Khulna University
Life Science School
Forestry and Wood Technology Discipline

Author(s): Manising Biswas

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Supervisor(s): Arifa Sharmin, Professor, Forestry and Wood Technology Discipline, Khulna University

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Farmer's Perception and Adoption of Agroforestry in Gopalganj District

MANISING BISWAS
STUDENT ID: 140506

FORESTRY AND WOOD TECHNOLOGY DISCIPLINE
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MANISING BISWAS

STUDENT ID: 140506

Forestry and Wood Technology Discipline
Khulna University
Khulna.

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Supervisor

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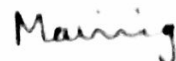
Arifa Sharmin
Professor
Forestry and Wood Technology
Discipline
Khulna University
Khulna-9208.

Prepared by:

Maising
01·10·18

Manising Biswas
Student ID: 140506
Forestry and Wood Technology
Discipline
Khulna University
Khulna-9208.

Forestry and Wood Technology Discipline
**Khulna University**
Khulna.

Declaration

I do here by declare that, except for references to other people's work which have been done cited, this work submitted as a thesis to the Department of forestry and wood Technology, Khulna University, Khulna, for the degree of B.sc (Honors) in forestry, is the result of my own investigation.

Manising Biswas

APPROVAL

This is to certify that the present project entitled "Farmer's Perception and Adoption of Agroforestry in Gopalganj District" has been conducted by Manising Biswas (Student ID: 140506) under my direct supervision and guidance. Project thesis submitted to the Forestry and Wood Technology Discipline, Khulna University, Khulna, Bangladesh in partial fulfilment of the requirements for the four years professional B.Sc. (Hons.) degree in Forestry. I have approved the style and format of the project thesis.

1.10.18

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Arifa Sharmin

Professor

Forestry and Wood Technology Discipline

Khulna University

Khulna-9208.

DEDICATION

This work is dedicated to my Beloved Parents.

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ABSTRACT

The study was focused on farmer's perception toward agroforestry practices and identifies the demographic factors of the responding farmers that influence agroforestry adaption. The study was conducted in Gopalganj District during May-June, 2018 using semi structured questionnaires. Multistage random sampling was applied to select 120 respondents in total for the questionnaires survey. In addition to interviews, field observation was also carried out to obtain additional information. Likert scale was used to identify the attitude of farmers toward homestead agroforestry, cropland agroforestry, woodlot plantation and impacts of planting trees with agricultural crops. In this study we found that agroforestry is becoming popular in Gopalganj district. Middle aged farmers (36-50years) are more interested in agroforestry practice than traditional practice. In the study area almost maximum farmers practice homestead agroforestry, 42.5% people prefer to plant tree species like mehgani, eucalyptus, korai, and other fruit trees in agricultural land and Small portion (15.67%) of the farmers are practicing fish farm agro forestry. Because they think that it increases their income and it also fulfills their household demand. The response of the majority of the respondent (54.17%) was found to be favorable to agroforestry practice on cropland but some respondents (15%) did not show much interest to agroforestry. On the other hand, 8.33% farmers strongly disagree with this practice whereas 22.5% respondents did not provide comments for or against agroforestry practice. Most of the respondents said that trees are harmful for agricultural crops because of difficulties in management, cause significant disturbance on crop thereby reducing the production. Besides, they indicated that trees help to produce quality products. On the contrary, 34.5% respondents said that trees are not harmful for agricultural practice and believe to play a great role in management and space utilization.

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Chapter One: INTRODUCTION

1.1 Background of the study:

Bangladesh is the most populated country of the world which population is about 170 million. The area of this country is only 147,570 square kilometers. Still the population is increasing an alarming rate. To fulfill the demand of food, fuel, housing material etc. of this increased people, a greater pressure has been put on the forest resources of the country. As a result, forest and forest resources of the country is decreasing day by day. Adverse effect of this reduced forest cover is influencing upon the environment gradually. Diminishing of Government and village forest along with the present situation, timber and fuel wood scarcity is increasing more and more. Bangladesh has a classified natural forest area of about 10 percent of the total land area, but only 6-8 percent of this has good canopy cover, which is far below the desired level. About 50 percent of the destruction of forests has been taken place during the last 20 years. The major causes of deforestation are industrialization, rapid urbanization and high population pressure on existing forestland, both for settlement and shifting cultivation. Other causes include encroachment, grazing, fire, uncontrolled and wasteful commercial logging, illegal felling, fuel wood collection and official transfer of forestland to other sectors i.e. for settlement, agriculture and industries. In this way, almost half of the existing forestland under different types of non-forest use (Anon., 1989).

Due to severe scarcity of fuel wood, timber and increasing demand for land in alternative production systems to produce food, fodder and other products in order to meet the needs of a fast growing population, there has been a growing interest in agro forestry in the recent years.

Agroforestry is the art and science of growing woody and non-woody plants together in the same unit of land for range of benefits (BBS, 2013). GoI (2001) defines agroforestry as" a sustainable management system for land that increases overall 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 local population." Agroforestry has long been recognized sustainable development model throughout the world due

to the benefits they brings not only to the economy and society but also to the ecosystem (Thanh, 2005).

Agro forestry is an age old land use that has been practiced for thousands of years by farmers the world over. Although the recent years it has also been developed as a science that promises to help farmers increase the productivity. Agro forestry research is being transformed from a collection of largely descriptive studies into more scientific approaches based on process oriented research. It is a land use that involves deliberate retention, introduction or mixture of trees or other woody perennials in crop/animal/fish production fields to benefit from the resultant ecological and economical interactions (Vergara, 1981).

In Bangladesh people are increasing day by day but the land is remaining same. So the life styles of the village people are going to be low. Agro forestry ensures the maximum utilization of the same piece of land and generates the income opportunity of the farmers and other village peoples. Agro forestry consists of different types of components. Nature of component is includes agrisilvicultural, silvopastoral, agrosilvopastural and others. Others include multipurpose woodlot, apiculture with trees, aquasilviculture etc. (Nair, 1993).

1.2 Justification of the study:

Bangladesh is a small country with huge population. Because of the density of the population pressure is increasing day by day over land and natural resources such as forest. But our land is finite and natural resource is limited. So we are trying to find out a land use system by which we will be able to utilize our land best without harming the land and the environment to fulfill the demands of our population. In this circumstance, traditional land use pattern should be converted into sustainable land uses, which will permit maintenance of productivity combined with conservation of the resource. Agroforestry is such a sustainable land use system. Agroforestry is a sustainable management system for land that increases total production which combines agricultural crops, tree crops, forest plants and animal.

Agroforestry system provides notable contribution to sustainable agricultural production because of their potentiality to meet economic, social, ecological and institutional condition for sustainable livelihoods (Nair, 2006). Agroforestry systems are more extensive in developing countries where approximately 1.2 billion people are depending on variety of products and

services of agroforestry (IPPC, 2000). Besides agroforestry offers a number of service functions. The major service functions of agroforestry are its role in soil management, including control of erosion and maintenance and improvement of soil fertility (Young, 1997). For this purpose agroforestry is the best tool to poverty alleviation as well as minimize the pressure on natural forest and may be the best potential land use system for sustainable livelihoods in our country.

Gopalganj district is selected because this area has a reputation of cultivating various types of cash crop like jute, paddy etc. and as well as producing huge amount of seasonal vegetables. This district contains fresh water and the soil is free from salinity. So the area is very much suitable for agro forestry practice. The study can also help the people to know about various types of agro forestry practice and earning more money and developed their socio economic condition by utilizing the same piece of land.

Objectives of the study:

- ➤ To find out the existing agroforestry practices in Gopalganj District.
- ➤ To know farmers attitude and perception toward their various agroforestry practices.
- ➤ To identify the problems they faced to agroforestry practices and constraint the problems.

Chapter two: LTERATURE REVEW

2.1 History of Agro forestry

Throughout the world, at one period or another in its history, it has been the practice to cultivate tree species and agricultural crops in intimate combination. Agro forestry is the traditional practice of growing trees on farms for the benefit of the farm family. It has been in use for at least 1300 years according to pollen records although tree domestication probably started much earlier (Stoler 1978). The examples are numerous.

2.1.1 In Europe:

It was the general custom in Europe, at least until the middle Ages, to clear-fell derelict forest, burn the slash, cultivate food crops for varying periods on the cleared areas, and plant or sow tree species before, along with, or after the sowing of the agricultural crop. This "farming system" is, of course, no longer popular in Europe. But it was still widely followed in Finland up to the end of the last century, and was being practiced in a few areas in Germany as late as the 1920s (King, 1987).

2.1.2 In America:

In tropical America, many societies have traditionally simulated forest conditions in their farms in order to obtain the beneficial effects of forest structures. Farmers in Central America, for example, have long imitated the structure and species diversity of tropical forests by planting a variety of crops with different growth habits. Plots of no more than one-tenth of a hectare contained, on average, two dozen different species of plants each with a different form, together corresponding to the layered configuration of mixed tropical forests: coconut or papaya with a lower layer of bananas or citrus, a shrub layer of coffee or cacao, tall and low annuals such as maize, and finally a spreading ground cover of plants such as squash (Wilken, 1977).

2.1.3 In Asia:

In Asia, the Hanunoo of the Philippines practiced a complex and somewhat sophisticated type of shifting cultivation. In clearing the forest for agricultural use, they deliberately left certain

selected trees which, by the end of the rice-growing season, would "provide a partial canopy of new foliage" to prevent excessive exposure to the sun "at a time when moisture is more important than sunlight for the maturing grain". Trees were an indispensable part of the Hanunoo farming system and were either planted or conserved from the original forests to provide food, medicines, construction wood and cosmetics, in addition to their protective services (Conklin, 1953).

2.1.4 In Africa:

The situation was little different in Africa. In southern Nigeria, yams, maize, pumpkins and beam were typically grown together under a cover of scattered trees. In Zambia, in addition to the main crop in the homestead, there were traditionally numerous subsidiary crops that were grown in mixture with tree species (Anon., 1989). Indeed, the Yoruba of western Nigeria, who have long practised an intensive system of mixed herbaceous, shrub and tree cropping, explain that the system is a means of conserving human energy by making full use of the limited space laboriously won from the dense forest. They compare the method to a multistoried building in a congested area in which expansion must perforce be vertical rather than horizontal. They also claim that it is an inexpensive means of combating erosion and leaching, and of maintaining soil fertility. As they picturesquely described it, "the plants eat and drink, as it were, not from one table, but from many tables under the same sky" (Haily, 1957).

These examples indicate the wide geographical coverage of the system and its early origins. What is more important perhaps, they clearly point to the fact that the earliest practitioners of what has now become known as agro forestry perceived food production as the system's raison deter. Trees were an integral part of a farming system. They were kept on established Farmland to support agriculture. The ultimate objective was not tree production but food production. (Conkclin, 1953)

By the end of the nineteenth century, however, the establishment of forest plantations had become the dominant objective wherever agro forestry was being utilized as a system of land management. This change of emphasis was not, at first, deliberate. It began fortuitously enough in a far-flung outpost of the British Empire. In 1806, U Pan Me, a Karen in the Tonze forests of

Tharairawaddy Division in Burma, established a plantation of teak through the use of what he called the "taungya" method and presented it to Sir Dietrich Brandis. Brandis is alleged to have prophesied that "this, if the people can ever be brought to do it, is likely to become the most efficient way of planting teak" (Conkclin, 1953)

The taungya system spread to other parts of Burma, Schlich recording in 1867 that he had been shown a taungya teak plantation in its second year in the Kabaung forests of the Taungoo Division.

From these beginnings, the practice became more and more widespread It was introduced into South Africa as early as 1887 (Hailey, 1957) and was taken from Burma to the Chittagong area in India in 1890 and to Bengal in 1896 (Raghavan, 1960).

It must not be imagined that once introduced, the system was practiced continuously in India. It was abandoned both in Bengal and in the Chittagong, and was not resumed until 1908 and 1912, respectively. In the second decade of the twentieth century, however, the system became more and more popular with foresters as a relatively inexpensive method of establishing forests, and as became a full and rising flood. In 1920 it was adopted in Travancore (now Kerala), in 1923 in the United Province (now Uttar Pradesh), and in 1925 in the Central Provinces (now Madhya Pradesh) (Raghavan, 1960). This period also saw its wider dispersal in Africa, and today it is practiced in varying degrees in all the tropical regions of the world. Teak is, of course, not the only forest species which is being established by the use of this agro forestry method. Indeed, the evidence suggests that if the system is utilized for the sole purpose of establishing forest plantations that is only until the first closure of the forest canopy is attained then it may be used in the establishment of forest plantations of most species.

Today, agro forestry is taught as a part of forestry and agriculture degree courses in many universities in both the developing and developed world; and specific degrees in agro forestry are already offered in a few. Today, instead of agro forestry being merely the handmaiden of forestry, the system is being more and more utilized as an agricultural system, particularly for small-scale farmers. Today, the potential of agro forestry for soil conservation is generally accepted. Indeed, agro forestry is fast becoming recognized as a system which is capable of yielding both wood and food and at the same time of conserving and rehabilitating ecosystems.

2.2 Concept of Agro forestry:

Agro forestry is an age old land use that has been practiced for thousands of years by farmers the world over Although the recent years it has also been developed as a science that promises to help farmers to increase the productivity, profitability, and sustainability of production of their land, The science of agro forestry lags far behind the art of existing agro forestry practices. Efforts to define agro forestry began in the mid-1970s and evolved rapidly as studies began on the diversity and scope of agro forestry practices. In the late 1970s and early 1980s the field of agro forestry suffered from a surfeit of definitions and a general lack of common understanding caused by a paucity of hard information. These early struggles to define a broad new area of study have resulted in a conceptual understanding from which to examine complex systems and practices. (Vergara, 1981)

Agro-forestry has been defined in different ways. An early definition of agro-forestry in seventies considered "Agro-forestry as a sustainable land management system, which increases the yield of the land, combines production of crops (including tree crops) and forest plants and/or animals simultaneously or sequentially, on the same unit of land, and applies management practice that are compatible with cultural practices of the local population" Bene *et al.* (1977) and King (1987). Recently, agro forestry is defined as a land use system that involves deliberate retention, introduction or mixture of trees or other woody perennials in crops/animal production to benefit from the resultant ecological and economic intersections (Nair, 1984). Agro forestry is, therefore, a generic term which embraces agro-silviculture, silvo-pastoral and agro-silvo-pastoral systems for elaborate definition. Each definition may have some limitation but some basic ideas emerging from all the definitions are:

➤ Agro-forestry is a land use system including combination of agriculture, forestry, horticulture, animal husbandry, etc.
➤ Integration of trees with crops and/or animals is with the main objective of reducing risk and increasing total productivity.
➤ Agro-forestry system should be ideally stable and sustainable.
➤ Integration of trees with agricultural systems may result in more efficient use of sunlight, moisture and plant nutrients than is, generally, possible by mono-cropping of either

agriculture or forestry crops. There may be competition between the trees and crops for these resources but net effect is positive.

2.3 Importance of Agroforestry:

In Bangladesh, because of various factors such as competition for land due to intensified population pressure, rapidly depleting fuel wood resources, time-scale for orchard operations, dispersed distribution of benefits from forestry and seasonal shortage of labor, the growing of trees did not find a suitable place in the rural economy. Due to the high ecological and social costs and land degradation, highly adverse land-man ratio and more pressure on non-renewable land resource great emphasis has now to be given on the research and developmental aspects of the various agro-forestry systems.

However, people's involvement in such programs is very much essential because they know better what species are best adapted to a particular micro-climate and would have the greatest survival. They should alone decide what are their optimum needs and channels of marketing their surplus produce. Then, they will themselves protect these plantations once they have made the decisions themselves and have been involved in their execution.

2.3.1 Agro forestry for Food, Fuel and Fodder Needs

Because of increase in population of human and cattle, there is increasing demand of food as well as fodder, particularly, in developing countries like Bangladesh. Each year, the farmers of the world must now attempt to feed 81 million more people irrespective of weather conditions. It is important that there will be 19 per cent decline in crop land per capita by the end of this century due to population explosion.

In general, there is acute shortage of food, fuel and fodder in developing countries. However, the situation in Asia is more alarming than in other countries of the third world. Asia possesses the smallest area of "potentially arable land" (672 million ha as compared to 681 million ha in South America and 734 million ha in Africa) and has the highest population. Out of this area, 590 million ha (83 per cent) is already under cultivation. Therefore, there is a little scope to increase food production by increasing more area under cultivation. Hence, food production is to be increased from and already under cultivation or from land not conventionally considered to be

arable. A management system, therefore, needs to be devised which is capable of producing food from marginal agricultural land and also capable of maintaining and improving quality of the producing environment. (Tewari, 1996)

2.3.2 Agro forestry for soil and water conservation

Soil and water conservation is a serious problem in all the developing countries including India, which is reflected by frequent occurrence of floods and droughts. About 44 per cent of the geographical area of India is subjected to serious erosion. It has been reported that 33 per cent of forest land, 86 per cent of cultivable waste, 95 per cent of permanent pastures and other grazing lands, 75 per cent of fallow land and 24 per cent of lands under trees and groves are subjected to serious erosion problems (Tewani, 1996).

Agro-forestry offers answers to the problem of soil and water conservation. Clothing of some of barren and wastelands of watersheds can be achieved through agroforestry interventions. Integration of tree component on pasture or on agricultural land will further induce more interception of rainfall, higher infiltration rates and decrease in intensity of rainfall thereby reducing soil and water loss.

2.3.3. Agro forestry and Improvement of Soil

Agro-forestry practices not only conserve the production base of the soil but also tend to improve it. Agro-forestry trees, particularly leguminous type, enrich soil through biological nitrogen fixation, addition of organic matter and recycling of nutrients. Agro forestry systems help in meeting the requirement of crop plants growing in association with trees, thus, reducing need of fertilizer application. Some tree species such as Leucaena leucocephala have been reported to fix as much as 400-500 kg N/ha, which may symbiotically benefit crops growing in its association and improve soil fertility. Primary aim of agro-forestry happens to provide sufficient fuel-wood, thus, diverting 300-400 million tons of cow dung to agricultural uses rather than burning it as fuel. All these may lead to the improvement of soil due to adoption of agro-forestry systems. (Tewari, 1996)

2.3.4 Agro forestry and Agro-based Cottage Industries

According to Asian Survey of Agrarian Reforms and Rural Development sponsored by FAO, 70 per cent of Indian farmers are marginal (more than 300 million have an average holding of less than 2. ha). They live much below the poverty line. No amount of urban industrialization can raise their economic standards. The ultimate solution of their economic up liftment lies on agro-based cottage industries at village level. Agro-forestry programmed will help in the promotion of agro –based cottage industries, such as, dairying, fruit and fiber industries, piggery, poultry, gum, paper pulp, herbal drugs, cut flowers, beekeeping, sericulture, production of silk, dyes and mushroom industries, etc. Such cottage industries will provide gainful employment to farmers and raise their economic standards. This appears to be the right way to mitigate poverty at grass-root level. (Tewari, 1996)

2.3.5 Agro forestry and Micro-climatic Moderation

Poverty seems to be inescapable evil in semi-arid and arid regions of India where agriculture is not a stable enterprise due to poor yields and frequent crop failures by low and truant rainfall. Agro-forestry compensates the failures by giving income from products other than the crops, therefore, making the entire system reasonably stable.' Agro-forestry programmed will further help in moderation of micro climate in the vicinity of trees, which will benefit field crops growing in association with trees, which is very important for arid and semi-arid areas, beneficial effect of Khejri (Prosopis cinerariu) in western Rajasthan on field crops are well established due to favorable moisture regimes under the trees and micro-climatic conditions. Plantation of tree grows on field boundaries has beneficial influence of wind breaks in protecting crops. In such arid and semi-arid regions, domestic needs of the farmers with respect to fire-wood, timber for house construction, agricultural implements, and fodder for cattle and manure for his field are fulfilled by adoption of agro forestry program. Not only the farmer will be self-sufficient with respect to his needs but can augment his income without affecting agriculture and can overcome adverse tide imposed by the climate. (Tewari, 1996)

2.3.6. Agro forestry and Ecological Balance

There is a tendency of growing ecological imbalance due to population pressure on forests. Now, the forests are confined mostly to hilly tracts and poor soils not suitable to agriculture. Marginal

lands more suitable for forests than for agriculture have been brought under the plough which has further aggravated the ecological imbalance. The forests now cover only 19.47 per cent of the geographical area of the country (Anon., 1989), whereas National Forest Policy provides that the forest are in hilly region should be 66 per cent and for the country as a whole 33 per cent. As some blank areas scrub areas and areas above the tree limit in Himalayas are also included in the forest area, the wooded area is much less than the total forest area. Most of the wooded areas are not fully stocked. Due to population pressure, it is difficult to allocate agricultural lands for growing forest. (Tewari, 1996)

Here, agro-forestry systems offer considerable scope of harnessing advantages of forest by growing trees on marginal lands or with crops on agricultural lands. Agro forestry, thus, can restore ecological balance without reducing the area under agriculture as such. Non-arable marginal and degraded lands, which are about 43 million ha in India, can be brought under agro-forestry systems. Besides, agro-forestry can also be practiced on arable and at suitable places.

Agro-forestry systems are very much site and climate specific. Hence, an attempt has been made in the present book to review the various systems in existence in India under the following five broad agro-climatic regions:

1. Hill region
2. Alluvial Plain Region
3. Arid and Semi-Arid Region
4. Tropical Region and
5. Humid and Sub-humid Region.

2.4 Classification of Agro forestry system:

Nair (1985) categorized agro forestry systems on the basis of four major criteria:

2.4.1 Structural Basis:

It refers to composition and arrangement of components, especially woody ones. The system can be grouped as

Agri-silviculture: Use of land for concurrent production of crops (including tree crops) and forest crops. Here forest trees and agricultural crops are practiced together. This also includes agri-horticulture system.

Silvi-pastora: Use of land for forest trees with pasture, wherein cattle are allowed, to graze. The silvopastural system means a land management system in which forests are managed for the production og wood as well as for rearing of domesticated animals (King, 1987).

Agri-silvi-pastoral: Concurrent production of agricultural crops and forest crops with pasture wherein cattle are grazed.

2.4.2 Functional Basis:

It refers to the main output and role of components, especially woody ones. These can be productive functions (production of basic needs, such as, food, fodder, fuel-wood and other products, etc. and protective roles (soil conservation, soil fertility improvement, wind breaks and shelterbelts and so on).

2.4.3 Ecological Basis:

It refers to environmental conditions and ecological adaptability of system for defined agro ecological zones, such as, low and humid tropics, arid and semi-arid tropics, tropical high lands and so on.

2.4.4 Socio-economic Basis:

It refers to level of inputs of management (low input, high input) or intensity or scale of management and commercial goals (subsistence, intermediate and commercial). Each of these criteria has merits and applicability in specific situations but they have limitations too so that no single classification scheme can be accepted as universally applicable. Classification will depend upon the purpose for which it is intended.

There are three basic sets of components in all agro-forestry systems, viz. wood perennials, herbaceous plants and animals. Therefore, a logical step would be to classify agro-forestry systems based on their component composition into agri-silviculture, silvi-pastoral and agri-silvi-pastoral (or any other specialized) as have been shown by Nair (1985). Subsequently, these

systems can be grouped according to any of the purpose-oriented criteria. The resulting system name can, thus, have anyone of the three basic categories as a prefix; for example, agri-silviculture system for soil conservation. The scheme appears a logical, simple, pragmatic and purpose-oriented approach for classification of agro-forestry systems.

2.5 Types of Agro forestry practices:

Agro forestry practices can be defined as specific land management operations that include some combination of trees, crops and livestock. Practices are the key to most of the benefits and limitations of agro forestry as a land use system. The various forms of agro forestry practices followed by the farmers of Bangladesh are broadly described in the next page:

2.5.1 Trees with crops:

This type of agro-forestry deals with the combination of trees with crops, which is widely adopted. This may include horticultural trees as well.

2.5.1.1 Trees on Cropland

Intentional tree plantation on cropland or relation of existing trees on cropland in common combination of tree with crops is prevalent world over (Grandstaff et al., 1986). Some examples are: Acacia nilotica with rice, Paulownia with wheat, soybean and cotton, Carya lionensis with soybean and maize. Intercropping of *Acacia albida* and *Prosopis cineraria* with crop has been reported to increase yield of crop.

2.5.1.2 Tree Gardens

These include complex combinations of multistoried associations of trees which often shade tolerant herbaceous crops, at times integrated with livestock. Common tropical combinations include palm trees, bushes, banana and various other crops in garden and fields.

2.5.1.3 Taungya

Rising of forest trees with temporary combination of agricultural crops has been a common practice of reforestation in Burma and India, King (1987) has reviewed about 79 tree species and 42 agricultural crops in 'taungya' cultivation.

2.5.1.4 Improved Fallows

Replacement or enhancement of natural fallow vegetation comprise of trees and shrubs for fallow improvement. Rain tree and Warner (1986) have reviewed this system in detail.

2.5.1.5 Plantation Crop Combination

Perennial trees and shrubs are planted with annual crops in tropics (Courtenay, 1965). Common examples are plantation of shrubs, trees, tea, coffee, rubber, coconut and oil palm with maize, peanuts, vegetables, sugarcane, rice, yams and cassava.

2.5.1.6 Alley Cropping

Alley cropping, also known as hedgerow intercropping and alley farming is a simultaneous agro forestry system where trees, mainly leguminous are grow in dense hedges between alleys of specified width where short cycle food crops are grown. The hedges are pruned periodically and the resulting mulch is placed on the alleys to provide nutrients and control weeds [Kang et al, 1981]. Interactions between the tree and the crop components are maximized by this spatial arrangement. Alley cropping should not be confused with contour hedges, another simultaneous system where the hedges are planted along contours on steep slopes but at variable widths and usually include grasses and trees that are not pruned.

2.5.1.7 Windbreaks and Shelterbelts

Strips of trees or shrubs are provided as shelter from wind, sun or snow etc. which improve yield of crops and provide wood products. All these forms of existing practices of agro-forestry in the country may be defined under various systems. The words "System", "Subsystem" and "Practice" are used interchangeably as synonymous in agro-forestry literature. Agro-forestry system refers to a type of agro-forestry land-use that extends over a locality to the extent of forming a land utilization type of the locality. Sub-systems and practice are lower order terms in the hierarchy with lesser magnitude of role, content and complexity. In broad sense, following systems may be recognized in agro-forestry.

2.5.1.8 Live fences:

Fences composed of living trees not only providing fencing for livestock, protection and privacy but can also serve as windbreaks that produce wood and foliage products. In arid and semi-arid zones live fence are often made of thorny species of the Acacia or Prosopis genera. In the humid and sub humid tropics leguminous species such as Gliricidia sepium or species of multipurpose like Hibiscus or Ipomea hedges are used. (Budowski, 1987).

2.6 Area Selection for Agro forestry practice:

The following type of land can be assigned for Agro-forestry:

a) Field boundaries.
b) Along with farm road and nallah sides affected by erosion.
c) Pockets within the cultivated holding where cultivation is not possible and lines along with agricultural crop with proper spacing.
d) Old fallows.
e) Cultivable waste.
f) Site of pump houses, cattle sheds and kitchen gardens. It is useful to investigate the land-use practices in the area in which agro-forestry can be incorporated.

2.7 Species selection for Agro forestry practice:

The following considerations should be kept in view while selecting species:

+ Suitability for growing under the prevalent Agro-climatic conditions.
+ Utility of trees for meeting the needs of the farmers for timber, fodder, fuel, fruit and fiber, etc.
+ Preference may be given to indigenous and fast growing species, leguminous and other nitrogen fixing species. Species which provide raw material for cottage industries should be encouraged.
+ Species which have good market value.
+ Those species are preferred which has good resistant power against pest and diseases.

Experience has shown that people accept only multi-purpose trees from which they are sure to get benefits. There may be a shortage of fuel-wood, but the farmer will not plant a fast growing fuel-wood tree until he is able to manage the straw of lopping material, dung cakes etc. for burning from community lands. Sometimes, the overriding concern is for multi-purpose fruit trees and fodder trees and not for trees to simply produce fuel-wood. In Northern Yemen, it was noticed that people were more interested in planting trees for environmental protection rather than for fuel wood. (n Senegal, people are interested in planting trees for fodder, shade, fruit, gum Arabic and constructional materials but not for fuel wood. In Punjab, people grow trees for highly valued reasons. But it must not be forgotten that people fully expect to get fuel wood from trees which are though planted for other purposes. In many situations, planting at the household level is preferred over communal woodlots because of greater control and access to benefits.

2.8 Limitation of Agro forestry:

2.8.1 Increased competition:

Trees compete with annual crops for nutrients, growing space, solar energy, and soil moisture and may significantly reduce the yields of favored food crops. This drawback may however be minimized by the choice of deep rooted tree species to avoid nutrient and moisture competition with shallow rooted crops. Likewise tree species with narrow crowns are likely to be less competitive in suppressing neighboring vegetation and may also be more effective in light interception due to the large vertical crown depth. (Karki, 1985)

2.8.2 Potential for accelerated nutrient loss:

Tree species serve as nutrient pumps that deposit nutrients in the soil surface through the mechanism of litter fall branch decomposition and rain wash. Nutrient deposited on the soil surface can be lost to wind and water erosion. While nutrient pumping by the tree components is an advantage when crop roots are able to uptake and use these nutrients, the process is a disadvantages when they are not taken up and are then lost from the site.

2.8.3 Damage to tree and crop components from livestock:

Agro silvopastoral system, which integrates livestock, crops and trees have a potential for negative interactions among these components. Grazing animals often damage trees in

silvopastoral plantations (Lewis *et al*, 1984).This may be a serious problem when species with palatable foliage such as Dalbergia sisoo or Shorea robusta are used.

2.8.4Allelopathy:

Seed germination and plant growth can be inhibited by the release of naturally occurring compounds from roots and aerial tissues of other plants. (Kramer and Kozlowski, 1979). These compounds are called allelochems and include a wide range of compounds such as tannins, alkaloids, phenolic compounds, organic acid, quinines etc. Allelopathy, injurious or detrimental effects of one plant on another through the release of allelochems is a potential disadvantage of agro forestry combinations.

2.8.5 Potential increased erosion:

Soil erosion can increase when tree canopies are high above the ground and shading results in reduced ground cover. Raindrops intercepted by leaves can coalesce and form bigger drops that have greater erosive power than rainfall which is not intercepted. (Vergara, 1981)

2.8.6 Mechanical damage from cultivation and harvest:

Cultivation and harvesting operation cause mechanical damage to mixed agro forestry crops. This is particularly true for mixtures that include high value tree species. Mechanical damage to the tree species is potentially great during the early stages of the tree crops rotation and is potentially more damaging to other associated crops as the trees grow larger and thinning and harvesting operations are required. (Vergara, 1981)

2.8.7 Habitat or alternative host for pests:

When in proximity to other crops trees can provide a habitat for pests off all sorts. This is particularly true for trees and cereal combinations, where the cereals are attractive food for rodents, birds or insects. Again home garden – like agro forestry planting can provide an improved habitat for rodents, birds, snakes, and other insects and disease pests. Some pests of trees can also affect crops and vice versa. (Vergara, 1981)

Chapter three: GENERAL DISCRIPTION OF THE STUDY AREA

3.1 The Study Area

Gopalganj District is located under Dhaka Division. It is situated on the southern part of Bangladesh. It was a former subdivision of Faridpur district. Gopalganj Mohakuma or sub-division emerged as Gopalganj district on the 1st day of February in 1984 The area of Gopalganj is about 1489.92 sq km which is located in between 22°50' and 23°01' north latitudes and in between 89°40' and 90°02' east longitudes. It is bounded by faridpur district on the north, pirojpur and bagerhat districts on the south, madaripur and barisal districts on the east, narail district on the west (BBS, 2011).
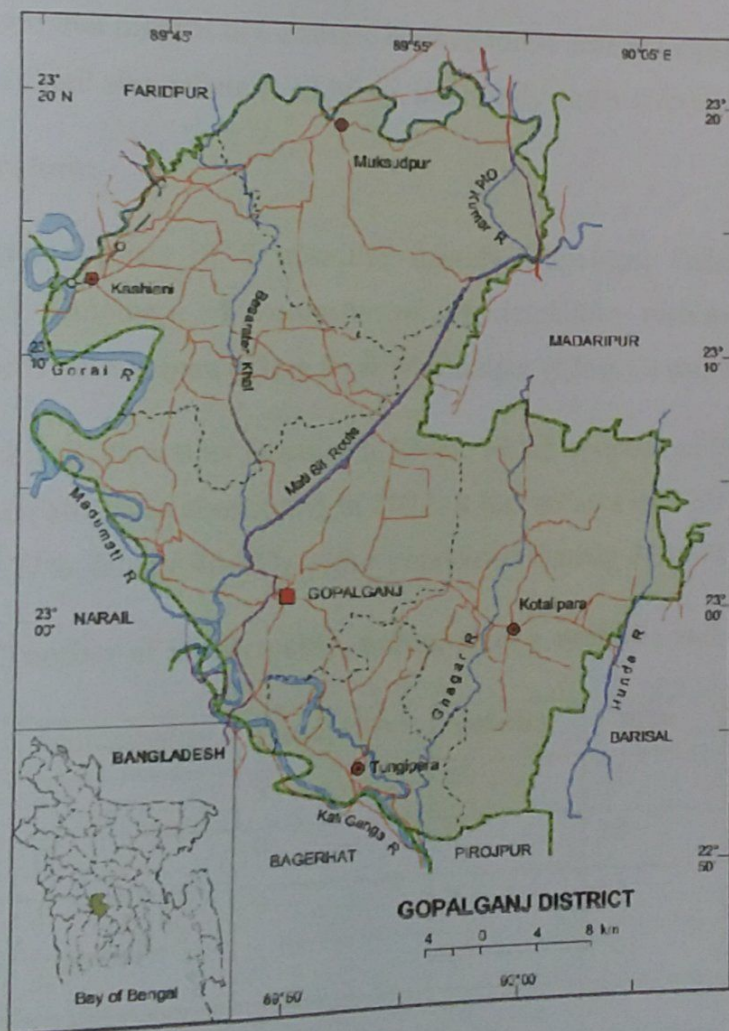
Fig: 3.1- Map of Gopalganj District (Banglapedia, 2015)

3.1.1 Broad classification of the area:

Table 3.1: Area Classification (in sq. km)

Upazilla	Total area	Land area	Reserve forest	Riverine area
Gopalganj Sadar	389.61	375.53	0	14.08
Kashiani	286.31	281.21	0	5.10
Kotalipara	355.90	352.2	0	3.70
Muksudpur	308.36	307.84	0	0.52
Tungipara	128.53	121.64	0	6.89
Total	1468.71	1438.42	0	30.29

(Source: BBS, 2011)

In the table we see that there is not a single reserve forest area in Gopalganj District. Here about 1438.42 sq. km is land area where is 33.80 sq. km is only under riverine area.

3.1.2 Administration:

Gopalganj district consists of 5 upazillas namely Gopalganj Sadar, Kotalipara, Kashiani, Muksudpur. and Tungipara; 4 Pourashavas/ Municipalities namely Gopalganj (Class A), Tungipara (Class B), Kotalipara (Class B) & Muksudpur (Class C) and 68 unions (BBS, 2011).

The main township is known as Gopalganj Sadar, which consists of 9 wards and 49 mahallas. Gopalganj municipality was constituted in 1972. It has an area of 8.59 km² and a population of 40,987; male 53.27%, female 46.73% with a population density of 4,771 per km² (BBS, 2011).

Table 3.2: Number of municipality, union, mauza, mahalla and village (BBS, 2011)

Upazila	Municipalily	Ward(PSA)	Mahalla	Union	Mauza	Village
Gopalganj sadar	1	9	47	21	127	197
Kashiani	0	0	0	14	151	162
Kotalipara	1	9	9	12	101	208
Muksudhpur	1	9	15	16	206	255
Tungipara	1	9	13	5	34	67
Total	4	36	84	68	614	889

3.1.3 Population:

Total population of Gopalganj District is about 1172415 of which 577868 are male and 594547 are female. So the ratio of male and female is about 97:100. Here the density of population is about 798 per sq. km. Among the people about 113133 lives in urban areas and other 1059282 lives in rural areas. (BBS, 2011)

3.1.4 Literacy:

Average literacy 51.4%; of them male is 55.2% and female is female 47.4%. Educational institutions: college 23, secondary school 188, primary school 786, community primary school 24, kindergarten 38, madrasa 62. (BBS, 2011)

3.1.5 Income sources:

Main sources of income are Agriculture 61.75%, non-agricultural laborer 2.23%, industry 0.58%, commerce 13.92%, transport and communication 2.30%, service 11.14%, construction 1.60%, religious service 0.29%, rent and remittance 0.70% and others 5.49%. (BBS, 2011)

3.1.6 Temperature and Rainfall:

The maximum and minimum average temperature in Gopalganj district varies from 23.3°C to 8.6°C. Total rainfall of the district is recorded as 1620mm. (BBS, 2011)

3.1.7 Economic situation:

The economy of Gopalganj is predominantly agricultural. Out of total 230494 holdings of the district, 67.88 holdings are farms that produce va rieties of crops namely Local and HYV paddy, sugarcane, wheat, vegetables, spices, jute, pulses, and other minor cereals. Various fruits like mango, banana, jackfruit, guava, coconut etc. are grown in the district. Almost all kinds of vegetables are cultivated particularly;bitter guard (karala), pumpkin (misti kumra), potato and brinjal are abundantly grown. Pisciculture and rearing of livestock and poultry adds an additional income to the rural households. Fish of different varieties abounds in the District. Moreover, varieties of fish are caught from rivers, tributary channels, even from paddy field during the rainy season. Non-farm activities also play an important role in the economic development of Gopalganj district (BBS, 2011).

Chapter four: MATERIALS AND METHODS

4.1 Materials and Method

The study was conducted at Gopalganj district of Bangladesh during May 2018. An exploratory survey was conducted in Gopalganj district to explore information regarding the demographic profile of respondents, annual income of respondents and attitude towards agroforestry practices, perception and adoption of agroforestry practices.

4.1.1 Selection of the study area:

A multistage random sampling technique was adopted during the study. Gopalganj district was selected purposively as the study area. Three upazilla are namely- 1.Gopalganj Sadar, 2. Kotalipara and 3. Muksudpur were selected randomly using lottery. These are first sampling unit. Then again from each upazilla two unions were selected randomly as second sampling unit. Finally, two villages from each union were selected as third sampling unit.

4.1.2 Selection of the respondents:

From each village 10 respondents were selected. A total of 120 respondents participated in the face-to-face interview. A detailed socio-economic survey was conducted by using a semi structured questionnaire to assess the demographic profile of the respondents, present agroforestry practices in that area, farmer's attitude towards the practice, their perception and adoption of agroforestry practice and problems related to the practice. All the sampling units are shown in the Table 4.1:

Table 4.1: Name of the sampling unit in Gopalganj district

Name of the District (1st sampling unit)	Name of the Upazilla (2nd sampling unit)	Name of the Union (3rd Sampling Unit)	Name of the Village (4th Sampling Unit)
Gopalganj	Gopalganj Sadar	Satpar	Satpar
			Vennabari
		Raghunathpur	Raghunathpur
			Silna
	Kotalipara	Sadullapur	Hazrabari
			Konervita
		Ramshil	Ramshil
			Kafulapari
	Muksudpur	Jalirpar	Jalirpar
			Baniarchor
		Gobindapur	Gobindapur
			Rajpath

4.1.3 Data collection process:

Primary sources are original sources of data from which data were collected that have not been collected previously and secondary sources are collecting data already collected and compiled for another purpose. The main focus and target of the study was on collecting data of farmer's perception, attitude, interest and adoption of agroforestry in Gopalganj district.

4.1.3.1 Questionnaire survey:

In order to obtain relevant information, the interview schedule was carefully designed mind the objective of the study. The formal survey of each upazilla carried out by, semi-structured questionnaire to obtain data on farmer's household characteristics, perceptions of agroforestry etc. The questionnaire covered on:

- ➤ Annual income of the farmers who are involved in agro forestry practice.
- ➤ Farmer's knowledge about agro forestry practice.
- ➤ Types of agro forestry practice done by the farmers of the area.
- ➤ Their perception of the agroforestry practice.
- ➤ Problems of agro forestry practiced in the study area.
- ➤ Suggestion to overcome the problems of the farmer.

4.1.4 Procedure of data collection:

A relevant information and literature were collected from the two main sources in order to fulfill the objectives set out for this study. One is primary data and the other is secondary data.

4.1.4.1 Primary data collection:

The primary data has been collected by conducting a survey work with a semi structured questionnaire. For this reason, interviewers were selected purposively. It is also done by the farmers of the site and then interviewing the respondent.

4.1.4.2 Secondary data collection:

The secondary sources of data including books and journals from Khulna University Library, Seminar Library, various publications of government, and other organizations, articles of local and national newspapers and other research papers on same or similar issues have been used for data collection.

4.1.5 Data process and analysis:

The surveyed data were converted into percentage forms. After collecting from primary and secondary sources, data are processed and analyzed by following steps:

- Reviewed of collected data and informational.
- Discarded of unnecessary parts of the information and data.
- Sorted of revised data and information.
- Analyzed for easy explanation.

4.1.6 Report writing:

After successful completion of primary data analysis and arrangement of all primary and secondary information, then a draft final report was prepared and it was finalized after some necessary correction.

4.2 Likert Scale:

A Likert Scale is a psychometric scale commonly involved in research. It is a type of rating scale used to measure attitude or opinions of a topics. With this scale, respondents are asked to rate of agreement. For example:

a) Strongly Disagree
b) Disagree
c) Neutral
d) Agree
e) Strongly Agree

This scale was used to know farmer's attitude towards agroforestry, homestead agroforestry, cropland agroforestry, woodlot agroforestry etc.

4.1.7 Limitation of the study:

- Survey is costly and time consuming.
- Sometime respondents are confused to give their information.

Chapter five: RESULT AND DISCUSSION

5.1 Demographic features of the respondents:

Demographic feature of the respondent is very important for the study. Firstly this discussion shows the demographic description of the respondents. Here their attitude and perception on agroforestry in agroforestry is our main focus. The biographical characteristics include age, education, occupation, land holding pattern; income etc. different studies revealed that the socioeconomic characteristics had much influence on the adoption behavior regarding new practices. On the following basis the socio-economic characteristics are:

5.1.1 Gender distribution of the respondents:

In the study area both male and female are involved in agroforestry practices in which 81% respondents are male and 19% are female. It indicates that males are quite active in outside profession specially farming.
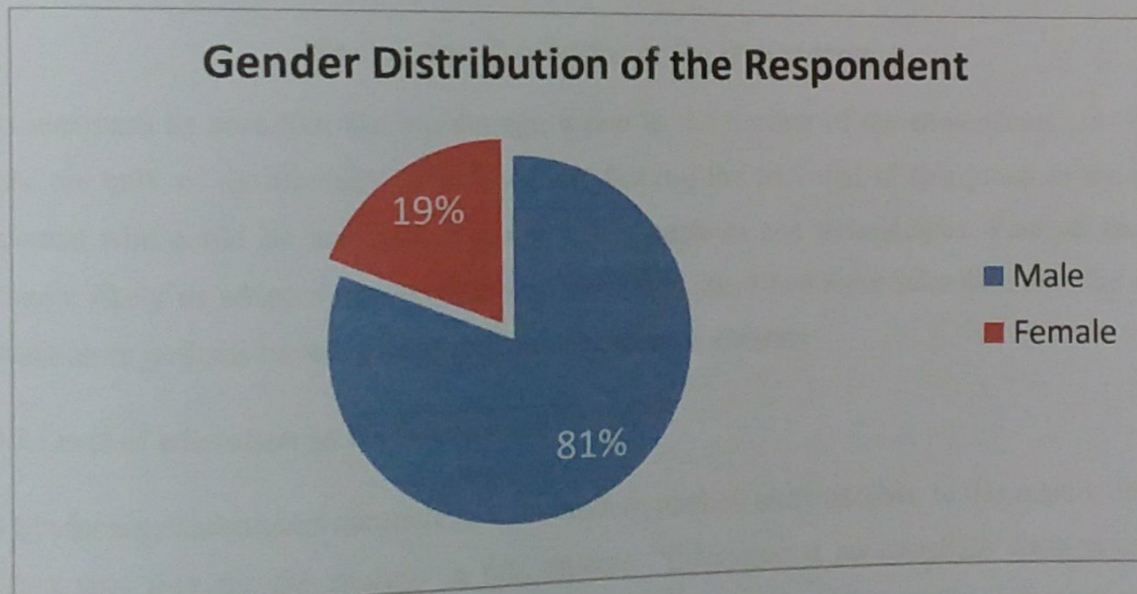
Fig-5.1: Gender distribution of respondents.

5.1.2 Age distribution of respondents:

Here the following graph shows the age distribution of the respondents. The age of farmers divided into four categories. They are- Very Young (18-25 yrs), Young (26-35 yrs), Middle Aged (36-50 yrs) and Old (50+yrs). From the graph we can see that most of the framers practicing agroforestry are middle aged (42.5%).

Age catagory
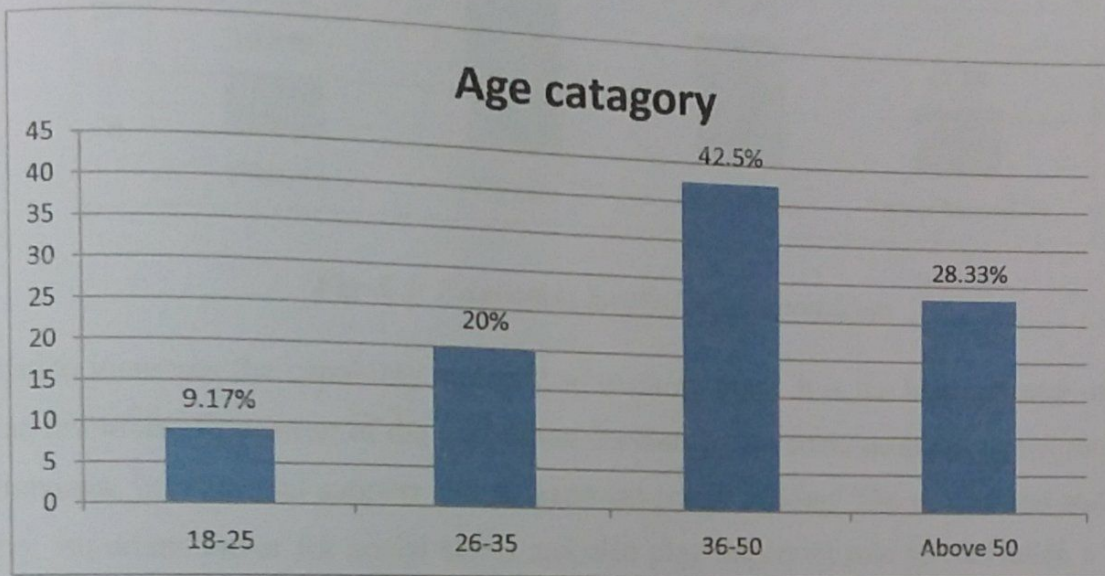
Fig-5.2: Age distribution of the respondents.

It is important to note that the middle age group in the context of the respondents (18-26yrs) forms the bulk of agroforestry practitioners indicating the potential of this group as the most important who could be involved in agroforestry practices and technologies. Younger farmers are more likely to adopt a new technology, since they have had more schooling than the older generation or perhaps have been exposed to new ideas as migrant

5.1.3 Level of education of respondents:

As agroforestry techniques are include with modern method and materials; in this regard, literacy plays a vital role for the success in this aspects. "Education is an important socio-economic variable that may make a farmer receptive to advice from an extension agency or more able to deal with technical recommendation that requires a certain level of literacy" Tripp (1993).
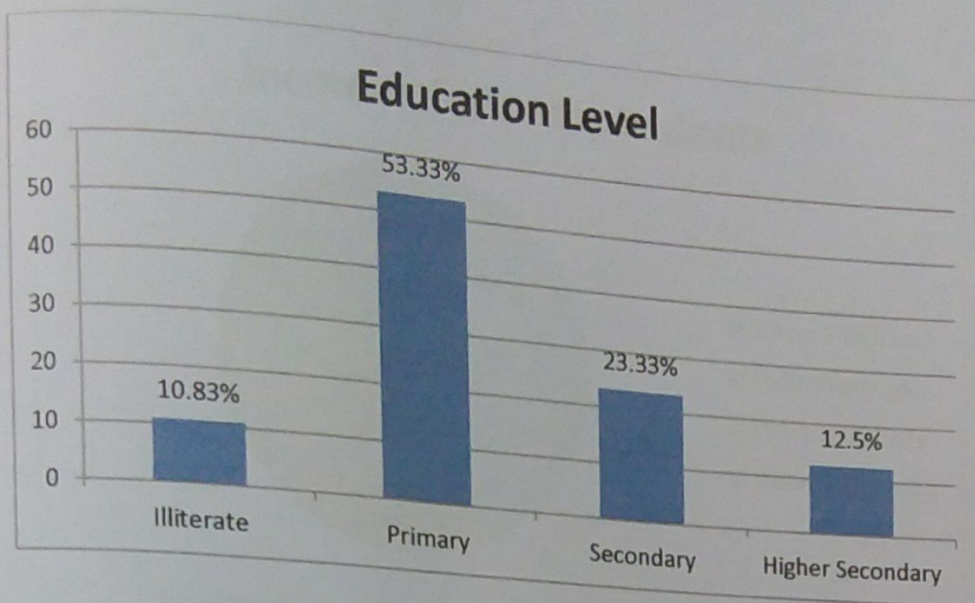
Fig-5.3: Education level of the respondents

Education increases the capability and skill of working force. It is the best indicator of efficient human resources. Education of the population depends on the socio economic condition, suitable environment, institutional support and government policy making. The educational qualification is very important factor for social status and also play important role in cultivation a technical knowledge. The graph indicates that a majority of the respondents studied primary (53.33%). Among the others 10.83% are illiterate, 23.33% have passed in SSC exam and 12.5% have passed in the HSC level or completed their graduation.

5.1.4 Income of the respondents:

The annual income of the farmers falls in four categories. The highest percentage (42.5%) is represented by farmers who earn less than 1 lakh taka and appear to be in the middle income category. 29.17% of the respondents earn from 1lakh-2 lakh taka, 15.83% of the respondents earn 2lakh -3lakh taka whereas about 12.5% of the respondents earn above 3 lakh taka per year.

Income of the respondents

12.5%

15.83%

42.5%

29.17%

- Below 1 lakh taka
- 1lakh-2lakh taka
- 2lakh-3lakh taka
- above 3 lakh taka
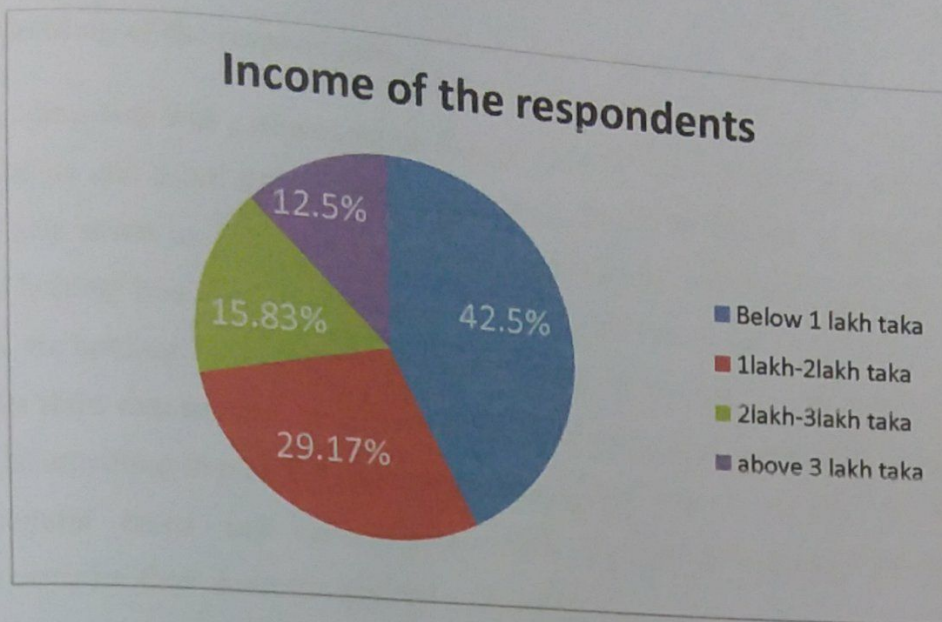
Fig-5.4: income of the respondents

5.1.5 Occupation of the respondents:

In the study area most of the people who practice agroforestry people are farmer (55.83%) who are directly involved or depended on agriculture. Among other people businessman are 15.83%, civil service or employee are 10.84% and the rest of the respondents (17.5%) are engaged with various profession like tailor, day laboring, driving and fishing etc.

Occupation of the respondent

17.5%

10.84%

55.83%

15.83%

- Farming
- Business
- Civil Service
- Others
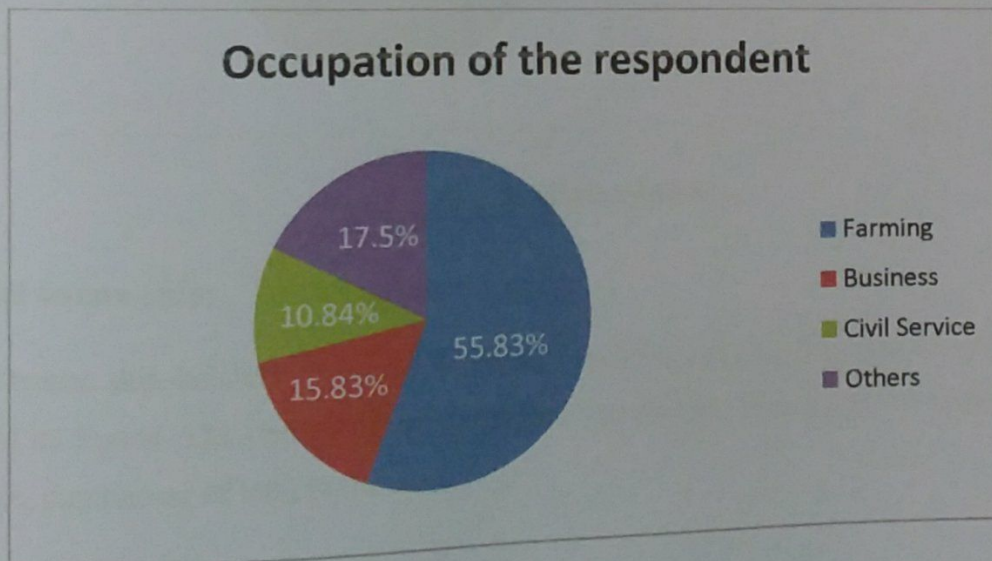
Fig-5.5: Occupation of the respondents

5.1.6 Land holding of the respondents:

The land holding size was categorized in four groups i.e., Land less or less than 1 bigha, 1-2 bigha, 2-3 bigha and more than 3 bigha. The land, which the farmers own and manage, was asked. The data given in Table-5.6 indicated that mostly the respondents (37.5%) are farmers having land holding less than 1bigha. From remaining 26.67% of farmers are holding 1-2 bigha and 25.83% are holding 2-3 bigha, while 10% respondents own land holding more than 3 bigha. These results show that mostly the farmers in the study area have small land holdings; therefore they are to be unwilling in planting trees on their farmlands. They think that the trees compete with agricultural crops and reduce crop yield. The farmers are more interested to grow agriculture crops for their domestic use and cash crops.
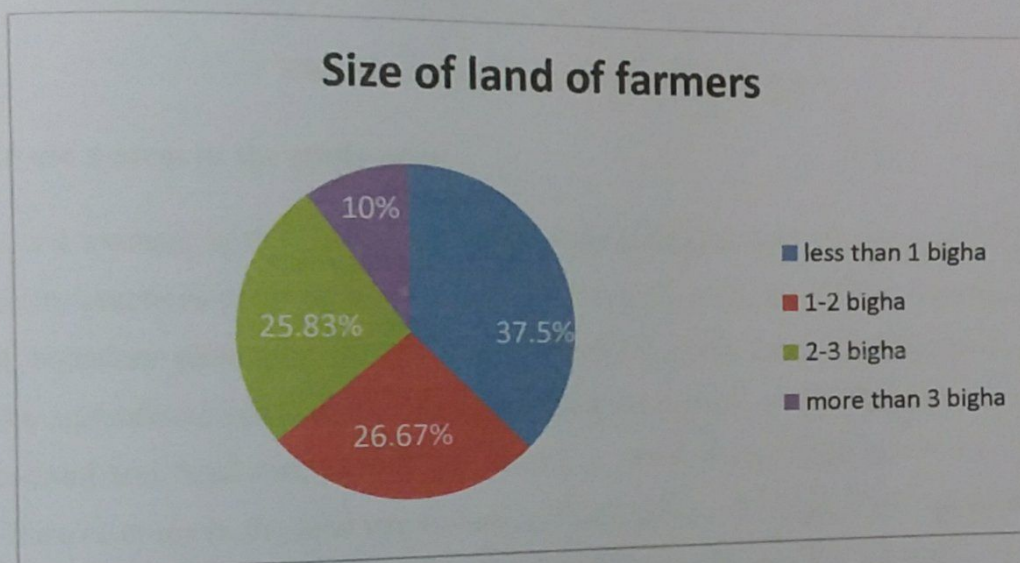
Fig-5.6: Size of land of farmers

5.1.7 Land tenure-ship:

The land tenure ship below in Figure 5.7: shows inheritance (67%), followed by tenancy (5%) and (16%) by leased. The remaining 12% included purchasing. Majority of the respondents via inheritance, purchasing of land in the area.
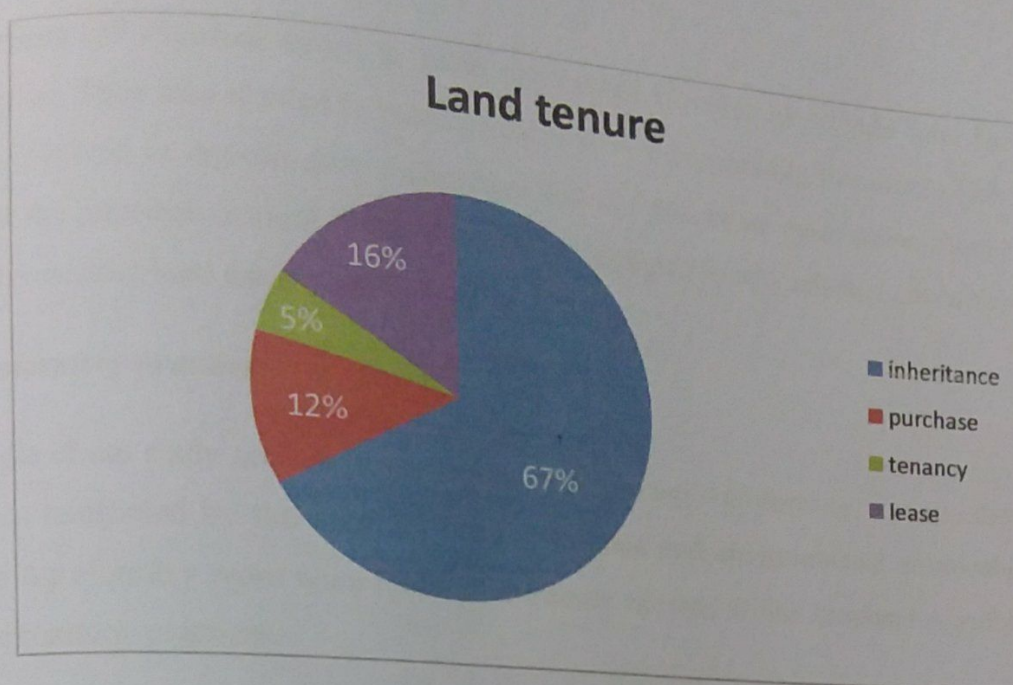
Fig-5.7: Land tenure of the respondents

5.2 Land use system in the study area:

The land use systems in the study area include crop production and animal production systems. Agroforestry practices undertaken by farmers in the study area include homestead agroforestry, woodlot, boundary plantation etc. 93% of the farmers are intercropped agricultural crops and trees. The agricultural crops cultivated in the land use system included papaya, banana, black berry, coconut and betel nut, paddy, jute, wheat, oil seed, potato, sugarcane, kalai, khesari and maize. The tree crops in the land use system included Mango, jackfruit, citrus sp, cashew and oil palm, khejur and coconut. Food crops were grown to provide food for household consumption and farmers wanted to increase income by incorporating tree/cash crops. Farmers also cultivated ginger cabbage, potato, lady's finger as additional source of income.

Table 5.1: types of crops grown in the study area

Types of land use	No of farmers	percentage
Annual crops	71	59.2%
Annual crops + Tree	49	40.8%

Most farmers (59.2%) had desire to grow food crops in order to provide food for household consumption. They also wanted to increase income by incorporating tree crops. This shows that agencies involved in Agroforestry technology transfer and other innovations should first study and know the priorities of rural farmers in order to design a locally adapted one which can easily fit into the existing land use system.

5.3 Agroforestry practices:

The people of the study area have a tradition of practicing Agroforestry; recently their practices have been reinforced by the need for socio-economic and environmental sustainability. Three common Agroforestry types were found in the study site and within cropland Agroforestry there are three common practices.

1. Homestead Agroforestry
2. Cropland Agroforestry
   2.1 Boundary Plantation
   2.2 Woodlots
   2.3 Fruit- based agroforestry
3. Fish-farm based agroforestry

Table 5.2: Agroforestry system practiced in the study area

Agroforestry system	No. of respondents	percentage
Homestead agroforestry	112	93.33%
Cropland agroforestry	51	42.5%
Fish-farm agroforestry	18	15%

5.3.1 Homestead agroforestry:

Home gardens are important for additional food supply, fruits, and medicinal uses fuel wood fodder for livestock, shading and ornamental or fencing function. In Gopalganj, almost maximum farmers (93.33%) practice homestead agroforestry. Observations within the villages showed that there are areas reserved for grazing livestock (goat, sheep, and cattle etc). The homestead structure is very complex a 3-layer storey recognized. The upper storey is made of tall tree species, which along contours to the upper side of barrier produce timbers, fuel wood and fodder. The middle-storey is made up of small trees and shrubs that tolerate some amount of shade. This layer typically includes banana, papaya and other types of fruits and species. The under storey consists of low growing crops such as halud, ginger, kachu, and vegetables up to approximately 1.5 to 2.0 m high. The above arrangement shows that the components are mixed or appear in an irregular manner.

5.3.2 Cropland agroforestry:

For the cropland agroforestry the farmers of Gopalganj district showed a little less interest than the homestead agroforestry. Trees in cropland are a very common concept of agro forestry practice in other countries. It means trees grow with the agriculture crop in cropland. Now a days in our country, it is not so much popular agroforestry practice but farmers are becoming interested in such type of practice because of their awareness about the benefit of agroforestry practice. In the study area 42.5% people perfect to plant tree species in cropland. Because they are thinking it increase their income and sometime it fulfill their household demand. They get fuel wood, fodder, timber, fruit from the same piece of land which are more profitable. Three types of cropland agroforestry was found in the study area. They are below:

5.3.2.1 Boundary Plantation:

Boundary plantations combine perennial, preferably leguminous trees or shrubs, grown around an arable crop. Boundary plantations as windbreaks also protect crops. Timber trees planted along boundaries. Commonly used trees are Babla (*Acacia nilotica*), betel-nut (*Acacia catachu*), khejur (*phoenix sylvestries*) and coconut (*coccos nucifera*) eucalyptus (*Eucalyptus brassiana*) are

grown along field boundaries or bunds of paddy, jute, wheat fields. Eucalyptus and akashmoni (*acacia auriculiformis*) are fast growing trees with high timber values; babla and betel-nut also have high commercial values. Boundary plantations are so popular in the study area for their benefits. Farmer's perception and my observation coconut and paddy are the best combination for boundary plantation in Gopalganj district. About 26.38% 0f the respondents practice boundary plantation.

Picture 5.1: Boundary plantation

5.3.2.2 Woodlot:

In the study area 17.5% of the respondents practice woodlot agroforestry. The main reason for practicing woodlot plantation in a small range is the lacking land and tendency of growing annual crops. Various types of trees such as mehgoni, raintree, sissoo, korai, eucyliptus, lombu, etc. are commonly planted in the woodlots of the respondents of the study area.

5.3.2.3 Fruit based agroforestry:

A small portion of population (14.17%) of the respondents practice fruit based agroforestry. Fruits trees grown of farmlands for their non-timber forest products such as fruits, nuts, and spices etc. are considered as a sustainable farming system throughout the world. Farmers prefer

fruit-producing species to other trees for no-farm planting all over the study area and appreciate the duel contributions of food for consumption and the potential for income generation. In fruit based agroforestry mainly mango, kul, guava, litchi etc. fruit tree and among the tree many agricultural crops are practiced.

Picture 5.2: Fruit based agroforestry

5.3.3 Fish farm agroforestry:

Fish farm agroforestry is not very popular in the study area. Small portion (15.67%) of the farmers are practicing fish farm agro forestry. This strategy has become a favorable livelihood opportunity to sustainably augment fisher's income and at the same time contribute to tree component increment. Farmer's in the study areas practice fish farm agroforestry in their farmland and gets benefited.

5.4 Perception of Farmers on Agroforestry system:

Perception is a way of seeing, understanding and interpreting about something, it is the deeper natural understanding and awareness than usual. In other word, perception is the ability see, hear or understand. In this thesis paper, perception indicates that the farmer's awareness and understanding about the Agroforestry systems in Gopalganj district

Table 5.3: Farmers perception of agroforestry practices in Gopalganj district

Perceptions	Response Frequency	Percentage (%)
Increase farm productivity	72	60
Increase household income	67	55.83
Food security	34	28.33
Decrease cash crops production	56	46.67
Difficult to practice	27	22.5

N.B. Some respondents stated more than one reason.

Perceptions about Agroforestry in the villages were diverse. The farmers of Gopalganj district practices Agroforestry traditionally within their agricultural cropland as well as their homestead. They perceived that the practice is done for their own satisfaction and household consumption. In the study area farmers thinks positively about agroforestry systems. 60% of the respondents said that agroforestry practice increase their farm productivity, 55.83% of the respondents are said that it increase their household income and 28.33% opinion was about food security. On the other hand 46.67% said that it decrease cash crops production and 22.5% felt difficulty during practicing agroforestry.

5.5 Farmer's Attitude towards agroforestry:

The results revealed that majority of the farmers in Gopalganj District had 'favorable' to 'more favorable' attitude towards agroforestry. But they showed slight different attitude in term of homestead and cropland agroforestry. This attitude is expressed in Likert scale following.
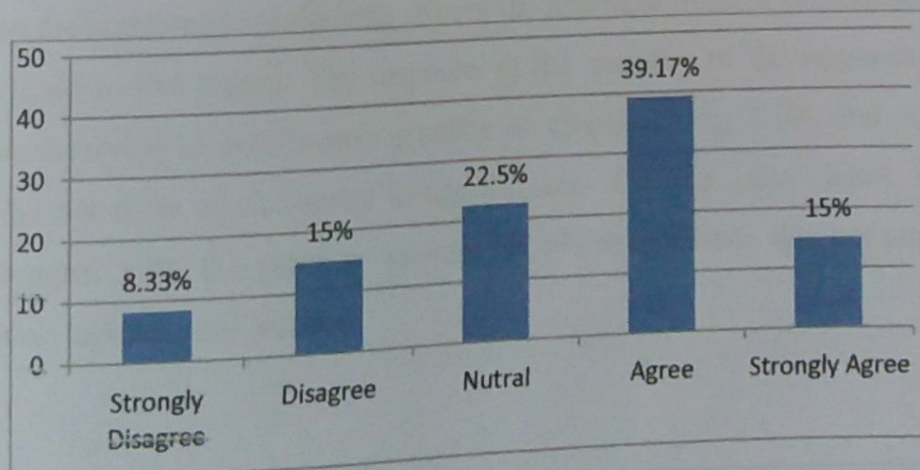
Fig-5.8: Farmer's attitude towards agroforestry practice

5.5.1 For homestead:

Homestead agroforestry has been practicing long time ago and it is a traditional practice. Consequently the farmers tend to be very positive where the score 5 in Likert scale. They get different benefits from this system like protein, food from cattle, fuel, fodder, vegetables and also cash from these. For the homestead agroforestry the farmers of Gopalganj District showed positive attitude and 84.17% of the farmers showed positive attitude towards homestead agroforestry.
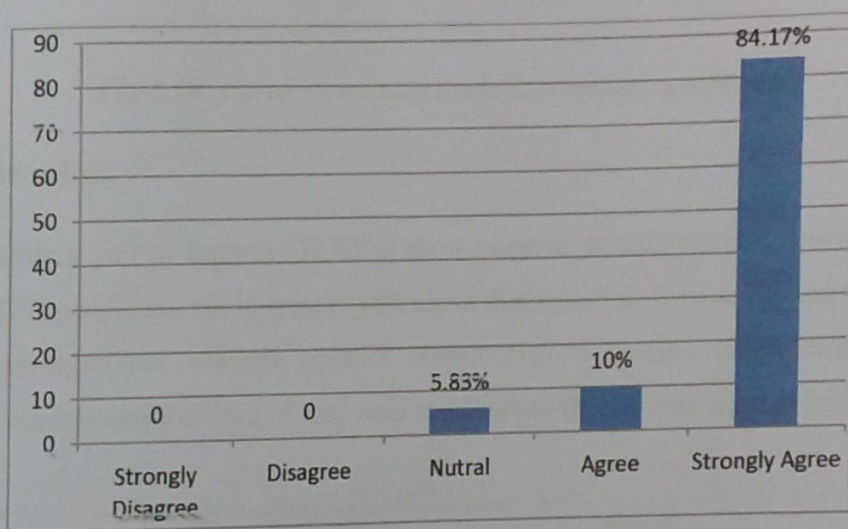
Fig-5.9: Farmer's attitude toward homestead agroforestry

5.5.2 For cropland:

For the cropland agroforestry the farmers of Gopalgamj District showed a little less interest than the homestead agroforestry. Never the less most of them showed positive attitude in the Likert scale in this regard. The response of the majority of the respondent (40%) was found to be favorable to agroforestry practice on cropland (Fig. 5.10). But some respondents (21.67%) did not show much interest to agroforestry. On the other hand, 10.83% farmers strongly disagree with this practice whereas 17.5% respondents did not provide comments for or against agroforestry practice.
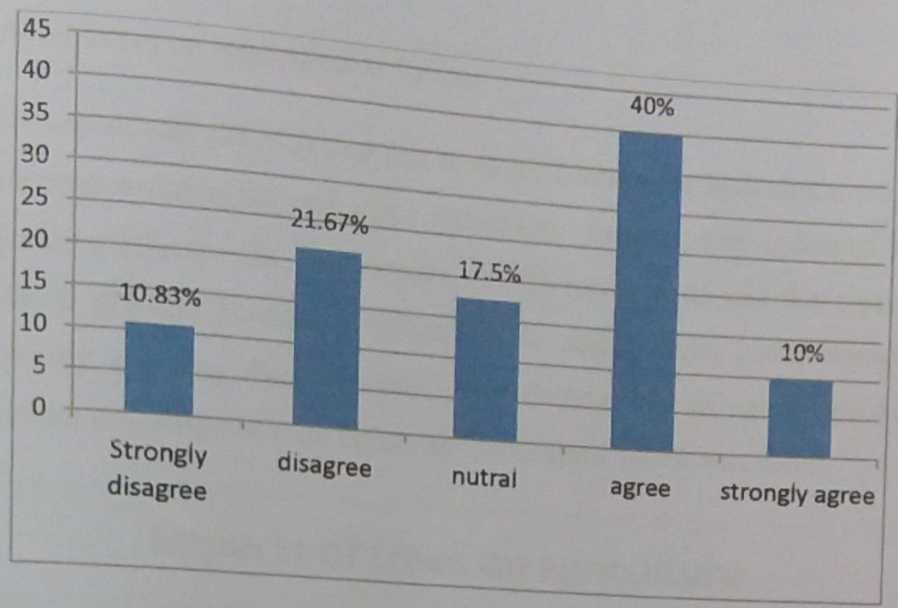
Fig-5.10: Farmer's attitude towards cropland agroforestry

5.5.3 For Woodlot:

In linkert scale a part of farmers (30.83%) show positive attitude towards woodlot plantation. About 26.67% people are not interest to talk about that woodlot. A large portion of farmers had shown negative attitude towards woodlot. About 11.67% farmers are strongly disagree to practice woodlot because of lake of crop land and some of them do not want to take risk.
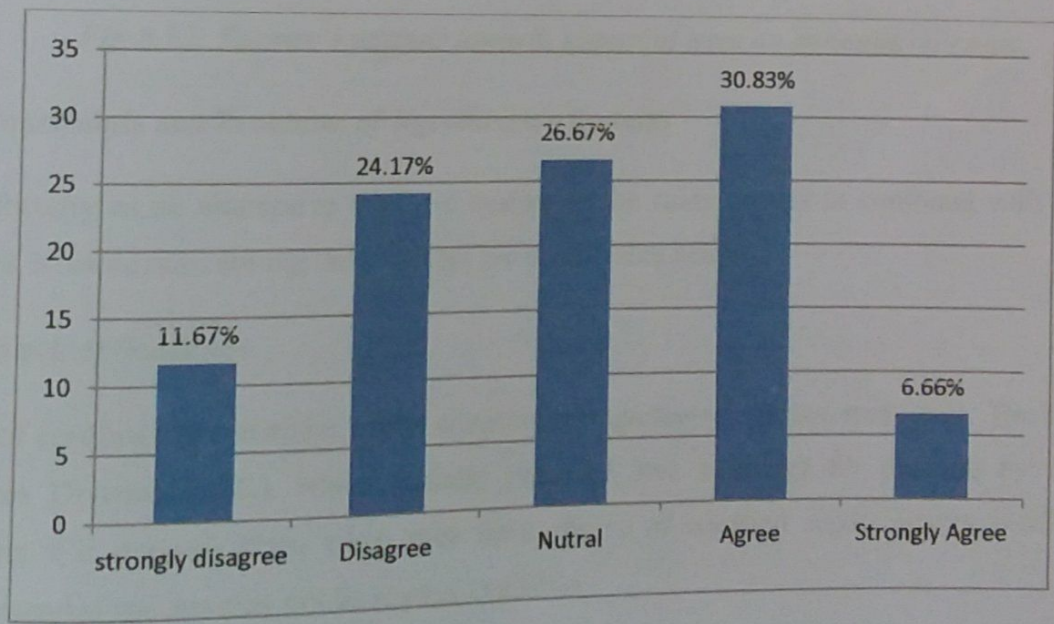
Fig-5.11: Farmer's attitude towards woodlot plantation.

5.4 Impacts of Trees on Agricultural Crops:

Most of the respondents (34.5%) said that trees are harmful for agricultural crops and believe to play a great role in managing and space utilization. Besides, they indicated that trees help to produce quality products. On the contrary, 48.3% respondents said that trees are not harmful for agricultural practice because of difficulties in management, cause significant disturbance on crop thereby reducing the production. This finding was in agreement with that reported where increased possibility of crop failure and pathogenic attack was noted.

Fig-5.12: Farmer's attitude towards impact of trees on agricultural crops

5.6 Constraints and Problems of Agroforestry Systems

Agroforestry as an alternative land use system in the study area is to confound with a lot of factors. Notable ones among these factors are enumerated below.

5.6.1 Lack of Seedlings

Lack of seedlings is constraint to the adoption of Agroforestry in the study area. The Forestry Services Division (FSD), which initially provided free seedlings for planting by farmers, however it's stopped. Even when they have choice of certified seeds, quality seedlings of recommended species may not be always available.

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5.6.2 Lack of Credit Facilities

Farmers in the study area have lack of credit facilities which are not available for expansion of their farm size. Government agencies and NGOs make some amounts of modest credit facilities to the farmers for Agroforestry and nursery construction to raise seedlings.

5.6.3 Environmental Constrain

Possible competition of trees with food crops for space, sunlight, moisture and nutrients with may reduce food crop yields. Damage to food crops is during tree harvest operation, Potential trees to serve as hosts of insect pests that are harmful to food crops.

5.6.4 Socioeconomic Constraints

Increase the labor costs with the heavy requirement of labor for Agroforestry all over the year to other labor oriented activities. Loss of food crops during harvesting of tree crops. Longer period of time required for trees to be maintained and acquire an economic value. Difficult for small land holders to displace food crops by trees, especially where land is particularly used for agriculture. Agroforestry is more complex land use technique and more difficult to apply as compared to single crop.

5.6.5 Others

Damage by animals is a major problem for Agroforestry plantation. In Homesteads, goats and cattle often damage seedlings. Almost all farmers stated that trees occupied much more space above- and below ground than the crops and were dominating in the competition for space and light. Lack of capital, lack of knowledge on Agroforestry systems, delay in profit earning, lack of technical assistance, high risk of crop protection from damage due to some social, economic and natural dangers, don't have suitable land for this cultivation practice, and unstable market price for Agroforestry products.

Chapter six: CONCLUSION AND RECOMMENDATION

6.1: Conclusion:

Continuous increase in population and changing socio-economic conditions, have tremendous pressure on forest resources. In the recent past, there has been a massive deforestation for industrialization, rapid urbanization, and high population pressure on existing forestland for both settlement and shifting cultivation and reduced productivity in agro-ecosystems. To fulfill the demand it is necessary to adopt various types of agro forestry practice such as homestead forest, aqua silviculture, woodlot, trees in cropland which help to increase forest, produce timber as well as reduce the food scarcity. Agroforestry is becoming popular in Gopalganj district. Middle aged farmers (36-50years) are more interested in agroforestry practice than traditional practice. Most of the respondents (84.17%) showed positive attitude towards homestead agroforestry. The response of the majority of the respondent (54.17%) was found to be favorable to agroforestry practice on cropland but some respondents (15%) did not show much interest to agroforestry. On the other hand, 10.83% farmers strongly disagree with this practice whereas 22.5% respondents did not provide comments for or against agroforestry practice. 60% of the respondents said that agroforestry practice increase their farm productivity, 55.83% of the respondents are said that it increase their household income and 28.33% opinion was about food security. On the other hand 46.67% said that it decrease cash crops production and 22.5% felt difficulty during practicing agroforestry. Most of the respondents (48.3%) said that trees are harmful for agricultural crops because of difficulties in management, cause significant disturbance on crop thereby reducing the production. Besides, they indicated that trees help to produce quality products. On the contrary, 34.5% respondents said that trees are not harmful for agricultural practice and believe to play a great role in managing and space utilization.

6.2 Recommendation:

- Government should frame proper policy to make the agroforestry system popular in Gopalganj district.
- An education program should be designed and carried out with the purpose to promote the practice of Agroforestry and improve the system.
- Along with the GO the NGOs must have to take initiative for achieving the best output from agroforestry.
- Proper motivation can be helpful for the farmers to introduce the agroforestry systems in their cropland.
- Community based Agroforestry can be practiced for the optimum production, which will make the agroforestry system popular.
- Promotion of fruit trees as an Agroforestry component.
- In case of species selection, priority must be given to the indigenous species, which have the fuel and medicinal value.
- The farmers should be trained in establishing a nursery, maintenance and marketing of plant material.
- Emphasis should be given to the homestead Agroforestry by which the different fallow land can be utilized properly.
- Homestead Agroforestry can be practiced in the large amount of land around the house of the farmers, which can meet the demands of forest products for the local people.
- Farmers should be trained through the different package programs. So that they can realize the importance of trees and the management of trees on their agricultural cropland.

Chapter Seven: REFERENCES

References:

Anonymous.1989. The state of forest reports 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India. Dehradun.

Banglapedia 2015, National encyclopedia of Bangladesh. (http://www.banglapedia.org)

B.B.S. 2011. Statistical Year Book of Bangladesh, Bangladesh, Bureau of Statistics, Statistics Division, Ministry of Planning, Government of Bangladesh.

B.B.S. 2013. Statistical Year Book of Bangladesh, Bangladesh, Bureau of Statistics, Statistics Division, Ministry of Planning, Government of Bangladesh.

Bene, J.G., Beall, H.W. and Cote, A. 1977. Trees, Food and People, LR.D.C., Ottawa, Canada.

Budowski, G. 1987b Living fences: A wide spread agro forestry practice in America. Martinus Nijfoff, Dordrecht, The Netherlands.

Conkclin, H. C. 1957. Hanunoo agriculture : A report on integral system of shifting cultivation

in the Philippine. Food and agriculture organization of the united nations, Rome.

Conkclin, H. C. 1953. Ethnographic atlas of Ifugao: A study of environment, culture and socity in northern Luzon. Yale university press. New heaven. Conn.

Courtenay, P.P. 1965. Plantation Agriculture. Bell Press, London.

Dwivedi, A.P. 1992. Agroforestry Principles and Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, P 365.

GoI (Government of India)2001. Report of the Task Force of on Greening India for Livelihood Security and Sustainable Development, Planning Commission. New Delhi, pp. 17-44

Grandstaff, S. W. 1986. Trees in paddy field in northeast Thiland. In: Martin.G.G (ed). Traditional agriculture in southeast Asia. A human ecology perspective. Westveiw press, Bouldor. Colo.

Haily lord, 1957 An African survey. Oxford University press, Oxford.

IPCC (Intergovermental Panel on Climate Change) 2000. Land-use, land-use change and forestry. Special Report, Cambridge University Press, Cambridge

Kang, B. T and G. F. Wilson.1987. The development of alley cropping as a promising agroforestry technology. International council for research in agro forestry. Nairobi, Kenya.

Karki, L. 1985 Definition and exploitation of forest tree ideotypes in finland. Huntingdon, London.

Kerkhof, P. 1990. Agroforestry in Africa : A Survey of Project Experience. Panos Inst., London, UK.

King, K. F. S. 1987. The history of agroforestry. In: Steppler, H. A. and P. K. R. Nair (eds). Agroforestry a decade of development. International council for research in agro forestry. Nairobi, Kenya.

Kramer, P. K. and T. T. kozolwski.1979. Physiology of woody plants. Academic press, Newyork.

Lewis, C. E. 1984. Integration of pine and pastures for hay and grazing. Agro forestry syst. 2: 31- 41

Nair, P.K.R. (ed.). 1984. Agroforestry Systems in the Tropics. Kluwer, Dordrecht, The Netherlands

Nair, P.K.R. 1985. Classification of Agroforestry systems. Agroforestry systems 3: 97-128.

Nair, P.K. 1993. An introduction to AgroforestryICRAF/Kluwers Academic Publishers, Dordrecht, The Netherlands, pp 13-155,

Nair, P.K.R. 2006. Whither homegardens? In: Kumar, B.M. and Nair, P.K.R. (eds.), Tropical Homegardens: A time-tested example of sustainable agroforestry. Springer, Netherlands, Volume three, pp. 355-370.

Raghavan, M. S. Genesis and history f the kumri system of cultivation proceddings of the ninth silviculture conference. Dehra Dun , India . 1960

Tewari D.N. and Sing, M. P. 1996. Agro forestry and wasteland, 1st edition, Anmol publications private limited, New Dellhi. PP-299

Stolar A. 1978. Garden use and household economics in the rural Java. Bull. Indonesian Stud. 14: 85-101

Thanh, M.V. 2005. Center for Agricultural Research and Ecological Studier, Hanoi Agricultural University.

Tripp, R. 1993. Adoption of Agricultural Technology: A guide for Survey Desi CIMMYT. Mexico.

Vergara, N. T. 1981. Integral agro forestry a potential strategy for stabilizing shifting cultivation and sustaining productivity of the natural environment. Working paper. Environment and policy institute. East west center, Honolulu. Hawaii.

Warner and Raintree, J. B. 1986. Agro forestry pathways for the intensification of shifting cultivation. Agro forestry syst. 4: 39 – 54.

Wilken, j. C. 1977. Integrating forest and small scale farm systems in Middle America. Agro ecosystems 3: 291-302

Young, A. 1997. The Potential of Agroforestry as a Practical means of sustaining soil fertility.ICRAF, Nairobi,Kenya.

APPENDIX

Questionnaire for the field survey for the study of "Farmer's Perception and Adoption of Agroforestry practices in Gopalganj district."

(SD= Strongly disagree, D=Disagree, N= Neutral, A=Agree, SA= Strongly Agree)

Date: . . . .   Village: . . . .

Union: . . . .   Upazilla: . . . .

Serial no: . . . .

A. General information of the respondent:

1. Name of the respondent: . . . .
2. Gender: Male/Female
3. Age (Years): . . . .
4. Education level: Primary/Secondary/Higher secondary
5. Total number of family members: . . . .
6. Total income per year: . . . .

B. Information about agroforestry practice:

1. What is the total land you manage in acres? . . . .
2. What is your land ownership type and quantity? a) Owner-occupied   b) Tenant c) Both
3. Have you listened about agroforestry before?   a) Yes b) No
4. Are you interested about agroforestry practice?

SD	D	N	A	SA

5. What type of agroforestry you practice? a) Cropland b) Homestead c)Woodlot d)Others
6. Are you interested about practicing cropland agroforestry?
7. Are you interested in practicing homestead agroforestry?
8. Are you interested in practicing woodlot?

SD	D	N	A	SA
SD	D	N	A	SA
SD	D	N	A	SA
SD	D	N	A	SA

9. Tree species you planted on your farmland?

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

d). . . . . c). . . . . f). . . . .

10. Crop/ vegetables/ fish/ others species you plant on your farmland:

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

d). . . . . c). f). . . . .

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

12. How long are you practicing agroforestry on your farmland? . . . . months/years

13. Source of seedlings/ planting material: a) Raised   b) Purchased

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

   ➢ . . . .

   ➢ . . . .

   ➢ . . . .

15. Criteria for species selection:

   ➢ . . . .

   ➢ . . . .

   ➢ . . . .

16. Do you think crop/ vegetables/ fish production influenced by perennial plants?

   a) Yes b) No

17. What type of product you obtain from trees?

   a) Fuelwood   b) Timber c) Fodder d) Fruits e) Cash f) Others

18. What is your perception of agroforestry practice?

   a) Increase farm productivity   b) Food security   c) Difficult to practice

   d) Decrease cash crops production   e) Increase household income

19. Market facilities: Excellent/ Good / Poor

20. Do you think that agroforestry practices have increased your household income?

SD	D	N	A	SA

21. What problem faced practicing agroforestry?

> ....
> ....
> ....

22. Did you adopt agroforestry practice or will you adopt it in near future? a) Yes b) No

23. Do you think that trees are harmful for agricultural crops?

   a) Yes   b) No   c) Neutral

24. What facilities influences/ encourage you to plant trees in in your farm?

> ....
> ....
> ....

25. Suggestions/ recommendation:

> ....
> ....
> ....