ROLE OF INCOME FROM HOMESTEAD AGROFORESTRY SYSTEM FOR POVERTY REDUCTION IN THE SELECTED AREAS OF MYMENSINGH DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled **"ROLE OF INCOME FROM HOMESTEAD AGROFORESTRY SYSTEM FOR POVERTY REDUCTION IN THE SELECTED AREAS OF MYMENSINGH DISTRICT"** submitted to the DEPARTMENT OF AGROFORESTRY AND ENVIRONMENTAL SCIENCE, Faculty of Agriculture , Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE AGROFORESTRY AND ENVIRONMENTAL SCIENCE**, embodies the result of a piece of bona fide research work carried out by **MD. SIFAT ULLAH, Registration No. 14-06086** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, as has been availed of during the course of this investigation has been duly acknowledged by the author.

Dated: June, 2021
Dhaka, Bangladesh

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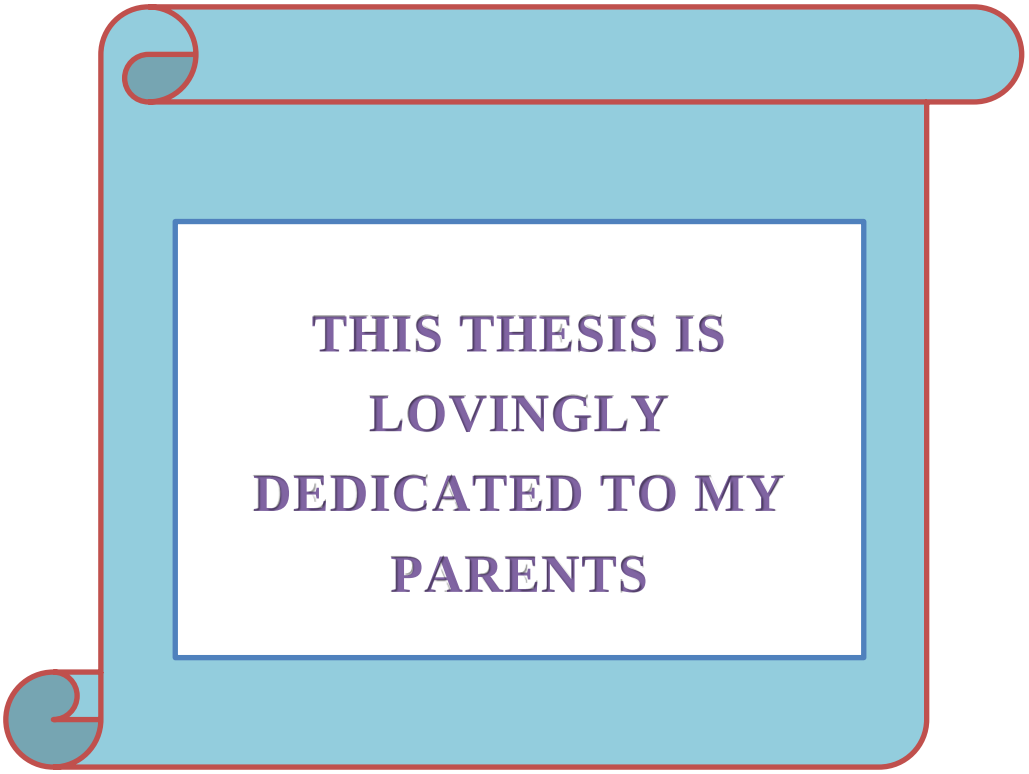
THIS THESIS IS
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ABSTRACT

Homestead Agroforestry is an important consideration for socio-economic development in our country and also all over the world. Systematic Agroforestry practice is becoming popular day by day in the Mymensingh district of Bangladesh. Considering the situation, the present study aims to find out the existing situation of homestead agroforestry practices in the study area, to determine the extent of income from agroforestry system to reduce poverty, to explore the role of the selected characteristics of the farmers practicing homestead agro-forestry system to reduce poverty. Data were collected by purposive random sampling method of 60 respondents from 1202 farmers of ten villages of Trishal and Fulbaria upazila under Mymensingh district by using a pretested interview schedule during the period of 01 January to 27 January 2021. Data were analyzed by SPSS version 23. Findings indicated that the highest portion (65 percent) of the farmers had medium income from homestead agroforestry system compared to 20 percent having low and only 15 percent had high income from homestead agroforestry system. Out of 10 selected characteristics of the respondents, education, knowledge on homestead agroforestry and training on homestead agroforestry system had positive significance with Contribution of income from homestead Agroforestry towards reducing poverty. The rest of the variables namely: age, family member, occupation, farm under homestead agroforestry, homestead agroforestry system experience, managed homestead agroforestry and annual family income did not show any significant correlation with the income from homestead Agroforestry system for reducing poverty.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
etc.	Etcetera
e.g.	exempli gratia (L), for example
SAU	Sher-e-Bangla Agricultural University
et al.,	And others
HG	Home garden
NGOs	Non-Governmental Organization
SAAO	Sub Assistant Agriculture Officer
DAE	Department of Agricultural Extension
M.S.	Master of Science
%	Percentage
SPSS	Statistical Package for Social Science
S D	Standard Deviation
SPSS	Statistical Package for the Social Sciences
FAO	Food and Agricultural Organization
ADB	Asian Development Bank

CHAPTER 1

INTRODUCTION

Homestead is the home and very adjacent lands occupied by the family for their living and provide support as the ground for homestead agroforestry. Homestead agroforestry is the subsistence system and potential production area in Bangladesh, especially for the rural poor people. Homestead production system, which is popularly called homestead agroforestry or home gardening (the integrated production of crops, trees, and/or livestock in the household's residence and its surrounding areas), has been playing an important role in the rural economy of Bangladesh since time immemorial, and providing various essential products and services to millions of rural households.

Bangladesh is one of the most densely populated countries of the world with more than 1125 persons per km^2. About 85 per cent of population lives in the rural areas in 160 million households spreading over 85000 villages (FAO, 1986; BBS, 2020). Bangladesh possesses a glorious tradition of Agroforestry systems practiced by her farming communities. Well planned interacted land use system combining woody perennials and other production enterprises in accordance with the farmers' need, goals and resources base can only lead to viable farming system towards sustainable livelihood in the coming future. The homestead of rural people is a unique feature of combination of trees, shrubs, vegetables, livestock, ducks, poultry, and pigeon from ancient time. In Bangladesh 68% of the forest products is fuel wood but this met only 10% of the demand to national fuel energy (ADB, 1993). Byron (1984) observed that 90% of the fuel wood and 70% of timber requirement of the country were met from the homestead plantation. The major portion of the rural household has homestead and cropland areas, and thus can contribute to the economy of the country to a large extent (Rahman, 1995).

In North Bengal of Bangladesh, innovative farmers have spontaneously developed agroforestry systems in their homesteads and croplands. This

provides benefits to the rural community because trees offer facility such as shade, shelter, recreation, agroecological balance and so on (Roy *et al.*, 1996). Homestead agro-production has special significance in the context of Bangladesh where about 50% of rural households are landless (Januzi and Peach, 1977). Homestead farming is getting importance as the way of investing minimum capital but earning maximum income with increased participation of farmers in economic activities. Homestead agroforestry may contribute to uplift the socio-economic condition of the farmers, supply fuel wood, give protection from hazards, provide food and other benefits etc.

Population of Bangladesh increases day by day. Growth rate of population in 2021 is 1.36%. Population increase has a massive impact at the livelihood of smallholder farmers (Josephson *et al*.,2014). Due to rapid growth of population, farm sizes are declined. Land fragmentation and declining farm size is a essential trouble that smallholder farmers are facing for maintaining the conventional farming practices (Headey *et al.*, 2014). Bangladesh possesses a glorious tradition of Agroforestry systems practiced by her farming communities. Agroforestry home gardens are age-old and traditional land use systems with protection and production functions, contributing particularly to the food and nutrition security of smallholders (Vieira *et al.*, 2012). It is the form of agroforestry where different kinds of crops, including vegetables and trees are grown in mixture with or without livestock. In this farming system, deliberate planting and management of multipurpose trees and shrubs are followed in intimate association with annual and perennial agricultural crops and, invariably, livestock, within the compounds of individual houses (Alam *et al.,* 1996). Wood, tree branches, leaves and straw are the main household cooking fuels. Agroforestry provides 40% of fuel requirements, another 40% coming from home gardens and 20% from agricultural fields (Rahman, 2012).

When homestead agroforestry managed by farmer without scientific interruption is known as traditional homestead agroforestry. It is a eco-friendly production system and have no adverse effect in environment. In Bangladesh,

innovative farmers have spontaneously developed agroforestry systems in their homesteads and croplands. This provides benefits to the rural community because trees offer facility such as shade, shelter, recreation, agro-ecological balance and so on (Roy *et al.,* 1996). Homestead agroforestry may contribute to uplift the socio-economic condition of the farmers, supply fuel wood, give protection from hazards, provide food and other benefits etc. The farmers thought that the traditional homestead agroforestry systems had significant role in improving socio-economic status and up gradation of environmental condition in the area. Therefore, there is a great scope to improve the prevailing homestead agroforestry practices with the modern agroforestry technology for maximization of income of the farmers. The extent of knowledge regarding changes in attitude in livelihood encouraged them to adopt the traditional homestead agroforestry system which is not sufficient enough to adopt a well-planned and highly manageable system aiming higher profit and uplift of socio-economic condition(Pervin, 2007).Traditional agroforestry home garden is the main livelihood strategy of smallholder farmers that balances and maintains the natural, financial, human, social and physical livelihood assets and delivers essential livelihood outcomes for the livelihood of the rural community. Thus it is necessary to strengthen knowledge on homestead agroforestry for effective utilization of homestead areas with suitable sophistical agroforestry approach to maximize homestead productivity and family income (Pervin, 2007).

Homestead agroforestry is the combination of multi components including plants, animals and human habitats in the tiny pieces of land. Plant includes trees, shrubs, and herbs, growing in or adjacent to the homestead or home compound. All of these are planted and maintained by household member's especially female members with the view to household consumption; they have considerable ornamental value and provide shade to people and animals. It is also known as multipurpose agroforestry. It is also known as subsistence agroforestry. It aims at meeting the basis needs of small family having less holding and very little capacity for an investment. The form of agroforestry is

very wide and denoted by very common terms using, homestead agroforestry (Leuschner and Khaleque 1987), homegarden (Ramsay and Wiresum 1976; Millat *et al*. 1996), Javanese home garden (Soemarwoto *et al*. 1985), and homestead forest (Motiur *et al*. 2005). Homestead forests of Bangladesh constitute multi-storied vegetation of shrubs, bamboos, palms and trees that produce materials for a multitude of purposes, including fuel, shelter, structural materials, fruits, fodder, and medicines (Dauglas 1981). Bangladesh holds a total of 399585 hectares of homestead land with 0.03 ha per household, with marginal, small, medium and large household having an average 0.01, 0.02, 0.04 and 0.07 ha of total cultivated land respectively (BBS, 2020).

Homestead agroforestry provides dependable economic returns and greater diversity in social benefits on a sustained basis. Thus it is necessary to strengthen knowledge on homestead Agroforestry for effective utilization of homestead areas to maximize homestead productivity and family income.So the study was conducted to fulfill the following objectives.

Objectives of this study:

1. To find out the existing situation of homestead Agroforestry practices in the study area
2. To determine the extent of income from homestead agro-forestry system to reduce poverty
3. To explore the role of the selected characteristics of the farmers with their income from homestead agro-forestry system to reduce poverty.

CHAPTER 2

REVIEW OF LITERATURE

The researcher made an elaborated search of available literature for this research. But no study could be found to be specially undertaken in this direction. Therefore, attempt has been made in the present chapter to review some interlinked literature on this aspect from home and aboard. The interlinked reviews conveniently presented on the major objectives of the study as far as possible. This chapter is divided into four major sections. The first section deals with homestead in Bangladesh. The second section deals with traditional systems of agroforestry. Homestead agroforestry and its implication is presented in the third section. The fourth section deals with structure and components of homestead agroforestry and their contribution.

2.1 Homestead in Bangladesh

Homestead perhaps the important production unit in Bangladesh, which accounts about 25.36 million in the country with 21.90 million in the rural areas (BBS, 2001). The homestead and their vegetation in saline (south western part) and hilly (eastern part) regions are relatively larger in size compared to dry land area (north western part) due to socioeconomic and climatic advantages. There exists a positive relationship between the farm size and homestead area i.e. larger the farm size, larger the homestead area (Anam, 1999; Ahmed, 1999 and Basak, 2002). The country consists of 85,000 villages and each village contains on an average about 268 homesteads (BBS, 2003). It is the center of socio-economic activities and traditional cultural heritage of villages in Bangladesh. The homestead-in which the people live in are locally known as *'Bari'*, which occur in linear, cluster or individual pattern (Hussain and Miah, 2004). The average size of homestead is very small (0.02 ha), which varies widely according to region and socioeconomic status of the households. Depending on the locations, the homestead is raised above the f1ood level from the surrounding fields.

2.2 Traditional systems of Agroforestry

Different patterns of Agroforestry were common in the early days. For many upland farmers, Agroforestry was a way of life. Shifting cultivation, for example, is believed to have originated in the Neolithic period around 7000 BC (Sharma, 1976). In this system, still common in many hilly areas of tropical Asia, Africa, and Latin America, trees and agricultural crops are arranged sequentially in time and space. Its sustainability in the past was due to low population pressure and availability of large tracts of undisturbed forests. Today, shifting cultivation promotes soil erosion and land degradation. In as much as we have alternative methods of soil fertility restoration, shifting cultivation is no longer necessary. Homestead is another common Agroforestry system.

In this system, tall trees are intercropped with medium shrubs and short annual crops to produce a variety of foods and green manure besides reducing soil erosion. Intercropping in coconut and oil palm plantations is also common. Farmers generally plant smaller trees such as coffee, cacao, and banana underneath the palms. To arrest land degradation due to shifting cultivation, a fairly successful system called taungya was developed in the mid-1800s in Burma. In this system, the government gave land to shifting cultivators and allowed them to grow trees and agricultural crops together. When the tree canopy closed and precluded further agricultural cropping, farmers were shifted to another site. Taungya was later adopted by many countries of Asia, Africa, and Central America (King, 1968). Many of these systems have now given way to subsistence agricultural systems in several developing countries. Because subsistence farming practices are not ecologically sustainable and often not economical, interest in Agroforestry is increasing.

2.3 Homestead Agroforestry and its Implication

According to Alim (1980) the homestead Agroforestry practice is prevalent not only in Bangladesh but also in many South and South East Asian, Latin American and African countries.

Ahmed *et al.* (1980) mentioned that of people in west Java have shown that homegardens is an important "Social status symbol". People, who do not have a homegarden and hence, have to build their house on some-one else's homegarden, were considered of low status.

Byron (1984) mentioned that trees from homegardens were estimated to produce about 65 to 70 percent of timber and about 90 per cent of fuelwood and bamboo consumed in Bangladesh.

Hocking (1986) reported that some 15 million household of the country occupy about 0.3 million hectare under traditional Agroforestry practice in homestead. Hussain and Shailo (1987) estimated that 88.5 percent of wood and 48 9% of fuelwood would come from homestead forest.

Lai (1988) found in his study that application of appropriate technology in relation to production and management of trees and crops in the homestead better utilization of land can be achieved with the creation of better living environment there.

According to Leach and Meams (1988) and Dewees (1989), the projection of fuelwood consumption simply in line with population growth is rather unrealistic. Even when fuelwood becomes physically scarce, households have a great deal of latitude in changing their consumption patterns in response. As scarcity worsens and wood prices or the labour cost of gathering fuels increase many new coping strategies would come into play. Tree plantation might increase consumers may use fuels more economically switch to more abundant fuels such as crop residues or intensify efforts to encourage the natural regeneration of woody vegetation and so on.

According to Khandaker (1991), Agroforestry system is traditional in the homesteads of moist tropical world including rural areas of Bangladesh since the

establishment of houses. This system could be considered as potential technology for rural poverty alleviation because of its diversified functions.

Islam (1991) found that village forest mainly covered by homesteads accounts only 0.27 million ha and out of 64 districts as estimated 28 districts had no public forest land.

Mazher (1996) point out a typical homestead Agroforestry in Bangladesh provides an excellent opportunity for a number of economic activities to be undertaken in and around it. The homestead enterprises such as vegetables and fruits cultivation, fish culture, forest, poultry rearing etc. can contribute to have increased food availability and generate income of the rural farm families.

Homestead is an area of land in which the household has its own dwelling unit. Different authors have been defined homestead in different ways. Homestead refers to home and adjoining land occupied by a family for the purpose like small-scale agricultural production, home-up keeping, health sanitation and nutrition (Ninaz, 1998).

Anam (1999) reported that vegetables were grown in three types of micro sites within the homestead viz. in shady, open place and creeping on the tree.

Mosabber and Niaz (1999) studied the floristic composition and socioeconomic aspects of rural homestead forestry. Home gardens are located close to houses and characterized by a mixture of annual and perennial species. The proximity to natural forests and the availability of timbers in local markets also seen to influence the propensity to plant timber and fuel wood in homegardens. Fruit trees dominate the gardens, followed by fuel wood species. Women play an intensive role in the management of homegardens.

Forestry and Agroforestry production systems have been found to provide a multitude of goods and services and hence the capacity to address different

constraints for different consumers over different time periods (BBS, 2002). They can contribute to household income/consumption directly through the production of goods (fruits, poles, fuel wood) and indirectly through goods and services such as fodder for livestock, reduction of land degradation, improved soil and water conservation. In addition, other benefits can be realized downstream through reduction of soil erosion and/or increased water flow control. These systems at a more aggregate level can also provide services for international consumers, through benefits for example of carbon sequestration and protection of international waters (BBS, 2002).

2.4 Structure and Components of Homestead Agroforestry and their Contribution

Doglas (1982) estimated that homestead forested provided about 85 percent of the all wood consumed, including nearly 90 percent of fuel wood and 80 percent of timbers.

Dasgupta *et al*. (1988) showed that farmers grew various fruits and vegetables in their homestead These vegetables and fruits (i.e. Guava, papaya, lemon, jujube amaranth, bitter gourd, egg-plant, coconut, date plain, betel nut etc.), which are grown on homestead and farms varied according to their sizes and categories. Large farmers prefer growing a wide range of fruits and vegetables. They were not interested in replacing perennial trees. The potential of the homestead was great which could be improved by replacing the less productive plants with fast growing nitrogen fixing species to provide more fuel, fodder and green manure.
Sultana (1993) stated that homestead vegetables and fruits form in integral part of the family diet and a part of them enters the commercial market. Although every member of the family has some contribution, the major labor input was contributed by women. Most of the homestead agricultural activities, including seed preservation, land preparation, transplanting, watering and harvesting are done by women Men usually help in fertilizer and pesticide application.

Rahman (1995) dealt with the consequences of homestead crop production under homestead Agroforestry practices on family income and women's status. These farms had earned substantial income and production gains. The women of the households gained in terms of higher social status. The gender status in particular has improved significantly on these households as evidenced by the increased participation of homestead Agroforestry practicing women in taking decisions on crucial socioeconomic matters in the households.

Alam *et al.* (1996) conducted a study on diversity and economic aspects of village forests in Bangladesh. Both indigenous and trees are the major components of the village forests. Most of the village trees have multiple uses. About 40 per cent are fruit trees, and others produce timbers, fuel woods, fodders, tannins pharmaceutical products, etc. Homestead tree production system in villages is a mode of species and genetic conservation for a good number of trees. They can contribute to household income/consumption directly through the production of goods (fruits, poles, fuelwood) and indirectly through goods and services such as fodder for livestock, reduction of land degradation, improved soil and water conservation. In addition, other benefits can be realized downstream through reduction of soil erosion and/or increased water flow control.

Agroforestry systems at a more aggregate level can also provide services for international consumers, through benefits for example of carbon sequestration and protection of international waters (BBS, 2002).

Populations have greatest likelihood of persistence if their habitat is sufficiently connected to enable movements by individuals between subpopulations. Landscapes with good habitat connectivity (vegetation patches in close proximity to one another, retained riparian strips and other linking corridors, and the presence of native species such as pasture species and scattered paddock trees in the landscape matrix between remnants) generally represent better

quality habitat for native flora and fauna than isolated patches of vegetation (Seddon *et al*,. 2005).

A study was conducted at Sitakunda, Chittagong. Bangladesh, purposively from 14 May to 28 June 2006 *Eucalyptus* was found to raise as a component of Agroforestry in agricultural field and other fallow land of Homestead with the objective of getting more economic return. The main agricultural crops found were bean and rice. The study revealed that agriculture was the major occupation of the selected respondents (69%). The mean annual income of the respondents was Tk. 67,000.00 and average land holding was 31.5 decimal for the respondents who were practicing Agroforestry in their croplands and 14.5 decimal, which raised mono plantation of Eucalyptus and 13.27 decimal lands, which raised mixed home garden. All most all farmers reported the negative effect of Eucalyptus on rice yield. Regarding the investigation on allelopathic effect of Eucalyptus most of the farmers (92%) said that they did not know any allelopathic effect of it on other crops. The farmers in the study area favor the planting of eucalyptus for six important reasons of which the most important ones are it's adoptability to grows wells both in dry and wet sites followed by its fast growing characteristics (Ahmed, 1999).

The characteristics of traditional homestead Agroforestry have been discussed in terms of area distribution in different components, types of crops, trees grown, diversity of plants and changes made in the homestead Agroforestry. A traditional homestead Agroforestry is made of a house and other component such as Crops, plants and trees animal house tubewell/dug well open space. The vegetation in the homestead Agroforestry can be divided into three categories, *viz*., crops, woody trees and non-woody trees. Crops such as different vegetables formed the ground strata. Non-woody trees are mostly the middle-strata whereas the trees are the high-strata plants (Jana *et al.,* 2015).

Agroforestry is a dynamic, ecologically based natural resource management system that, through which the integration of trees/woody perennials in farm and

rangelands, diversifies and sustains production for increased social, economic and environmental benefits (Leakey, 1996). Agroforestry was expected to reduce soil erosion, improve soil quality, vegetative cover, land productivity and uplift the farmers level of living through sustained farm productivity Agroforestry can play a major role in bringing the desired level of diversification along with sustainability.

There are different combinations of fruit tree-vegetable associates. In a study (Ahmed, 1999) a total of 32 vegetables were found to grow in association with trees either under direct shade were food and cash generating plants and the associated fruit trees were Jackfruit, Mango, Date palm, Coconut, Jujube and Litchi etc. The creeper vegetables grown on the trees were sponge gourd, ribbed gourd, country bean, bitter gourd; sweet gourd and most common host plant were jackfruit, mango, coconut, jujube etc. Pineapple was grown under shade of jackfruits, litchi and coconut.

Home garden (HG) is a complex sustainable land use system (Marambe *et al.*, 2012), which generally combines multiple farming components, i.e., annual and perennial crops, trees, shrubs, livestock and fishery. The flow of goods and services from the home garden not only provides the household needs and employment support, but also environmental services similar to those of natural forests as a result of being a mixed farming system consisting of fruits, vegetables, trees and animals.

Gautam *et al.* (2004) reported that in India Agroforestry homegarden contributed 60% of the household's total fruit and vegetable consumption, in Philippines, twenty percentage (20%) of the foods consumed by families are produced in the homegarden whereas in Vietnam 51% of their produce is used by household members.

Small animals such as rabbits, poultry and bees can be associated with the garden for animal protein intake and vitamins. In home garden or Agroforestry

systems, tree fruits are increasingly cultivated for securing food and nutrition sources during crisis period of a year when adequate access to food is not possible (Rahman *et al.,* 2012).

Consumption of fruits and vegetables is vital for a diversified and nutritious diet for a family. Increasing dietary diversification is the most important factor in providing a wide range of micronutrients and this requires an adequate supply, access to and consumption of a variety of foods (Iannotti *et al*., 2009).

Khan *et al*. (2009) asserted that farmers consumed their harvested vegetables, sold some of them and also distributed to other to strengthen social relation. The findings also agreed with Islam *et al*. (2003).

Bloem *et al*. (2001) reported that vegetables and fruits production and consumption increased as well as income also increased among the beneficiaries of the homestead food production programme in Bangladesh.

Farmers benefited from homegarden in several ways. Homegarden act as a reserve bank of food and cash for farmers. The income from homegarden was significantly different within the farm categories. Larger farm categories were getting more income than the smaller farm categories because of having large pieces of land. It was observed that the medium farmers intensively cultivated the homegarden. This might be the reason for getting more income from their homegarden (Alam *et al*., 2005).

Homesteads are multipurpose entities with dwellings, vegetables, spices, fruits and fuel wood/timber species. Historically, homesteads have been providing multiple products to the households and meet their diversified need through the production of a wide variety of fruits, vegetables, spices and different tree products (Miah and Danesh, 2002). The prevailing climatic and edaphic

conditions of Bangladesh are the key factors for providing such a unique opportunity of producing a wide range of products. It has been reported that homestead production system collectively contributes about 70 percent fruits, 40 percent vegetables, 70 percent timber and 90 percent firewood and bamboo requirement of the country (Miah and Ahmed, 2003).

A vast majority of rural people in Bangladesh who cultivate land for crop production remains unemployed for a considerable period of the year because of seasonality of production activities and labor requirements. Homestead farming is the best answer to such unemployment situation through both vegetable growing, and culture of quick growing fruits enabling the people to remain employed round the year (Ahmad, 1995). It has been found that over the decades, small-scale homestead activities have become the most significant income generating activities of poor households. For example, over 5 million people in Bangladesh live in the riverine sand and silt landmasses (known as char in Bengali). These areas are highly prone to sudden flooding and erosion of land, and makes living in the chars hazardous and insecure. The Helen Keller International's homestead food production program was found to provide support to the fragile livelihood in the chars and improved the wellbeing of the entire household by promoting low cost technologies for gardening and livestock-raising, improving food security and dietary practices, providing employment for women and a source of income for the household (Helen Keller International, 2003). *Artocarpus heterophvllus* (Jackfruit) based system provides diversified outputs to the growers. The jackfruit is consumed almost as the main food during the main harvesting periods (July-August) and the seeds are used in various cooked forms (Miah and Ahmed, 2003). In addition, non-edible portion of the fruit and green leaves are fed to cattle and goats, its wood is used for making all kinds household furniture. During the season, almost all members of the family remain busy with harvesting, transportation and marketing of fruit.

Women - the vulnerable group of the society and half of the population have the

great opportunity for self-employment in the income-generation activities through the practice of vegetable and fruit production in the homestead. Use of family labour, especially women labour in the production process not only satisfies a wide range of domestic needs more economically but also ensures lowering of production costs and ultimately promotes more income. Average return per decimal of homestead land is far more than that of large farm households, possibly due to the more intensive labor inputs on the part of women in poor households (Ahmad, 1995).

Livelihood security comparison of traditional Agroforestry system and commercial Agroforestry system: In the traditional Agroforestry systems since the trees are naturally growing especially in traditional Agroforestry region and are just allowed to be thriving by the farmers, the costs associated with management of the trees are negligible except that of indirect costs associated with the shade and competition due to moisture and nutrient needs (Dwivedi *et al.,* 2007). Therefore, only the benefits from trees on account of harvest and sale of tree produce were accounted, while commercial Agroforestry system is characterized by trees in close association with crops either on farm bunds/ boundaries or within the fields. Although traditional Agroforestry seems less promising as compared to commercial Agroforestry, but it is also relevant to the farmers. Both the system will helpful for farmers livelihood.

Agroforestry homegardens are common in most tropical countries and they play a vital role in supporting households in many diverse ways, including provision of food, fuel wood, building materials, and fodder for livestock, and income. They are regarded as source of income diversification and also play crucial cultural and social role in rural communities (Fernandes and Nair, 1986; Bonifasi, 2004; Guuroh *et al*., 2011) defined homegardens as land use practices involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably,

livestock, within the compounds of individual houses, the whole crop-treeanimal unit being managed by the family labour. Agroforestry homegardens are primarily used for subsistence purposes by households; they are increasingly being used to generate income (Mendez *et al*., 2001). The quantity of Agroforestry homegardens production that actually gets sold is highly variable, differing from one household to another. Hoogerbrugge and Fresco (1993) reported that between 9% and 51% of production is sold in Indonesia.

In most tropical Agroforestry homegardens, food production is the firstfunction and role. One major aspect of significant role of food production in homegardens is to hold up continuous production throughout the year (Kebebew *et al*., 2011) reported that in Southern Ethiopia 88.8% of the surveyed households were food secured throughout the year. Homegardens also can solve the problem of land scarcity by using a small land the households have by integrating various components in the same piece of land hence food security and income generation (Abebe, 2005).

The combination of crops with different production cycles and rhythms results in a relatively uninterrupted supply of food products (Nair, 2012). Depending upon the climate and other environmental characteristics, there may be peak and slack seasons for harvesting the various products, but generally there is something to harvest daily from most homegardens (Kumar and Nair, 2004). Most of this production is for home consumption, but any marketable surplus can provide a safeguard against future crop failures and security for the interval between the harvests (e.g. rice in Java and Sri Lanka, coffee and maize in Tanzania, coconut and rice in southwestern India, and so on). Additionally, these harvesting and maintenance operations require only a relatively small amount of labor from the members of the family (Krishnal *et al*., 2012). Hence homegardens are among the best solutions of household food security and income generation to smallholder farmers due to their diversity (Kebebew *et al*.,

2011). This is especially in all areas of the tropics under pressure from increasing populations and unsystematic deforestation.

Homegardens can contribute to household income in several ways. Income from homegardens comes from selling cereal crops, fruits, vegetables and other cash crops (e.g., lime, rambutan, jackfruits, durian, cloves, and coffee) to local brokers or merchants (Marsh, 1998). In many cases, sales of products produced in homegardens significantly improve the family's financial status. For example in West Java, as much as two-thirds of the homegardens production is reported to be sold (Wilson, 1995), while in South African homegardens only 28% of such products were sold, the remainder being used for household consumption (High and Shackleton, 2000). In Indonesia and Nicaragua homegardens contributed 21.1% and 35% of their total income respectively (Tynsong andnTiwari, 2010). In South-West Bangladesh and North Eastern Bangladesh, an average of 15.9% and 11.8% of household income is derived from homegardens respectively (Motiur *et al*., 2005). Hence generally, homegardens play a great role in income generation as compared with other sources as it uses multiple components that produce diverse products. In this study it is aimed to assess the Agroforestry homegardens contribution to household food security and income generation in Rural District which is unknown.

CHAPTER 3

MATERIALS AND METHODS

The materials and methods used in conducting any research play a critically important role and deserve careful consideration by the researcher. The researcher was very much careful for using proper methods in all aspects of the investigation. Methods and procedures followed in conducting the study have been discussed in this chapter. Further, the chapter includes the operational format and comparative reflection of some variables used in the study. Also, statistical methods and their use have been mentioned in this chapter.

3.1 Locale of this Study

The study was conducted at ten villages of Trishal and Fulbaria upazila under Mymensingh district. Out of ten villages, five villages in Trishal and five villages in Fulbaria were selected randomly. The selected villages were Dhanikhola, Samaniapara, Salimpur, Kanabakhail, Namatrishal, Dhurdhuria, Kandania, Jungalbari, Langalshemul and Tukkirpar. The study area is situated 18 km away from Mymensingh district. There are twelve primary schools, two high schools and a college in the study area. There are also a post office and two market in the study area. There are eleven mosques, two madrashas and five mondhirs in this study area. Various NGOs are working on homestead development activities at the study area. A map of Trishal upazila showing the study areas in figure 3.1. and a map of Fulbaria upazila showing the study areas in Figure 3.2.

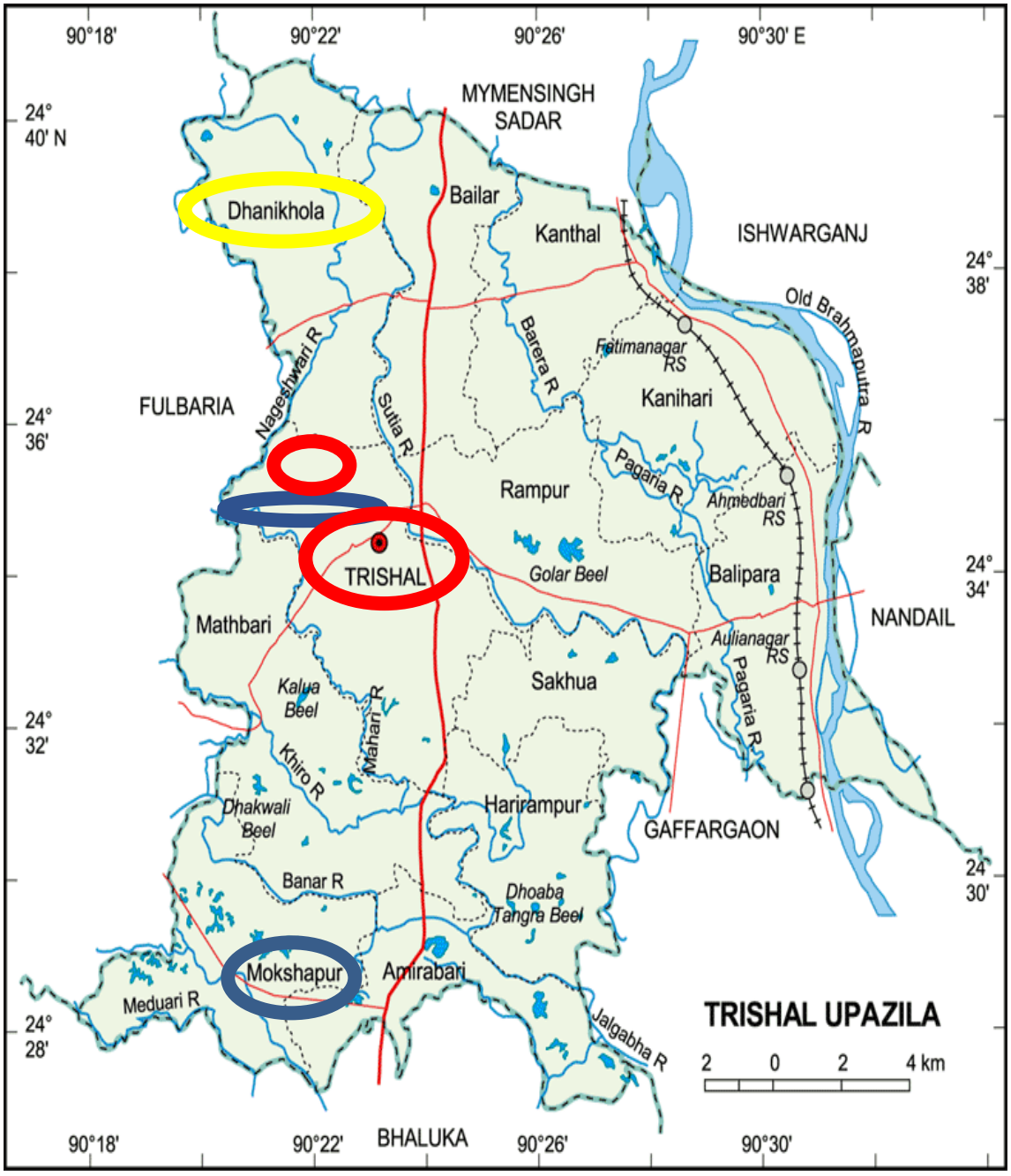

Figure 3.1: A map of Trishal upazila showing the study area

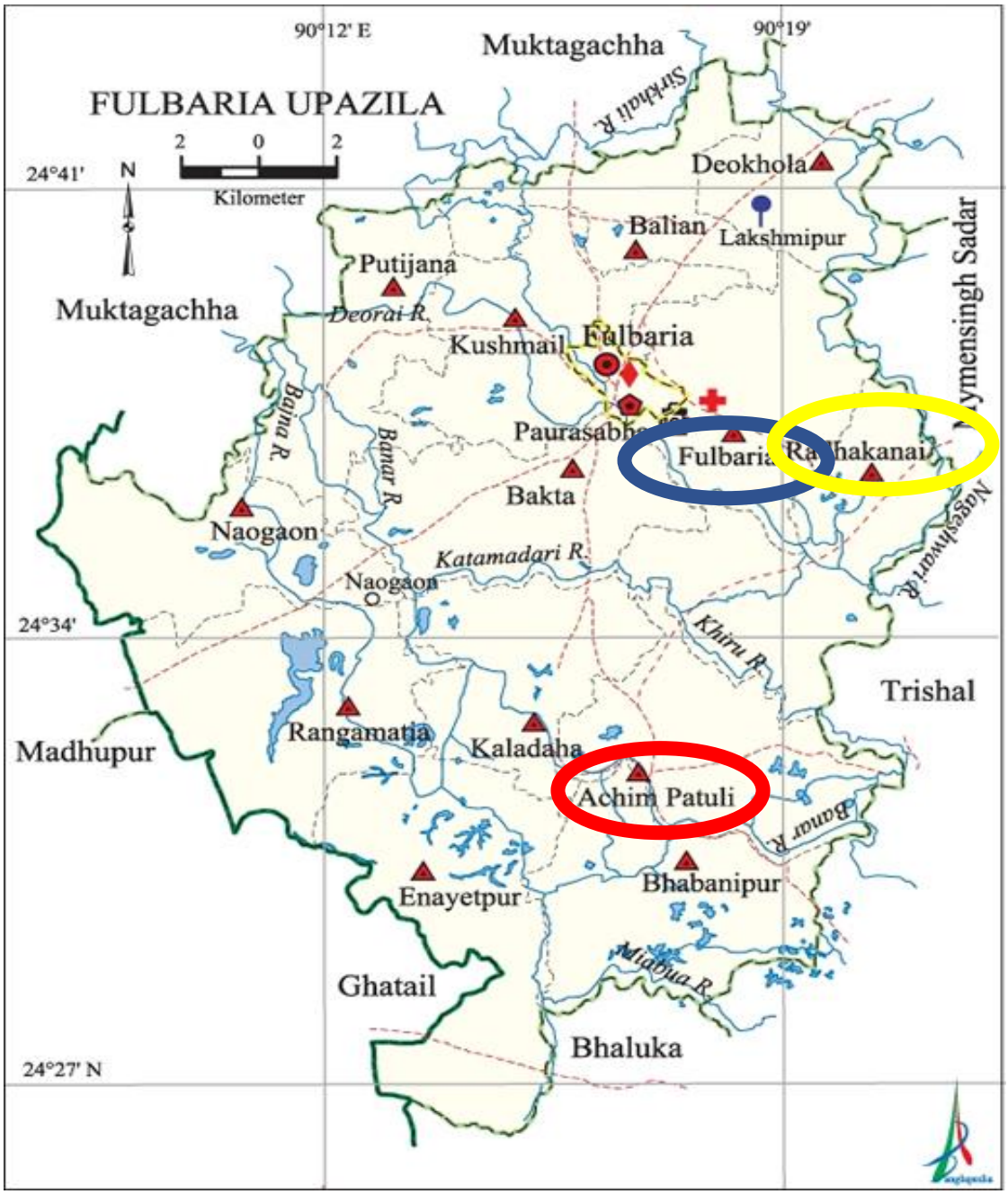

Figure 3.2: A map of Fulbaria upazila showing the study area

3.2 Population and Sample

The farmers of the selected ten villages were considered as the population of the study. A list of farmers who are currently cultivating homestead agro-forestry was prepared with the help of Sub Assistant Agriculture Officer. The number of respondents of the selected ten villages was 1202 which constituted the population of the study. About 5 percent of the population was selected proportionally from the selected villages as the sample by following random sampling method. Thus, the total sample size stood at 60.02, but 60 farmers was taken as the sample of the study. Moreover, a reserved list of 10 farmers was prepared for use when the farmers under sample were not available during data collection. The distribution of the farmers included in the population, sample and those in the reserve list appears in Table 3.1.

Table 3.1 Distribution of population, sample size and reserve list size of respondents in four selected villages of the study areas

Upazila name	Name of the Villages	Sample Size	Number of reserved list
Trishal	Dhanikhola	6	1
	Samaniapara	6	1
	Salimpur	6	1
	Kanabakhail	6	1
	Namatrishal	6	1
Fulbaria	Dhurdhuria	6	1
	Kandania	6	1
	Jungalbari	6	1
	Langalshemul	6	1
	Tukkirpar	6	1
Total		60	10

3.3 Data collection method

The survey was used to collect quantitative data that allow to answer the framed research questions and to gain an understanding of the contribution of homestead agroforestry practice towards reducing poverty in the selected areas of Mymensingh district.

3.3.1 Data collection tools

A structured interview schedule was prepared to reach the objectives of the study containing mostly closed questions. The questions in this schedule were formulated in a simple and unambiguous way and arranged in a logical order to make it more attractive and comprehensive. The instrument was first developed in English and then translated into Bengali. The survey tool was initially constructed based on extensive literature reviews and pre-tested. The schedule was pretested with 10 randomly selected farmers in the study area in identifying faulty questions and statements. Thus, necessary additions, deletions, modifications and adjustments were made accordingly in the schedule. The questionnaires were also checked for validity by supervisors and other experts at Sher-e-Bangla Agricultural University (SAU). Finally, based on background information, the interview schedule was finalized. Data was gathered by the researcher personally. During data collection, necessary cooperation was obtained from field staff of different GOs, NGOs and local leaders. The field data collection was started from 01 January and completed on 27 January, 2021.

3.4 Variables of the Study

Measurable characteristics of a population that may vary from element to element either in magnitude or in quality are called variables (Balzarini *et al*., 2004). The success of a research to a considerable extent depends on the exact selection of the variables. A research hypothesis contains at least two elements as independent variable and dependent variable. An independent variable is the factor which is manipulated by the experimenter to ascertain its relationship to an observed phenomenon. A dependent variable is the factor which appears, disappears or varies as the experimenter introduces, removes or varies the independent variable (Townsend, 1953). The dependent variable of the study is "income from homestead agroforestry" and independent variables were: age, level of education, family member, occupation, farm under homestead agroforestry, knowledge about homestead agroforestry, homestead agroforestry

system experience, manage your homestead agroforestry, training on homestead agroforestry system, annual family income. In order to conduct a study in accordance with the objectives it was necessary to measure the variables. The procedures of measuring the variables have been described below:

3.5 Measurement of Variables

In order to conduct a study in accordance with the objectives it was necessary to measure the variables. The procedures of measuring the variables have been described below:

3.5.1 Measurement of independent variables

The independent variables of this study were ten selected characteristics of the farmer as mentioned earlier. Procedure for measuring independent variables has been discussed below:

I. Age

Age of respondent sunflower farmers was measured by the period of time from their birth to the time of conducting interview and it was measured in terms of complete years on the basis of their response. A score of one (1) was assigned for each year age (Akter, 2003).

II. Level of education

Education of rural women was measured by the number of years of successful schooling. A score of one was assigned for each year of formal schooling completed by a respondent. For example, if a respondent passed the SSC examination, he was given a score of 10. Besides, a respondent did not know how to read and write her education score was assigned as 0 (zero), a score of 0.5 was given to those respondent who did not know how to read and write but could sign her name only.

III. Family member

Family size of an advice was determined by the total number of members in his/her family who live under same roof and share same kitchen including himself/herself, his/her wife/husband, sons, daughters and others fully or partially dependent on him/her. Total number of family members was considered as the family size score of a respondent. For example, if a respondent has four (4) members in his/her family, his/her family size score was 4 (four). This variable appears in item number three (4) in the interview schedule as presented in Appendix.

IV. Land under homestead agroforestry

Land under homestead agroforestry refers to the area used in Land under homestead agroforestry cultivation only by the farmers. It was first recorded in terms of local measurement unit i.e. decimal. The total area thus obtained was considered as the score of land under homestead agroforestry by assigning 1 score for one decimal of land. This variable appears in item number four (5) in the interview schedule as presented in Appendix.

V. Annual family income

Family income of a respondent was measured on the basis of total yearly earning from agriculture and other sources (service, business, daily labor etc.) by the respondent his/herself and other family members. For calculation of income score, one (1) score was assigned for each one thousand taka. For example, if a respondent mentioned that his/her annual family income is Tk. 1, 75,000 then his/her annual family income score would be 175.

VII. Training on homestead agroforestry

Training on homestead agroforestry score of a respondent was measured by the number of days that a respondent had received training on homestead agroforestry related in his/her entire life. It was indicated by the total number of days of receiving training by a respondent under different training homestead

agroforestry related programs. If a respondent did not participate any training courses his/her score was 0 and if a respondent attained 1 course with 5 days duration his/her assigned score was 5. If a respondent attained 2 courses with 5 days duration her assigned score was 10.

VIII. Knowledge on homestead agroforestry

Knowledge on homestead agroforestry is a very important to study the household contribution to reduce poverty. It was measured under the category of low, medium and high.

3.5.2 Measurement of dependent variable

Income from homestead agroforestry was the dependent variable of the study. Income from homestead agroforestry of a respondent was measured in thousands taka on the basis of total yearly earning of the respondent. For determining the annual income from homestead agroforestry of the families from all the sources were added together. It was expressed in thousands taka.

3.6 Instrument for Data Collection

Data were collected using a structured interview schedule. Both open and closed form questions were included in the schedule based on the measurement procedures discussed earlier in section 3.5.

Before finalization, the interview schedule was pre-tested with 10 rural women of the study area. On the basis of the pre-test experiences necessary corrections, modifications and alterations were made before finalizing the interview schedule for final data collection. During modification of the schedule, valuable suggestions were received from the research supervisor and relevant experts. The interview schedule was then printed in its final form and multiplied. A copy of interview schedule in English version was placed in Appendix I.

3.7 Collection of Data

Data were collected personally by the researcher himself through face to face interview. To familiarize with the study area and for getting local support, the researcher took help from the local leaders and the field staffs of Upazila Agriculture Office. The researcher made all possible efforts to explain the purpose of the study to the farmers. Rapport was established with the farmers prior to interview and the objectives were clearly explained by using local language as far as possible. The field data collection was started from 01 September and completed on 27 September, 2021.

3.8 Data Processing

After completion of field survey, all the data were coded, compiled and tabulated according to the objectives of the study. Local units were converted into standard units. All the individual responses to questions of the interview schedule were transferred in to a master sheet to facilitate tabulation, categorization and organization. In case of qualitative data, appropriate scoring technique was followed to convert the data into quantitative form.

3.9 Statement of Hypothesis

According to Kerlinger (1973) a hypothesis is a conjectural statement of the relation between two or more variables. Hypothesis are always in declarative sentence form and they are related, either generally or specifically from variables to variables. In broad sense hypotheses are divided into two categories: (a) Research hypothesis and (b) Null hypothesis

3.9.1 Research Hypothesis

Research hypothesis states a possible relationship between the variables being studied or a difference between experimental treatments that the researcher expects to emerge. The following research hypothesis was put forward to know the relationships between each of the eleven selected characteristics of the

farmers and their income from homestead agro-forestry. “Each of the ten selected characteristics of the farmers has significant contribution with their income from homestead agro-forestry.”

3.9.2 Null Hypothesis

A null hypothesis states that there is no relationship between the concerned variables. The following null hypothesis was undertaken for the present study “There is no contribution between the selected characteristics of farmers and their income from homestead agro-forestry.” “The selected characteristics were age, level of education, family member, occupation, farm under homestead agroforestry, knowledge about homestead agroforestry, homestead agroforestry system experience, manage your homestead agroforestry, training on homestead agroforestry system and annual family income.

3.10 Statistical Analysis

Data collected from the respondents were complied, coded, tabulated and analyzed in accordance with the objectives of the study. Various statistical measures such as frequency counts, percentage distribution, average, and standard deviation were used in describing data. SPSS (version 20.0) computer program were used for analyzing the data. The categories and tables were used in describing data. The categories and tables were also used in presenting data for better understanding.

For determining the contributions of the selected characteristics of the respondents’ income from homestead agro-forestry, multiple regressions analysis was used. Standardized Coefficients which are expressed in b. Five percent (0.05) level of probability was used as the basis for rejecting any null hypothesis.

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter the findings of the study and its interpretation are presented in three sections according to the objectives of the study. The first section deals with the selected characteristics of the farmers, while the second section deals with the extent of income from homestead agro-forestry system and the third section deals with the contribution to their income from homestead agro-forestry system.

4.1 Selected Characteristics of the Farmers

In this section the results of the farmers selected characteristics have been discussed. The salient feature of the respondents with their ten selected characteristics has been presented in Table 4.1.

Table 4.1 The salient features of the selected characteristics of the farmers

characteristics	Measuring unit	Range		Mean	S D
		possible	observed		
Age	Years	-	22-72	45.40	14.48
Education	Year of schooling	-	00-18	6.11	5.82
Family Size	Person	-	2-10	5.10	1.86
Occupation	Score		1-4	1.98	1.20
Farm size under homestead agroforestry	Decimal	-	4-60	20.50	13.76
Knowledge on homestead agroforestry	Score	-	0-3	1.65	1.30
Homestead agroforestry system experience	Score	-	3-37	16.05	7.28
Homestead agroforestry manage	Score	-	0-1	0.62	0.49
Training on homestead agroforestry system	Days	-	0-30	6.45	6.76
Annual family income	(‘000’ Tk.)	-	40-480	158.70	103.37

4.1.1 Age

The age score of the farmers ranged from 22 to 72 with an average of 45.40 and a standard deviation of 14.48. Considering the recorded age farmers were classified into three categories namely young, middle and old aged following MoYS,(2012).

Table 4.2 Distribution of the farmers according to their age

Categories (years)	**Farmers**		Mean	SD
	Number	Percent		
Young aged (up to 35)	19	31.67	45.40	14.48
Middle aged (36-50)	21	35		
Old aged (above 50)	20	33.33		
Total	**60**	**100**		

Table 4.2 indicates that the majority (35 percent) of the respondents were the middle-aged category while 31.67 percent and 33.33 percent were found young and old categories respectively. The mean value (45.40) rightly indicates the reality.

4.1.2 Education

Education of the respondents has been categorized as done by Poddar (2015). Education of the farmers ranged from 0 to 18 years of schooling having an average of 6.11 years with a standard deviation of 5.82. On the basis of their education, the respondents were classified into five categories as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Categories	**Farmers**		Mean	SD
	Number	Percent		
Illiterate (0-0.5)	24	40	6.11	5.82
Primary education (1-5 class)	6	10		
Secondary education (6-10 class)	14	23.33		
Above secondary level (above 10)	16	26.67		
Total	**60**	**100**		

Data contained in Table 4.3 indicates the 40 percent of the farmers were illiterate. It was found that 23.33 percent were secondary level of education, 10 percent were

primary level of education and 26.67 percent were above secondary level of education.

4.1.3 Family size

To describe the family size of the respondents, the category has been followed as represented by Poddar (2015). Family size scores of the fanners ranged from 3 to 9 with an average of 5.10 and standard deviation of 1.86. According to family size, the respondents were classified into three categories (Mean±SD) as shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their family size

Categories	Farmers		Mean	SD
	Number	Percent		
Small family (up to 4)	28	46.67	5.10	1.86
Medium family (5 -6)	20	33.33		
Large family(above 6)	12	20		
Total	**60**	**100**		

Data contained in Table 4.4 indicates that (46.67%) of the farmers had small family while 20 percent of them had large family and 33.33 percent of them had medium family. Thus, about above two third (80%) of the farmers had small to medium family size.

4.1.4 Farm size under homestead agroforestry

Land possession of the respondents varied from 0.17 to 4.68 hectare and the average being 3.50 hectare and standard deviation of 1.76. Depending on the farm size of the respondents were classified into three categories according to DAE (1999) as appeared in table 4.5.

Table 4.5 Distribution of the farmers according to their farm size

Categories (hectare)	Farmers		Mean	SD
	Number	Percent		
Marginal land (0.01-0.20 ha)	9	15	3.50	1.76
Small land (0.21-1 ha)	21	35		
Medium land (1.01-3 ha)	27	45		
Large land (above 3 ha)	3	5		
Total	**60**	**100**		

Similar result was observed Nasreen *et al.* (2013) where highest respondents were small farm sized. Data contained in table 4.5 indicates the 53.33 percent of the farmers had small land while 44.76 percent of them had medium land and only 1.91 percent of them were large farmer.

4.1.5 Annual family income

The annual family income of the farmers ranged from Tk. 40 thousand to Tk. 480 thousand with an average of Tk. 158.70 thousand and standard deviation of 103.37 thousand. Based on the annual income, the farmers were divided into three categories (Mean±SD) as shown in Table 4.6.

Table 4.6 Distribution of the farmers according to their annual family income

Categories ('000' Tk.)	**Farmers**		Mean	S D
	Number	Percent		
Low (up to 55)	2	3.33	158.70	103.37
Medium (56-261)	48	80		
High (above 261)	10	16.67		
Total	60	100		

Reza (2007) found the similar result where highest numbers of respondents were medium annual income. From the Table 4.6 it was observed that the highest portion (80 percent) of the farmers had medium annual family income compared to 3.33 percent having low and 16.67 percent had high annual family income.

4.1.6 Experience in homestead agroforestry system

The observed experience of the farmers ranged from 3-37, the mean being 16.05 and standard deviation of 7.28. According to their observed ranged of experience scores, the farmers were classified into three categories (Mean±SD) as shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their experience

Categories	Farmers		Mean	SD
	Number	Percent		
Low (upto 9)	6	10	16.05	7.28
Medium (10-23)	44	73.33		
High (above 23)	10	16.67		
Total	**60**	**100**		

Similar result was observed Poddar (2015) where highest respondents were medium experience. Data presented in the Table 4.7 indicated that 73.33 percent of the farmers had medium experience in homestead agroforestry system compared to 10 percent low and 16.67 percent of the farmers had high experience in homestead agroforestry system. Findings again revealed that almost all (90 percent) of the farmers had medium to high experience in homestead agroforestry system.

4.1.7 Occupational status of the farmers

Occupation is one of the important attributes of socio-economic characteristics. The work in which a man is engaged throughout the year is known as his main occupation. In Bangladesh, rural people's occupations are increasingly diversified. About 50% of rural people do not own any land. They seek off-farm and non-far income earning opportunities. In the selected area, the farmers were engaged in different occupations along with agriculture.

Table 4.8: Occupational status of the farmers

Categories	Farmers		Mean	SD
	Number	Percent		
Agriculture (1)	31	51.67	1.98	1.20
Business (2)	11	18.33		
Service (3)	6	10		
Others (4)	12	20		
Total	60	100		

In the case of main occupation, agriculture accounted of 51.67 percent and business accounted for 18.33 percent, service accounted 10 percent and others accounted for 20 percent, respectively (Table 4.8).

4.1.8 Training on homestead agroforestry system

The score of training on winter vegetable cultivation of the farmers ranged from 0 to 30 days, the mean being 6.76 and standard deviation of 6.45. Based on observed range, the farmers were classified into three categories as shown in Table 4.9.

Table 4.9 Distribution of the farmers according to training on homestead agroforestry system

Categories (days)	Farmers		Mean	SD
	Number	Percent		
No training (0)	19	31.67	6.76	6.46
Low training (up to 10)	28	46.67		
Medium training (11-20)	11	18.33		
High training (above 20)	2	3.33		
Total	**60**	**100**		

Data contained in Table 4.9 indicates that 46.67 percent of the farmers had low training on homestead agroforestry system; while 31.67 percent of the farmer's had no training on homestead agroforestry system and 18.33 percent had medium training on homestead agroforestry system and only 3.33 percent of the farmers had high training on homestead agroforestry system**.**

4.1.9 Housing condition

According to the scoring of housing condition, it is categorized into three levels as katcha ghar with straw or plastic, tin, bamboo and well-maintained house and brick, wood and galvanized iron house (Table 4.10).

At present, 40% farmers live in Tin, bamboo and well maintained house and 60% farmers live in brick, wood and galvanized iron house and no farmers live in katcha ghar with straw or plastic housing condition at present, where at 10 years ago, 38.33% farmers were lived in katcha ghar with straw or plastic and 60% were lived in Tin, bamboo and well maintained house and 1.67% farmers lived in Brick, wood and galvanized iron house (Table 4.10).

Table 4.10. Changing scenario of housing condition compared to 10 years ago regarding homestead agroforestry

Categories	Scoring	Farmers (N=60)				
		Housing condition				Difference (%)
		At present		10 years ago		
		No.	%	No.	%	
Katcha ghar with straw or plastic	1	0	0	23	38.33	38.33
Tin, bamboo and maintained house	2	24	40	36	60	20
Brick, wood and galvanized iron house	3	36	60	1	1.67	58.33
Total		60	100	60	100	-

4.1.10 Food condition

According to the scoring of household assets, it is categorized into five levels as presented in Table 4.11.

At present, 53.33% farmers ate fish weekly, 16.67% farmers ate milk weekly, 0% farmers ate bread weekly, 18.33% farmers ate egg weekly and 8.33% farmers ate meat monthly, whereas at 10 years ago, 51.67% farmers ate fish weekly, 15% farmers ate milk weekly, 13.33% farmers ate bread weekly, 16.67% farmers ate egg weekly and 3.33% farmers ate meat monthly (Table 4.11).

Table 4.11. Changing scenario of assets compared to 10 years ago in the study area regarding managed and unmanaged homestead Agroforestry

Categories	Farmers (N=60)				
	Asset				Difference (%)
	At present		10 years ago		
	No.	%	No.	%	
Bread (weekly)	0	0	8	13.33	13.33
Fish (weekly)	32	53.33	31	51.67	1.66
Milk (weekly)	10	16.67	9	15	1.67
Egg (weekly)	11	18.33	10	16.67	1.66
Meat (monthly)	5	8.33	2	3.33	5
Total	60	100	60	100	-

4.1.11 Sanitation

According to the scoring of sanitation system, it is categorized into four levels as open place, katcha toilet, half sanitary toilet and sanitary toilet (Table 4.12).

Table 4.12. Changing scenario of sanitary condition compared to 10 years ago regarding homestead Agroforestry

Categories	Scoring	**Farmers (N=60)**				
		Sanitation				Difference (%)
		At present		10 years ago		
		No.	%	No.	%	
Open place	1	0	0	11	18.33	18.33
Katcha toilet	2	0	0	39	65	65
Half sanitary toilet	3	18	30	8	13.33	16.67
Sanitary toilet	4	42	80	2	3.34	76.66
Total	-	60	100	60	100	-

At present, , 80% farmers has Sanitary toilet, 20% farmers has half sanitary toilet, no farmers completed their toilet in open place and no farmers has katcha toilet, where at 10 years ago, 65% farmers had katcha toilet and 3.34% farmers had Sanitary toilet, 18.33 farmers completed their toilet in open place and 13.33% farmers has half sanitary toilet (Table 4.12).

4.1.12 Sources of household income

Under the study, farmers showed their household income from different sources of homestead Agroforestry. Different vegetables, fruits, livestock and fisheries, firewood, dry leaves and timber etc. were considered as source of household income.

4.1.12.1 Vegetable production (seasonal basis)

Here, production status of vegetables is presented with seasonal basis. Many types of vegetables are available here, among them lalshak, brinjal, bottle gourd, tomato, beans, green pepper and papaya are the main products which are considered as a major source of household income.

Table 4.13. Production status (amount) of vegetable regarding production, consumption, sell and price

Item (vegetables)	Production, consumption and selling status of vegetable (average)			
	Farmers (N=60)			
	Production	Consumption	Sell	Price (tk)
Lalshak (kg)	265	100	165	3300
Brinjal (kg)	376	90	286	8580
Bottle gourd (pieces)	341	61	280	7000
Tomato (kg)	590	160	430	12900
Beans (kg)	230	25	205	4100
Green pepper (kg)	155	40	115	6900
Papaya (kg)	150	30	120	2400

Under the present study, it was found that production status of vegetable is higher. Consumption of every product was lower than sell.

4.1.12.2 Livestock and fisheries production (daily basis)

Livestock and fisheries are important sources of household income (Table 4.14). Under the present study, data were collected on daily basis. It was observed that Chicken egg, Duck egg, Cow's milk, Goat and Fishes were the main component of livestock and fisheries. Per day production status may be contributed to reduce poverty. Here, Consumption of every product was lower than sell.

Table 4.14. Production status (amount) of livestock and fisheries regarding total production, consumption, sell and price

Item (livestock and fisheries)	Production, consumption and selling status of livestock and fisheries (average)			
	Farmers (N=60)			
	Production	Consumption	Sell	Price (tk)
Chicken egg (pieces)	45	15	30	225
Duck egg (pieces)	15	5	10	100
Cow's milk (liter)	12	2	10	500
Goat (pieces)	4	--	4	20000
Fishes (kg)	523	56	467	4670

4.1.12.3 Fruit production (Season basis)

Under the present study, Jackfruit, Mango, Coconut, Betel nut, Lemon, Palmyra palm, Jujube, Guava, Gab, Banana, Litchi and Sapota were found as the main fruit for homestead production and after consumption a considerable amount was sold for household income (Table 4.15). Income from fruits, was also a major source of household income which contributed to reduce poverty of farmers effectively.

Table 4.15. Production status (amount) of fruit regarding total production, consumption, sell and price

Item (fruit)	**Production, consumption and selling status of fruit (average)**			
	Farmers (N=60)			
	Production	Consumption	Sell	Price (tk)
Jackfruit (no.)	195	43	152	7600
Mango (kg)	142	38	104	2080
Coconut (no.)	281	44	237	9480
Betel nut (kg)	59	12	47	4700
Lemon (kg)	161	22	139	2780
Palmyra palm (no.)	128	37	91	2730
Jujube (kg)	72	25	47	940
Guava (kg)	74	21	53	1060
Gab (kg)	83	22	61	610
Banana (Chora)	92	19	73	7300
Litchi (no.)	742	230	512	1024
Sapota (kg)	69	24	45	450

Here, it was also observed that managed homestead Agroforestry regarding fruit production was more profitable than others crops Agroforestry because of higher production was achieved from Agroforestry.

4.1.12.4 Firewood, dry leaves and timber production (daily basis)

A considerable amount of cash was achieved from Firewood, Dry Leaves and Timber which were also important source of household income that also might be contributed to reduce poverty (Table 4.16)

Table 4.16. Production status (amount) of firewood, dry leaves and timber production regarding total production, consumption and sell

Item (firewood, dry leaves and timber)	Production, consumption and selling status of firewood, dry leaves and timber production (average)		
	Managed (N=60)		
	Production	Consumption	Sell
Firewood (kg)	72	29	43
Dry Leaves (kg)	48	21	27
Timber (Tk.) in year	54000	14000	40000

4.2 Income from homestead agroforestry system

Income from homestead agroforestry system of the farmers ranged from Tk. 120 thousand to Tk. 2700 thousand with an average of Tk. 736.17 thousand and standard deviation of 525.77 thousand. Based on the annual income, the farmers were divided into three categories (Mean±SD) as shown in Table 4.17.

Table 4.17 Distribution of the farmers according to their income from homestead agroforestry system

Categories ('000' Tk.)	**Farmers**		Mean	S D
	Number	Percent		
Low (up to 211)	12	20	736.17	525.77
Medium (212-1261)	39	65		
High (above 1261)	9	15		
Total	60	100		

Reza (2007) found the similar result where highest numbers of respondents were medium income. From the Table 4.17 it was observed that the highest portion (65 percent) of the farmers had medium income from homestead agroforestry system compared to 20 percent having low and only 15 percent had high income from homestead agroforestry system.

4.3 The Contribution of the selected characteristics of the respondents on their income from homestead agroforestry system

In order to estimate the income from homestead agroforestry system, the multiple regression analysis was used which is shown in the Table 4.18**.**

Table 4.18 Multiple regression coefficients of the contributing variables related to income from homestead agroforestry system

Dependent variable	Independent Variable	β	P	R^2	Adj.R^2	F
Income from homestead agroforestry system	Age	0.155	0.143	0.728	0.672	13.09
	Education	0.344	0.004**			
	Family Size	0.026	0.759			
	Occupation	0.014	0.874			
	Farm size under homestead agroforestry	0.107	0.259			
	Knowledge on homestead agroforestry	0.317	0.040*			
	Homestead agroforestry system experience	0.086	0.366			
	Homestead agroforestry manage	-0.050	0.710			
	Training on homestead agroforestry system	0.277	0.029*			
	Annual family income	0.001	0.996			

** Significant at $p<0.01$;

*Significant at $p<0.05$

Table 4.18 shows that education, knowledge on homestead agroforestry and training on homestead agroforestry system of the respondents had significant positive contribution with their income from homestead agroforestry system. Of these, education was the most important contributing factors (significant at the 1% level of significant) and knowledge on homestead agroforestry and training on homestead agroforestry system of the respondents were less important contributing factors (significant at 5% level of significant). Coefficients of other selected variables don't have any contribution on their income from homestead agroforestry system.

The value of R^2 is a measure of how of the variability in the dependent variable is accounted by the independent variables. So, the value of $R^2 = 0.728$ means that independent variables account for 72% of the variation with their income from homestead agroforestry system. The F ratio is 13.09 which is highly significant ($p<0$).

However, each predictor may explain some of the variance in respondents their income from homestead agroforestry system simply by chanced. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but value 0.672 is still show that variance is their income from homestead agroforestry system can be attributed to the predictor variables rather than by chanced (Table 4.18). In summary, the models suggest that the respective authority should be consider the farmers' education, knowledge on homestead agroforestry and training on homestead agroforestry system of the respondents on their income from homestead agroforestry system and in this connection some predictive importance has been discussed below:

4.3.1 Significant contribution of education on the farmers' income from homestead agroforestry system

The contribution of education to the farmers' income from homestead agroforestry system was measured by the testing the following null hypothesis;

"There is no contribution of education to the farmers' income from homestead agroforestry system".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the education was at 1% significance level (.004)
b. So, the null hypothesis could be rejected.
c. The direction between education and income from homestead agroforestry system was positives.

The b-value of level education is (0.344). So, it can be stated that as education increased by one unit, the farmers' income from homestead agroforestry system increased by 0.344 units.

Based on the above finding, it can be said that farmers' education increased the farmers' income from homestead agroforestry system. So, education has significantly contributed to the farmers' income from homestead agroforestry system. Education plays an important role to reduce problems in income from homestead agroforestry system in many cases. Education enhances knowledge on many aspects such as training, participation, extension contact and so on.

4.3.2 Significant contribution of knowledge on homestead agroforestry on the farmers' income from homestead agroforestry system

From the multiple regression, it was concluded that the contribution of knowledge on homestead agroforestry to the farmers' income from homestead agroforestry system was measured by the testing the following null hypothesis;

"There is no contribution of knowledge on homestead agroforestry to the farmers' income from homestead agroforestry system".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the knowledge on homestead agroforestry was significant at 5% level (0.040)
b. So, the null hypothesis could be rejected.
c. The direction between knowledge on homestead agroforestry and income from homestead agroforestry system was negatives.

The b-value of knowledge on homestead agroforestry was (0.317). So, it can be stated that as knowledge on homestead agroforestry increased by one unit, farmers' income from homestead agroforestry system increased by 0.317 units.

Based on the above finding, it can be said that farmers had more knowledge on homestead agroforestry increased the income from homestead agroforestry system. So, knowledge on homestead agroforestry has high significantly contributed to the farmers' income from homestead agroforestry system. Knowledge on homestead agroforestry helps farmers to gather more knowledge on winter vegetable cultivation which ultimately helps farmers to reduce their problems in income from homestead agroforestry system.

4.3.3 Significant contribution of training on homestead agroforestry system of the farmers' income from homestead agroforestry system

From the multiple regression, it was concluded that the contribution of training on homestead agroforestry system of the farmers' income from homestead agroforestry system was measured by the testing the following null hypothesis;

"There is no contribution of training on homestead agroforestry system to the farmers' income from homestead agroforestry system".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the training on homestead agroforestry system was significant at 5% level (.029)
b. So, the null hypothesis could be rejected.
c. The direction between training on homestead agroforestry system and income from homestead agroforestry system was positive.

The b-value of training on homestead agroforestry system was (0.277). So, it can be stated that as training on homestead agroforestry system increased by one unit, the farmers' income from homestead agroforestry system increased by 0.277 units.

Based on the above finding, it can be said that farmers had more training on homestead agroforestry system increased farmers' income from homestead agroforestry system. So, training on homestead agroforestry system has high significantly contributed to the farmers' income from homestead agroforestry system increased.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 SUMMARY

The study was conducted at ten villages of Trishal and Fulbaria upazila under Mymensingh district. Out of ten villages, five villages in Trishal and five villages in Fulbaria were selected randomly to explore the contribution of the selected characteristics of the farmers with their income from homestead agro-forestry system to reduce poverty. The field data collection was started from 01 September and completed on 27 September, 2020.

The majority (35 percent) of the respondents were the middle-aged category while 31.67% and 33.33% were found young and old categories respectively. The highest 40 percent respondents of the farmers were illiterate. It was found that 23.33% respondents were secondary level of education, 10% respondents were primary level of education and 26.67% respondents were above secondary level of education. The majority (46.67%) of the farmers had small family while 20% of them had large family and 33.33% of them had medium family. The majority 53.33% of the farmers had small land while 44.76% of them had medium land and only 1.91% of them were large farmer. The highest portion (80 percent) of the farmers had medium annual family income compared to 3.33 percent respondents having low and 16.67% had high annual family income. The highest 73.33% of the farmers had medium experience in homestead agroforestry system compared to 10 percent low and 16.67 percent of the farmers had high experience in homestead agroforestry system.

In the case of occupation, Agriculture accounted 51.67% of respondents business accounted 18.33%, service accounted 10% and others accounted 20% of respondents. The highest portion 46.67% of the farmers had low training on homestead agroforestry system; while 31.675 of the farmer's had no training

on homestead agroforestry system and 18.33% had medium training on homestead agroforestry system and only 3.33% of the farmers had high training on homestead agroforestry system**.**

The highest portion (65 percent) of the farmers had medium income from homestead agroforestry system compared to 20 percent having low and only 15 percent had high income from homestead agroforestry system.

Education, knowledge on homestead agroforestry and training on homestead agroforestry system of the respondents had significant positive contribution with their income from homestead agroforestry system. Of these, education were the most important contributing factors (significant at the 1% level of significant) and knowledge on homestead agroforestry and training on homestead agroforestry system of the respondents were less important contributing factors (significant at 5% level of significant). Coefficients of other selected variables don't have any contribution on their income from homestead agroforestry system.

The value of R^2 is a measure of how of the variability in the dependent variable is accounted by the independent variables. So, the value of $R^2 = 0.728$ means that independent variables account for 72% of the variation with their income from homestead agroforestry system. The F ratio is 13.09 which is highly significant ($p<0$).

However, each predictor may explain some of the variance in respondents their income from homestead agroforestry system simply by chanced. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but value 0.672 is still show that variance is their income from homestead agroforestry system can be attributed to the predictor variables rather than by chanced. In summary, the models suggest that the respective authority should be consider the farmers' education, knowledge on homestead agroforestry and training on

homestead agroforestry system of the respondents on their income from homestead agroforestry system.

At present, 40% farmers live in Tin, bamboo and well-maintained house and 60% farmers live in brick, wood and galvanized iron house and no farmers live in katcha ghar with straw or plastic housing condition at present, where at 10 years ago, 38.33% farmers were lived in katcha ghar with straw or plastic and 60% were lived in Tin, bamboo and well-maintained house and 1.67% farmers lived in Brick, wood and galvanized iron house.

At present, 53.33% farmers ate fish weekly, 16.67% farmers ate milk weekly, 0% farmers ate bread weekly, 18.33% farmers ate egg weekly and 8.33% farmers ate meat monthly, whereas at 10 years ago, 51.67% farmers ate fish weekly, 15% farmers ate milk weekly, 13.33% farmers ate bread weekly, 16.67% farmers ate egg weekly and 3.33% farmers ate meat monthly.

At present, 80% farmers have Sanitary toilet, 20% farmers has half sanitary toilet, no farmers completed their toilet in open place and no farmers has katcha toilet, where at 10 years ago, 65% farmers had katcha toilet and 3.34% farmers had Sanitary toilet, 18.33 farmers completed their toilet in open place and 13.33% farmers has half sanitary toilet.

So the socioeconomic conditions of farmers have changed due to homestead agroforestry system practice which indicates to reduce poverty.

5.2 CONCLUSION

Finding shows that majority of the farmers had medium to high levels of knowledge on homestead production. Therefore, it can be concluded that knowledge on homestead production contributed to increase production which helps to reduce poverty.

Education of the farmers showed that there was significant contribution with contribution of homestead Agroforestry (i.e. household income) towards reducing poverty. So, it may, therefore be concluded that formal education of the respondents had contribution to increase household income towards reducing poverty.

Training on homestead agroforestry system of the farmers had significant positive contribution to their income from homestead Agroforestry towards reducing poverty. The farmers having many trainings and being economically solvent always try to increase their household income, it may be concluded that the contribution of income from homestead Agroforestry towards reducing poverty is remarkable to the farmers having many trainings.

Current housing condition and Current sanitation system had significant relationship with contribution of income from homestead Agroforestry towards reducing poverty. It can be concluded that any attempt to increase the socioeconomic status of the farmers would be helpful to reduce poverty.

RECOMMENDATION

Based on the findings and conclusions of the study, the following recommendations are presented:

i. Majority of the respondents had medium to high knowledge of education on Agroforestry production showed lower levels of education. Therefore, it may be recommended that attempts should be taken by Department of Agricultural Extension (DAE) and other extension providers to arrange training, motivational campaigning and provide effective technology to increasing homestead production.

ii. Farm size played important role for the farmers to increase their homestead production. Therefore, the Sub Assistant Agriculture Officer (SAAO) should motivate to increase household production through managed Agroforestry.

iii. Education of the respondent had significant positive contribution with income from homestead agroforestry system for reducing poverty. Therefore, it may be recommended that attempts should be taken to establish adult learning center to increase educational level as well as awareness on homestead Agroforestry system.

iv. Extension agencies like DAE should arrange more training to solve the existing problems of homestead production and take necessary steps to minimize these problems.

v. Vegetables, fruits, timber, livestock and fisheries production should be increased on homestead area to reduce poverty.

REFERENCES

Abebe, T. (2005). Diversity in Homegarden Agroforestry Systems of Southern Ethiopia. Dissertation, Wageningen University, The Netherlands 158pp.

ADB (Asian Development Bank). (1993). Master plan of forest production. Govt. Bangladesh, Ministry Env. Forest, Dhaka. p.66.

Ahmad, K.U. (1995). Vegetable crops business in Bangladesh. A consultancy report under AVRDC-BARC/BARI-USAID Bangladesh project, BARI, Gazipur, Bangladesh.

Ahmed, H., Martadihardja, A. and Suharto, A. (1980). Social and cultural aspect of homegarden. *Int. Soc. Trap. Ecol. Kualalumpur, Malaysia,* pp. 169- 178.

Ahmed, M.F.U. (1999). Homestead Agroforestry in Bangladesh: A case study of Gazipur District. AMaster of Science dissertation in Agroforestry and environment, Dept. of Agroforestry and Environment, Bangabandhu Sheikh MujiburRahman Agricultural University, Gazipur, Bangladesh.

Akhter, S. 2003. Comparison Between Knowledge and Skill of Women Led FFS of RDRS and Non-FFS Farmers. M.S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Alam, M.K., Mohiuddin, M. and Basak. S.R. (1996). Village trees of Bangladesh: Diversity and Economic Aspects. *Bangladesh J. Forest Sci*. **25**(1&2): 21-3.

Alam, M.S., Masum, K.M., Campus, B.F.R.I., and Sholashahor, B. (2005). Status of homestead biodiversity in the offshore island of Bangladesh. *Res. J. Agric. Biol. Sci*., **1**(3): 246-253.

Alim, A. (1980). Integrated rural development, protection of forest, use of forest soil potential and connection of rural poor to waste and marginal land. Ins. Forest., Chittagong Uni. Chittagong, Bangladesh, pp. 266-275.

Anam, K. (1999). Homestead Agroforestry in the Level Barind Tract:A Diagnostic Study. M.S. Thesis. BSMRAU, Gazipur. Bangladesh, pp.20-25.

Balzarini, M. (2011). Making genetic biodiversity measurable: A review of statistical multivarite methods to study variability at gene level. Rev. FCA UNCUYO. **43**: 261-275.

Basak, N. R. (2002). Study on composition of trees in homesteads at different ecological zones in Bangladesh. A master of science dissertation in Agroforestry and environment. Department of Agroforestry and Environment, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh.

BBS (Bangladesh Bureau of Statistics). (2002). Monthly Statistical Bulletin. Bangladesh. Bureau of Statistics, Statistics Division, Ministry of planning, Government of the People‟s Republic of Bangladesh, Dhaka, Bangladesh, pp.73.

BBS. (2001). Statistical Year Book of a Bangladesh. Bangladesh Bureau of Statistics Division; Ministry of planning. Government of peoples republic of Bangladesh. p. 42.

BBS. (2003). Monthly Statistical Bulletin of Bangladesh. Bangladesh Bureau of Statistics Division; Ministry of Planning. Government of People's Republic of Bangladesh, Dhaka, p. 1-2.

BBS. (Bangladesh Bureau of Statistics), (2020). Statistical pocket book. Statistic Division, Ministry of Planning. Government of the Peoples Republic of Bangladesh.

Bloem, M. W., De Pee, S., Graciano, F., Kiess, L., and Moench-Pfanner, R. (2001). Homestead food production--a strategy to combat malnutrition and poverty. Helen Keller Worldwide 2001. Pp. 1-5.

Bonifasi, E. M. (2004). Assessment of the Contribution of Agroforestry to Poverty Alleviation in Lushoto District. Dissertation for Award of MSc Degree at Sokoine University of Agriculture. Morogoro, Tanzania. 124pp.

Byron, N. (1984). People's forestry- a novel prospective of forestry in Bangladesh ADAB News. **11**:31 – 37.

Byron, R.N. (1984). People’s forestry a novel prospective of forestry in Bangladesh. ADAB News. **11**: 28-42.

DAE. (1999). Agricultural Extension Manual. Department of Agricultural Extension, Ministry of Agriculture, Government of the People’s Republic of Bangladesh.

Dasgupta, S., Azam A.k., Rahman. M. and Islam, K.D.K.M. (1988). Agroforestry status homestead area on vaskarkhills farming system research site, Kishoregonj (Bangladesh). Proc. N. Work. In Homestead Plantation and Agro- forestry in Bangladesh. BART, PIC, Great Britain. **17**(8): 1159-1172.

Dewees, P.A. (1989). The wood fuel crisis reconsidered: Observations on the dynamics of abundance and scarcity world development, pergamon press Pic, Great Britain. **17**(8): 1159- 72.

Doglas, J.S. (1982). Consumption and supply of Wood and Bamboo in Bangladesh. Field Document No. 2 UNDP–FAO–Project, BGD–8/010. Planning Commission, Dhaka pp.32.

Douglas, J.J. (1981). Supply and demand of forest products and future development strategies, field document no. 2, UNDP/FAO/Planning Commission (GOB) Project BGD/78/010.

Dwivedi, R.P., Kareemulla, K., Singh, R., Rizvi, R.H. and Chauhan, J. (2007). Socio-Economic Analysis of Agroforestry Systems in Western Uttar Pradesh. *Ind. Res. J. Ext. Edu.,* **7**(2-3):18-22

FAO (Food and Agricultural Organization). (1986). Community Forestry Hand Book. ADB Comm. Forestry Project. FAO-UNDP-BGD/81/028, Dhaka.

Fernandes, E.C.M. and Nair, P.K.R. (1986). An Evaluation of the Structure and Function of Tropical Homegardens. *J. Agric. System*. **21**: 279 – 3104.

Gautam, G., Mitchell, R., and Hanstad, T. (2004). Small homegarden plots and sustainable livelihoods for the poor. FAO-LSP, WP. p. 11.

Guuroh, R.T., Uibrig1, H., and Acheampong, E. (2011). Improving Benefits from Marginal Lands: Contribution of Homegardens to Household Income Generation in the Bieha District of Southern Burkina Faso. Conference on International Research on Food Security, Natural Resource Management and Rural Development held in University of Bonn, 5 – 7 October 2011. 5pp.

Headey, D., Dereje, M. and Taffesse, A.S. (2014). Land constraints and agricultural intensification in Ethiopia: A village-level analysis of high-potential areas. *Food Policy,* **48**:129-141.

Helen Keller International. (2003). Homestead food production program. Helen Keller Worldwide 2003. p. 43.

High, C. and Shackleton, C.M. (2000). The Comparative Value of Wild and Domestic Plants in Homegardens of a South African Rural Village. *J. of Agf. Syst.* **48**: 141–156.

Hocking, D. (1986). Village and Farm forestry in Bangladesh, Oxford Forestry Ins. Oxford.pp. 147.

Hoogerbrugge, I. D. and Fresco, L. (1993). Homegarden Systems: Agricultural Characteristics and Challenges, International Institute for Environment and Development, Gatekeeper Series No. 39.12pp.

Hussain, A. and Shailo, I. (1987). Deforestation in Bangladesh: Towards and Ecological Inferno. ADAB News. **17**(2): 170-177.

Hussain, M.J. and Miah, M. G. (2004). Homestead Agroforestry production and management manual. The small farmers and Agroforestry development programme (SADP), GTZ and DAE, Rangpur, Bangladesh.

Iannotti, L., Cunningham, K., and Ruel, M. (2009*).* Improving diet quality and micronutrient nutrition: homestead food production in Bangladesh. *Int.j. Food Policy Res. Inst*. pp. 154-159.

Islam, F., M. Akkas Ali and Ashraf, M. (2003). Homestead Vegetable Gardening: A Means of Homestead Food and Nutrition Security for Marginal Farmers. *Bangladesh J. Agric. Res*. **28** (2): 261-270.

Islam, M.N. (1991). Towards Sustainable Development: Energy- and Mineral resources of Bangladesh. National conservation strategy. BRAC, Dhaka pp. 145-170.

Jana, S., Roy, J., Marambe, B., Weerahewa, J., Pushpakumara, G., Silva, P., and Premalal, S. (2015). Home gardens in the Paschim Medinipur District of West Bengal in India: a land use system with multiple benefits. *Intl. J. Environ. Sust. Dev.* **14**(2), 191-206.

Januzi, R.T. and Peach, J.T. (1977). Report on the Hierarchy of interests land in Bangladesh, land Occupancy Survey of Rural Bangladesh, Washington, D.C., U.S. Agency Int. Dev.

Josephson, A.L., Ricker-Gilbert, J. and Florax, R.J. (2014). How does population density influence agricultural intensification and productivity? Evidence from Ethiopia. Food Policy, **48**:142-152.

Kerlinger, F.N. (1973). Foundations of Behabioural Research. 2nd Edn. Delhi: Surjeet Publications.

Khan. M.A.H., Ali, M.Y., Nazrul, M.I. and Quayyum, M.A. (2009). Year Round Homestead Vegetables Production: A Means of Reducing Poverty and Nutritional Deficiency for Small Farm. *Bangladesh J. Agric. Res.* **34**(1): 169-174.

Khandaker, K. (1991). Homestead Agroforestry in Bangladesh and its development, paper presented in a Train. Course on Res. Technique in Agroforestry. Bangladesh For. Res. Insti. Chittagong, Bangladesh p. 12.

King, K.F.S. (1968). An e-publication by the World Agroforestry Centre. Agroforestry a decade of development Print. Print Preview.

Krishnal, S., Weerahewa, J. and Gunaratne, L.H.P. (2012). Role of Homegardens in Achieving Food Security in Batticaloa District, Sri Lanka. International Conference on Economics and Finance Research IPEDR. IACSIT Press, Singapore. 32pp.

Kumar, B.M., and Nair, P.K.R. (2004). The enigma of tropical homegardens. *Agf. Syst.* **61**: 135-152.

Lai, C.J.K. (1988). Design of Agroforestry system with special Reference to Bangladesh. InTroc. Work. Homestead and Agroforestry. Bangladesh Agric. Res. Insti. Gazipur, Bangladesh pp.336-340.

Leach, G. and Meams, R (1988). Beyond the wood fuel crisis, people, Land and Trees in Africa. Eartscan Pub. Ltd., London.pp. 124-129.

Leakey, R.R.B. (1996). Definition of Agroforestry revisited. *Agroforestry Today* (ICRAF).

Leuschner, W.A. and Khaleque, K. (1987). Homestead forestry in Bangladesh. Agroforestry Systems, **5**: 139-51.

Marambe, B., Weerahewa, J., Pushpakumura, G., Silva, P., Punyawardena, R., Premalal, S., Miah, G. and Roy, J., (2012). Vulnerability of homegarden eco-systems to climate change and its impacts on food security in south Asia. *APN, Tokyo.*

Marsh, R. (1998). Household Gardening and Food Security: A critical Review of The Literature. FAO Nutrition Programmes Service, Food and Nutrition Division. Rome, Italy.11PP.

Mazher, K. (1996). An Economic Analysis of Homesteaded Farming in Some Selected Areas of Mymensingh District M.Sc. thesis, Department of Agricultural Economics, BAU, Mymensingh.pp.365-368.

Mendez, V.E., Lok, R. and Somarriba, E. (2001). Interdisciplinary Analysis of Homegardens in Nicaragua: Micro-Zonation, Plant use and Socioeconomic Importance. *J. Agroforestry System*. **51**(2): 85 – 96.

Miah, G.M., and Ahmed, M.M. (2003). Traditional Agroforestry in Bangladesh: Livelihood activities of the rural households. In A poster presented at the XII world forestry congress, held in September, Canada.

Miah, M. Danesh, D. (2002). Tree resources in the floodplain areas of Bangladesh. Schweizensche Zeitschnfi for Forstwesen. **153**(10): 53-55.

Millat-e-Mustafa, M.D., Hall, J.B. and Tklehaimanot, Z. (1996). Structure and floristics of Bangladesh homegardens. *J. Agroforestry System*. **33**(3): 263-280.

Mosabber, A.S. and Niaz. A.K. (1999). Floristic composition and socioeconomic aspects of rural homestead forestry in Chittagong: A case study Bangladesh *J. Forest Sci.* **28**(2): 94-101.

Motiur, M.R., Furukawa, Y. and Kawata, I. (2005.) Homestead Forest Resources and their Role in Household Economy: A Case Study in the Villages of Gazipur Upazilz of Central Bangladesh. Small-scale Forest Economics, Management and Policy. **4**: 359 – 376.

Motiur, M.R., Furukawa, Y., Kawata, I., Rahman, M.M. and Alam, M. (2005). Homestead forest resources and their role in household economy: A Case Study in the villages of Gazipur sadar upazila of central Bangladesh. Small-scale Forest Economics, Management and Policy, **4**(3): 359-376.

MoYS. (2012). The Population Category in Bangladesh. Ministry of Youth and Sports, Government of the People's Republic of Bangladesh.

Nair, P.K.R. (2012). The overstroy Homegardens. Kluwer Academic Publishers, the Netherlands. 64pp.

Nasreen, M., Hossain, K. M., and Azad, M. A. K. (2013). Climate Change and Livelihood in Bangladesh: Experiences of people living in coastal regions. Proce. of Int. Con. of Building Resilience, 1-25.

Pervin, S. (2007). Attitude of the rural women towards homestead agricultural production. MS (Ag. Ext. Ed.) Thesis.

Poddar, K. K. (2015). Effects of Climate Change on Rural Farmers Livelihood. M.S. (Ag. Ext. & Info. Syst) Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.

Rahman, M.H. (1995). Production of homestead enterprises implications on income and women's status. *Bangladesh Agric. Econ*. **18**(1): 99-105.

Rahman, M.H. (1995). Production of homestead enterprises, implication on income and women's status, Bangladesh J. Agric. Econ., 18(1): 99-105.

Rahman, S. A., Imam, M. H., Snelder, D. J., and Sunderland, T. (2012). Agroforestry for livelihood security in agrarian landscapes of the Padma floodplain in Bangladesh. *Small- scale Forestry*, **11**(4), 529-538.

Rahman, S.A., Imam, M.H., Snelder, D.J. and Sunderland, T. (2012). Agroforestry for livelihood security in agrarian landscapes of the Padma floodplain in Bangladesh. Smallscale Forestry, **11**(4), 529-538.

Ramsay, D.M. and Wiersum, K.F. (1976). Problems of watershed management and development in the upper Solo river basin. Paper presented at the Conference on Ecological Guidelines for Forest, Land or Water Resources. Institute of Ecology, Bandung, Indonesia.

Reza, A. A. (2007). Impact of Information and Communication Technologies (ICTs) use as perceived by the farmers of Bangladesh. MS thesis. Sher-e Bangla Agricultural University, Dhaka.

Roy, I. (1997). Cropland agroforestry: The experience of the village and farm forestry programme. Agroforestry: Bangladesh Perspectives. Dhaka: Bangladesh Agricultural Research Council, 98-118.

Roy, I., Siddiqui, A.R. and Azmal Huda, A.T.M. (1996). Village and Farm Forestry Program: An analysis of trend of plant for VFFP phases (1997-2001). An input of evaluation cum planning mission, Village and Farm Forestry Project (VFFP), Swiss Dev. Coop., Dhaka.

Seddon, J., Doyle, S. and Briggs, S. (2005). Biodiversity in Mixed Farming Landscapes in Central Western NSW. NSW Department of Environment and Conservation, CSIRO Sustainable Ecosystems, Canberra. pp. 114-130.

Soemarwoto, O., Soemarwoto, I., Karyona, Soekartadiredja, E.M. and Ramlan, A. (1985). The Javanese Homegardens as an integrated agro-ecosystem. Nutrition Bulletin, **7** (3): 44-7.

Sultana, P. (1993). Gender Roles in Agricultural Production, crop diversification programme. Workshop on social and social and Gender Anal. Gender Awaren. Building held during 1-2 December, Dhaka, Bangladesh.

Townsend, J.C. (1953). Introduction to Experimental Methods. International Student Edition, McGraw Hill Book Company Inc. New York.

Tynsong, H. and Tiwari, B. K. (2010). Plant Diversity in the Homegardens and their Significance in the Livelihoods of WarKhasi Community of Meghalaya, Noth-east India, Kumla Raj. J. Biodiversity. **1**(1): 1 – 11.

Vieira, T.A., Rosa, L.D.S. and Santos, M.D.L. (2012). Agrobiodiversity of homegardens in Bonito, State of Para, Brazil. Revista de Ciências Agrárias/Amazonian Journal of Agricultural and Environmental Sciences, **55**(3), 159-166.

Wilson, R. T. (1995). Livestock Production Systems. ICTA, Macmillan, UK. 141pp.

APPENDIX I

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English version of the questionnaire of the study on

"**ROLE OF INCOME FROM HOMESTEAD AGROFORESTRY SYSTEM FOR POVERTY REDUCTION IN THE SELECTED AREAS OF MYMENSINGH DISTRICT**"

Date: ---------- **Sample No: ----------**

Name:

Village:

Union :

Thana:

Mobile:

(Please provide the following information. Give tick (√) marks if necessary. Your information will be kept confidential and will be used research purpose only.)

1. Respondent

A. Age.

Please mention your age .....years

B. Level of Education

Please mention your educational level:

a. Can't read and write……..
b. b) Can sign only ……...……..
c. Up to or equivalent to class.....

C. Family member

Please mention the number of your family member in the following groups:

a) Male _____
b) Female _____
c) Total _____

D. Occupation

a. Agriculture (1)
b. Business (2)
c. Service (3)
d. Others (4)

2. Farm size under homestead agroforestry

(Please mention the total area of land you have homestead agroforestry in last 10 years)…….ha

3. Do you have any knowledge about Homestead Agroforestry?

a. No (0)
b. Low (1)
c. Medium (2)
d. High (3)

4. Homestead agroforestry system experience

(Please mention the following information)

How long have you been engaged in homestead agroforestry system?…….…….Years

5. Do you manage your homestead Agroforestry?

a.Yes b.No

6. Training on homestead agroforestry system

Have you attended any homestead agroforestry system program? ( ) Yes () No If yes, please mentions the following information:

SI. No.	Name of the training courses	Organization	Duration (Days)
1			
2			
3			

7. Annual family income

Please indicate your annual family income (in BDT)

Sl. No.	Source of income	Amount of income (in BDT)
1.	Agriculture	
2.	Livestock (cattle, goat, etc.)	
3.	Poultry (duck, poultry, etc.)	
4.	Fisheries	
5.	Service	
6.	Business	
7.	Other (Please specify)	
Total		

8. Vegetables production (kg in season)?

Vegetables	**Total amount**	**Consumption**	**Sell**	**Price**
Lalsak				
Brinjal				
Bottle gourd				
Tomato				
Beans				
Green pepper				
Papaya				

9. Timber production per Year (in taka)?

Total	**Consumption**	**Sell**	**Price**

10. Eggs production per day (in number)?

Item	Number	Total amount	Consumption	Sell	Price
Chicken					
Duck					

11. Fishes production per year (in kg)?

Total Amount	Consumption	Sell	Price

12. Milk production per day (in liter)?

Item	Number	Total amount	Consumption	Sell	Price
Cows					
Goat					

13. Firewood production per day (in taka)?

Total Amount	Consumption	Sell	Price

14. Fruit production (seasonal basis)?

Item (Fruit)	Production	Consumption	Sell
Jackfruit (number)			
Mango (kg)			
Coconut (number)			
Betel nut (kg)			
Lemon (kg)			
Palmyra palm (number)			
Jujube (kg)			
Guava (kg)			
Gab (kg)			
Banana (Chora)			
Litchi (number)			
Sapota (kg)			

15. Income from homestead Agroforestry in BDT (Last ten years)

a. Total trees …….
b. Total crops…….
c. Total livestock……...

16. Change in food consumption

Sl no	Food items	10 years ago	present
1	Rice (daily)		
2	Bread (daily)		
3	Vegetable (daily)		
4	Fish (weekly)		
5	Milk (weekly)		
6	egg (weekly)		
7	Meat (monthly)		

17. Change in housing condition

Sl no	Type of housing unit	10 years ago	present
1	Katcha ghar with straw or plastic		
2	Tin, bamboo and well maintained house		
3	Paka ghar		

18. Change in sanitation

Sl no	Type of toilet	10 years ago	present
1	Open place		
2	Katcha toilet		
3	Half sanitary toilet		
4	Sanitary toilet		

Thanks for your cooperation ……

APPENDIX II

Data analysis sheet

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.853[a]	.728	.672	301.099
a. Predictors: (Constant), Income, Family member, Age, Occupation, Farm Size, Experience, Training, Manage, Knowledge, Education				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11867244.133	10	1186724.413	13.090	<.001[b]
	Residual	4442374.200	49	90660.698		
	Total	16309618.333	59			
a. Dependent Variable: income.agro						
b. Predictors: (Constant), Income, Family member, Age, Occupation, Farm Size, Experience, Training, Manage, Knowledge, Education						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-261.354	230.746		-1.133	.263
	Age	5.639	3.785	.155	1.490	.143
	Education	31.045	14.213	.344	2.184	.034
	Occupation	6.256	39.109	.014	.160	.874
	Farm size	4.105	3.598	.107	1.141	.259
	Knowledge	128.318	60.817	.317	2.110	.040
	Experience	6.218	6.821	.086	.912	.366
	Manage	-53.902	144.110	-.050	-.374	.710
	Training	21.564	9.614	.277	2.243	.029
	Income	.004	.696	.001	.005	.996
a. Dependent Variable: Income from Homestead Agroforestry						

APPENDIX III

Plate 1: Data collection from Dhurduria village

Plate 2: Data collection from Namatrishal village

Plate 3: Data collection from Tukkirpar village

Plate 4: Data collection from Samaniapara village

Plate 5: Data collection from Dhanikhola village

Plate 6: Data collection from Kanabakhail village