

Adoption of Agroforestry Technologies among Small Scale Farmers of Patuakhali and Khulna Districts in Bangladesh

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ABSTRACT

These researches investigate used by small scale farmers in Patuakhali and Khulna Districts in Bangladesh. This experiment was conducted to identifying the types of agroforestry technologies adopted by farmers. Bangladesh is a disaster prone country among the south Asian sub-continent. The agro-forestry technology most effective weapons of efficient land use. Results from the study identified majority (75%) of least farmers adapting to agroforestry technologies while (25%) were not practicing the technology. The study also identified the major types of agroforestry technologies adopted by farmers. Adoption of agroforestry technologies by small scale farmers has been low leading to persistence of wood fuel deficit. A sample of 201 small scale farmers who were selected using stratified proportionate random sampling in the location was used in the study. The study found out that farm size, sex (gender), land tenure, and farm preparation methods influences adoption of agroforestry technologies in the study area. So, this study recommends that extension services to encourage more small scale farmers adopt these technologies be intensified.

Keywords: Adoption, Agroforestry Technology, Small farmer, Khulna Koyra and Patuakhali.

INTRODUCTION

In Bangladesh Environmental resources support economic production and consumption opportunities. The climatic resilience is not enough to mitigate the adverse effect of environmental condition so, agro- forestry

modern technology is the best ways of safe the environment to support the climatic hazard in coastal areas of Bangladesh .The Most Governments in developing countries see forest resources as assets to exploit without re-investment to ensure sustainability. In Bangladesh, deforestation is still rampant particularly in villages and among highland farmers where land for cultivation is priority. Population pressure, improper Government policies and disruption of indigenous traditional land-use management practices, have contributed to accelerated degradation of forest land and loss of Biodiversity in Bangladesh (Kio and Abu, 1994). Thus consequently put forest cover in Bangladesh at less than 1.7% below the world recommended cover of 10%. It is therefore against this background that efforts to improve Agro-forestry technologies aimed at the integration of compatible components of Forestry and Agricultural Production System should be encouraged. EMCA, (1999), has come up with measures to encourage the planting of trees and woodlots by individual land users, Institutions and by Community organized groups. Ludekiet. al, (2004), has recommended farm forestry as an opportunity to protect existing forests. The Forest Act no. 7 of 2005 recognizes the importance of farm forestry as it diversifies farm production and provides both subsistence and income through such products as timber, fuel wood, herbal medicine, and fodder and soil conservation. Agro-forestry technologies seek to increase land productivity and income generation with environmental rehabilitation and diversification of agro-ecosystems. This is where other systems of income generation such as milk production are failing and people rely mostly on crop production. Therefore, need to investigate socio-economic and cultural factors influencing the adoption of Agro-forestry technologies as a potential to enhancing diversification of farm production and increase income generation at household level.

Objectives of the research: The broad objective of the study was Agro-forestry technologies practices within Patuakhali and Khulna District. A program to be adopted at the household level, to enhance on-farm forestry will be developed based on these findings. The program will integrate the local people's needs, their valued tree species and the benefits accruing out of certain preferred Agro forestry tree species. These results will help communities, stakeholders and policy makers to understand the need for on-farm afforestation in Bangladesh.

MATERIALS AND METHODS

The materials and methods of the study are given below-

Description of Patuakhali District

Geographic Area and Location: Patuakhali district is a part of the Barisal Division. It is bounded on the north by Barisal district, on the east by Bhola district, on the south by the Bay of Bengal and on the west by Barguna. It lies between 21°48' and 22°36' north latitudes and between 90°08' and 90°41' east longitudes.

Temperature and Rainfall: Annual average temperature of Patuakhali district varies from maximum 25.3°C to minimum 12.2°C and anual rainfall 2377 mm.

Main Crops and Fruits: Paddy, jute, potato, mug, lentil, khesari, gram, sesame, chilli, mustard, linseed, coriander seed, ground nut, betel leaf, sugarcane, watermelon, vegetables. Mango, jackfruit, banana, papaya, guava, plum, lemon, coconut, betel nut, palm, wood nut, kajjou nut etc. are main fruits of this district.

Agricultural Economic Situation: Various fruits like banana, jackfruits, guava, coconut, etc. are grown. Fishes of various species abound in the district like other parts of the country. Farm-holdings produce varieties of crops, namely local and HYV rice, wheat, vegetables, spices, cash crops, pulses, oilseeds, maize and others. Varieties of fish are caught from rivers, tributary channels and creeks and from paddy fields during rainy season. Besides, crops, livestock, forestry and fishery are the main source of household income. Valuable timber and other forest trees are also grown in this district.

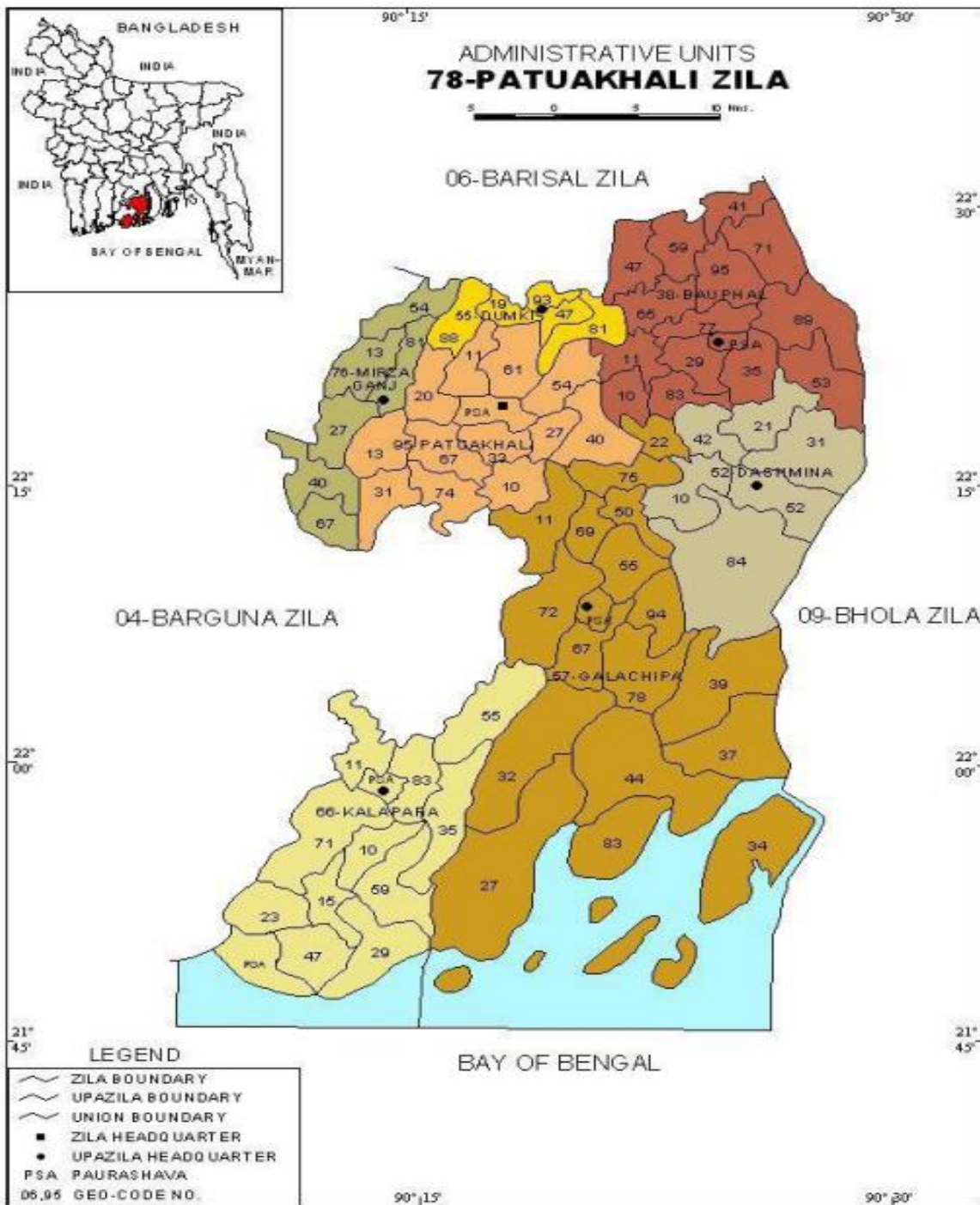


Figure 1. Map of Patuakhali district

Description of Khulna District

Geographic Area and Location: The Khulna district is bounded on the north by Jessore and Narail districts, on the east by Bagerhat district, on the south by the Bay of Bengal and on the west by Satkhira district.

Climate: The district has a hot summer and a mild winter. The summer begins from the middle of April and continues till the middle of June. The winter starts from November and continues till February. The monthly average minimum temperature falls down to 21.8°C in the month of January.

Agricultural Economic situation: The production of varieties crops, namely local and HYV paddy, wheat, jute, vegetables, spices, pulses, oilseeds, sugarcane and others .Various fruits like mango, banana, Jackfruit guava, coconut and betel nut etc. are grown. Varieties of fishes caught from rivers, tributaries, channels and creeks and even from paddy field during the rainy season.The Economic Activities that are developing in the district.

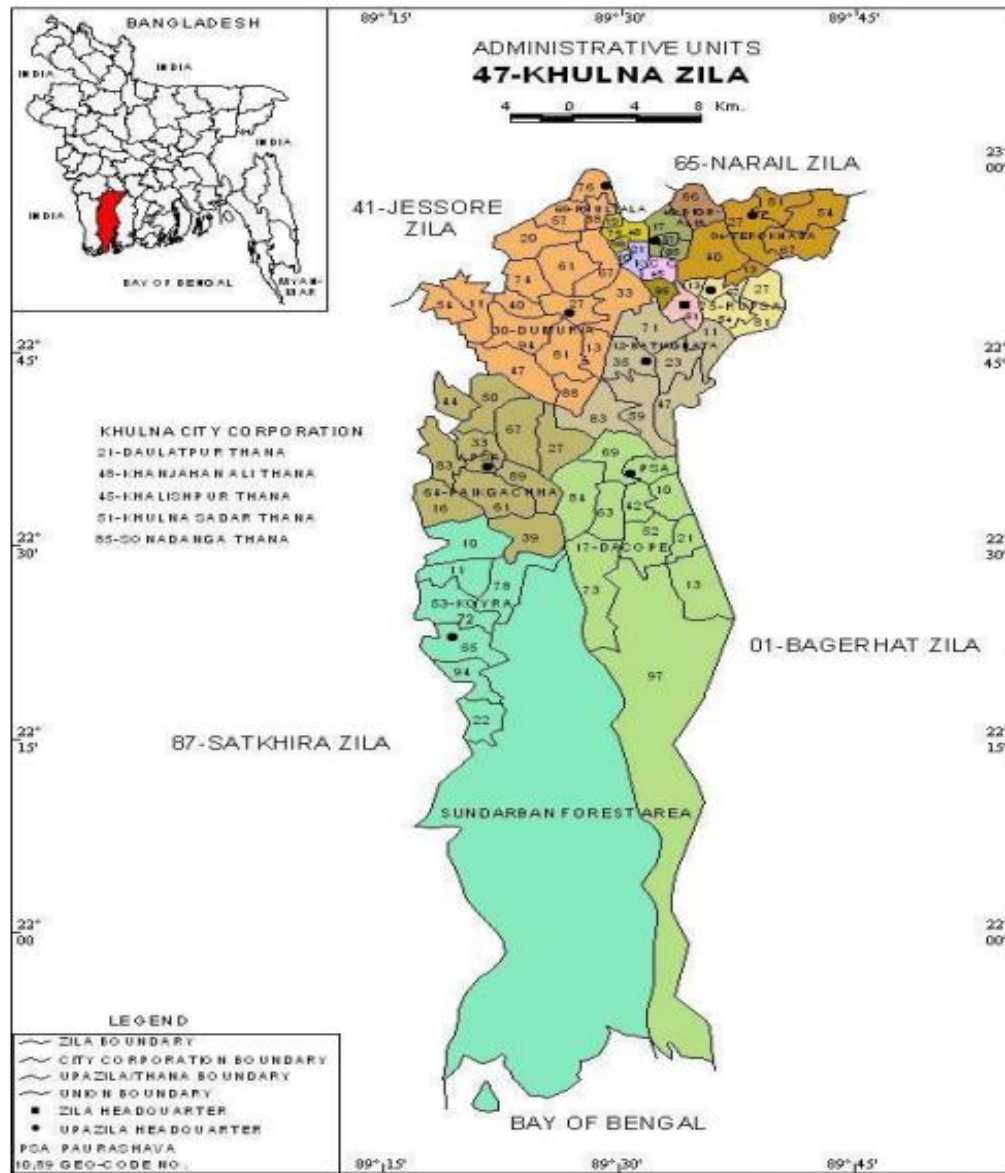


Figure 2. Map of Khulna district

Data Collection and Data Sources

A reconnaissance survey to the research area was carried out for the purpose of familiarization and pre-testing of the questionnaire. This facilitated necessary adjustments to the questionnaire and increased the reliability of the data. Data was collected on the following variables: land tenure, tree tenure, cultural beliefs and taboos, farm size, knowledge about Agroforestry technologies and their benefits.

Sampling Procedures

A sample of 240 small-scale farmers was used in the study. Stratified proportionate random sampling and non-probability sampling procedures were used to obtain a sample of 240 respondents in the four sub-locations.

Table 1: Stratified Proportionate Random Sampling

Sub-Location	Population	No. of Household	Area Km ²	Sample Size
Dumki	70655	15542	92.41	50
PatuakhaliSadar	316462	68813	362.46	65
Dumuria	306000	71909	454.23	55
Koyra	194000	45750	1775.40	70
Total	887117	202014	2684.5	240

The procedure has the advantage of being easy to administer, is less costly and respondents are selected depending on their knowledge, experience and relevance to the study.

Key Informants and Observations 2

The key informants included local men and women leaders who have influence in the community. They provided information on the planting of trees, use of trees and knowledge of Agroforestry technologies in the study area. The researcher made observation in the study area. This approach was important in comparing the reported information with the actual occurrences in the study area.

Data Analysis

The model being useful for situations in which you want to be able to classify subjects based on values of asset of predictor variables. This model is similar to logistic regression but it is more general because a dependent variable is not restricted to two categories. The probability of a given household being in one of the three levels of adoption given asset of explanatory variable is given by the expression below:

$$Y=0+_1X_1+_2X_2+.....+_nX_n+\epsilon_i..... (1)$$

Where

0= constant; 1.....13= estimated coefficients; Y=level of adoption; $X_1 - X_n$ are the explanatory variables and is the error term. The following are the variables used in the Multinomial.

RESULTS AND DISCUSSION

General Discussions

This chapter presents the results and general discussions on the findings. The results are presented in tables and figures and plates (photographs). The farmers were asked to respond to a set of questions on their characteristics that have an influence on the adoption of Agroforestry technologies. These included the age distribution of the farmers, marital status of farmer, education level, family sizes, their income levels, contacts with extension staff, land tenure, tree tenure rights, tradition believes and taboos and their farm preparation methods.

Number of farmers with different Agroforestry technologies

The following Agroforestry technologies are practiced by farmers in the study area: Woodlots, Tree planting on the homestead, Home gardens, Hedge planting and Boundary marking. The results also show that the adoption of Agroforestry technologies in the location was very high.

Table 2: Percentage number of farmers practicing different Agro forestry technologies

Agro forestry Technology	Percentage No. of farmers
Boundary marking	92.0
Hedges	81.6
Planting on Homesteads	76.6
Home garden	75.6
Wood lots	64.2

A comparison of the adoption levels in the 4 sub locations is shown in figure 1.

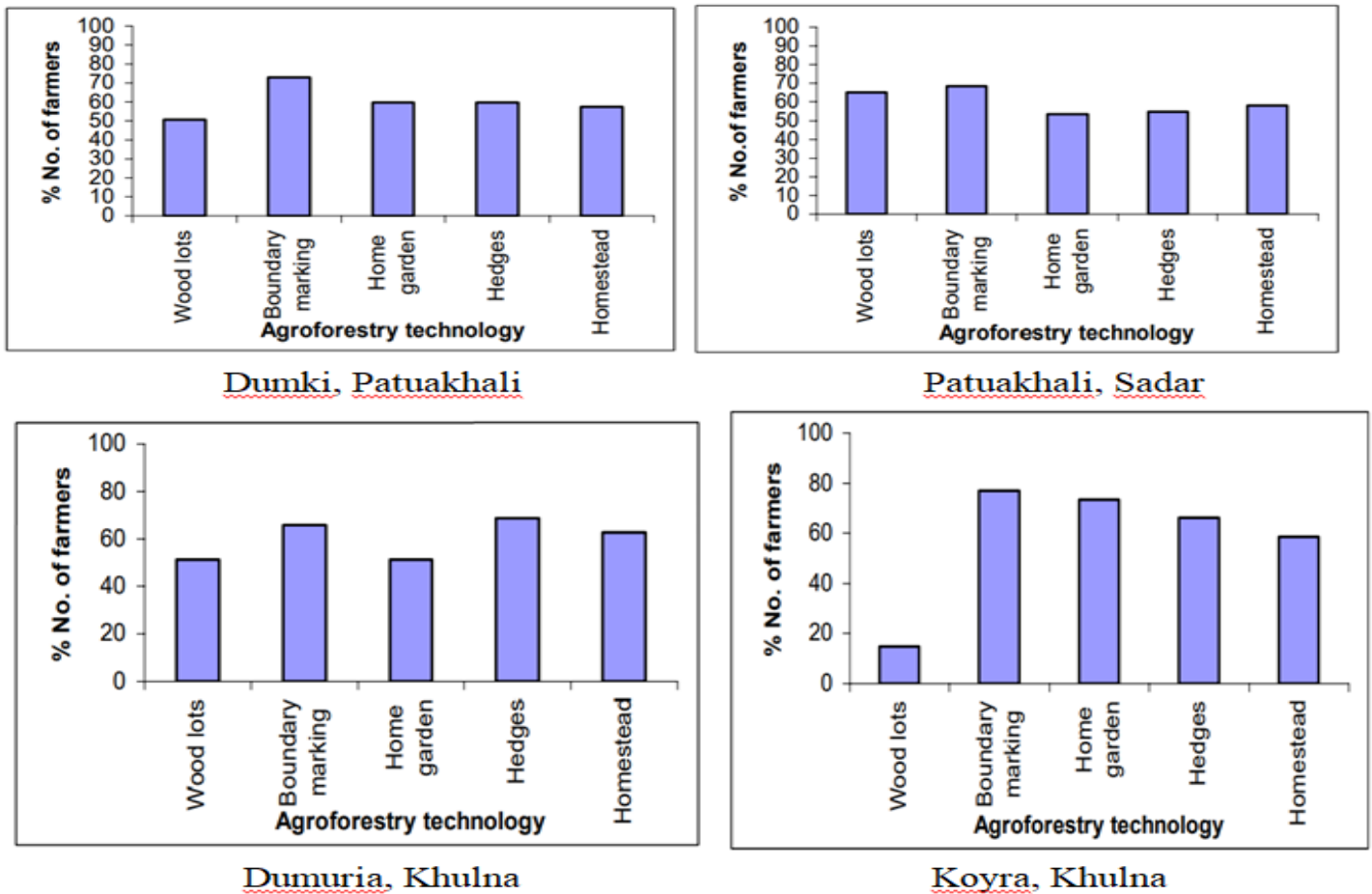


Figure 3: A comparison of adoption levels in the four sub locations

Boundary marking was highly ranked in all the 4 sub locations indicating its preference. It was characterized by planting trees a long boundary of two different farms. Here, *G. robusta* and *C. lusitanica* were common sources of firewood. Sharma (1995) indicated that farmers in most cases tend to accept multipurpose and fast growing tree species that yield benefits early rather than those that take long maturity periods



Plate 1: An integrated boundary planting of *Grivellea robusta* and *Agave sisalana*

Hedge technology was the second highest adopted technology by farmers in the study area. Like boundary marking, hedges are trees and shrubs planted in thick bushes around farms and mainly play the role of fences and aesthetics. The tree species that were found commonly used in this technology included: *Lantana camara*, *Dovyaliscaffra*, *Cupressus lusitanica* and *Psidium guajava*. This technology also helps in soil erosion control, protection of cultivated fields against destruction and Fuel wood ICRAF (1992). Homestead planting technology was a common practice across the four sub-locations and third most adopted technology by the farmers. This technology involved planting of trees in the homestead which had a number of uses; providing shade, beauty, fruits, timber fuel wood and acting as windbreakers.



Plate 2: A hedge showing a well-trimmed *Dovyaliscaffra* live fence.

home if planted. These limitations to tree planting identified in the study area agree with the findings of Gichuki and Njoroge (1989), who stated that certain traditional beliefs were a negative factor in adoption of Agroforestry practices. Also Kerkhof (1992) noted that in Southern Bangladesh, there are distinct tree species for men and women. Women were not allowed to plant certain tree species and it was believed if she did she becomes barren.



Plate 3: *Mangifera indica*, *Persia americana*, and *Eryabotrya japonica* in a homestead

Home garden as an Agro forestry technology was adopted across all the four Sub-Locations. Those farmers who had fodder crops and didn't own livestock confirmed that they sell to those with livestock and that there is a good market for such crops.



Plate 4: A young woodlot of *Eucalyptus saligna* with species of *Markhamia lutea*

planted and used *L. leucocephala* and *C. calothyrsus* for fodder in home gardens increased their milk production and dung for manure, which further led to improved crop production and household income. Similar findings from the Chagga home gardens (Kerkhof, 1990) show that farmers were sufficient in fodder produced primarily from tree and shrubs. Studies by ICRAF (1992) in Bangladesh found that *S. Sesban* is inter planted with maize, beans and sorghum because it has light crown with minimal effects on Agricultural crops, is fast growing and produced firewood in about a year. This is also in line with the findings of Sharma (1995) who found out that farmers in most cases tend to accept multipurpose and fast growing tree species that yield benefits early rather than those with long maturity periods.

Home garden planted with *Persia americana*, *Carica papaya*, maize and bananas Woodlot agro forestry technology though lowest ranked was adopted in all the four sub-locations in the study area. Woodlots comprise of sections of the farm set aside purposely for tree planting. Woodlots were most common (65% of all respondents) in PatuakhaliSadar sub location and least common in Koyra sub location. Where farm sizes were relatively big compared to Koyra where farm sizes were small and woodlots were less common.

Factors Influencing Adoption of Agroforestry Technologies

Farmers were compared as low, moderate and high adopters depending on the frequency of occurrence of the various Agroforestry technologies in their farms. The indicators for Agroforestry adoption were woodlots, boundary planting, home gardens, hedge planting and homestead planting. Six (6) points were awarded. Each farmer was allocated to one of the three levels of adoption namely Low adopter (0 – 10 points), Moderate adopters (11 – 20 points) and High adopters (21 – 30 points). It shows that farmers have integrated a variety of Agro forestry technologies in their farms which can be classified as very good. Dumuria and Koyra sub locations had the biggest number of high adopters and at the same time happened to have smaller farm sizes while PatuakhaliSadar with average big farm sizes had the lowest adoption levels.

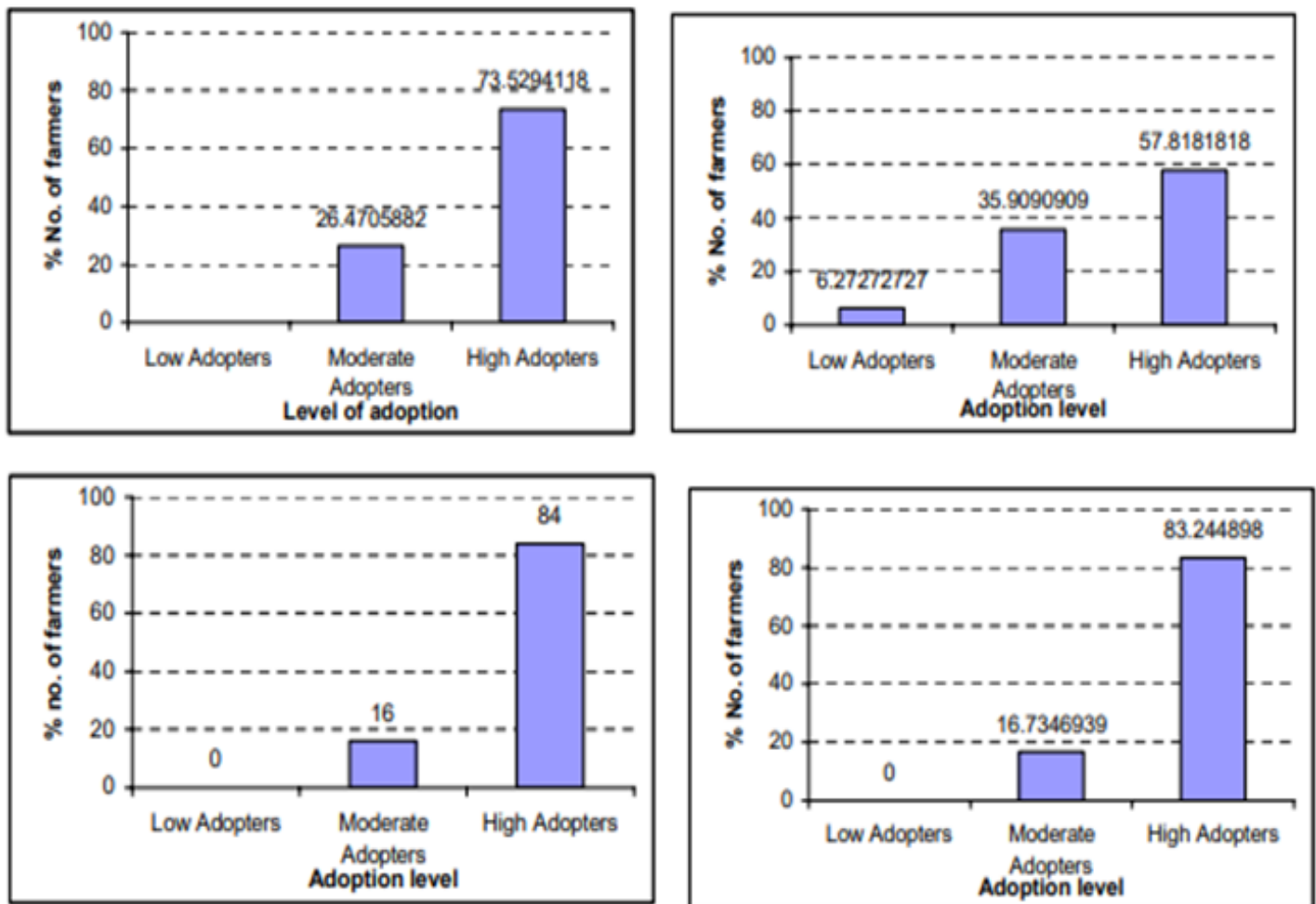


Figure 4: Level of Adoption for Agroforestry Practices by Sub Location

Likelihood Ratio Test for Factors Influencing Adoption Level

The likelihood ratio test shows the contribution of each variable to model. The variables with significant influence to the model ($P < 0.05$), Majority of the farmers (52.7%) denied they harbor traditional believes and taboos concerning tree planting and use to discriminate women. They noted that women were their partners in the management of household affairs and could not afford to discriminate against them. 46.3% believed women should not plant trees, should not utilize certain tree species and should not own land. Women in most cases assume the duties of laborers on the farm, weeding food crops, looking after livestock, fetching firewood, water, nurturing trees and so appreciating them is paramount. Women are mostly residents on the farm and therefore adoption of agro forestry technologies very much depends on the extent at which they are involved.

Farm Size

The relationship between farm size and adoption of Agro forestry technology was best explained by a linear function $y = -3.5749x + 96.449$ ($R^2 = 0.9444$) indicating that as farm size increases, the level of adoption of an Agro forestry technology decreases (Figure 5). The results explain that farmers with smaller pieces of land opt to practice Agroforestry more than those with bigger chunks of land. The farmers with smaller pieces of land had a variety of Agroforestry technologies on their farms. 2

Respondents had acknowledged that farm sizes were small, yet the adoption level was high with moderate and high adopters making up 86.8% of the respondents. This means that small farm sizes are not a constraint to production and that farmers understood the need for being self-sufficient in wood and wood products. They pointed out the rising cost of fuel wood and poles being a driving force in their adoption of agroforestry technologies.

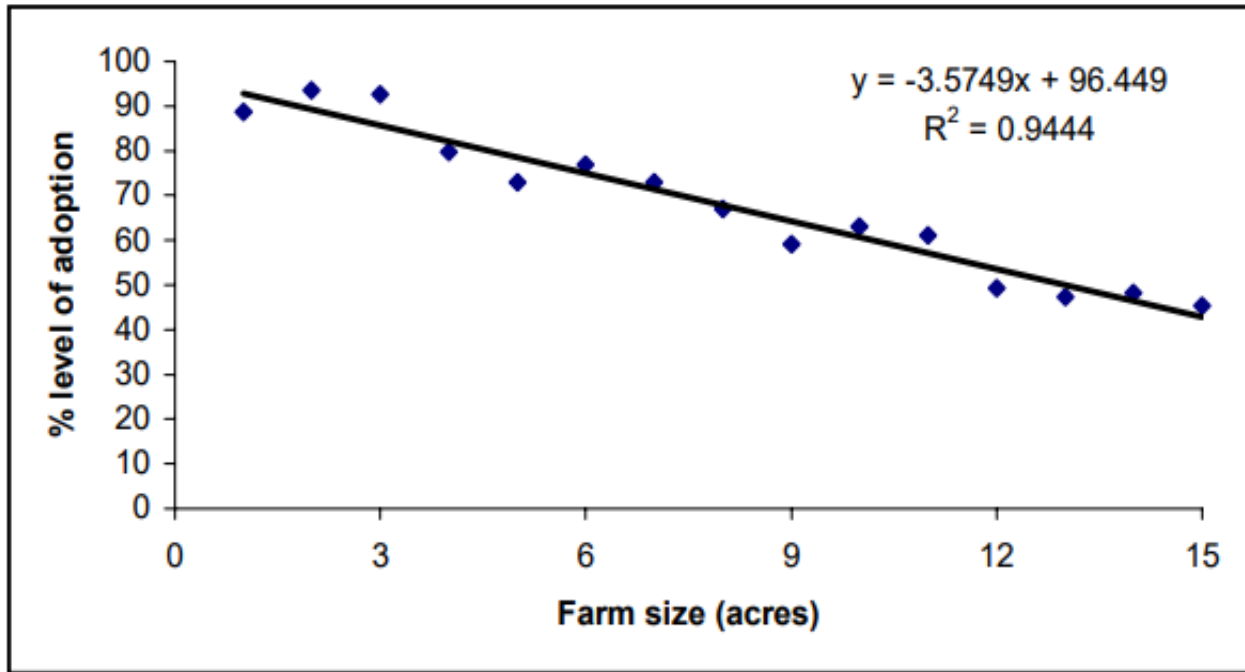


Figure 4: The negative correlation between farm size and adoption level

As farm sizes become small and smaller, cultivation by farmers becomes intensive in order to meet family food requirements and therefore the realization by farmers to plant trees in their farms conserves they would have exhausted soils for improved farm production and environmental conservation.

Sex (Gender) of Household Head

The sex of a household head is important in the sense that most decisions are made by the head. Majority of the respondents 118 (59%) were male heads of household and only 83 (41%) were women who mostly stood in for their husbands who were away working in towns or those who were widows. In this study sex was found to significantly influence Agroforestry adoption $P < 0.05$ at 0.010 (Table 4). Figure 6 further illustrates this.

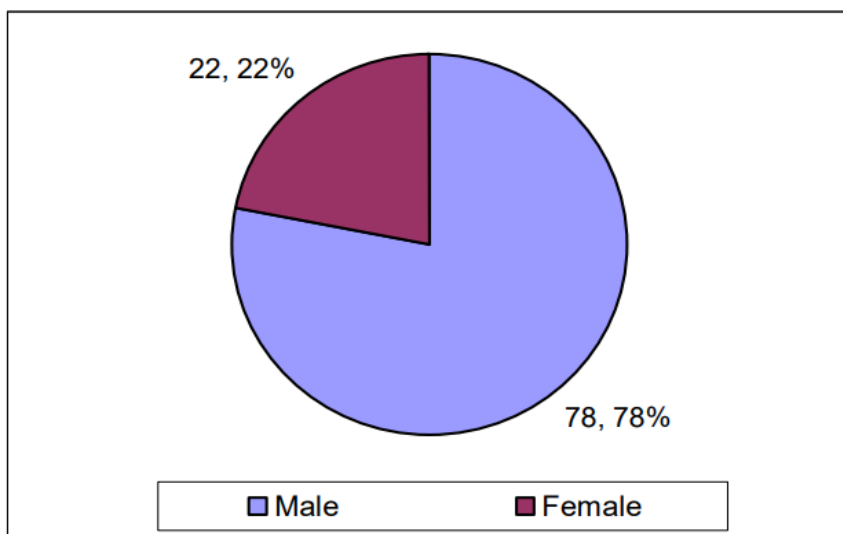


Figure 5: The percentage of decision makers in farms classified as high adopters

However, studies by Kimwe (1994), observed that gender might not be a factor in the adoption of entire innovation but a factor in the adoption of specific technologies. Farmers prefer small gradual changes in farming methods that are not labour intensive.

Table 4: Percentage contribution of family members in tending trees

Tree Tending	Percent contribution
Wife	14.0
Children	63.0
Both wife and husband	5.0
Husband	2.0
Whole family	16.0
N = 201	100

Land tenure

Agro-forestry production systems that involve local farmers will directly be related to the flexibility of the land tenure system. Secure tenure provides for proper incentives for farmers to make investments in the long-term productivity of their land. Only 5% of respondents recorded in high adoption farms were living on other people's land. They were either renting or were guarding the land on behalf of relatives. The other 95% of high adopters were living on their own land. With the ownership of a title deed the farmer is assured of the trees he/she plants on that particular piece of land. This is also supported by Busienei (1991), who found out that the low participation in Agroforestry activities in Barisal. A farmer's ownership of land with all due legal rights that include title deed is important to a farmer's investment on the farm since he/she knows that whatever is invested on such land is fully owned.

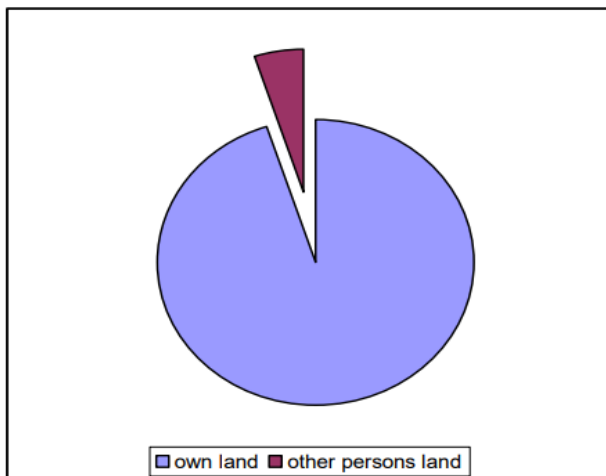


Figure 7: The percentage of high adopter with tenure right.

Table 5: Sources of seedlings for tree planting

Source	Percent respondents
From on-farm nurseries	26.9
Bought from private nurseries	71.0
Borrow from friends	2.0
Total (n=201)	100

The results show the willingness of farmers to plant trees despite the fact that these seedlings may have to be bought. These findings illustrate a great need by farmers of the study area to plant trees.

Farm preparation methods 2

Adoption of Agroforestry technologies differed with farm preparation methods. Adoption levels in Koyra sub location as opposed to PatuakhaliSadar sub location where farms are relatively big and allows mechanized farming. Since farming methods were always analyzed by farm size, Figure 8 shows how the increase in farm size decreased Agroforestry adoption level.

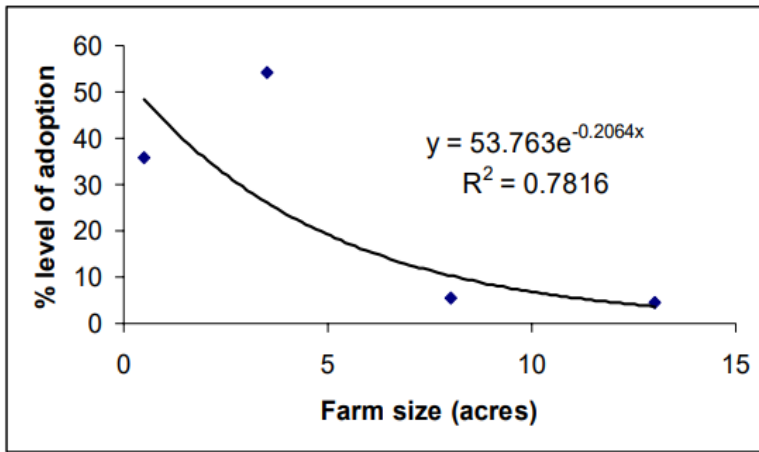


Figure 8: Level of agroforestry technology adoption and farm size

Mechanized ploughing needs less tree populations and especially for tractors, which need movement space hence farmers with relatively large farms and using tractors in the study area were found to be low adopters of agroforestry technologies. In Bangladesh, the usefulness of trees has always conflicted with need for Agricultural land (ILEG, 2004).

Constraint to Agroforestry production in Study area

Some of the problems highlighted by farmers in the study area relating to Agroforestry adoption included cost of buying seedlings 24.4%, farm labour 27.4%, Extension services 25.9% and Traditional believes 21.9% despite high cost of buying seedlings and limited Extension services, shows that farmers understood the importance of trees and their products and willing to plant trees at whatever cost. Also since they owned title deeds, gave them the confidence of utilizing their farms to their best production levels. Extension services are poor and only 24.4% of the farmers acknowledged having come in contact with the extension staff The Government on its part should allocate adequate funding to the field staff to promote extension services and come up with mechanisms to subsidize cost of seedlings to farmers. Farmers also pointed out that, farm labour was a constraint.

SUMMARY AND CONCLUSION

The study revealed that the farmers in the study area have a positive perception about benefits of agroforestry such as its economic advantage, soil erosion reducing and soil nutrient increasing properties. The socio-economic factors influencing farmers' decision to adopt agroforestry technologies were age, marital status, agroforestry education awareness, landownership, land size, nature of land and access to credit and these were identified as significant positive variables.

There are a variety of Agroforestry technologies that have been adopted. The major factors influencing agroforestry adoption in the area were sex, land tenure, farm size and farm preparation method. The agroforestry technologies practiced in Patuakhali and Khulna Districts have many benefits including control of soil erosion, boundary marking, wood fuel energy provision, fodder provision and food provision there is a need to further study the specific economic benefits that the farmers get from each of the Agroforestry technology adopted. Since farmers already know and understand the uses of Agroforestry tree species in the area, need to be supported in the provision of free seedlings and extension services to further improve on their wellbeing. The Government should promote the extension services by allocating sufficient funds to facilitate extension staff to reach farmers frequently to teach new ideas in Agroforestry.

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