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AGROFORESTRY PRACTICE IN THE MONIRAMPUR  
UPAZILLA OF JESSORE DISTRICT

RIPON SHAIKH



FORESTRY AND WOOD TECHNOLOGY DISCIPLINE  
KHULNA UNIVERSITY  
KHULNA

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**AGROFORESTRY PRACTICE IN THE MONIRAMPUR  
UPAZILLA OF JESSORE DISTRICT**

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This thesis paper has been prepared and submitted to Forestry and Wood Technology Discipline, Khulna University, Khulna-9208, Bangladesh for the partial fulfillment of the BSc (Hons.) degree in Forestry.

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## **DECLARATION**

I, Ripon Shaikh declare that this thesis is a result of my own works and that it has not been submitted or accepted for a degree in any other university.

I, hereby, give consent for my thesis, if accepted, to be available for photocopying and for inter-library loans, and for the title and summary to be made available to outside organizations.

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**(Ripon Shaikh)**



*DEDICATED TO  
MY  
BELOVED PARENTS*

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## ABSTRACT

The study was undertaken to identify different types of agroforestry practice and overview of the status of agroforestry by the farmers of selected Monirampur upazilla of Jessore district. It also explored the relationships among the selected characteristics namely age, education, family size, homestead area; annual income only from agroforestry, communication, organizational participation and problems. The finding revealed that, agroforestry were more popular and it was found that 74% of the respondents were involved in agriculture. Generally they have been practicing homestead agroforestry (53.75%), Silvopasture (2.5%), Trees in agriculture field(20.62%) and also popular boundary plantation(16.25%). It was found about 6.87% of the respondents practice woodlot agroforestry and become interested about fast growing species but fruit yield species still first choice for the homestead area. In case of crops and vegetable, seasonal vegetable and crops are practiced by them. They also introduce shade tolerate species of vegetable which can grow well under tree. On the other hand, some areas of the homestead were found to be unutilized that could be used for growing more trees and vegetable crops. They lack in modern technology and organizational support is not adequate. Only 5% have a good organizational participation with low communication facilities. They faced some other problems, one of them is Vabodaha problem, serious stagnation has taken place since 2005. As a result, huge home-stead area and agriculture land went under water during rainy season. Agroforestry practice has long been hampered in Vabodaha region. Financial problem, irrigation problem, lack of proper seeds and fertilizer supply are also prevalent. In spite of those lacking, farmers have been practicing agroforestry.

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*Chapter One*  
**INTRODUCTION**

### 1.1. Background

Agroforestry as an intensive land management system that optimizes the benefits from the biological interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock.

According to Nair (1990), Agroforestry is a land-use system that involves socially and ecologically acceptable integration of trees with agricultural crops and/or animals, simultaneously or sequentially, to get increased total productivity of plant and animal in a sustainable manner from a unit of farmland, especially under conditions of low level of technological inputs and marginal lands.

Agroforestry is a sustainable land management system, which increases the overall yield of the land, combines the production of crops (including tree crops) and forest plants and/or animals simultaneously or sequentially, on the same unit of land, and applies management practices that are compatible with the cultural practices of the local population (King , 1979).

Agroforestry is a form of multiple cropping which satisfies three basic conditions: 1) there exists at least two plant species that interact biologically, 2) at least one of the plant species is a woody perennial and 3)at least one of the plant species is managed for forage, annual or perennial crop production (Somarriba,1992).

Agroforestry is a collective name for land use systems involving trees combined with crops and/or animals on the same unit of land, Further, it:

- Combines production of multiple outputs with protection of resource base;
- Places emphasis on the use of multiple indigenous trees and shrubs;
- Is particularly suitable for low- input conditions and fragile environments;
- Involves the interplay of socio- cultural values more than in most other land use systems; and it is structurally and functionally more complex than monoculture.

(Kenneth and Napoleon, 1989).

Agroforestry is an age-old land use system that has been practiced for thousands of years by farmers the world over. Although in recent years, it has also been developed as a science that

promises to help farmers increase the productivity, profitability, and sustainability of production on their land, the science of agroforestry lags far behind the art of existing agroforestry practices. Farmers, especially those in the tropics, have a long tradition of cultivating food crops, trees and animals together as well as exploiting a multiple range of production of natural wood lots. However, foresters and agriculturist who have traditionally operated within rather rigid disciplinary boundaries concerned with monoculture production of their preferred commodities of agricultural crops, trees and animals used to ignore such combined integrated production system. (Kenneth and Napoleon, 1989).

### 1.2. Rationale of the Study

Bangladesh is one of the most densely populated country of the world having about 164.4 million (UNFPA, 2016) people in its area of 148560 sq. km with more than 1138 persons per sq km. there are 9.2 million hectares of cultivable land and about 8461 sq. miles of forest in Bangladesh (BBS2003). Agriculture is the foundation of the country, which contributes about 37 percent to the gross domestic product (ADB 2016). About 80 percent people lives in rural areas in 15.4 million households spreading over 87000 villages (, BBS, 2016)

In situation of current population growth rate 1.20 percent, the per capita land is decreasing at an average rate of 0.005 hectare in 2016. In Bangladesh 68 percent of forest product is fuel wood but this meets only 8 percent of national fuel energy need (ADB, 2016). Only 5.4 percent of the forest land is under actual tree cover, which is decreasing at an alarming rate.

Agricultural productions in homestead are indispensable for a country like Bangladesh where the population growth rate is very high and faster than its agricultural growth rate. Due to lack of fallow land new families are influencing on the existing homestead are and for building their dwelling house on agricultural land. The construction of roads, buildings and other infrastructure are also occupying significant portion of agricultural land. The country cannot produce enough food to meet up the ever increasing demand of overpopulation i.e. cereals, vegetables, fish, meat, milk and egg due to lack of modern techniques, inputs and arable land. The major portion of the rural household has homestead and cropland areas, which can be used to grow vegetables, fish



and poultry, medicinal and other necessary plants, and thus can ensure maximum land use with traditional agroforestry system.

The land is limited. So there is no scope to increase the forest land and agricultural land. In these circumstances, traditional land use pattern should be converted into sustainable land use, which will permit maintenance of productivity combined with conservation of the resources on which, that production depends. So the multilayer use of land and the use of same land for many purposes at the same time should be developed, for example, agroforestry in farming system. Agroforestry is a sustainable land use and management system for land that increases total production; combine agricultural crops, tree crops, forest plants, animals and thereby increase total production.

Agroforestry is very common in Jessore district. Both in homestead and cropland people grow trees to meet their family requirements. In homestead horticultural based agroforestry system is generally found. Besides there a wide range of tree species are found in this area both in homestead and cropland.

Agroforestry is very age old practiced in Monirampur of Jessore district. The most successful traditional form of agroforestry system of Bangladesh is found in this region. In fact agroforestry is the main economic activity in this region. But no study concerning agroforestry system and vegetation status in homestead and cropland areas has yet been carried out. So Monirampur Upazilla of Jessore district was selected purposively for this study.

### 1.3. Objectives of the study

- To know the existing agroforestry practices at Monirampur upazilla in Jessore district.
- To know the present status and species composition of agroforestry at Monirampur upazilla in Jessore district.
- To identify the problems of agroforestry practices and to generate useful suggestions to the farmers to improve the agroforestry practice in the area.

*Chapter Two*  
**REVIEW OF LITERATURE**

## 2.1. History of Agroforestry

The origin and development of agroforestry can be traced back to the movement from Hunting/gathering and pastorals systems to the first shifting agricultural or crop rotation practices (Myers, 1980). Though shifting cultivation techniques have been and continue to be most widely practiced in the tropics and subtropics, some of the earliest European agricultural systems used these methods (Russell, 1968).

Shifting cultivation is not a single technique but a varied collection of techniques referred to by a dozen or more names such as, swidden, slash and burn, and Milpa. There is, however, a common pattern. An area of land is cleared of vegetation, prepared for planting, cultivated for a relatively short period, generally 2-3 years and then left to fallow to low for 5-20 years. The farmer then moves on to a new area where he/she repeats the process (Cox & Atkins, 1979).

One form of crop rotation, actually considered a modern agroforestry practice, though introduced in its present form to Burma by that government in the late 1800s, is called Taungya. This method, based on the German Waldfeldbau system, a method of cultivating agricultural crops in forests, has been used as a means of reforesting teak (*tectona grandis*) on open lands at minimal cost (Nair, 1984). Specific government lands are temporarily allocated to individual farmers who are then under contract to plant and care for the government selected tree seedlings in return farmers are permitted to cultivate farm crops between the seedling and are entitled to all produce harvested from them. When the tree canopies begin to close and shade the crops, reduced yields induce farmers to move to new plots to start the pattern over. These in the recently cultivated area are then left until maturity at which time they are harvested and the area is replanted by the same process (Vergara, 1985; King, 1968).

In practice, however, Taungya has incurred its share of problems. Some claim that it is a system the government and landowners use to exploit the labor of farmers who gain only the short-term use of a plot to supply their food needs (Nair, 1984). Others cite evidence that in some areas the trees have been damaged to prevent them from maturing by farmers attempting to secure tenure for themselves (Fortmann & Riddell, 1985; Vergara, 1985).

Agroforestry principles are found in spatially, temporally, and biologically diverse systems in many regions of the southern hemisphere. One of the major export systems introduced by colonialism was that of woody perennial plantation agriculture. High value commodity crops such as oil palm, rubber, coconuts, cacao, coffee, tea, cashew, sisal and sugarcane were cultivated by indigenous peoples for the colonial powers. Though many of these plantations were monocultures, in several parts of Latin America, Africa, and Asia, cash crops were interplanted with annual crops, lower-story tree and shrub crops, and upper-story trees for shade and a diversity of products and uses. Thus, these plantations, which included annual and perennial crops, can be classified as agroforestry systems (Ruthenberg, 1980; Nair, 1984).

## 2.2. Agroforestry System

Lundgren and Rain tree (1982) mentioned that agroforestry is a collective name for land use system and technologies where woody perennials (trees, palms, bamboos, etc.) are deliberately used on the same land management unit as agricultural crops and or animals in same form of spatial arrangement or temporal sequence. In an agroforestry system, there are both ecological and economical interactions between the different components.

According to Femands and Nair (1990), the term agroforestry refers to land use practices involving deliberate management of multipurpose trees and invariably livestock within the compounds of individual houses, the whole crop tree animals units being intensively managed by family labor. It can therefore, be seen that home garden display many agroforestry features; the intimate mixture of diversified agricultural crops and multipurpose trees fulfill most of the fundamental needs of the local populations and their multistoried configuration and high species diversity avoid the environmental problems commonly associated with mono-cultural production systems.

Agroforestry is a land use system that involves socially and ecologically acceptable integration of trees with agricultural crops and/or animals, simultaneously or sequentially, so as to get increased total productivity of plant and animal in a sustainable manner from a unit farmland especially under conditions of low levels of technology inputs and marginal lands (Nair, 1989).

Agroforestry is a sustainable management system for land that increases over all production combines agricultural crops, tree crops and forest plants and/or animals simultaneously or sequentially and applies management practices that are compatible with the cultural patterns of the local population (Bene *et al.* 1977).

Abedin and Quddus (1991) described in detail the traditional cropland agroforestry systems in the Ganges floodplain region of Bangladesh. A few trees of *Phoenix sylvestris*, *Borassus flahellifer*, *Bombax malabaricum* and other were also often found on the higher parts, particularly on plot boundaries in the districts of Chuadanga, Meherpur and Kushtia. Recently there has been a growing trend, particularly among the richer farmers, to plant *Dalbergia sissoo* trees on agricultural lands, with regular species and with primary emphasis on the timber crop. Agricultural crops were intercropped as long as possible. Some farmers were also establishing *A. heterophyllus* and *P. sylvestris* plantations on agricultural lands in that area.

Jackson (1987) stated that agroforestry systems that incorporate a range of tree and crop species offer much more scope for useful management of light interception and distribution than monoculture forest and agricultural crops. The potential benefits as a result of combining field crops with trees are so obvious from consideration of use of the waste nutrient resources experienced in orchards and tree crop combination.

Akhter *et al.* (1989) mentioned that farmers consider tree as savings and insurance against risk of crop failure and low yield, as well as assets for their children. Some farmers stated that tree would contribute toward expenses for marriage of their daughters. Agroforestry can provide a sound ecological basis for increased crops and animal productivity more dependable for economic returns and greater diversity in social benefits on a sustainable basis (Saka *et al.* 1990).

King (1978) suggested that agroforestry might be considered to be practiced whenever trees and agricultural crops are grown in mixture, provided that the combined widths of the rows of agricultural crops do not exceed the heights of the forest trees at maturity.

Abedin *et al.* (1990) mentioned that agroforestry is considered as one of the strategies for augmenting tree production for a country like Bangladesh where there is a little scope of developing pure forest due to obvious priority for food crop production.



Khandaker (1991) reported that agroforestry system is traditional in the homesteads of moist tropical world including rural areas of Bangladesh. This system could be considered as potential technology for rural poverty alleviation because of its diversified functions.

Lawrence and Hardostry (1992) mentioned that the landowners cited potential advantages to practicing agroforestry were land use diversity (25 percent) enhanced productivity (18percent). aesthetics ( 1 3 percent), income diversity ( 1 3 percent) and the most frequently identified potential obstacles to practicing agroforestry were: lack of information (28 percent), lack of technical assistance (1 8 percent), establishment cost. It was suggested there is great potential for application agroforestry throughout the S.I.D.C. and non-industrial private forestland owners were selected for future study of this potential.

Solanki (1998) reported that agroforestry can significantly contribute to increasing demand of fuel wood fodder and lack of cash and infrastructure in many developing countries. He also stated that agroforestry has high potential with simultaneously 3 important objectives:

- 1) protecting and stabilizing the ecosystems
- 2) producing a high level of output of economic goods (fuel, fodder, small timber, Organic fertilizer etc.) and
- 3) providing stable employments improved income and basic material to rural populations.

Basavaraju and Guru raja (2000) concluded that selection of suitable tree species for agroforestry is important. However, it is not always possible to select tree species having all the desirable characteristics for agroforestry because of different production and protection goals. It is stated that in such cases, agroforestry systems have to be managed through planting optimum density of trees, proper special arrangement and pruning and thinning of tree crown and roots to reduce the negative effects.

Neupane and Thapa (2001) cited that the practices which minimize the rate of soil degradations increase crop yields and raise farm income are key to sustaining agricultural productivity in the

hills of Nepal. They also stated that agroforestry has great potential for enhancing food production and farmer economic conditions in a sustainable manner through its positive contribution to household income.

In agroforestry systems there are both ecological and economical interactions between the different components. It can provide a sound ecological basis for increase crop and animal productivity, more dependable economics returns and greater diversity in social benefits on sustained basis (Saka *et al.*, 1990).

Nahidur (2009) stated agroforestry practice had significant role in improving the economic status of the people . It is implied that if people are encouraged to plant trees in their homestead, thereby, the people can live in a healthy environment at the same time if can ensure the supply of timber, fuel, fodder ,nutrient and other products. Therefore, there is a great scope to improve the prevailing homestead agroforestry practices with modern agroforestry technologies for maximization of income of the farmers.

Khan (2007) suggested that Agroforestry might be considered to be practiced whenever trees and agricultural crops are grown in mixture, provided that the combined widths of the rows of agricultural crops do not exceed the heights of the forest trees at maturity and provided further that the combined widths of rows of forest trees do not exceed the height of the tree crops at maturity or at some selected rotations.

Noppen *et al.* (2004) observed the rural firewood markets and village dynamics; the impacts of the strategy (in relation to poverty, the environment/ forests, and rural urban tradeoffs etc); the challenges that still need to be faced; the potential offered by Niger's rural fuel wood markets

Wihkramasinge (1997) illustrated that Agroforestry is important for income, nutrition and health, for reducing economic risk and for improving food security at household level. Home farmers were seen as having potential role to play in maintaining biological diversity at both the species and subspecies level.

## 2.3. Agroforestry System in Bangladesh

### 2.3.1. Traditional agroforestry systems

Agroforestry is an age-old practice in Bangladesh as an indispensable part of rural lives and livelihoods. In most of the agro-ecological regions of the country, the farmers in the rural communities have been practicing agroforestry for centuries, where growing different tree species in their homestead compounds or/and in their crop fields is a common phenomenon with its virtue of short-term benefits from agricultural crops and long-term benefits from trees (Lai 1991; Alam 1993; Chowdhury 1993; Mallick 2000). In homestead agroforestry (also known as home-gardens), crops, trees, livestock and fish ponds in and around the homesteads are integrated into the homestead production system; while in crop fields, especially in rain-fed agricultural upland areas, farmers grow trees intentionally or retain the naturally occurring plants along field boundaries or within fields in association with the main crop (Ali & Ahmed 1991; Alam 1993). Cropland and homestead agroforestry are practiced on the private land of the land-owner. In addition, shifting cultivation and taungya system, the oldest traditional agroforestry systems, are practiced by the tribal communities in the hills which are the center of their livelihood activities (Miah *et al.* 2002). These are the 'traditional' systems in the country that have been developed and practiced by the farmers through trial and error over centuries based on their needs and knowledge. The country has been maintaining these various types of traditional agroforestry systems in different agro-ecological regions. Depending on the topography and climatic variations, there are several major agro-ecosystems in Bangladesh, such as floodplain, hill and terrace ecosystems (Miah *et al.* 2002). Homestead agroforestry, the most dominant system in the country, is found all over the country regardless of ecosystem. Cropland or farmland agroforestry is practiced predominantly in floodplain and terrace ecosystem areas, whereas shifting cultivation and taungya system are found in hill ecosystems.

### **2.3.1.1 Homestead agroforestry**

'Homestead' is composed of home and adjacent land occupied by a household. With the increased scarcity of arable land, agroforestry in homesteads is considered as the potential area of intercropping in the context of rural Bangladesh which is usually managed by household members, particularly women (Khan 2007; Miah & Hossain 2010).

Homestead agroforestry is an integral part of the life of rural folks to meet their daily necessities and contributes to household food security. It provides opportunities for income generation with substantial benefits to resource poor farmers and female farmers (Miah & Hussain 2010; Alam & Sarkar 2011). It offers them a spectrum of products, such as food (fruits, vegetables, and spices), tree products (timber, firewood), non-timber products (medicinal and aromatic plants, bamboos) and others (Miah & Ahmed 2003; Miah & Hussain 2010). The benefits of homestead agroforestry can be understood more clearly by some numeric representations. For instance, this system contributes nearly 50% of the cash flow to the rural poor, and also contributes about 70% of the fruit, 40% of the vegetables, 70% of the timber, and 90% of the firewood and bamboo requirement of Bangladesh (Miah & Hussain 2010).

In this system, rural people utilize their homesteads for multi-strata cropping that includes various types of tree resources (such as trees, shrubs, herbs) and rearing livestock. Farmers grow diverse species in three to seven layers where generally the lowest layer is comprised of shade-tolerant species (e.g. pineapple, turmeric, ginger), the lower-middle layer by medium sized trees (e.g. banana, olive, papaya etc.), the upper-middle layer by medium-tall fruit trees (e.g. jackfruit, mango, litchi etc.), and the highest layer by tall trees (e.g. palmyra palm, coconut etc.) (Miah & Husain 2010). Such multi-strata systems represent their wisdom as well as their necessities, and results in intensive plant associations and efficient use of the available land even in a small-sized homestead compound (Rahman *et al.* 2008; Miah & Hussain 2010). Because of the high species density and the characteristics of regeneration, homestead agroforestry systems are often compared to natural forest ecosystems (Khan 2007). The type of trees planted in a homestead varies by ecological and socio-economic factors such as farmers' judgment and preferences (Miah & Hussain 2010).

### 2.3.1.2. Cropland agroforestry

Floodplain and terrace are the major ecosystems of Bangladesh in terms of traditional farmland agroforestry systems. Some most important traditional systems on the basis of tree species dominance with reference to ecosystems are described below:

#### a) *Phoenix sylvestris* based system (Date palm)

*Phoenix sylvestris* (Date palm) system is dominant in the rain fed and irrigated highland ecosystem of high Ganges River floodplain in the south and southwest region of Bangladesh. Date palm is also used as minor species in *Artocarpus heterophyllus* based system in the floodplain and in the terrace ecosystem of the central region of the country.

#### b) *Borassus flabellifer* based system (Palmyra palm)

*Borassus flabellifer* (Palmyra palm) based system is predominantly distributed in the Lower Ganges Floodplain area in the central south region, southwest coastal region and in the terrace ecosystem of central and northwest regions.

#### c) *Artocarpus heterophyllus* based system (Jackfruit)

*Artocarpus heterophyllus* (Jackfruit) based system is predominantly distributed in the central terrace ecosystem in the central region and sporadically in almost all over the country except the saline coastal region. The lateritic highland soils of Bhawal and Madhupur tract are ideal for jackfruit, which is planted systematically as orchard as well as along boundaries and within fields randomly.

#### d) *Acacia nilotica* based system (Babla)

*Acacia nilotica* (Babia) is adapted in flood free and drier areas of High Gang River floodplain and terrace ecosystem of High Barind Tract covering parts of Rajshahi. Pabna. Natore, Kushtia and Jessore districts.

In Bangladesh rice is cultivated in most of the croplands, and historically several species of tree have been growing naturally in these fields for years, and some farmers started keeping those trees in their croplands or the borders of their fields (Hocking & Islam 1994). Now the country is



enriched with various patterns of cropland agroforestry systems throughout its different agro-ecological regions. In general, the composition and prevalence of tree species are different in different agro-ecological regions reflecting biophysical and social variations. Based on the dominant species of the respective region five interactive systems can be found in the country: date palm (*Phoenix sylvestris*) based systems in High Ganges River Floodplain, palmyra palm (*Borassus flabellifer*) based systems in Lower Ganges Floodplain, babla (*Acacia nilotica*) based systems in terrace ecosystems of Barind tract and jackfruit (*Artocarpus heterophyllus*) based systems in the central terrace ecosystem of Madhupur Tract (Ahmed 2001). The trees are planted on the borders or within the field, systemically or sporadically, usually with crops such as rice, wheat, jute, pulses, oilseeds, sugarcane, vegetables and others, and when trees have high canopy coverage (e.g. jackfruit) farmers grow shade-tolerant crops such as turmeric, ginger and aroid (Miah *et al.* 2002). In a study of cropland agroforestry in Bangladesh Hocking *et al.* (1997) found that, though farmers face some crop yield loss under tree species, they accept the loss in return for the tree products.

#### **2.3.1.3 Alley cropping agroforestry**

This practice mixes trees, planted in single or grouped rows, with agricultural, horticultural, or forage crops that are cultivated in the wide alleys between tree rows. Alley cropping can be a way to convert marginal cropland to high value woodland while continuing to earn income from annual crops during the early years of the project, or to protect sensitive crops such as vegetables and fruits from wind. Annual crops (row crops, forages, vegetables) cultivated between rows of trees provide extra income before nut or fruit trees bear or early in the long-term timber rotation. High-value hardwoods (oak, walnut, ash), fruit and nut trees, fast-growing trees (hybrid poplar and cottonwood), or fruit, nut, or floral producing shrubs are potential species for alley cropping.

#### **2.3.1.4 Woodlot agroforestry**

A woodlot, called farm forests in India or tree farms in the Philippines, is any area of farm-land with trees, the purpose of which is more than just providing shade and shelter. However, woodlots need not necessarily be restricted to farms and farmland, and any small plantation or group of trees, on a farm, around a village, in waste-ground, or beside a road may fit the purpose of a woodlot. Woodlots, whether planted or natural, fulfill two important needs, in addition to

providing protection or shelter. They are a source of firewood and, if given rudimentary management, will produce small round wood such as posts, poles, or even pulpwood. These provision, fuel and construction material are two of the five physical requirements for living. In many parts of the tropics development is so pressing that many people, especially in rural areas, can not presume on the availability of, or may not even have, these five basic necessities. Frequently, such poverty is most acute in places where there is little natural woodland (Young, 1989). In areas devoid of tree cover, establishment of woodlots is an effective means of raising rural living standards. Two benefits alone illustrate this. By planting a woodlot near a village less time is needed for collecting firewood and other domestic wood needs and more time is available for more productive activities such as cultivation of agricultural crops, food preparation and cooking, spinning, tool making, etc. Moreover, a woodlot provides wood for fuel so that dung and other organic matter need not be burnt and can be used for fertilizer to improve crop yields. In addition, because produce from woodlots is usually marketable they are a source of income (a cash crop) for the owner or the village. Such income generation is an important feature and reflects the role of trees as savings and security for many people in rural areas (Arnold 1990 and Chambers and Leach 1990).

#### **2.3.1.5 Forest farming agroforestry**

Forest farming is producing specialty crops under a tree canopy. Forest farming can provide annual or periodic income either before, or as an alternative to, harvesting the trees for wood products. Potential understory crops are those that grow naturally under forest conditions or are adapted to shade, and that can be sold for medicinal, ornamental, handicraft, or culinary uses. Shade-tolerant crops such as ginseng, decorative ferns, goldenseal, black or blue cohosh, or shiitake mushrooms can be intensively cultivated under a forest cover that has been modified to provide the correct level of shade.

### **2.3.1.6 Shifting Cultivation**

The hill ecosystem represents 10-12 percent of the total land of the country covering the Chittagong Hill tracts, Sylhet and Mymensingh districts. The hill ecosystem represents the oldest agroforestry practices in the country known as Jhum or shifting cultivation. This shifting cultivation is the center of livelihood activities of the tribal people living in these hill tracts.

### **2.3.1.7. Taungya System**

In the hills, the Taungya system was introduced to Bangladesh in 1971 by the then British government. Under this system, teak plantations were established in the Chittagong Hill Tracts. Though introduction of teak plantations, the Taungya system was subsequently extended to all types of forest plantations provided the forest soil was fertile enough to sustain a good agricultural crop. Tea gardens present a unique feature of agroforestry systems in Sylhet region where tea is cultivated under the shade of big trees. Another some minor systems such as *Dalbergia sissoo* based system, tree betel leaf peeper association. Lac culture, sericulture and apiculture are also traditionally practiced.

Hocking (1986) stated that some 15 million household of the country occupy about 0.3 million ha under traditional agroforestry practice in homestead. According to FAO (1986), home garden is one of the most collaborate systems of indigenous agroforestry found most often in tropical and subtropical areas where subsistence land use systems predominate. In traditional agroforestry systems of Bangladesh. Farmers consider trees as savings and insurance against risk of crop Failure or compensate low yields of crops (Aktar *et al*, 1989).

*Chapter Three*

*GENERAL DESCRIPTION OF STUDY  
AREA*

### **3.1. Geography and Constitutes:**

Monirampur is the second largest upazilla of jessore district of Bangladesh. Monirampur is located at 22°55'0"N-23°06'N and 89.22°E. Total area 444.73 km<sup>2</sup>. Monirampur consist of 17 Unions, 9 Wards, 34 blocks, 246 mouzas, 249 villages and 59615 units of house. It is bounded by Jhikorgacha on the north, Keshabpur and Dumuria upazilla on the south. Main rivers are Hari ,Vodra and Kapattakha, but they lost their deepness and water flow. As a result, during rainy season west part of this upazilla is submerged into water. Another flood affected area is Vabodhaho at estern part of the upazilla.

(Source: Monirampur Upazilla krishi office, 2016).

Monirampur has a population of 3, 92,082. (Males-1, 97,871 and females-1, 94,22) Muslim is about 70%, Hindu 29% and 1% others. The family number are 80,880 and farmer dominant family are 76,940. Monirampur has an average literacy rate of 50.56%. Population density is about 733/sq.km.

(Source: Monirampur Upazilla krishi office 2016).

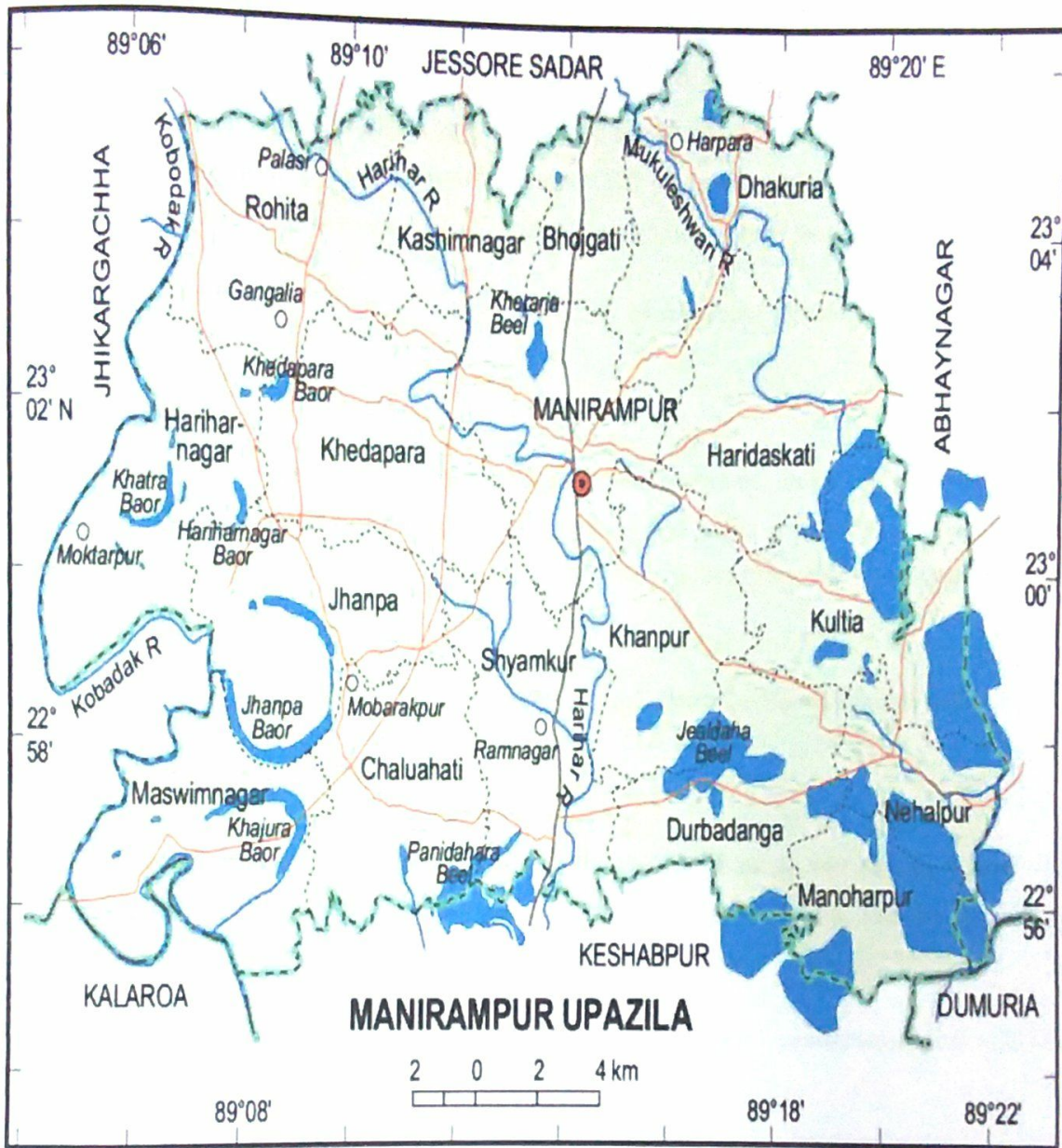


Fig 1: Map of Monirampur upazilla



### **3.2. Land Type**

The area is mainly level and upland. Upper land types are about 22,871 hectares, moderate upper land are 16,478 hectares, moderate lower land are 4,329 hectares and lower land are about 813 hectares. The AEZ-11 type lands are 33,247 hectares and AEZ-14 type land are 3, 231 hectares.

(Source: Monirampur Upazilla krishi office 2016).

### **3.3. Land Use**

Total land is 44,491 hectares and cultivable land 36,478 hectares, fallow land 110 hectares; single crop 3,880 hectares, double crop 26,397 hectares and treble crop 6,091 hectares. Crops density is about 205.51%; density of land use is 81.98%. The irrigation fascinated land is about 31,025 hectares.

(Source: Monirampur Upazilla krishi office, 2016).

### **3.4. Land Control**

In Monirampur upazilla the total number of farmer families are about 76,940 Among them 9,010 are landless, 26,870 are marginal, 30,950 are small, 8,830 are intermediate, and the number of rich farmer are about 1,280. Cultivable land per head 0.093 hectares

(Source: Monirampur Upazilla krishi office, 2016).

### **3.5. Climatic Condition**

#### **3.5.1. Rainfall**

Mean annual rainfall varies from about 1,500-2590 (mm) at Monirampur Upazilla. There is a six-month dry season during which evaporation exceeds precipitation. Conditions are mostly saline in February-April, the depletion of soil moisture being coupled with reduced freshwater flow from upstream.

## **Chapter Three: General description of the study area**

(source: Monirampur Upazilla krishi office, 2016).

### **3.5.2. Temperature**

The average temperature of Monirampur upazilla is 26.7°C. Temperatures rise from daily minima of 2-4 degrees Celsius in winter to a maximum of about 43 degrees Celsius in March and May exceeds 32 degrees Celsius in the monsoon. Storms are common in May and October-November.

(Source: Monirampur Upazilla krishi office, 2016).

### **3.6. Soil Condition**

Monirampur upazilla is very near Kapatakha river. Its soil is loamy and sandy loamy and fertility is very high. The soil is mainly drained and moderately well drained, brown and grey in color. The moisture content was increased due to forestation at both depths across the land strips studied. Maximum (20.43% to 23.3%) in soil moisture content was recorded in surface soil of Monirampur Upazilla. The soil pH was found 7.3 to 6.40 on the study area.

(Source: Monirampur Upazilla krishi office, 2016).

*Chapter Four*

**METHODOLOGY**

**4.1. Selection of the Study Area**

Monirampur Upazilla of Jessore district was selected purposively for this study. After selecting the study area, a reconnaissance survey was carried out to have a preliminary knowledge regarding traditional agroforestry practice in that upazilla. There are 17 unions in this upazilla and randomly selected 8 unions. Two village from each union was chosen randomly. 10 farmers from each village were interviewed. Choosing of villages and farmers were also done purposively.

Table 4.1: Name of all sampling units at Monirampur upazilla at jessore district.

SL No.	Name of the union	Name of the villages
1	Horidaskathi	Hogladanga, Bahadurpur
2	Khanpur	Sheikhpara, Mashna
3	Durbadanga	Khusari kuna, Kaziara
4	Monirampur	Hazrakhati, Jhaljara
5	Kultia	Kultia, Mohisdia
6	Nehalpur	Nehalpur, Kalibari
7	Moshimnagor	Moshimnagor, Juranpur
8	Jhapa	Chandipur, Aminpur

Source: Field survey, 2016

**4.2. Reconnaissance Survey**

A reconnaissance survey was carried out to locate the plantations of the study area and to prepare a set of questionnaire to fulfill the purpose of the current study. The draft schedule was pre-tested by interviewing sample farmers of selected area. Thus, some parts of the draft schedule were improved, rearranged and modified in the light of the actual and practical experiences.

### **4.3. Measurement of Variables of the Study**

#### **4.3.1. Age**

The age of respondents were classified in to three categories, as young age (up to 30), middle age (31 to 45) and old age (above 45)

#### **4.3.2. Education**

If a respondent passed final examination of class five he is considered as primary level, such as up to class eight secondary level. Above SSC Higher level and who did not know reading or writing consider as illiterate.

#### **4.3.3. Family size**

Family size of a respondent was determined in terms of total number of members of each respondent. It can be classified in to three; small family contain the members of 2-5, medium (6-9) and large (above 9)

#### **4.3.4. Homestead area**

It was measured by the area of the raised land in which the household has its entire living room, livestock and poultry shed, yard under vegetable, home garden, fruit and timber trees, back yard bushes, bamboo bunches ponds etc. it was expressed in hectare. Landless and marginal, small (0.03-0.09 ha), medium (0.09-0.15 ha) and large (above .15 ha) are considered as category of homestead area.

#### **4.3.5. Annual income**

This refers to total earning of all family members of a farmer.

#### **4.3.6. Communication exposure**

It refers to the exposure or extends of contact of a respondent with different information sources to find out its relationship with agroforestry improvements of the farmers. Extension contact score was computed on the basis of a respondent's extending of contact with 14 selected information media.

**4.3.7. Organizational participation**

Organizational participation of a farmer was measured on the basis of the nature of his involvement and duration of participation in different local, formal and informal groups in the study area as shown in item number 10 of the interview schedule.

**4.4. Secondary Data Collection**

Before the field survey existing data or information is essential to make a concept about the study area and that would be very helpful for conducting these activities. Source Relevant data and types of data are shown by following table

Table 4. 2: Source Relevant data and types of data

Source of data	Types of collected data
Monirampur, Jessore.	Agroforestry condition, union, villages information, land use, land types, Soil condition, climatic condition, land control demographics, geography etc.
Seminar Library, Forestry & Wood Technology Discipline, Khulna University	Published reports, journals, previous thesis work regarding agroforestry
Newspapers.	Deferent report about agroforestry.
Internet browsing.	Model of agroforestry , definition, types of agroforestry etc.

#### **4.5. Field Survey and Data Collection**

Field survey was carried out in selected village of study area in order to obtain relevant information, data. The survey work runs by using the semi-structured questionnaire. The question were asked in Bengali but written in English language.

Agroforestry practices were visited and farmers were visited and farmers were interviewed to get information regarding agroforestry.

#### **4.6. Data Processing and Analysis**

After field survey and data collection, data regarding agroforestry were arranged and converted into percentage, and information regarding agroforestry was presented in tabular form.

#### **4.7. Limitation of the Study**

- It was not possible to conduct survey extensively due to the lack of fund.
- It took much time to make the local people understand the purpose of the survey. They did not respond spontaneously.



*Chapter Five*

**RESULT AND DISCUSSION**

The finding of the study area presented in three parts. The first chapter deals with the description of selected characteristics of respondents. Agroforestry practices in different sites of study area were discussed in the second part. Third part discussed about the problems of agroforestry at Monirampur.

## 5.1. About the Respondent

### 5.1.1. Age:

The respondents are selected which are only engaged with agroforestry. Age of the respondent ranged from 16 to 65 years with an average of 42.03. The respondents were classified into three categories as young age (up to 30) is about 28%, middle age (31 to 45) and old age (above 45).

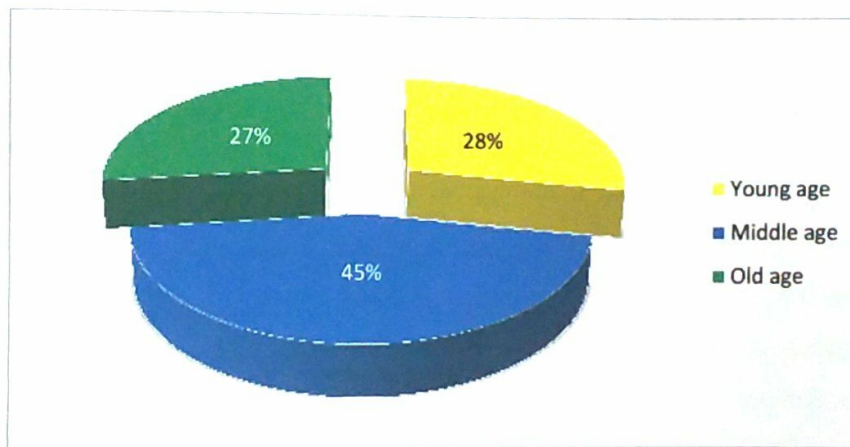


Figure 5.1: The percentage of age status of the respondents

### 5.1.2. Education:

Educational status of the population depends on the socio-economic condition, environment, institutional support and government policy making. Educational attainments help develop conceptual skill and also facilitate the acquisition of technical knowledge about their profession. In this study the farmers; which are related with agroforestry, among them 40% of farmers had

secondary level education whereas 16% of them were illiterate, 32% were primary level and 12% were of higher secondary level.

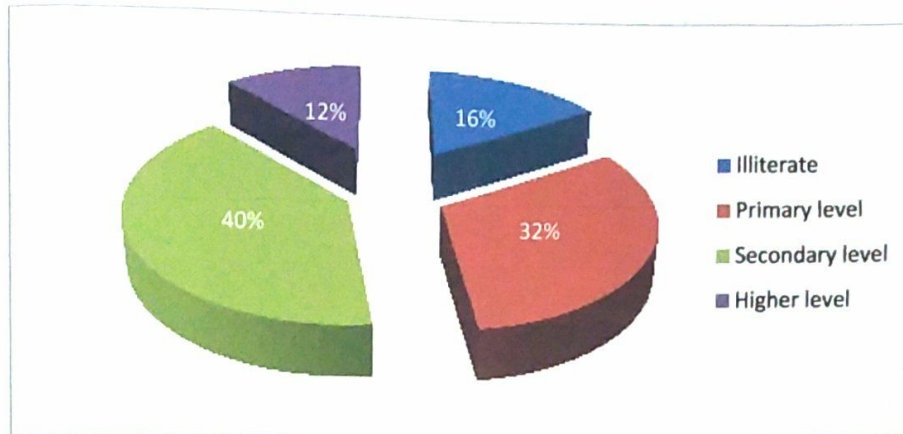


Figure 5.2: The percentage of literacy level of the respondents.

### 5.1.3. Family size:

Family size of a respondent was determined in the term of total number of members of each respondent. The family members include respondent himself, spouse sons, daughter and other dependents. Generally in village extended family is found and some where nuclear family. The family member are about 2-12, somewhere above 12. Most of the farmers had medium (6-9) families (54%) compared to 31 % small (up to 5) and 15% large (above 9) families.

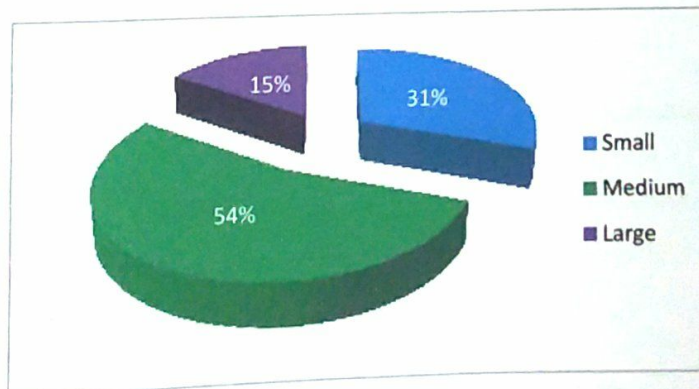


Figure 5.3: The percentage of family size of the respondent



**5.1.4. Homestead area:**

The homestead of the farmer ranged from 0.01-0.23 hectare with an average 0.06 hectare. Among the farmers 23% had landless and marginal, 17% had medium (0.06-0.09 ha), 7% had large (above 0.09) homesteads and while lastly small was 53% (0.03-0.09 ha).

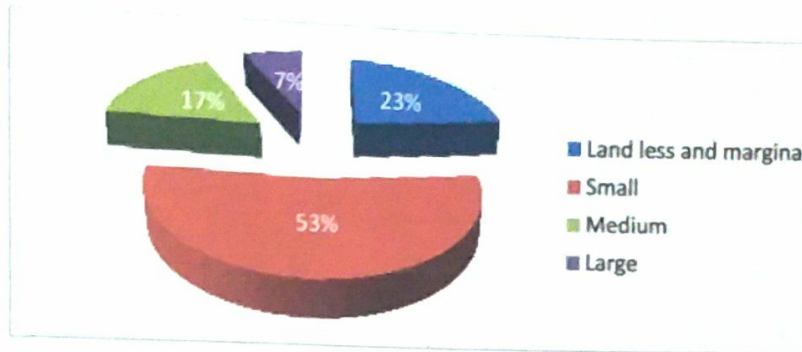


Figure 5.4: The percentage of homestead area of the respondents

**5.1.5. Occupational status of the respondents**

In the study area, people have different occupation. From the survey, it found that 74% of the respondents were involved in agriculture. 12% of the respondents were labor. They have no land. They work others land at a daily payment basis. Beside that 8% of the respondents' occupations were business and rest 6% were service. These findings indicate that most of the respondents depend on agriculture as their primary source of income.

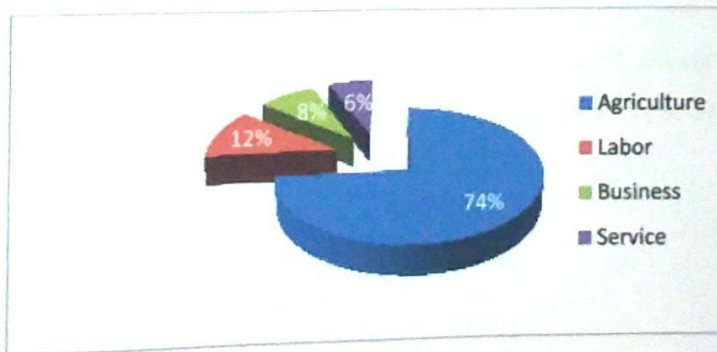


Figure 5.5: The percentage of occupational status of the respondent

**5.1.6. Per year family income of the respondents**

Most of the respondents 41.25% of the respondents were in the range of Tk. 1, 50,000-Tk. 2, 00,000 while (8.75%) were in the income range of Tk. 50001 – 100000, 36.25% of the respondents were in the range of Tk. 100001 – 150000, and 13.75% were in the range of Above tk. 2,00,000.

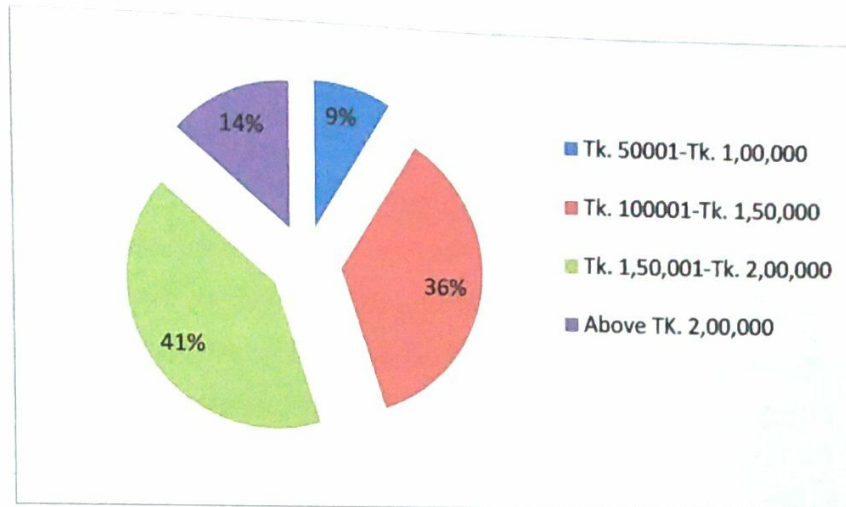


Figure 5.6: Family income of respondents (per year)

**5.1.7. Communication exposure**

Communication exposure is very low in the study area. Most of time they can not keep communication with others i.e. farmers, agricultural officer, fisheries officer and others officer. According their communication exposure it can be classified in to three types Low, medium, high. The percentage is shown by following pie chart.



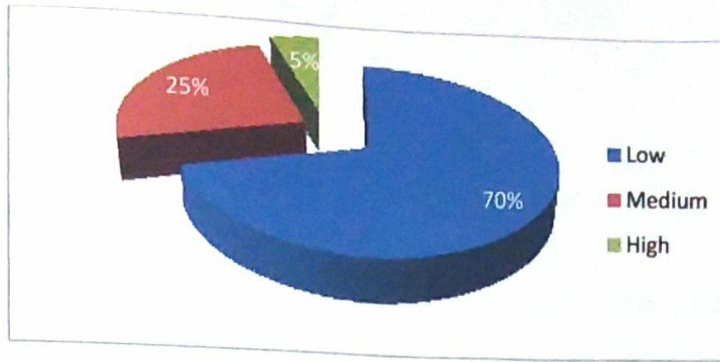


Figure 5.7: The percentage of communication exposure of the respondents

### 5.1.8. Organizational participation

The organizational participation is also very low in the study area. Somewhere no organizational participation at all. There are few organization especially NGOs are attributed with farmers but they only provide microcredit. They do not support directly for developing of home stead agroforestry. It can be classify four types, High (5%), medium (10%), low (55%), and nil (30%).

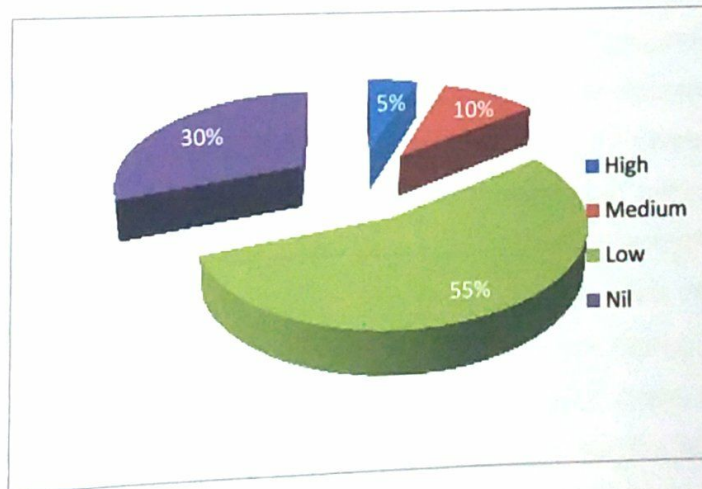


Figure 5.8: The percentage of organizational participation of the respondents

### 5.2. Agroforestry in Study Area

Agroforestry systems are practiced vastly in the selected Monirampur Upazilla in Jessore district which includes the woody perennials like Raintree(*Somanea samana*), Mahagoni(*Swietenia mahagoni*), Neem(*Azadirachta indica*), Ipil-Ipil (*Leucaena leucocephala*) etc and the variety of fruit trees like Mango (*Magnifera indica*), Jackfruit(*Artocarpus heterophyllus*) Banana(*musa indica*)Coconut (*Cocos nucifera*) etc. There are various type of crops associate with homestead i.e. Mustard, Gram, Sesames, Jute, Paddy, Wheat, Lentil etc. Various types vegetable like Brinjal, Onion, Cauliflower, Potato, ladyfinger, Arum, Karolla, Potol, Bean, Ladyfinger, Piper, , etc. after extensive survey of the selected area, the following agroforestry practiced were identified.

#### 5.2.1. Homestead agroforestry

In case of homestead agroforestry in study area, any fixed system or design of agroforestry cannot be practiced by the farmer of the study area. Generally they have been associated tree, crops, and vegetables with random spacing. In homestead forestry farmers meet up their fruits, vegetables, fuel wood and timber demands. Generally multipurpose tree species (MPTs) were chose for homestead forestry. Mango (*Magnifera indica*), Jackfruit (*Aurtocarpus heterophylous*), Jam (*Sygygium cumuni*), Coconut (*Cocos nucifera*), Guava (*Psidium guajava*) Banana (*Musa spp*), Dalim (*Punica granatum*), Lamon (*Citrus aurantifolia*) etc. fruit species were plant for fruit demand as well as extra income. For timber production Mahogany (*Swietenia mahagoni*) was first choice of the respondents. Bamboo is the common multipurpose species in homestead forestry in the study area. In small scale they also planted Eucalyptus (*Eucalyptus camaldulensis*), Koroi (*Albizia procera*), Kadam (*Anthocephalus chinensis*), Nim (*Azadirachta indica*) etc. timber producing species. Along with the fruit species and timber species they also planted different types of seasonal crops and vegetables, i.e. Mustard, Gram, Pigeon pea, pea, Sesames, Jute, Paddy, Wheat, and Lentil etc. Various types of vegetable like Brinjal, Cucumber, Onion, Cauliflower, Potato, ladyfinger, Arum, Balsam-apple, Parble, Bean, Ladyfinger, and Pepper etc. Different types of livestock's like cow, goat, ram, duck, hen, pigeon etc. also rare in homestead agroforestry system.





Fig 5.9: Homestead agroforestry

### 5.2.2. Trees in agriculture field

Trees in agriculture field is a very important factor for the success of any agroforestry practices. Traditionally farmers have been grown different types of vegetables under tree. Sometime farmers also uses tree as the support of creeper of vegetables. Some agroforestry system has been proved as a very unique production system. In surveyed region Turmeric, Ginger, potato, Catjong, Bottle ground is found . In place where trees are very large and mature Turmeric, Ginger, and Arum are found to be grown under trees. As land areas are high only aman paddy is found to be grown under tree in very few places.

Table 5.1: Trees in agriculture field

Tree species	Crop species
Mango, Sofeda, date palm, neem etc.	Brinjal, Potato, Arum, Balsam apple, Parble, Bean, Piper, Sesames seed , Jute, Paddy, Wheat, and various types of vegetables.
Ipil-ipil, Eucalyptus, Coconut, Date Palm, Babla, Neem etc.	Pigeon pea, pea, Arum, Arum bulbous, Gram, Papaya, Banana, Lady's finger, Pepper, Pumpkin, etc.
Mahagony, Sissoo etc.	arum, Arum bulbous, Onion, Zinger, Turmeric etc.



Fig 5.10: Trees in agriculture field



### 5.2.3 Boundary plantation

Boundary plantation has been practiced around the agricultural land. Farmers were practice boundary plantation for protection of annual crops from strong wind, control soil erosion, support climber species etc. purpose. From boundary plantation the farmers' also earn extra income by selling fruits, vegetables, timber, fuel wood, fodder etc. In the study area 17% of the respondents practice boundary plantation. Farmers were maintaining 6''×6'' and 8''×8'' spacing in case of tree species. In this system farmers plant timber species and fruit species on the boundary of the agricultural land. They also plant different types of vegetables like Papaya (*Cracia papaya*)), Brinjal (*Solanum melongena*), Turmeric (*Curcuma longa*), Karala etc. In the field they cultivate mainly Paddy (*Oryza sativa*), Jute (*Corchorus olitorius*) annual crops and different types of seasonal vegetables



Fig 5.11: Boundary plantation

### 5.2.4. Silvopasture

From the survey, it was found that 25% of the respondents has domestic animal within their tree farm. Cow, goat, duck, hen, etc are practiced by the farmer. Cow, goat, ram in this system must be associated under large size trees as if they may not harmful for those trees. It has been practiced under Sisso (*Dalbargia sissoo*), Mahagoni (*Swietenia mahagoni*), Coconut (*Cocos nucifera*), Rain tree (*Somanea samana*) etc. species.



Fig 5.12: Silvopasture

#### 5.2.5. Woodlot

Woodlot plantation is another common agroforestry practice in Monirampur upazilla of Jessore district. Mainly the multipurpose tree species are preferred in this system. The major woodlot species in Monirampur upazilla are Mehogoni, Rain tree, Sisso, , Ipilipil, *Eucalyptus*, Akashmoni etc. About 4% respondents were or are now practicing woodlot plantation because of its rapid large amount cash return.



Fig 5.13: Woodlot

Table 5.2: Agroforestry practices and respondents percentage in the study area

Agroforestry practice	No. of Respondents	Percentage of Respondents
Homestead agroforestry	86	53.75%
Trees in agriculture field	33	20.62%
Boundary plantation	26	16.25%
Woodlot	11	6.88%
Silvopasture	4	2.5%
Total	160	100%

### 5.3. Harmful Effect of Trees in Agroforestry

According to the respondents, trees have some harmful effect also. Most of the farmers said that trees have negative effects on crop yield i.e., trees reduce crop yield. In fact this is due to growing of minor shade bearing vegetable (Turmeric, Ginger, Arum) in homesteads and growing of major high demanding agricultural crop in croplands.

### 5.4. Problem Faced by Farmers in Agroforestry Practice at Monirampur

The special problem of Monirampur is Vabodaha problem, frequent water stagnation occurs since 2005. As a result, huge home stead and agriculture land area went under water during rainy season. Agroforestry practice has long been hampered in Vabodaha region. Some various problems are faced by the farmers of Monirampur Upazilla. Those are given below:



- Lack of technical knowledge.
- Lack of financial facilities.
- During dry season and also insufficient rain in the rainy season farmers (60%) face serious irrigation problem. Again due to frequent power cut, farmers cannot run smoothly their sawmill machine for water supply in their field.
- Sources of planting materials were not adequate in the site. Most of the cases the respondents (70%) have collected planting materials from long distance and at a high price.
- Due to planting trees in cropland, harmful birds, pests/insects etc. get suitable habitat on these trees. So these birds and insects can easily damage the annual crops. In case of cropland agroforestry, farmers face phloem sapping and laddering problem because of shallow root systems. Sometimes natural disaster and grazing animals damage crops.
- Sometimes conflicts arise with the neighbor farmers because trees spread roots and provide shade on their land.
- Farmers (40%) were not got real price of their products. They sell their products in local market because in some areas the communication system was not well with Jessore district and also lack of vehicles and high transport cost.
- In agroforestry system, land is cultivated again and again and thus reduce soil nutrients.
- Small farmers (34%, who has less than 1 acre land) face capital shortage during cultivation of land.
- Some farmers (24%) require training, technical facilities etc. on different agroforestry systems.
- The farmers do not get adequate support from agricultural office or other organization, most of respondent says (55%) they support from NGOs and other organization is very poor.

*Chapter Six*

**CONCLUSION AND RECOMMENDATION**



### 6.1. Conclusion

Farmers have been practicing agroforestry systems from time immemorial. The present study focuses on different aspect of agroforestry systems of Monirampur upazilla. Here maximum farmers are small land holder. But their family needs are higher compare to their assets. So, to fulfill their family needs, they practice different types of agroforestry in their land. This helps them to improve their socio-economic condition. Agroforestry are more popular in the study area but no systemic or modern agroforestry system is followed. Generally they have been practicing mixed homestead agroforeatry, livestock's under tree, tree-crops association and also popular boundary plantation. It was found that farmers become interested about fast growing species but fruit yield species still first choice for the homestead area. In case of crops and vegetable, seasonal vegetable and crops are practiced by them. They also introduce shade tolerate species of vegetables which can grow well under tree. On the other hand, some areas of the homestead were found unutilized that could be used for growing more trees and vegetable crops. In fact, they lack in modern technology and their organizational support is not adequate. In this situation proper guidance to farmers on different aspects of agroforestry can make the improvement of existing practice. For this, Government has to take initiative to establish local level organization for assisting agroforestry and also for strong extension work.

## 6.2. Recommendation

- Suitable tree and vegetable species for a climatic area should be selected. To avoid shade effect, species should be selected wisely.
- More attention should be given on proper care and management of the system to gain more profit. Tree species and vegetables having more economic and food value should be planted.
- Seedlings should be raised locally on potential sites near the field. This will ensure good supply of planting materials at a reasonable price.
- Nitrogen fixing multi-purpose tree species should be selected for maintaining and increasing soil fertility. Selection of low crown diameter species provides less shade in cropland. Deep rooted species could not hamper ploughing and laddering. It also helps to minimize the conflict with neighbor farmers.
- Some place of Monirampur are in water stagnant condition (i.e. Vabodaha ) and if it is not possible to avoid this situation species that tolerate water stagnation should be selected. Floating vegetable cultivation system can be practiced. Where use big size pot or tub for cultivation and grown up climber type vegetable like Bean, Pumpkin, Catjon etc.
- Where irrigation problems are found irrigation problem farmers can dig narrow channel in one side of their land for storing water. They also collect water nearby water body with pump machine.
- Necessary efforts should be taken by the concerned authorities e.g. Government and non government organization though training programs for farmers, extension workers, and NGO representatives on proper planning, designing, management and maintained of the agroforestry system.

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## APPENDIX

### Questionnaire for the field survey for the study of "Status of Agroforestry Practices in the MONIRAMPUR UPAZILLA OF JESSORE DISTRICT"

Sample no. :

Date:

Village :

Union :

Upazilla :

#### A. General information of the respondent:

1. Name of the respondent: .....

Gender		Age (Years)	Educational level			Total no. of family member	Total income per year (Taka)	Occupation	
			Primary	Secondary	Higher secondary			Main occupation	Other
Male	Female								



**B. Information about Agroforestry practices:**

i. What is the approximate total area of land that you manage in acres? .....

ii. Which of the following best describes the tenure of your farm?

- 1. Owner-occupied 2. Tenant 3. Both

iii. What type of Agroforestry you practice on your farm?

- 1. Cropland Agroforestry 2. Homestead Agroforestry 3. Woodlot Plantation 4. Others

iv. How trees are growing on your land?.....naturally / planted

v. Tree species you planted on your farmland:

1.....2.....3.....

4.....5.....6.....

vi. Crop/vegetables/fish/others species you preferred to plant on your farmland (if any):

a) ..... b) ..... c) .....

d) ..... e) ..... f) .....

vii. No. of agro crops you cultivate each year : .....

viii. How long are you practicing agroforestry on your land?.....months/years

ix. Sources of seedling/planting material: a) raised b) purchased

x. Why planting trees in cropland/homestead/other land use? :

.....

.....

.....

.....

xi. What types of product you obtain from trees?

Sl. No.	Products	Amount (Kg or taka)
1	Fuel wood	
2	Vegetables	
3	Fruit	
4	Fodder	
5	Other	

xii. Are you satisfied with the communication facilities in this area? Yes or No; how good is that?

1.Low 2.Medium 3.High

xii. Do you get any assistance from NGO? Yes or No; If yes how much?

1.Low 2.Medium 3.High

xiv. Suggestion/ Recommendations :

- .....
- .....
- .....