore the need for public- private partnership to enhance the delivery of extension services in the study area.

6. Acknowledgement

The authors wish to thank the participating farmers for their valuable time and patience in providing data and information for this study. We also thank Miss Linda Bana of Ministry of Fisheries and Aquaculture Development, Accra, Ghana for providing us with the needed information. We finally thank Angela Opare Kumea for her role in the data collection.

7. References

1. Rouhani QA, Britz PJ. Contribution of aquaculture to rural livelihoods in South Africa: A Baseline Study. 1st Edn. Water Research Commission, Gezina, 2004, 105. ISBN-10:1770051864
2. Nandi JA, Gunn P, Adegboye GA, Barnabas TM. Assessment of Fish Farmers' Livelihood and Poverty Status in Delta State, Nigeria. *Agriculture, Forestry and Fisheries*. 2014; 3(5):427-433.
3. Inoni OE. Allocative efficiency in pond fish production in Delta State, Nigeria: A production function approach. *Agric. Tropica Subtropica*. 2007; 40:127-134.
4. Himanshu KD, Dileep KP. Constraints to women's involvement in small scale aquaculture: an exploratory study. *Int. J Agr Ext*. 2014; 02(01):81-88.
5. FAO. The state of world fisheries and aquaculture. Rome: Food and Agriculture, 2012.
6. Lim G. Value chain upgrading: Evidence from the Singaporean aquaculture industry. *Mar. Policy*, 2015. <http://dx.doi.org/10.1016/j.marpol.2015.03.016i>.
7. Orchard JE, Abban EK. Financial Services for SME Aquaculture and Fisheries Producers. Ghana Case Study. German Agency for Technical Cooperation (GTZ), 2011.
8. Cobbina R, Eiriksdottir K. Aquaculture in Ghana: Economic Perspectives of Ghanaian Aquaculture for Policy Development. (Final project). United Nations University- fisheries training programme, 2010, 47.
9. MOFA. Fisheries Commission: Data on Aquaculture Production per Region in 2011. Inland Fisheries Unit, Fisheries Commission 2011, Fisheries Commission, Ghana, 2012.
10. Asmah R. Development potential and financial viability

- of fish farming in Ghana. (Doctoral dissertation). University of Stirling, Stirling, UK, 2008, 269.
11. Directorate of Fisheries. Ghana: Post-harvest fisheries overview. Directorate of Fisheries, Ministry of Food & Agriculture, Ghana. 2003, 70.
 12. Aheto DW, Quinoo B, Tenkrang EY, Asare C, Okyere I. Economic Value Assessment of Small-Scale Fisheries in Elmina, Ghana, Firstworld sustainability forum, 2011. file:///C:/Users/toshiba/Downloads/wsf_719_manuscript.pdf
 13. Ansah YB, Frimpong EA. Impact of the adoption of BMPs on social welfare: A case study of commercial floating feeds for pond culture of tilapia in Ghana. *Cogent Food & Agriculture*. 2015; 1:1048579.
 14. Ainoo-Ansah J. Tilapia farming in Ghana: Breeding, feed advances support rising output. *Global Aquaculture Advocate* 2013; 16:24-26.
 15. Frimpong E, Ansah Y, Amisah S, Adjei-Boateng D, Agbo N, Egna H. Effects of two environmental best management practices on pond water and effluent quality and growth of Nile tilapia, *Oreochromis niloticus*. *Sustainability*. 2014; 6:652-675. <http://dx.doi.org/10.3390/su6020652>
 16. Ajayi AO. Assessment of Agricultural Extension Agents' Knowledge and Attitude towards Agricultural Insurance in Osun State, Nigeria. *Journal of Agricultural Science and Applications*. 2013; 2(3):143-150.
 17. Purcell DL, Anderson JR. *Agricultural extension and research: Achievements and problems in national systems*, World Bank, Washington, DC, 1997.
 18. Birkhaeuser D, Evenson RE, Feder G. The economic impact of agricultural extension: A review. *Econ. Devel. Cult. Change*. 1991; 39(3):607-640.
 19. Anderson JR, Feder G. Agricultural extension, in R.E. Evenson and P. Pingali (eds.), *Handbook of agricultural economics, Agricultural development: Farmers, farm production, and farm markets*, Elsevier, Amsterdam. 2007; 3:2343-2378.
 20. Anderson JR. *Agricultural advisory services.* Background Paper for World Development Report 2008, Agriculture for Development, World Bank, Washington, DC, 2007.
 21. Landon LC, Powell AP. Participatory Rural Appraisal concepts applied to agricultural extension: a case study in Sumatra. *Quarterly Bulletin of IAALD*. 1996; 41(1):100-103.
 22. Davidson AP, Ahmad M, Ali T. Dilemmas of Agricultural Extension in Pakistan: Food for thought. *Agricultural Research and Extension Network*, 2001, 116.
 23. Adereti FO, Fapojuwo OE, Onasanya AS. Information Utilization on Cocoa production Techniques by Framers in Oluyole Local Government Area of Oyo State, Nigeria. *European Journal of Social Science*. 2006; 3(1):1-7.
 24. Mgbada JU. Effectiveness of Information sources on improved farming practices to women farmers in Enugu State, Nigeria. *Global Approaches to Extension Practice*. 2006; 2(1):67-78.
 25. Agbebi FO. Assessment of the Impact of Extension Services on Fish Farming in Ekiti State, Nigeria. *Asian Journal of Agriculture and Rural Development*. 2012; 2(1):62-68.
 26. Ofosu DK. Assessing the spatial distribution of health facilities in the eastern region of Ghana. Theses. Kwame Nkrumah University of Science and Technology. 2012, 77. <http://hdl.handle.net/123456789/7607>
 27. Sulaiman VR, Hall AJ. Beyond technology dissemination: Reinventing agricultural extension. *Outlook Agric*. 2002; 31(4):225-233.
 28. Machila M, Lyne M, Nuthall P. Assessment of an outsourced agricultural extension service in the Mutasa district of Zimbabwe. *J Agric Ext Rural Dev*. 2015; 7(5):142-149.
 29. Buadi DK, Anaman KA, Kwarteng JA. Farmers' perceptions of the quality of extension services provided by non-governmental organisations in two municipalities in the Central Region of Ghana. *Agric Sys*. 2013; 120:20-26.
 30. Ani AO. Assessment of farmers' extension education needs in Yobe State, Nigeria. *Nigerian J Agric Educ*. 1998; 1:152-158.
 31. Alene AD, Manyong VM. The effects of education on agricultural productivity under traditional and improved technology in northern Nigeria: an endogenous switching regression analysis. *Empir Econ*. 2007; 32:141-159.
 32. Ani AO, Ogunnika O, Ifah SS. Relationship between Socio-Economic Characteristics of Rural Women Farmers and Their Adoption of Farm Technologies in Southern Ebonyi State, Nigeria. *Int J Agr Biol*. 2004; 6(5):802-805.
 33. Waller BE, Hoy CW, Henderson JL, Stinner B, Welty C. Matching innovations with potential users: A case study of potato IPM practices. *Agr Ecosyst and Environ*. 1998; 70:203-215.
 34. Caswell M, Fuglie K, Ingram C, Jans S, Kascak C. *Adoption of Agricultural Production Practices: Lessons Learned from the U.S. Department of Agriculture Area Studies Project*. Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. *Agricultural Economic Report No. 792*, 2001.
 35. Asiedu-Darko E. Effects of gender, education and age on the adoption of agricultural technologies in Ashanti, Northern and Eastern regions of Ghana. *Journal of Applied Science and Research*. 2014; 2(1):112-118.
 36. Kumaran M, Deboral Vimala D, Chandrasekaran VS, Alagappan M, Raja S. Extension Approach for an Effective Fisheries and Aquaculture Extension Service in India. *The Journal of Agricultural Education and Extension*. 2012; 18(3):247-267.
 37. Ammani A, Sani MH, Kura HN, Hussaini Y. An assessment of agricultural extension services in irrigation schemes under RBDAs' control in Nigeria: The case of Kano River irrigation project. *Journal of Agricultural Extension and Rural Development*. 2011; 3(1):13-18.
 38. Adesina AA, Baidu-Forsan J. Farmer's perception and adoption of new of agricultural: Evidence from analysis in Burkina Faso and Guinea, West Africa. *J Agr Econ*. 1995; 13:1-9.
 39. McNamara KT, Wetzstein ME, Douce GK. Factors affecting peanut producer adoption of integrated pest management. *Rev Agr Econ*. 1991; 13:129-139.
 40. Harper JK, Rister ME, Mjelde JW, Dress BM, Way MO. Factors the adoption of insect management technology. *Am J Agr Econ*. 1990; 72(4):997-1005.
 41. Bonye SZ, Alfred KB, Jasaw GS. Promoting Community-Based Extension Agents as an Alternative Approach to Formal Agricultural Extension Service Delivery in Northern Ghana. *Asian Journal of Agriculture and Rural Development*. 2012; 2(1):76-95.
 42. Jamu DM, Ayinla OA. Potential for the development of aquaculture in Africa NAGA. 2003; 26:9-13.
 43. Fagberro OA, Arowosegbe IA. Utilization of

- agricultural waste and byproducts in fish feed production in Nigeria. Proc. 6th Ann. FISON Conf., Lagos 1991, 121-130.
44. Ayuba VO, Alli MA, Oyeniye ME. Effects of fish oil replacement with palm kernel oil as lipid source on the growth performance of *Clarias gariepinus* fingerlings. Direct Research Journal of Agriculture and Food Science. 2015; 3(6):132-137.
 45. Gabriel UU, Akinrotimi OA, Bekibele DO, Onunkwo DN, Anyanwu PE. Locally produced fish feed: potentials for aquaculture development in Sub-Saharan Africa. Afr. J Agric Res. 2007; 2(7):287-295.