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AGRICULTURE EXTENSION

Optimal Size of Fish Pond for Socio-Economical Development of Cachar (Assam)

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Abstract

Aquaculture is one of the main sources of livelihood of the state of Assam in the northeast of India. In this study, Cachar district of Assam has been selected to study and assess the impact of various sizes of fish farm on the economic condition of farmers. The study was conducted in the villages of 5 blocks namely Borjalenga, Tapang, Narsingpur, Sonai and Palonghat with an objective to suggest optimum size of the pond and analyze the production rate of different type of fish farm. The data was collected from around 169 farmers by the principle of participatory rural appraisal a method used by non-governmental organizations. Most of the farmers are not much educated and most of them lived below poverty line. The number of medium size ponds (0.5 to 1 hectare), and small farm ponds (between 0.3 to 0.5 hectare) are highest followed by very small (less than 0.3 hectare) and then large size ponds (more than 1 hectare). In the study area, both excavated and embankment type pond exist. The results indicate that even with possession of small and medium size fish farms, better annual production rate of fish can be achieved by better management practices. 83% of all fish farms in Cachar district are very small, small or medium size fish farms. Only 17% of the farms are of large size. The annual production is remarkably good for small and medium size farms. The results indicate that small and medium farm sizes have better annual production rate than other farms. Thus, small to medium farms are economically more viable for the Cachar district.

Highlights

- Cachar district has been selected for optimal study of fish pond.
- The study is based on socio-economic condition of fish farmers.
- The fish farm has been divided in small, medium and large size ponds.
- The results reveal that small to medium size ponds is optimal pond size.

Keywords: Fish Farm, Cachar, pond size, aquaculture, participatory rural appraisal

Fisheries play an important role in the economy of India in augmenting food supply, generating employment, raising nutritional level and in earning foreign exchange. Fishes are invariable living components of water bodies. These organisms are important food resources and good indicators of the ecological health of the water they inhabit. Fish farming involves raising fish commercially in tanks or enclosures, usually for food. Aquaculture has been a fast-growing industry because of significant

increases in demand for fish and seafood throughout the world. It is growing more rapidly than any other segment of the animal culture industry. In many parts of Asia, small-scale, low input aquaculture technologies are seen as an important tool for improving food security, especially in areas where there is a shortage of fresh fish (Marutani and Brown 2014, Salama and Murray 2011). In Bangladesh, several projects have been undertaken to assist farmer adopt fish culture in small water bodies in and around their homesteads (Belton *et al.* 2012).

The state of Assam covers about 30 per cent of the North Eastern Region of India, which has an area of 78438 km^2 and is located between 21.570°N – 29.30°N latitude and 89.460E – 97.30°E longitude. Rice and fish are the two basic items in the diet of the Assamese people. For 95% of them, fish is an important protein rich food. Assam currently produces about 159000 tons of fish from all sources annually as against an estimated annual demand of 250000 tons. The demand is estimated to increase to 320000 tons in the near future. The state of Assam in north-eastern India has an excellent sub-tropical climate for the development of fresh water fish culture in a variety of aquatic bodies. Aquaculture not only plays an important role in nutrition but also in the rural economy of the State.

For better understanding of the fish cultivation at a place, it is important to have a survey of that place. The outcome of this type of survey sometimes suggests very important information about the economic status of farmers in that locality (Zalkuw *et al.* 2014). For example to understand the impact of different type of fish cultivation on the farmer's economic condition, it is important to have a survey. In the past few years, lot of research has been done for rural India which is entirely based on survey of an area. Goswami et *al.* (1999) reported about fish farming through community participation in Assam. The study was done for fish culture in the community tank in Lahkimpur district and five villages of Darang district, Assam during January-July 1999 through personal interviews in five villages involved in fish culture. The community tank development program, culture practices and their impact on socioeconomic development were also studied. They suggested that community tanks have the potential for increasing fish production through community participatory fish culture. Das and Goswami (2002) has studied on the present status of fish culture being practiced by the rural farmers. Study was conducted in four villages of two districts of central Assam, viz., Nagaon and Morigaon. As fish culture in the small ponds can be operated with resources available within the family, there was an excellent opportunity for the development of small-scale fish culture enterprise (Aguado and Ruiz 2012, Masters *et al.* 2013, Zhao *et al.* 2013). An attempt was made by Das (2002) to introduce the farmers' participatory small-scale aquaculture extension program in the villages of the Amsoi area in Nagaon district of Assam, under an innovative scheme of the Assam Rural Infrastructure and Agriculture Service Project (ARIASP, World Bank) for three years starting from 1998. The primary objectives of this pilot project were to develop appropriate technologies for the target community and to create a farmer-based extension system.

Further, Hortle (2007) reported a regional study giving overview of production levels, consumption levels of fisheries. Descriptive statistics were used in methodologies as the data's were collected from over 20 different surveys. Jahan *et al.* (2010) collected data from 225 farmers in 2001-05 for the Development of Sustainable Aquaculture Project (DSAP) to calculate the impact of aquaculture projects on fish consumption (using a before/after, with/without trial), calculated in terms of annual per capita fish. They also made calculations for the consumption of other foodstuffs, and record the types of fish that are consumed. Allison (2011) collected the data of relationship between export trade and national fish protein supply (not micro-nutrients) from FAO for the year of 1976-2007. Dey and Ahmed (2005) and Jahan *et al.* (2010) conducted the micro-studies on pro-aquaculture projects to improve incomes and consumption for participant households on their respected countries. Bene *et al.* (2003, 2009) and Itam *et al.* (2014) conducted micro-level studies revealing

the extent to which poorer groups participate in and benefit from fisheries or aquaculture. They used a Gini decomposition exercise and collected the data by their own survey. They collected data from 43 fishing camps by conducting surveys, interviews and group discussions. It includes records of peoples' incomes and expenditures in the previous year. They used statistical tests (an analysis of variance and pair wise multiple comparison) to determine correlations on the role of fisheries particularly regarding income generation.

Stanley *et al.* (2003), reported about the economic effects of fisheries on shrimp. Study conducted by Stanley *et al.* (2003) was mainly based on national household survey; Stanley's methodology was a qualitative approach on a country specific basis and is seen as the best option for appraising aquaculture's contribution to a regional economy.

Likewise, Olasunkanmi (2012) reported about the economic analysis of fish farming in Osun State, South-Western Nigeria. The data were collected from seventy two randomly selected fish farms. Data were analyzed using descriptive statistics, costs and returns, as well as multiple regression analysis. Chakravartty *et al.* (2012) worked on the fish diversity with special reference to the classified ornamental fishes and their prospects in the Kapla Beel of Barpeta District. Dey *et al.* (2005) conducted studies of disaggregating consumption of fish at the national level across different income groups and different species of fishes. In methodology, they used multi-commodity model, three-stage budgeting network, quadratic almost ideal demand system (QUAIDS) model, regression analysis, Duncan's Multiple Range Test (DMRT). Aiga *et al*. (2009) studied about the contribution of small-scale fisheries to reducing malnutrition.

Despite the vast aquatic resources, Assam has not been able to produce ample fish to cater to the needs of its ever increasing population. Assam's share of the total inland fish production in India is 6.55%. The size of a fish farm plays a very vital role in deciding the income of a farmer. In this study, an optimal fish farm size has been determined on the basis of total fish production in the farm.

Materials and Methods

This section deals with the study area (location, climate, geographical area, status of fishery), questionnaire, procedure of data collection and their statistical analysis.

The Cachar district is situated in the southern part of Indian state of Assam. The total geographical area of the district is 3,786 Sq. Km. The district lies between 92° 24′ E and 93° 15′ E longitude and 24° 22′ N and 25° 8′ N latitude 35 meters above mean sea level. Total population of Cachar district is 17, 36,319 as per Census 2011. Average density is 459 per sq. km. The location of Cachar district is shown in Figure 1.

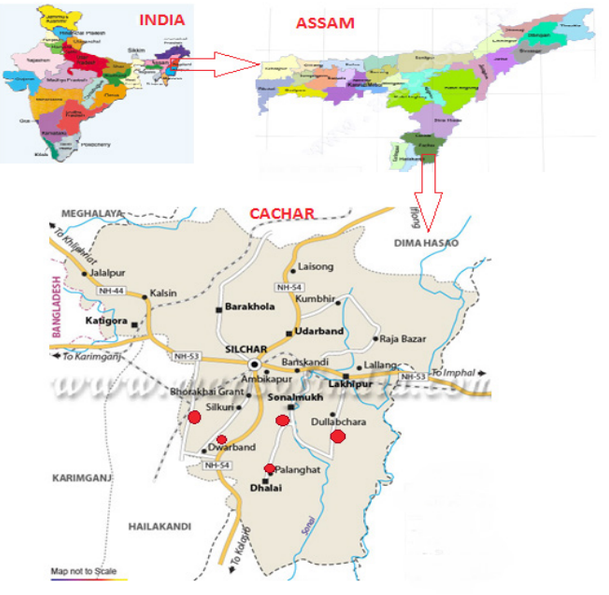

Figure 1. Cachar District Map

The distinguishing feature of the climate of Cachar is copious rainfall between March and May. Cachar district receives an average annual rainfall of 3000 mm in a year. Climate of the valley is generally hot

and humid with temperature ranges from 10^0C to 15^0C during winter season and 35^0C to 40^0C during summer season with the relative humidity 92 to 98 percent. The area is characterised by tropical monsoon climate having three distinct seasons viz., summer (March-May), Rainy season (June-September) and winter. Towards the mid April rain clouds starts covering the skyline. Cachar is frequently inundated due to excessive rainfall and flooding by the river Barak. In the last three decades, Cachar and the Barak Valley have been ravaged by three major floods in 1986, followed by the one in 1991, and more recently in 2004. Geographical area of Cachar district is 3,786 Sq. Km. Total 21,516 hectares of land are used for fish farming in this district. Fish farming is the second important source of livelihood of cachar district. The fishermen in Cachar have failed to meet the target of fish production this fiscal. As per the district fisheries development officer, total population of fishermen is about 1.5 Lakh. Womens also have a large contribution in this occupation (Ranfu *et al.* 2010). However, they able to produce only 21,500 tonnes of fish per year from the different water bodies, including the Barak river, whereas the annual demand are estimated at 36,000 tonnes. More than 165 kinds of fishes are found in Assam. All the species are not cultivated commercially, Some species like; Ilish, chital, kandhuli, balisonda, puthi, mirika, bhangone, nara, rau, common carp, grass carp, silver carp, big head carp, singorah, arii, barali, magur, thiland magur, singhi,goroi, cheng, kuchia, shol, sal, japani kawai, kholihona are cultivated commercially in Cachar.

Data collection

Survey was conducted in five blocks of Cachar district to collect the information related to the fish farming pattern. The following steps were undertaken for the data collection. First of all five main fish cultured blocks, which are nearby Assam University Silchar, were identified with the help of district fishery officer. There are 15 blocks in Cachar district namely Silchar, Salchapra, Tapang, Udarbond, Sonai, Borkhola, Kalain, Katigorah, Banskandi, Binnakandi, Lakhipur, Rajabazar, Narsingpur, Borjalenga, Palonghat. Fish farming is carried out almost in all the blocks. However, Tapang, Narsingpur, Sonai, Borjalenga and Palonghat were indentified as five extensive fish cultured blocks, nearby Assam University Silchar. A set of questionnaire was formed and distributed among the farmers to collect the data related to fish farming. The questionnaire contains the information related to the livelihood of farmer, technical and economical aspect of fish farming pattern.

A principle of Participatory Rural Appraisal (PRA) was adopted during the visit in different blocks. The highest fish producers as per the questionnaire and with the consultation of the Gram Mukhya in the selected blocks were also identified. Participatory Rural Appraisal is an approach used by non – governmental organizations and other agencies involved in rural development. The approach aims to incorporate the knowledge and opinions of rural people in the planning and management of development projects and programs funded by the GOI or any private institutions. Documentation and analysis of fish farming pattern of Cachar district were carried out based on information collected from 170 farmers of 20 villages. All the analysis were carried out based on the type of fish ponds, structure of the fish ponds, size of the fish farms, volume of the fish ponds, variety of fish culture, seeding rate and production rate in each fish farm, size and rate of selling for different types of fishes in different fish farms, number of culture cycles adopted by the fish farmers in a year, total expenditure and profit for each fish farm.

Further volume of fish pond can be calculated by equation (1):

$$V_p = A_s D_m V_p = A_s D_m \quad \text{... (1)}$$

Where, $V_p V_p$ is the volume of the pond, $A_s A_s$ is the surface Area of the pond, and $D_m D_m$ is the average depth of the pond.

Production rate is referred as the amount of total fish harvested in one year from one hectare size of pond. It can be estimated by using equation (2)

$$PR = \frac{M_T}{A} PR = \frac{M_T}{A} \quad \text{... (2)}$$

Where, $PRPR$ is the production rate of the fish (kg/ha/year), $M_T M_T$ is the total mass of fish production annually (kg/year) and AA is the total size of the fish ponds (ha)

Results and Discussion

Size of fish pond plays a very important role as far as economic status of a farmer is concerned. Every farmer can't afford a large size pond. Most often it has been observed that farmers may also increase the productivity of his farm land by his intense labour and endeavour. Thus, in the present study, it is important to know whether the annual fish production in Cachar district is influenced by the farm size or not.

For compilation of results in more exhaustive way, the ponds (which is also called fish farm) of Cachar has been divided into four types which is based on its size. The smallest pond is termed as very small pond having area less than 0.3 hectare. Ponds having free surface area of 0.3 to 0.5 hectare are termed as small ponds. Further, medium ponds are those ponds which has surface area between 0.5 and 1 hectare. Those ponds having surface area more than one hectare is termed as large ponds. The annual production of fishes has been determined by collecting data for all types of fish farm. The results suggest that the average annual fish production for very small size farm is 1703 kg/ha/year. The production rate of fishes for very small size farm has been shown in Figure 4.9. From this figure, it can be depicted that the maximum annual production of fishes in some of the very small farm may reach to 2091 kg/ha/year. This may be achieved by some of the farmers with adopting proper management practices in their farm lands.

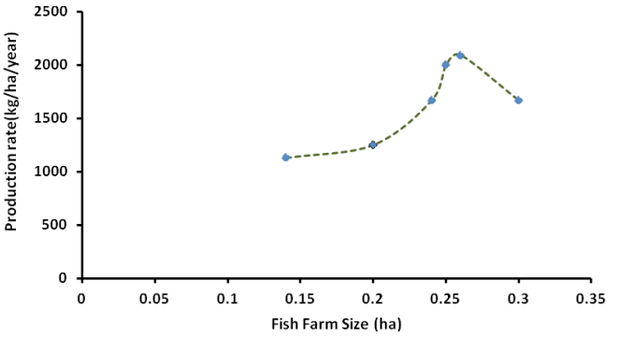

Figure 2. Production rate of fish in very small size fish farms

Further, after conducting survey for small size fish farm, it has been observed that the average annual production of fishes is 1985 kg/ha/year. The annual production of fishes for small size fish farm is depicted in Figure 4.10. During survey, it has been observed that the annual production of fishes for such fish farm vary from 761 kg/ha/year to 2650 kg/ha/year. The production rate of fishes in case of small sizes farm is remarkably more than very small size fish ponds.

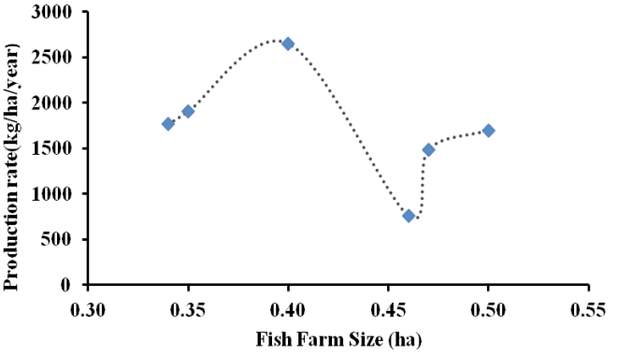

Figure 3. Production rate of fish in small size fish farms

For medium size fish farms, it has been observed that the annual fish production varies from 1028 kg/ha/year to 3636 kg/ha/year. Figure 4.11 presents production rate of fish for medium size fish farm. The average annual production in this case is 1815 kg/ha/year. The production has increased as compared to very small and small sizes farm.

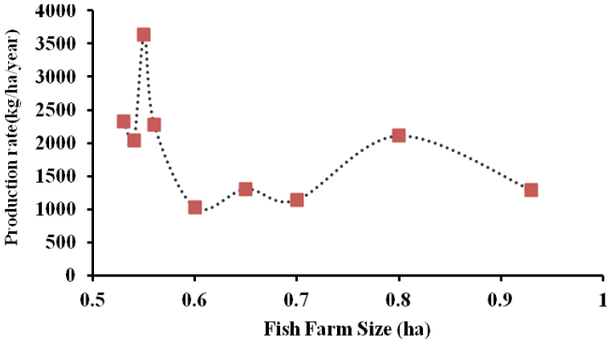

Figure 4. Production rate of fish in medium size fish farms

Furthermore, data collected for large sizes fish farm indicates that the production rate of fishes vary from 938 kg/ha/year to 1489 kg/ha/year. Figure 4 shows the annual production of fishes for large size fish farms.

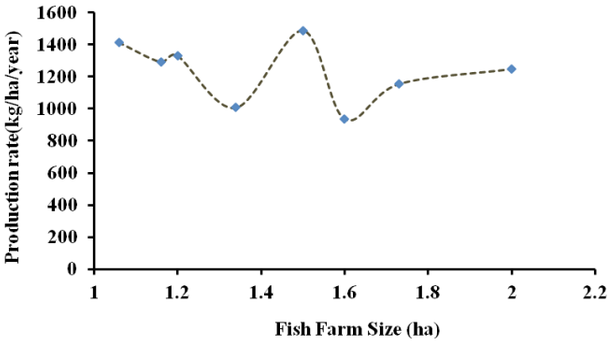

Figure 5. Production rate of fish in large size fish farms

The annual average production in this case is 1426 kg/ha/year. It can also be depicted from these facts that the annual production rate of fishes for large size fish farms is less than that of medium size fish farm. The low production rate of large fish farm may be due to the fact that the farmers has large farm sizes but there economic condition is not well suited for the proper management of such large fish ponds. Thus, it can be concluded that even with possession of small and medium size fish farms, better production rate can be achieved by better management practices. Eighty six percentages of all the fish farms in Cachar district are very small, small or medium size fish farms. Only 14% of the farms are of large size. The annual production is remarkably good for small and medium size farms. Thus, government should encourage farmers to manage fish farms even if its size is small.

Conclusion

The present study is focused on the analysis of fish farming pattern in Cachar district, Assam. The analysis is based on the information collected from this area. Fisheries is the second most important source of livelihood in the region. Due to lack of manpower and poor economical conditions of farmers in the region, the fish production in the region has not been able to meet the total demand of fishes. In the present study, attempted has been made to analyze the optimal farm size of the fish farm so as to increase the economic returns of the farmers. To analyze fish farming pattern of study area, extensive survey was conducted in five blocks of Cachar district i.e. Borjalenga, Tapang, Sonai, Narsingpur, Palonghat, among 169 farmers and data was collected. A set of questionnaire was prepared, which includes general and technical information of fish culture i.e. farmer name, village name, block name, education of farmer, nature of holding, type of ponds, structure of ponds, volume of ponds, seeding rates, type of seeds, production rate, fish culture type, rate of selling, size of ponds, total expenditure, etc. For the purpose of better analysis, fish ponds of study area was divided into four categories based on their surface area; i) Very small pond (0 < 0.30 ha), ii) Small pond (0.30 - 0.50 ha), iii) Medium pond (0.50 – 1.0 ha) and iv) Large pond (> 1.0 ha). The results suggest that even if farmers possess small to medium size fish farms, better production rate can be achieved by improving management practices. Eighty six percentages of all the fish farms in Cachar district are very small, small or medium size fish farms. Only 14% of the farms are of large size. The annual production is remarkably good for small and medium size farms. Since production rate for these medium size farms are high, the economical benefits earned by the farmers will also be high. Thus, government should encourage farmers to manage fish farms even if its size is small.

References

Aguado-Giménez F, and Ruiz-Fernández J M 2012. Influence of an experimental fish farm on the spatio-temporal dynamic of a Mediterranean maërl algae community. *Marine Environmental Research* **74**: 47-55. http://dx.doi.org/10.1016/j.marenvres.2011.12.003

Aiga H, Sadatoshi Matsuoka S, Kuroiwa C, Yamamoto S 2009. Malnutrition among children in rural Malawian fish-farming households. *Royal Society of Tropical Medicine and Hygiene* **103**: 827—833. http://dx.doi.org/10.1016/j.trstmh.2009.03.028

Allison EH 2011. Aquaculture, fisheries, poverty and food security, World Fish Centre Working Paper 2011-65

Belton B, Haque MM and Little DC 2012. Does size matter? Reassessing the relationship between aquaculture and poverty in Bangladesh. *Journal of Development Studies* **48**(7): 904-922. http://dx.doi.org/10.1080/00220388.2011.638049

Bene C, Neiland A, Jolley, T Ovie, S Sule, O Ladu, B Mindjimba, K Belal, E Tiotsop, F Baba, M Dara, L Zakara, A and Quensiere J 2003. Inland fisheries, poverty, and rural livelihoods in the Lake Chad Basin, *Journal of Asian and African Studies* **38**(1): 17-51. http://dx.doi.org/10.1177/002190960303800102

Bene C, Steel E, Kambala B, Gordon A 2009. Fish as the ''bank in the water"– *Evidence from chronic-poor communities in Congo, Food Policy* 108-118. http://dx.doi.org/10.1016/j.foodpol.2008.07.001

Chakravartty P, Chakravartty M and Sharma S 2012. Investigation about the survey on the fish diversity with special reference to the classified ornamental fishes and their prospects in the Kapla beel of Barpeta district. Ph.D. Thesis. Guwahati University, Assam, India.

Das SK and Goswami UC 2002. Current status of culture fisheries in the Nagaon and Morigaon districts of Assam. *Applied Fisheries and Aquaculture* **2**(2):33-36.

Das SK 2002. Seed production of Magur (Clarias batrachus) using a rural model portable hatchery in Assam, India – A farmer proven technology. *Aquaculture Asia, NACA,* Bangkok. **7**(2): 19-21.

Dey MM and Ahmed M 2005. 'Aquaculture – Food and Livelihoods for the Poor in Asia: A Brief Overview of the Issues', *Aquaculture Economics and Management* **9**(1-2): 1-10. http://dx.doi.org/10.1080/13657300591004970

Dey MM, Rab MA, Paraguas FJ, Piumsombun S, Bhatta R, Alam F and Ahmed M 2005. 'Fish Consumption and Food Security: A Disaggregated Analysis by Types of Fish and Classes of Consumers in Selected Asian Countries', *Aquaculture Economics and Management* **9**(1-2): 89-111. http://dx.doi.org/10.1080/13657300590961537

Goswami M and Sathiadhas R 1999. Study about the fish farming through community participation in Assam. Department of Fisheries Economics and Extension, at the Central Institute of Fisheries Education Versova, Mumbai 400061, India.

Hortle KG 2007. Consumption and the yield of fish and other aquatic animals from the Lower Mekong Basin. MRC Technical Paper No. 16, Mekong River Commission, Vientiane. 87 pp.

Itam KO, Etuk, E A, and Ukpong, IG 2014.. Analysis of resource use efficiency among small-scale fish farms in Cross River State, Nigeria. *International Journal of Fisheries and Aquaculture* **6**(7): 80-86.

Jahan KM, Ahmed M, Belton B 2010. 'The impacts of aquaculture development on food security: lessons from Bangladesh' *Aquaculture Research* **41**: 481-495. http://dx.doi.org/10.1111/j.1365-2109.2009.02337.x

Marutani M, and Brown, J 2014. A Small-Scale Integrated Farm System in a Tropical Insular Environment of Guam: A Case Study. In Sustainable Horticultural Systems (pp. 79-93). Springer International Publishing. http://dx.doi.org/10.1007/978-3-319-06904-3_4

Masters WA, Djurfeldt AA, De Haan, C, Hazell, P, Jayne T, Jirström M and Reardon T 2013. Urbanization and farm size in Asia and Africa: implications for food security and agricultural research. *Global Food Security* **2**(3): 156-165. http://dx.doi.org/10.1016/j.gfs.2013.07.002

Olasunkanmi JB 2012. Investigation about the Economic Analysis of Fish Farming in Osun State, South-Western Nigeria. Ph.D. Thesis. Department of Fisheries and Wildlife Management, College of Agriculture, Ejigbo. Osun State University, Osogbo. Nigeria.

Raufu MO, Salau SA, Adedeji IA, Adeniyi RA 2010. Effect of Credit Source on Women Fish Farmers in Ikorodu Logical Government Area of Logos State. *International Journal of Agriculture, Enviornment and Biotechnology* **3**(1): 87-90

Salama NK, and Murray AG 2011. Farm size as a factor in hydrodynamic transmission of pathogens in aquaculture fish production. *Aquaculture Environment Interactions* **2**: 61-74. http://dx.doi.org/10.3354/aei00030

Stanley DL 2003. The economic impact of Mari culture on a small regional economy, *World Development* **31**(1). http://dx.doi.org/10.1016/s0305-750x (02)00176-6

Zalkuw J, Singh R, Pardhi R, Gangwar A 2014. Analysis of Technical Efficiency of Tomato Production in Adamawa State, Nigeria. *International Journal of Agriculture, Environment and Biotechnology* **7**(3): 645-650, Article DOI : 10.5958/2230-732X.2014.01371.0

Zhao S, Song K, Gui F, Cai H, Jin W and Wu C 2013. The emergy ecological footprint for small fish farm in China. *Ecological Indicators* **29**: 62-67. http://dx.doi.org/10.1016/j.ecolind.2012.12.009