Original Research Article

Effect of Public Fisheries Extension Service on the Selected Socioeconomic Aspects of the Clients in Two Selected Sub-districts under Barisal District in Bangladesh

ABSTRACT

:
Fisheries extension is an education and communication process of delivering knowledge and technical support to the fish farmers, fishermen, and other stakeholders connected with fishing and fish farming system. This study was preceded with the aim of evaluating the effect of public aquaculture extension service on the socioeconomic development of the clients in two selected sub-district namely Barisal Sadar and Babugonj under Bariasal district. To achieve its objectives, this study exerted importance on quantitative approach using face-to-face interview method. However, this research also considered desk studies to reveal the situation. Data were collected with a structured interview schedule for the month of October 01 to October 28, 2015, from 140 randomly selected fish farmers. To find out the effect of public aquaculture extension 140 farmers were divided into two equal sized groups based on their contract with public aquaculture extension service. Findings of chi-square analysis represented that the farmers in contact with public aquaculture extension service, seems to be significantly in better position in terms of usages of communication media, organizational participation, income from fish farming, knowledge in fish farming, and attitude toward natural resource conservation., etc., than their non-contact counterpart. The findings of the regression modeling established the fact that extension contacts have significant impact on income from fish farming, and attitude towards natural resource conservation. Farmers in response to an open question indicated less frequent extension contact, political interference in selecting group member, lack of input supplies, the absence of regular subsidies, etc. as the main problems with the public fisheries extension service. This study also referred some concrete recommendations for up scaling public fisheries extension service in Bangladesh.

Keywords: Socioeconomic Effect; Public fisheries extension service; Bangladesh

1. INTRODUCTION

Bangladesh is the largest delta in the world, and eventually knit with a huge number of rivers, cannels, ponds, lakes, and other water bodies. The inland water bodies covered 12.4 % of the total land area of the country [1]. So, due to rich heritage and geographic advantages [2], aquaculture is a common occupation for many rural dwellers in the country. Traditionally, people of Bangladesh depend on fish and fish products as a part of their daily food consumption. Unfortunately, depletion of natural resources and excessive use of agrochemicals especially in crop sector, almost demolish indigenous fishes and aquatic resources in the country in an accelerated rate [3]. However, contrasting depletion of aquatic resources, the population in the country was booming at an alarming rate until the first decade of the 20th century. As a result, fish consumption of mass people depends largely upon the dissemination of modern aquaculture technologies.

Dissemination of modern aquaculture technologies in Bangladesh is comparatively a recent phenomenon compared to crop and livestock sector. Modern aquaculture technologies have started their voyage in late sixties. As a result of enormous demand, aquaculture technologies and innovations spread throughout the country in a remarkable rate in the next few decades. According to FAO, Bangladesh has been in the top five fish cultivation countries for several years and jumped to second position superseding India in 2006. Fish production in the country increased by 53% from the year 2004 to 2014 [4]. From the year 1999-2000 to the year 2011-2012 annual yearly increment of fish production was 5.61% [4]. As noted by Dr. Golam Hossain, former Director General, Bangladesh Fisheries Research Institute, with in a period of 10 years from 2002 to 2012, only tilapia production has increased from 4000 metric tons to 134,000 metric tons [6]. However, despite of this fabulous success in cultured fish production, Bangladesh has so far addressed only a fraction of its production potential [7][8]. Apart from pond culture, other water bodies remain noticeably underutilized. For instance, fish culture in floodplains, rice fields, cages, and oxbow lakes at present accounts for only around 2% of total aquaculture production [9].

Agricultural Extension, one of the essential pillars for the development, can play a vital role in aquaculture development [10][11]. Reviewing a number of literatures, efforts to define and characterize agricultural extension, [12] conceptualize extension as " a set of functions encompasses: transfer of technology for sustainable agricultural production; transformation and marketing; transferring management to mobilize and organize producers, rural groups, and communities; transferring capacity to educate, build human resources and enhance local capacity." In general the role of extension is to help people to help themselves through education, so that they can improve their socioeconomic condition [13]. Extension provides a channel through which the problems of the farmers can be identified for research and formulation of aquaculture and fisheries policies for the benefits of the rural communities. Actually, the farmers -who get timely and appropriate information- from the extension actors, can persistently develop their economic status.

Bangladesh can utilize the potentials of fisheries sector through strong aquaculture or fisheries extension programs [14]. Unfortunately, Lack of effectiveness of aquaculture extension service is a major challenge of technology transfer in fisheries sector of this country [15]. In fact, areas of operational improvement for any service predominantly depend upon the identification of client's need [16]. Actually, farmer's need of extension service may vary with the variation of their socioeconomic status. So, efficiency improvement of extension service is profoundly depending upon the identification of its contribution to the socioeconomic status of the clients. These might also help us to detect the areas need more concentration, in future extension planning for equilibrium development of the beneficiaries. However, with the aim of exploring socioeconomic effect of aquaculture extension service, this study forward with the following specific objectives:

- To reveal the situation of present public aquaculture extension service.

- To assess socioeconomic status of the selected respondents in terms of selected factors
- To determine the factors affecting socioeconomic impact of public aquaculture extension service in the study areas

1.2 CONEPTUAL FRAMEWORK

Fish is the second most important agricultural crop in Bangladesh which provide sustainable livelihood, employment opportunities, and source of animal protein [7]. Eventually, aquaculture is one of the most important and flourishing industries in Bangladesh. If carefully managed, this sector has the potential to be an important tool in addressing issues such as poverty and food security [17][18]. Lamentably, catch from inland water bodies cannot supply sufficient quantities of fish to feed the increasing population and thus aquaculture is developing rapidly [19]. However, due to shrinkage of cultivable land, as a result of progressive population, the only option left is the intensification of aquaculture in existing ponds rather than digging new ponds.

The intensification of aquaculture overwhelmingly depends upon the performance of aquaculture extension service. Aquaculture extension is an educational communication system provides need-based information and knowledge in aquaculture techniques and skills to rural communities with the aim of improving their production, income, and quality of life. As described by FAO[1], "A system which assists people in the fish and the fishing industry, through educational procedures, in improving fishing, fish farming and fish processing methods, increasing production efficiency and income, and improving their socioeconomic conditions".

A magnitude of public, private and non-government organizations is catering extension services to the fish farmers in Bangladesh [20]. However, up until now, government extension services are considered as the major force for fisheries sector development. So, overall developments of the fisheries sector through various advanced practices are mostly depending on the efficiency of the public fisheries extension services. Aquaculture extension can play pivotal role in the improvement of the socioeconomic status of the clients [21][22]. According to the study of [14], well trained female fish farmers can significantly increase their fish production than untrained fish farmers. [23] in his study mirrored that aquaculture extension has real potential in the poverty reduction of the fish farmers in Bangladesh. Aquaculture can play a pivotal role at the producer level via higher productivity, income, and better livelihood [24]. In their study in Lagos and Ongo states of Nigeria, [25] claimed that good extension service can enhance production in fish farming. In fact, effective aquaculture extension service can contribute to different socioeconomic aspects of the clients, such as rising income, upgrading social status, increasing knowledge in fish farming, changing attitude towards natural resource management, etc.

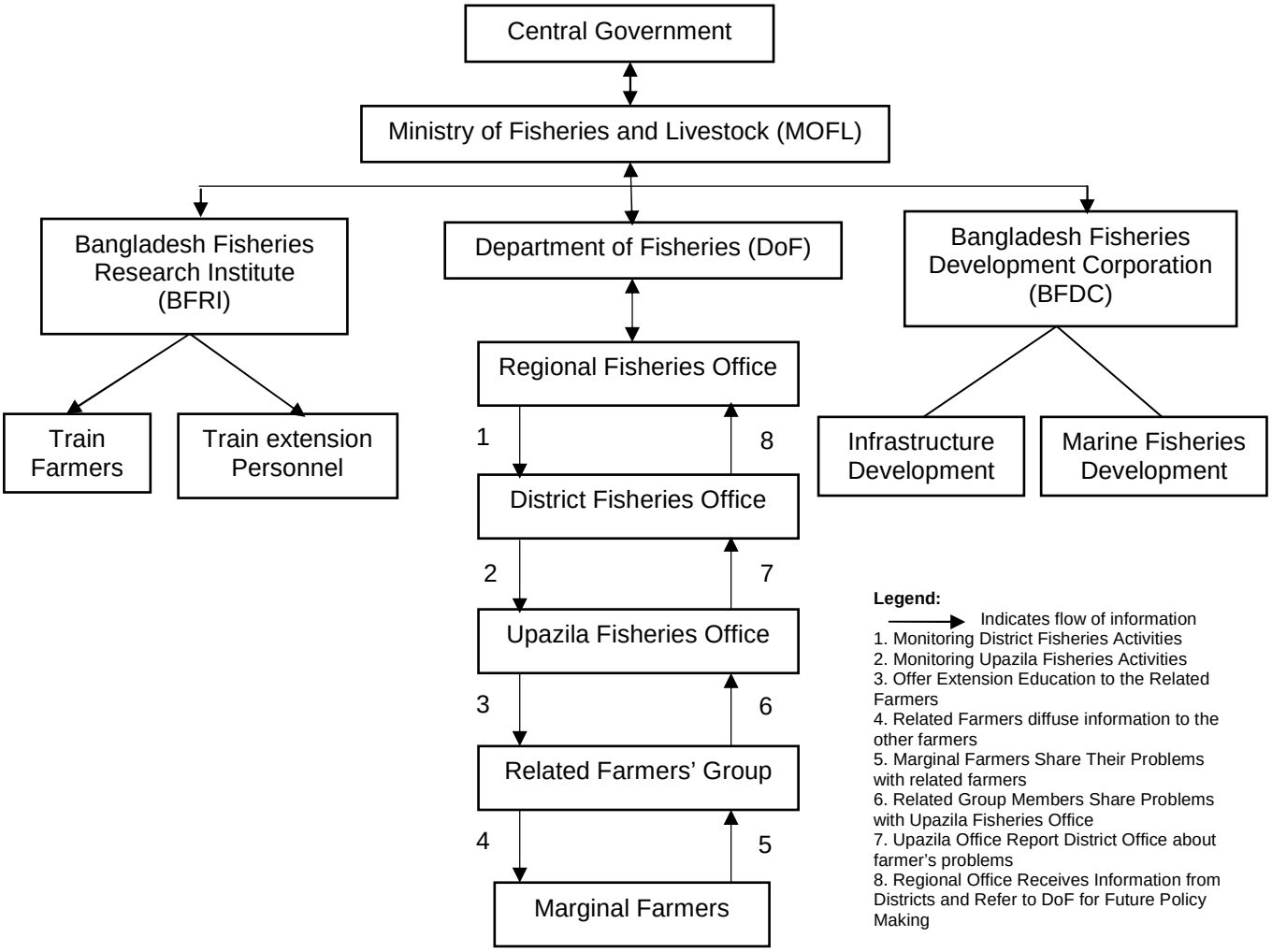
1.3 PUBLIC FISHERIES EXTENSION SERVICES IN BANGLADESH

Department of Fisheries (DoF) under the Ministry of Fisheries and Livestock (MOFL) plays the central role in controlling aquaculture in Bangladesh. DoF is headed by a Director General, who is assisted by four Directors (one reserve) and 2 Principal Scientific Officers (PSO) (equivalent to Director). There are administrative set-ups at division, district and Upazila[2] (sub-district) levels headed by Deputy Director, District Fisheries Officer and Senior/Upazila Fisheries Officer respectively. Besides these, there are three fish inspection and quality control stations under DoF. Furthermore, DoF is also composed of Marine Fisheries Station, Fisheries Training Academy, Fisheries Training and Extension Centers, and Fish Hatcheries [26]. The main function of DoF encompasses planning, development,

[1] Please see http://www.fao.org/docrep/field/003/ac061e/AC061E21.htm (Accessed 29 June, 2016)

[2] An administrative unit of Bangladesh. Please see www.slideshare.net/fahim002/administrative for details. (Accessed 30 June, 2016)

extension, and training. DoF executes its mandated activities via six divisional, 64 district, and 497 upazila (sub-district) level officials [27]. Bangladesh Fisheries Research Institute (BFRI), is an autonomous research organization also conducts few extension activities alongside its main function research coordination. The headquarters of the institute is located in Mymensingh[3]. The institute has 5 stations and 5 sub-stations based on different aquatic ecosystems. BFRI, generally conducted the research works, after all it contributes on national fisheries and aquaculture extension program by various research work on biodiversity conservation, improved sustainable farming technique development, and transfer the technologies to users through training of extension workers, planners, fish farmers, and other relevant persons [28]. Youth Development Training Centers, under the Ministry of Youth and Sports, also promote extension training for unemployed young people and fish farmers in the country. Public universities at the same time are playing a pivotal role in public fisheries extension service. At present, there are about 14 universities having fisheries faculty or department, which produce a good number of fisheries graduates every year. These graduates are catering technical supports and extension services to the fish farmers all over the country through both public and private sectors. However, the main organizations related to the aquaculture sector in Bangladesh are presented in the following Figure along with their major function.



[3] A district of Bangladesh.

Fig. 1. Major public organizations related to aquaculture sector in Bangladesh
Source: Adopted by the authors

2. MATERIALS AND METHODS

This study was conducted in 8 selected unions under Barisal Sadar and Babugonj upazila in Barisal district. These two upazilas were selected for their rich heritage in fish production. For instance, 3280 fishermen reside in the selected upazilas with yearly fish production equivalent to 8193 metric tons [29]. To reveal the effect of public fisheries extension service on the socioeconomic development of the clients, this study considered 70 randomly selected farmers from each group of related (RF) and non-related farmers (NF). Here, RF were those farmers who are in continuous contact with public fisheries extension service for at least one year and NF were farmers who are continuously apart from public fisheries extension service for at least one year. Initially, a list of RFs was collected from Upazila Fisheries Office of the selected areas and 70 farmers were randomly selected from a population of 243 farmers. In case of NFs, an initial list was prepared from the same territory where RFs were selected and 70 farmers were selected from a list of 248 farmers. It is noteworthy to mention that this sample size is good enough to fulfill the assumptions of chi-square analysis. As referred by [30], chi-square required a reasonably large number of items, usually be at least 50. Data collection was performed in the period from 1October to 28 October, 2015 using a structured interview schedule. The interview schedule was finalized following a pretest with 25 similar respondents to remove unnecessary and invalid questions. For ensuring validity of the questionnaire, this study considered other studies [31][32][33] and reviewed the questionnaire by number of experts in relevant field. Reliability of the questions related to knowledge in fish farming was confirmed by test-retest method, where the questions were found to yield similar results. The consistency of the questions related to 'attitude towards natural resource management' was measured based on Chronbach α. This value was 0.703 which was more than the value suggested by [34].

This study evaluated the effect of public fisheries extension service comparing RFs and NFs. Different demographic variables such as age, sex, education, farm size, along with objectives of fish farming, and frequency of extension contact, were considered to describe the general characteristics of the respondents. Effect of extension service was measured based on use of extension communication media, organizational participation, income from fish farming, knowledge in fish farming, and attitude towards natural resource management. To measure the significance of difference between farmers, Chi-square test was employed. The research also revealed the effect of public fisheries extension contact along with some other selected predictor variable on income from fish farming, knowledge in fish farming, and attitude towards natural resource management. The measurement procedures of all the variables were placed in Appendix 1. This study adopted 7 point Likert scale for measuring satisfaction and attitude towards natural resource management, as this scale offer more distinction, more reliability and validity [35], and seems to reduce skewness and closest to normal [36]. For performing all the statistical analyses this study used SPSS 16.0.

3. RESULTS AND DISCUSSIONS

3.1 THE SILENT FEATURES OF THE FISH FARMERS

The result of the descriptive analysis presented in Table 1 shows that the mean age of both RFs and NFs are around 40 years and fish farming is heavily dominated by male farmers (75 %). The majority of public fisheries extension services related farmers objected their farming for both family consumption and commercial purpose (74.3%) while none of the NFs run their farm with commercial intentions. In case of education, more than 80% of RFs achieved primary to secondary level education and none of them were illiterate. However, among the NFs more than 70% possess illiterate to primary level education. In terms of farm size, 71.4% of the NFs are homestead based fish farmers, while 51.5 percent of the RFs were

either medium or large farmers. When comes frequency of extension contact 90.6 percent of the RFs maintained at least one contact in every three months, while only 8.6 percent of NFs had one contact in the last six months and the rest did not have any contact in last six months with public fisheries extension service.

Table 1: Descriptive characteristics of the respondents (N= 140).

Variable	Scale	Categories	Frequency		%	
			RF	NF	RF	NF
Age	Ratio	Mean (RF=40.57, NF=39.74), Standard dev. (RF=11.80, NF=12.56), Obs. range (RF=22-68, NF=20-70)				
Gender	Nominal	Male	49	56	70	80
		Female	21	14	30	20
Objective of Fish Farming	Nominal	Commercial	10	0	14.3	0
		Family consumption	8	39	11.4	55.7
		Both	52	31	74.3	44.3
Education	Ordinal	Illiterate	0	26	0	37.1
		Primary	24	22	34.3	31.4
		Secondary	33	10	47.1	14.3
		HSC or above	13	12	17.1	15.7
Fish farm size	Ordinal	Homestead pond	8	50	11.4	71.4
		Small (up to 0.40 ha)	19	17	27.1	24.3
		Medium (0.401-0.80 ha)	34	03	48.6	4.3
		Large(>0.80 ha)	9	0	12.9	0
Frequency of extension contact	Ordinal	None/ last six months	0	64	0	91.4
		Once/six months	8	6	11.4	8.6
		Once/three months	16	0	22.9	0
		Once/ month	35	0	50	0
		Once/15 days	11	0	15.7	0

Source: Field study, 2015

3.2 COMPARISON OF RFS AND NFS BASED ON SELECTED SOCIOECONOMIC ASPECTS

Comparison of related farmers (RFs) and non-related farmers (NFs) was observed based on chi-square analysis. The findings presented in Table 2 exhibit that there is a significant difference between RFs and NFs in terms of all the selected socioeconomic aspects, where RFs were found to be in a better position. They had more use of communication media, more organizational participation, better income from fish farming, enhanced knowledge in fish farming, and more positive attitude towards natural resource management.

Table 2. Comparison of RFs and NFs based on selected socioeconomic aspects (N=140).

Socio-economic aspects	Category	RF		NF		Row Total	Mean		df	Chi-sq Value
		f	%	f	%		RF	NF		
Use of communication	Low	9	12.9	42	60	51	9.67	4.84	2	36.10**
	Medium	34	48.6	21	30	55				

media	High	27	38.6	7	10	34				
Organizational participation	Low	37	52.9	66	94.3	103	2.11	0.185	1	31.00**
	Medium & High	33	47.1	4	5.7	37				
Income from fish	Low & Medium	9	12.9	43	51.50	52	57.18	20.12	1	35.34**
	High	61	87.1	27	38.6	88				
Knowledge on fish cultivation	Low & Medium	26	37.2	56	80	106	13.70	10.25	1	26.50**
	High	44	62.8	14	20	64				
Attitude towards natural resource management	Low & Medium	23	32.9	64	91.4	87	62.07	48.00	1	53.10**
	High	47	67.1	06	8.6	53				

Note: **significant at 1% level, Cells are merged to keep frequencies more than 5%
Source: Field study, 2015

3.3 DETERMINANTS OF SELECTED ECONOMIC AND PERSONAL CRITERION OF THE CLIENTS

Determinants of the selected economic and personal criterion of the clients were measured using multiple regression analysis following enter method. Data arranged in Table 3 indicates that seven predictor variables, namely the frequency of extension contact, use of extension communication media, organizational participation, satisfaction with extension service, gender, income from fish farming, and attitude towards natural resource management can collectively describe 60.2 percent variation in client's knowledge in fish farming, hence confirmed the acceptability of the model ($F_{7,140}$=31.01, p<0.000). Data presented in the second column of Table 3 further revealed that satisfaction with extension service is the most important contributor (β=0.329) followed by income from fish farming (β=0.242), attitude towards natural resource management (β=0.212), and gender (β=127). Data arranged in the third column of the same table confirmed that total income (β=0.526) is the most important determinant of a client's income from fish farming followed by frequency of extension contact (β=0.267), and knowledge in fish farming (β=0.162). Regression results presented in the third column of Table 3 mirrored that attitude towards natural resource conservation is heavily influenced by the frequency of extension contact (β=0.307) followed by the satisfaction with extension service (β=0.250), and knowledge in fish farming (β=0.156). Echoing our findings, [37] in his study in ten selected villages of Gazipur district of Bangladesh found that extension contact has a positive significant impact on farm income of the rice farmers. [38] in his study on rice farmers in seven rural provinces of rural China claimed that farmers' participation in agricultural extension has a trivial positive impact on retaining the farmer's nutrient management behavior.

Table 3. Contribution of selected factors on selected economic and personal aspects of clients (N=140).

Predictor variables	**Criterion variables**		
	Knowledge on fish farming	**Income from fish cultivation**	**Attitude toward NRC**
Extension contact	-0.019	0.267**	0.307**
Use of communication	0.137	0.054	0.263**

media			
Organization participation	-0.040	-0.020	-0.048
Satisfaction with service	0.329**	-0.157	0.250**
Gender	0.127*	--	--
Total income	--	0.526**	--
Knowledge in fish farming	--	0.162*	0.156*
Income from fish farming	0.242**	--	0.016
Attitude toward NRC	0.212*	0.123	--
Model specification	$F_{7, 140}$= 31.013, P<0.0000, R^2= 0.610, Adj. R^2= 0.602	$F_{7, 140}$= 46.60, P<0.000, R^2= 0.712, Adj. R^2= 0.697	$F_{6, 140}$= 57.35, P<0.000, R^2= 0.721, Adj. R^2= 0.709

Note: *significant at 5% level, **significant at 1% level; VIF value for all the predictor variable is <5
Source: Field study, 2015

3.4 PROBLEMS OF PUBLIC FISHERIES EXTENSION SERVICE AND PROBABLE SOLUTIONS

Problems and solutions regarding public fisheries extension service were sought via open questions in the interview schedule. As per the opinion of the respondents presented in Table 4, public fisheries extension service is biased to affluent and politically strong clients, lack of contact frequency, lack of input supply, inability to provide standard service, unavailability of extension agents during necessity, etc. The respondents also suggested a package of nine solutions to improve the standard of public fisheries extension service. The major suggestions were providing quality input support to the clients, sufficient client training programs, removal of political biases in group selection, offering timely service, etc. However, the rest of other problems and suggestions can be observed from Table 4.

Table 4. Perceived problems and solutions regarding public fisheries extension service by the clients.

Problems	F	Suggestions	F
Extra care for affluent and politically strong clients	35	Quality input support for the clients	93
Lack of contact frequency	34	Sufficient training programs for the clients	31
Lack of input supply	25	Removal of political biasness in group selection	22
Incapable to provide standard service	25	Timely service	14
Unavailability of the extension agents in time	20	Special care for women and young clients	14

Unequal treatment among the clients	14	Selecting true farmers for the groups	13
Failure to encourage women and young clients	13	Good relationship with the clients	11
Insufficient number of field workers	11	Motivation campaign with posters and leaflets	10
Field officials are not cordial enough	10	Helping the real poor clients	11

Note: F= Frequency; One respondent bear the freedom to mention more than one problems/suggestions
Source: Field study, 2016

3.5 DISCUSSION

Bangladesh, a small country of Southeast Asia, is knit with numerous rivers and water bodies. The county is blessed with abundant aquatic resources. So, fisheries sector has remarkable potential in the development of the economy of the country. Lamentably, this sector's progress is not up to the mark and at present this country is not capable enough to utilize its full potential. Many reasons can be attributed for this backdrop. However, one of the important of them is absence of well developed fisheries extension service for all sorts of clients.

The findings of this study have confirmed the fact that fish farming is dominated by man, although small-scale homestead fisheries are predominantly a women's business, and they are conspicuously involved in various activities such as pond preparation, pre-stocking management and fry stocking, feed and fertilizer application, fish harvesting and fish marketing [39]. Lamentably, their contribution to small scale aquaculture is often unrecognized [40]. Nonetheless, in many societies despite women's significant participation in agricultural production activities, they have been excluded from training and extension service (Mbilinyi, 1994; Due et al., 1996; Beintema, 2006; Sanga et al., 2011; and Manfre et al., 2013 in [41]). The lack of women access to livelihood assets, and empowerment opportunities may create obstacles to receive her status as an individual farmer.

This study established the fact that the farmers in contact with public extension service were more educated, possessed a large farm size compared to their non-contact counterpart. In Bangladesh, extension service is very centralized and less farmer driven, where large and medium farmers receive more attention compared to other categories of farmers [42][43][44]. So, it is apparent from the findings that public aquaculture extension service is also suffering from the failure to reach all categories of farmers equally.

The findings of this study confirmed that the farmers in contact with public fisheries extension service have more use of communication sources, increased participation in organization, enhance knowledge in fish farming, better income from fish farming, and have more positive attitude towards natural resource conservation. Studies around the globe [45][46][47][48] has revealed that extension contact can influence production, adoption of new inputs and technologies, farmer-to-farmer diffusion, client's knowledge, decision making capacity, and income. In fact, regular participation in public agricultural extension service offers more opportunities in group interaction, receiving information, and share problems with other farmers. Contact farmer also has more scope of receiving need based training. These extra facilities may create a difference among contact and non-contact farmers in terms of selected socioeconomic variables.

Frequency of extension contact has significant impact on farmers' income from fish farming and building positive attitudes towards natural resource management. However, public extension didn't have any significant contribution on farmers' knowledge in fish farming. In Bangladesh, many private and non-government organizations cater extension support to the

fish farmers. So, farmers not in contact with public service may receive agricultural information from their peers, and/or sources other than public fisheries extension service. Public fisheries extension has countrywide network and a numerous socioeconomic aspects are influenced by this service. Unfortunately, this study encompasses limitation both in terms of geographical coverage and consideration of limited numbers of socioeconomic aspects.

4. CONCLUSION

Agricultural extension is a crucial pillar for sustainable agricultural development. The information arranged in this study established the logic that agricultural extension has enormous potential for the development of rural residents, especially marginal and small farmers. Although, many public organizations are catering extension service for the fish farmers, lamentably there is no specialized organization for delivering quality fisheries extension service to the farmers. The present extension service is gender biased, and predominantly centered to the medium and large farmers. Farmers connected with the public fisheries extension service were seemed to be better in terms of all the selected socioeconomic dimensions compared to their not-connected counterpart. Most importantly the connected farmers have more income from fish farming, more knowledge in fish farming, and more favorable attitudes towards natural resource management. This study found that fish farmers extension contact can significantly contribute to clients' income from fish production, as well as the development of positive attitude towards natural resource management. The clients encountered a magnitude of problems with public fisheries extension service, such as ill-timed supply of information, less frequency of extension contact, and limited opportunity of receiving fish farming related training. As a way of solving the aforesaid problems, they suggested an increasing frequency of extension contact, increasing number of extension workers, creation of opportunity for fish farming related training for the clients, and politically unbiased selection of true fish farmers during group formation.

5. RECOMMENDATIONS

Based on the findings, this research proposed the following recommendations:

- Similar to many other extension services, fisheries extension service seemed to be gender bias, although a major section of rural women is involved in fish farming activities in different ways. So, special programs centering rural women are essential for improving fish production and reducing gender gap in the fisheries sector.
- Large and medium farmers are normally more in contact with public fisheries extension service, leaving homestead based and marginal farmers away, although these groups need more extension support due to intensive management of the small farm. So, the creation of space in public extension service, for homestead based and marginal fish farmers are necessary.
- Ensuring satisfactory income and conservation of natural resource is necessary for sustainable development of the fisheries sector in Bangladesh. This study established the fact that the increasing frequency of extension contact can improve farmers' income from fish and develop positive attitudes of farmers in natural resource conservation. So, increasing frequency of public extension contact via different communication media is crucial for sustainable development of the fisheries sector in Bangladesh.
- Bangladesh is endowed with aquatic resources and aquaculture extension service bears the potential to develop this sector, so government can furnish a new and expanded policy agenda for aquaculture extension service focusing food security and income generation of people.

6. REFERENCES

[1] FAO. Fishery and Aquaculture country profile. Bangladesh. Fact Sheets. In: FAO Fisheries and Aquaculture Department [on line]. Rome. 2010. Accessed 23 May 2016. Available at: http://www.fao.org/fishery/facp/BGD/en#CountrySector-Overview

[2] Lynsey. Aquaculture in Bangladesh. 2005; Available: http://aquaculture.ako.net.nz/2005/11/09/aquaculture-in-bangladesh/

[3] Rahman MR. Causes of biodiversity depletion in Bangladesh and their consequences on ecosystem services. American Journal of Environmental Protection, 2015; 4(5):214-236. Doi: 10.11648/j.ajep.20150405.13

[4] Mahmud I. Bangladesh stands fourth in fish production. The Daily Prothom Alo [on line]. 2014. Accessed 28 June 2016. Available: http://en.prothom-alo.com/bangladesh/news/56042/Bangladesh-stands-fourth-in-fish-production

[4] Kunda MS, Castine, Thilsted S. Bangladesh: Country overview on the importance of fish for nutrition and the current activities fisheries & aquaculture. 2014. Accessed 23 April 2016. Available: http://www.worldfishcenter.org/content/bangladesh-country-overview-importance-fish-nutrition-and-current-activities-fisheries-and

[5] Towers L. Improving quality tilapia seed production for Bangladesh's sustainable aquaculture development; 2013. Accessed 3 June 2016. Available: http://www.thefishsite.com/fishnews/20795/improving-quality-tilapia-seed-production-for-bangladeshs-sustainable-aquaculture-development/

[6] Ghose B. Fisheries and aquaculture in Bangladesh: challenges and opportunities. Annals of Aquaculture & Research, 2014;1(1): 1001.

[7] Sakib MH, Afrad MSI, Prodhan FA. Farmers' knowledge on aquaculture practices in Bogra district of Bangladesh. International Journal of Agricultural Extension, 2014; 2(2): 121-127.

[8] WorldFish Center. Aquaculture and fish consumption in Bangladesh. 2011. Accessed 29 June 2016. Available: http://www.worldfishcenter.org/resource_centre/WF_2970.pdf

[10] Adeokun OA, Adereti FO. Agricultural extension and fishery development: Training for women in fish industry in Lagos state, Nigeria. J Sc Sci. 2005; 11(1): 1-5.

[11] Halwart M, Funge-Smith S, Moehl J. The role of aquaculture in rural development. Review of the State of World Aquaculture, FAO, Rome, 2003; 47-58.

[12] Feder G, Willett A, Zijp W. Agricultural extension-generic challenges and some ingredients for solutions. Working Paper, Washington, D.C.: World Bank, 1999.

[13] Maunder AH. Agricultural extension, a reference manual, 3rd printing, FAO, Rome, 1978.

[14] Rahman MA, Mustafa MG, Barman BK. Impacts of aquaculture extension activities on female fish farmers in different areas of Bangladesh. Bangladesh J Zoology. 2011; 39(2): 213-221.

[15] UNDP. Sharing innovative experiences, examples of successful initiatives in agriculture and rural development in the south. UNDP Unit for Technical Cooperation among Developing Countries. 2001.

[16] Howardell D. How to improve customer service. 2011. Accessed 04 August, 2016 Available: www.theacagroup.com/hot-to-improve-cs/

[17] Belton B. Little DC. Immanent and interventionist inland Asian aquaculture development and its outcomes. Development Policy Review. 2011; 29(4): 459-484.

[18] Paul BG, Vogl CR. Impacts of shrimp farming in Bangladesh: challenges and alternatives. Ocean and Coastal Management, 2011. 54(3): 201-211. Doi; 10.1016/j.ocecoaman.2010.12.001.

[19] Pemsl DE, Dey MM, Paraguas FJ, Bose ML. Determining high potential aquaculture production areas-analysis of key socio-economic adoption factors. IIFELT Portsmouth Proceedings. 2006. Accessed 19 June 2016. Available: https://www.academia.edu/16376748/Determining_high_potential_aquaculture_production_areas_analysis_of_key_socio-economic_adoption_factors

[20] Gias UA. National Aquaculture Sector Overview. Bangladesh. National Aquaculture Sector Overview Fact Sheets. In: *FAO Fisheries and Aquaculture Department* [online]. 2005. Rome. Accessed 5 August 2016. Available: http://www.fao.org/fishery/countrysector/naso_bangladesh/en

[21] Belton B. et al. Review of aquaculture and fish consumption in Bangladesh. Studies and Reviews 2011-53. The WorldFish Center. November ,2011.

[22] Aghazadeh E. Fisheries socioeconomic analysis and policy. Technical report BGD/89/012. Fisheries Research Institute, Ministry of Fisheries and Livestock, UNDP, FAO. 1994.

[23] Islam M. Perspectives of the coastal and marine fisheries of the Bay of Bengal, Bangladesh. Ocean and Coastal Management, 2003; 46(8): 763-796.

[24] Ahmed M. Lorica MH. Improving developing country food security through aquaculture development – lessons from Asia. Food Policy, 2002; 27:125-141.

[25] Akindiya AJ. Roles of agricultural development programs (adps), extension services to aquaculture development in Lagos and Ondo states of Nigeria. A project report, Department of Aquaculture and Fisheries Management, College of Environmental Resources Management, University of Agriculture, Abeokuta. 2012.

[26] DoF. Fisheries Statistical Yearbook of Bangladesh 2012-2013. Department of Fisheries. Ministry of Fisheries and Livestock, Dhaka, Bangladesh. 2014.

[27] Mazid MA. Development of fisheries in Bangladesh: plans, and strategies for income generation and poverty alleviation. Momin Offset Press, Dhaka, Bangladesh, 2002. pp176.

[28] BFRI. BFRI at a Glance. Bangladesh Fisheries Research Institute Official Website, Bangladesh Fisheries Research Institute, Mymenshing, Bangladesh. 2016. Accessed 25 April 2016. Available: http://www.fri.gov.bd/.

[29] BBS. District statistics 2011: Barisal. Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh; 2013.

[30] Kothari CR. Research methodology methods and techniques (2nd edition). Wishwa Prakashan: New Delhi. 1990; 280-282.

[31] Rashid MMU, Uddin ME, Haque ATMS. Shrimp farmers' usage and preference of extension communication media in selected areas of Bagherhat district of Bangladesh. British Journal of Applied Science & Technology, 2016;15(4):1-12, Doi: 10.9734/BJAST/2016/24637

[32]Thompson AW, Reimer A, Prokopy S. Farmer's view of the environment: the influence of competing attitude frames on landscape conservation efforts. Agriculture and Human Values, 2014; 32(3):385-399.

[33] Okwu OJ, Dadu S. Extension communication channel usage and preference by farmers in Benue state, Nigeria. Journal of Agricultural Extension and Rural Development. 2012; 3(5):88-94.

[34] Nunnally JC. Psychometric Theory. 2nd ed. McGraw-Hill, New York, 1978.

[35] Krosnick JA, Presser S. Question and questionnaire design in handbook of survey research (2nd edition), Emerald, 2010.

[36] Leung Shing-On. Comparison of psychometric properties and normality in, 4-, 5-, 6-, and 11- point Likert scales. Journal of Social Service Research, 2014; 37(4).

[37] Haq AZM. The impact of agricultural extension contact on crop income in Bangladesh. Bangladesh Journal of Agricultural Research, 2013; 38(2): 321-334.

[38] Pan D. The impact of agricultural extension on farmer nutrient management behavior in Chinese rice production: a household level analysis. Sustainability, 2014; 6(10):6644-6665. Doi: 10.3390/sub6106644.

[39] Shirajee S. women and small-scale freshwater aquaculture in Bangladesh: a study in Trishal upazila of Mymensingh district. LAP LAMBERT Academic Publishing. 2011.

[40] Ahmed MK, Halim S, Sulatana S. Participation of women in aquaculture in three coastal districts of Bangladesh: approaches towards sustainable livelihood. World Journal of Agricultural Science, 2012; 3(3): 253-268.
[41] Sanga C, Kalungwizi VJ, Msuya CP. Bridging gender gap in provision of agricultural extension service using ICT: experiences from Sokoine University of Agriculture (SUA) Farmer Voice Radio (FVR) project in Tanzania. International Journal of ICT Research and Development in Africa, 2014; 4(1), Doi: 10.4018/ijictrda.2014010101.
[42] Swanson BE. Assessment of Bangladesh's pluralistic extension system: a MEAS rapid scoping mission in Bangladesh. Modernizing Extension and Advisory Services (MEAS) Project. Report prepared for USAID, February, 2011
[43]World Bank. Revitalizing the agricultural technology system in Bangladesh. Bangladesh Development Series, paper no. 7, Dhaka, 2005.
[44] Sobhan R. Growth and stagnation-a review of Bangladesh development 1995. Dhaka, Center for Policy Dialogue, 1995.
[45] Yang P, Liu W, Shan X, Li P, Zhou J, Lu J, Li Y. Effects of training on acquisition of pest management knowledge and skills by small vegetable farmers. Crop Protection, 2008; 27 1504-1510.
[46] Yamazaki S, Resosudarmo B. Does sending farmers back to school have an impact? revisiting the issue. The Developing Economies, 2008; XLVI(2):135-150.
[47] Cerdán-Infantes P, Maffioli A, Ubfal D. The impact of agricultural extension services: the case of grape production in Argentina. Office of Evaluation and Oversight Working Paper OVE/WP-0508, Inter-American Development Bank, Washington D.C. 2008. Accessed 8 August 2016. Available: http://ideas.repec.org/p/idb/ovewps/0508.html.
[48] Feder G, Murgai R, Quizon JB. Sending farmers back to school: the impact of farmer field schools in Indonesia. Review of Agricultural Economics, 2004; 26 (1): 45-62. http://dx.doi.org/10.1080/01488376.2011.580697.

Appendix-1

Table . Measurement of the variables of the study

Variables	Measurement
Age	Year
Sex	Nominal (Male=1, Female=0)
Educational status	Categories based on level of schooling in Bangladesh
Farm size	Categories based on farm size
Mode of fish farming	Nominal (Family consumption=1, Commercial=2, Both=3)
Contract with extension service	Categories based on frequency of contact/last six months
Economic status	'000' Tk/year
Production	Kg/Year
Usage of communication media	4 point rating Scale (Frequent use 3…… 0 don't use)
Membership in the organization	Years and membership status
Annual income	'000' Taka/Year
Knowledge on fish farming	Score

Satisfaction with PFES	7 point Likert scale (Very satisfied 6……..0 Dissatisfied)
Attitude toward natural resource conservation	7 point Likert scale (Strongly agree 6…….0 Strongly disagree)

Note: 78 Tk= 1 USD