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Farmers' Perception and Adoption of Agroforestry Practices in Faridpur District of Bangladesh

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Abstract— *This study mainly focused on exploring perception of farmers' towards agroforestry practices and identifying the demographic factors influencing agroforestry adoption in Faridpur district. Field survey was conducted during November-December, 2016 using semi-structured questionnaire. Multi-stage random sampling was used to select upazillas, unions and villages. Snowball purposive sampling was applied to select 84 respondents in total for the questionnaire survey. Chi-square was used to test variables at 5% level of significance. Homestead agroforestry was found to be the most common agroforestry practice (39.28%), followed by fruit-based agroforestry (21.42%), woodlot plantation (13.09%) and so on. Agroforestry was perceived to increase farm productivity by 82.14% of the respondents, 73.8% opined that agroforestry increase household income, while 30.95% perceived it as a means to food security. On the contrary, 34.52% opined that agroforestry practices decrease cash crops production, 17.85% of the respondents stated agroforestry as a difficult practice. Chi-square test showed no significant association between the adoption of agroforestry practices and respondent's age ($P > 0.05$) or income range ($P > 0.05$) of the respondents. On the other hand, there is a positive significant association between the adoption of agroforestry practices and educational level ($p< 0.05$) as well as the farm size ($p< 0.05$) of the respondents. The study suggests raising awareness regarding the benefits of agroforestry practices as well as providing technical assistance.*

Keywords— ***Adoption, Agroforestry practices, Faridpur district, farmers' perception***

I. INTRODUCTION

Agriculture has been the most prominent sector of Bangladesh economy contributing around 17% of GDP and also providing employment to 45% labor force (BBS, 2014). The area of the country is very small having a huge amount of population making it one of the densely populated countries in the world with the annual growth rate of 1.37 % (BBS, 2017). New pressure has been created on limited resources such as agriculture, forest and land resources due to rapid population growth. The forest coverage of Bangladesh is one of the lowest as 11% and at the same time the deforestation rate is the highest as 3.3% per year of any country in the world (Gain, 1995; FAO, 2010; Rahman *et al*., 2010). Finding the best possible way to produce more agricultural crops and forest products deploying these scarce resources is a dire need to meet the demand of increasing population.

Agroforestry systems are preferable to monocropping as they are able to generate income from agricultural crops, tree sales and carbon trading programmes, such as REDD+ schemes. Agroforestry can be the most effective way to reduce deforestation in Bangladesh which could bring 'win-win' solutions to meet both environment and development objectives (Rahman, 2012). Agroforestry can be recognized as potential solution to meet the needs of the society as well as sustainable development models due to its benefits not only to the economy and society but also to the ecosystem (Bargali *et al*., 2009; Thanh, 2005). Farmers can benefit from agroforestry technologies that give solutions to issues with soil productivity, product diversification, and economic problems (Franzel and Scherr, 2002). Haque (1993) mentioned that agroforestry as a means to meet the dimensional needs of the rural people in terms of food, fuel, timber, construction materials, thereby helping them to lead a self-sustained life. It is estimated that about 80-82% of forest products produced anually in the country come from this agroforestry farming system (GOB, 1992).

Agroforestry systems may provide efficient, productive, and/or sustainable land use but doesn't matter unless and until they are adopted and maintained over longer period of time (Scherr, 1992; Sanchez, 1995). Farmers invest in

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agroforestry practice only if the expected gains from this practice are higher than the alternatives for the use of their resources. Households tend to invest in uncertain and unproven technologies when they have more risk capital available in terms of land, labor, capital etc. (Mercer, 2004). The main objective of this study was to investigate and analyze farmers' perceptions of different agroforestry practices and to determine the socio-economic factors influencing adoption of agroforestry practices in Faridpur district.

II. MATERIALS AND METHODS

2.1 Site description

Faridpur is a district in central Bangladesh. It is a part of the Dhaka Division. Faridpur District has a population of over 1.7 million people and is situated on the banks of the Padma river (Lower Ganges). It is about 2072.72 sq. km, located in between 23°17' and 23°40' north latitudes and in between 89°29' and 90°11' east longitudes. It is bounded by Rajbari and Manikganj districts on the north, Gopalganj district

on the south, Dhaka, Munshiganj and Madaripur districts on the east, Narail and Magura districts on the west (Banglapedia, 2016). The rainy season duration is June to October and the winter season duration is November to February. The annual average temperature in this area varies maximum 37.40 ^{0}C to minimum 8.60 ^{0}C. The annual average rainfall is 1310 mm (BBS, 2015).

Fig. 1: Map of the study area

2.2 Sampling design

Faridpur district was purposively choosen as first sampling unit. Multistage random sampling was adopted in the selection of villages. In this study five upazilla out of nine were selected randomly as second sampling unit and then two unions from each of the five upazilla were taken randomly as third sampling unit. Again two villages from each union were selected in random manner as fourth sampling unit. Random sampling (Zhen *et al*., 2006) was used to select villages because the reconnaissance survey identified all villages where agroforestry practices had taken place and those without agroforestry. Finally four to five

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respondents were selected from each village using snowball purposive sampling and total of 84 respondents were contacted for the survey. Both random and purposive sampling can be combined to produce a good method of sampling (Albertin and Nair, 2004) as well as to add credibility to the result of a larger study (Teddlie and Tashakkori, 2009).

2.3 Data collection methods Two main sources were used to collect data, these were primary and secondary. Questionnaire, interviews and field observation methods were applied to collect detailed information on perception and the demographic features of the respondents. Rectified semi-structured questionnaire was used to obtain data on the demographic characteristics of the farmers. Data was gathered on farmers' household characteristics, occupational characteristics, perceptions of agroforestry and demographic factors that may influence farmers' decision of adopting agroforestry practices. The secondary sources of data were collected from journals, books, various publications, government department, extension officers, local leaders, published and unpublished reports, internet browsing etc.

2.4 Data analysis

Field data collected using semi-structured questionnaires was presented in Microsoft Excel, 2010 while information gathered through observation was presented descriptively. The data gathered was analyzed using descriptive statistics that include the use of percentages tables, column chart charts, pie charts etc. Chi- square test (goodness of fit) was followed (Adedayo and Oluronke, 2014) to test the nature of association between adoption of agroforestry practices and respondent's age, level of education, annual income and farm size.

III. RESULTS AND DISCUSSION

3.1 Demographic features of the respondents

The demographic features of the respondents in the study area are shown in Table 1. The age of the respondents is divided into four categories. Major respondents (47%) were young aged, 31% respondents were middle aged, 19% were old and 3% respondents were very young. The Table 1 indicates that a majority of the respondents (49%) studied secondary level followed by 32% to primary level, 13% to above secondary level and 6% to illiterate. The annual income of the farmers falls in four categories. The highest percentage (32%) is represented by farmers who earn from $ 1201-$1800 and appear to be in the middle income category. 16% of the respondents earn upto $1200 and 24% of the respondents earn from $1801-$2400 whereas about 28% of the respondents earn above $2400 per year. The land holding size was categorized in four groups i.e., small (16%), medium (26%), large (34%) and very large (24%). Demographic features of the respondents play an important role in determining their perception and attitude towards the adoption or rejection of new ideas (Ghauri and Qureshi, 1999). Different studies revealed that the socio-economic characteristics had much influence on the adoption behavior regarding new practices.

Table 1: Demographic profile of the respondents

Characteristics	Categories	Percentage of farmers (%)
Age	Very young (18-25 yrs.)	3
	Young (26-35 yrs.)	47
	Middle-aged (36-50 yrs.)	31
	Old (50+ yrs.)	19
Education Level	Illiterate	6
	Primary	32
	Secondary	49
	Above	13
Annual income	Low (Upto $1200)	16
	Medium ($1201-$1800)	32
	High ($1801-$2400)	24
	Very High (Above $2400)	28

	Small (upto 0.33 acre)	16
Farm size	Medium (0.34- 0.66)	26
	Large (0.67- 0.99)	34
	Very Large (Above 1 acre)	24

3.2 Agroforestry practices in the study area

There are various types of agroforestry practices in Faridpur district. The study area mainly covers the following types of agroforestry practices with some other minor types. From Table 2, 40% of the respondents had homestead agroforestry followed by 12% to cropland agroforestry, 21% to fruit based agroforestry, 10% to boundary plantation, 13% to woodlot plantation and 4% to fish farm agroforestry.

Table.2: Agroforestry Practice by Respondents in the Study Area

Agroforestry Systems	No. of Respondents	Percentage of Respondents
Homestead Agroforestry	33	39.28%
Cropland Agroforestry	10	11.9%
Fruit-based Agroforestry	18	21.42%
Boundary Plantation	8	9.52%
Woodlot Plantation	11	13.09%
Fish farm Agroforestry	4	4.76%

3.3 Farmers' perception of agroforestry practices in the study area

Majority of the respondents in the study area were aware of the positive impact of agroforestry practices. The respondents were aware of the economic and productive benefits of agroforestry practices and had favorable perception towards those practices. Perception of agroforestry practices from Fig. 2 indicated that the productive values (82.14%) were considered most important among majority of the respondents. Because they understood agroforestry as a means to meeting their basic needs in terms of fuel wood, fruits, fodder, timber, vegetables etc. Similarly, a significant proportion (73.80%) of the respondents realized the economic aspects as most important.

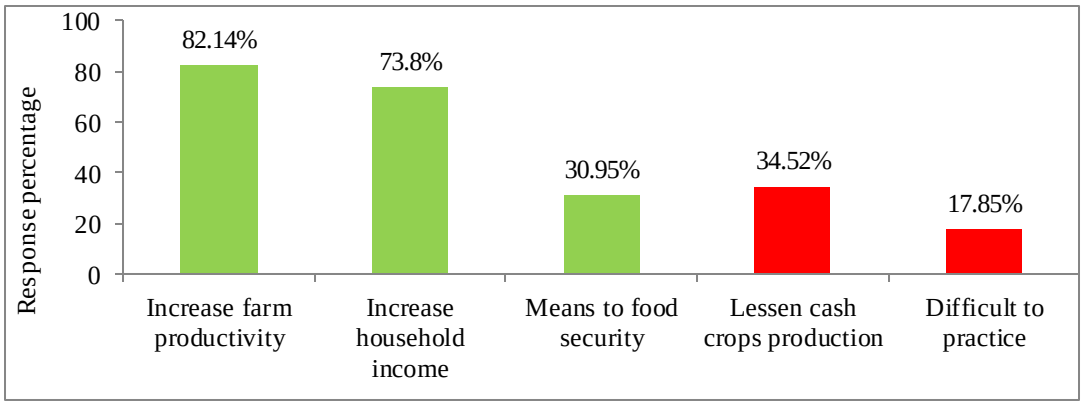

Fig. 2: Farmers' perception of agroforestry practices

This is because agroforestry increased family income, employment opportunities, decreased farm expenditure etc. Farmers' perceived some protective roles of agroforestry such as soil conservation, erosion control, flood control etc. It is noteworthy that, respondents opined that agroforestry is difficult (17.85%) to practice this is an indication of lack of knowledge. Besides, some of the surveyed farmers (34.52%) opined that crop yields are reduced when trees are grown in the fields.

3.4 Trees and agricultural crops in the study area

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Various tree species as well as agricultural crops were found in the farmlands of the respondents. The Table 3 shows the crops in the agroforestry farmlands. Mahagoni, raintree, sissoo, neem, mango, jackfruit, rose apple, coconut, palm-tree etc. were found in the study area. On the other hand, papaya, turmeric, banana, eggplant, peas, jute, mustard, lentil etc. cash crops were grown in their fields.

Table 3: Crops found in the agroforestry farmlands

Practices	Tree species found	Agricultural crops found
Homestead Agroforestry	*Mangifera indica, Artocarpus heterophyllus, Syzygium cumini, Cocos nucifera, Azadirachta indica, Swietenia macrophylla, Manilkara zapota, Areca catechu, Citrus maxima*	*Basella alba, Lagenaria siceraria, Typhonicum trilobatum, Cucurbita moschata, Benincasa hispida, Vigna sesquipedalis, Carica papaya*
Cropland Agroforestry	*Phoenix sylvestris, Borassus flabellifer, acacia auriculiformis, Mangifera indica, Swietenia macrophylla, Citrus limon*	*Corchorus capsularies, Momordica charantia, Amaranthus lividus, Solanum melongena, Pisum sativum*
Fruit-based Agroforestry	*Mangifera indica, Manilkara zapota,, Citrus limon, Psidium guajava, Litchi chinensis*	*Zingiber officinale, Curcuma longa, Brassica nigra, Lens culinaris, Vigna unguiculata*
Boundary plantation	*Phoenix sylvestris, Borassus flabellifer, Cocos nucifera, Swietenia macrophylla, Samanea saman*	*Carica papaya, Musa sapientum, Moringa oleifera, Basella alba*
Woodlot	*Swietenia macrophylla, Samanea saman, Dalbergia sissoo, Albizia lebbeck*	×
Fish farm agroforestry	*Mangifera indica, Litchi chinensis, Psidium guajava, Azadirachta indica*	*Lablab niger, Basella alba, Vigna sesquipedalis etc.*

In spite of having some constraints agroforestry were perceived as advantageous practices. Table 4 shows several beneficial and harmful features of various agroforestry practices in the study area.

Table.4: Beneficial and harmful characteristics perceived by respondents

Agroforestry Practices	Beneficial features	Harmful features
Homestead Agroforestry	Household consumption (81%) Easy to manage as near to houses (43%) Protection from natural calamities (28%) Multiple products (67%)	Large trees may fall above house during storm (37%)
Cropland Agroforestry	Avoid single crop failure (60%) Profitable in the long run (40%) Provide cash in a continuous basis (30%)	Crops may not grow well after several years. (50%) Some plants may affect tree growth (e.g. banana) (30%)
Fruit-based Agroforestry	Very productive system (72.13%) Higher economic return per year (77.7%) Some fruit trees tolerate drought (22%) Some crops can be grown after tree canopy closure (28%)	Fruit trees will not live long (e.g. 10-12 years) (22%) Pest attack (16%) Higher initial investment (34%)
Boundary Plantation	Fencing (62.5%) Soil stabilization (62.5%)	May hamper adjacent crops (37.5%)

	Regular management is not required	Farmers' have to wait for a long time
Woodlot	(54%)	(72%)
	Less labor required (37%)	Higher initial input required (63%)
	Big amount of cash at a time (72%)	
Fish farm Agroforestry	Productive integrated system(25%)	Leaf fall into the water (50%)
	Diversified products (50%)	Shade problem (25%)
	Soil conservation (50%)	

3.5 Farmers' adoption of agroforestry practices in the study area

Agroforestry can provide the next step in sustainable agriculture by promoting and implementing integrated, bio-diverse processes (Wilson and Lovell, 2016). However, the success of agroforestry practices is determined by the level of adoption of agroforestry by the farmers. This study revealed that, fruit-based agroforestry has been adopted by 77.78% of the respective respondents followed by homestead agroforestry (69.7%), boundary plantation (62.5%) and so on. Adoption percentage was measured according to the respective practice. Here, average adoption percentage of agroforestry practice was 64.28%.

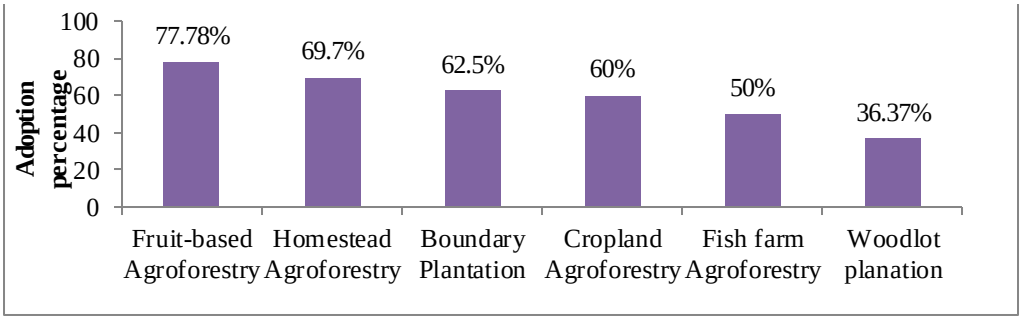

Fig. 3: Farmers' Adoption of agroforestry practices in the study area

Findings showed that, on an average significant proportion of farmers (64.28%) have adopted Agroforestry practice while 35.72% did not adopt the practice. The main reason for high level of adoption was may be because of multiple benefits gained by the farmers from the crop-tree combination and also because agroforestry has been an age-old practice among the local farmers not only in the study area but also in number of districts in the country.

3.6 Demographic features and adoption of agroforestry practices

Table 5 shows the association between demographic features and adoption of agroforestry practices in the study area. Chi-square test shows no significant ((P>0.05)) association between respondents' age and the adoption of agroforestry practices. This result is in line with Mwase *et al*., (2015), who found that age does not affect the adoption of agroforestry.

Table 5: Chi-square statistic for demographic features and adoption of agroforestry practices

Factors	Categories	Adoption Frequency	P-value
Age (years)	Very young (18-25 yrs.)	7	
	Young (26-35 yrs.)	20	
	Middle-aged (36-50 yrs.)	16	
	Old (50+ yrs.)	11	0.066
Education	Illiterate	3	
Level	Primary	18	
	Secondary	26	
	Above	7	0.00002

Annual income (taka)	Low (Upto $1200)	8	
	Medium ($1201-$1800)	19	
	High ($1801-$2400)	13	
	Very High (Above $2400)	14	0.211
Farm size (acre)	Small (upto 0.33 acre)	11	
	Medium (0.34- 0.66)	25	
	Large (0.67- 0.99)	12	0.002
	Very Large (Above 1 acre)	6	

Chi-square statistic from the Table 5 showed a positive significant ($p<0.05$) association between the education level of the respondent and their awareness about the agroforestry practices.

Findings clearly indicated that educated farmers had more awareness and they are very keen to adopt agroforestry practices as compared to illiterate farmers. When farmers are educated they have better access to information and innovations which help farmers to quickly adopt new technology. However, this finding supports Mekoya *et al*., (2008) who found that agroforestry technologies are knowledge intensive and therefore require enough education in the adoption process. Farmers' income range is classified into four categories. They have various income ranges to lead their life. However, from Table 5 chi-square test indicated that respondents income range and adoption level is not significant ($P>0.05$) and therefore does not seem to affect the adoption of agroforestry in the study area.

Again, Chi- square statistic from Table 5 also indicated that there is significant association ($p<0.05$) between respondents farm size and the adoption of agroforestry practices in the study area. Thus, findings revealed that large landholders had more interest as compared to small landholders. Similar findings were given by Amsalu and Graaff (2007) that, in Ethiopia farmers with large farm sizes are more likely to invest in soil conservation measures as the farmers can take more risks, including relatively high investment, and survive crop failure. 40% of the respondents mentioned lower production rate of agricultural crops as a significant reason for planting trees on the croplands. Farmers' integrate trees and agro crops on the same piece of land to avoid uncertainty of agricultural crops production rate. Respondents stated that flood water comes and destroys the agricultural crops in the rainy season in some areas. Therefore, they don't want to waste their valuable resources and were reluctant to cultivate agricultural crops solely.

A large number of labors have been shifted outside the country in search of works thus giving rise to the labor shortage to cultivate agricultural crops. This labor shortage may be a reason for stopping agricultural crops cultivation alone and practicing Agroforestry thereby adopting it. Market facilities for agroforestry products were satisfactory to 88% of the farmers. Farmers stated clearly that they can sell their products without any significant difficulties which improve their living conditions and reduce poverty.

IV. CONCLUSIONS

Significant proportion of respondents (82.14% on the average) perceived agroforestry as a practice that can improve their farm productivity and overall income in comparison to monoculture. Besides, 73.8% of the respondents found agroforestry as household income raising practice while 30.95% mentioned agroforestry as a means of food security. In spite of this, 34.52% perceived it as methods that lessen cash crops production while some of them (17.85%) perceived it as a scientific method that is difficult to practice. Therefore, all the farmers in the study area did not adopted agroforestry practice. Finally, it can be concluded that the successful adoption of agroforestry to raise farm productivity and overall income of the respondents in the study area depends on raising awareness on benefits of agroforestry, providing adequate technical supports as well as ensuring the efficient use available farmlands of all types of landholders.

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