AGROFORESTRY STATUS AND ITS IMPACT ON LIVELIHOOD OF CHAR LAND FARMERS IN NILPHAMARI DISTRICT

A THESIS
BY

MD. SHAFIQUL ISLAM

REGISTRATION NO.: 1805097

SESSION: 2018

THESIS SEMESTER: JULY-DECEMBER, 2019

MASTER OF SCIENCE (M.S.)
IN
AGROFORESTRY AND ENVIRONMENT

DEPERTMENT OF AGROFORESTRY AND ENVIRONMENT
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Dedicated

To My Beloved

Parents

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AGROFORESTRY STATUS AND ITS IMPACT ON LIVELIHOOD OF CHAR LAND FARMERS IN NILPHAMARI DISTRICT

ABSTRACT

The present study was conducted among the char land area of two Upazila namely Jaldhaka and Dimla of Nilphamari district of Bangladesh to find the agroforestry status and its impact on the livelihood of charland farmers. A total sample of 100 (50 from each Upazila) farmers were selected randomly for data collection. Data were analyzed with a combination of descriptive statistics, mathematical and statistical techniques. Majority of the respondent family (56 %) were in the age category of middle aged (years) which are considered as the most active and working group. Most of the respondents can sign only category of education level (53 %) in the study areas. Majority of them have (62 %) were medium knowledge with mean score 22.8 with a standard deviation of 10.59 of the knowledge of agroforestry. Better part of the respondents were found to consume fruit and rest of them engaged in fruit distribution and sale. More than 53 % of these charland farmers had sign only educational level; therefore they have not enough knowledge about the benefit of medicinal plants of homestead agroforestry. The highest percentage of respondents assigned/involved in various management practices i.e. seed collection, watering, weed control, maturing, fertilization, pruning and insecticide spray in the study area. The extension workers in the charland did not have enough facilities to communicate (information from UAO AEO, SAAO, NGOs, GD, participation in field day, TV, Radio and newspaper, leaflet, bulletin) for the development of homestead agroforestry. Among the respondents, 95% (highest) and 6% (lowest) were mango and tamarindus tree farmer respectively. The highest (39%) of respondents was found eucalyptus with ranked 1 and lowest (4%) of respondents was found east African mehogony and banyan tree and then the ranked (11) were same. Results shows that the highest (68%) of respondent family were lal shak and ranked 1 and lowest (10%) of respondents was cultivated cucumber, ridge gourd and cauliflower vegetable at home and then the ranked (18) were same species diversity in homestead agroforestry. Most of the respondents faced problems damaged by animals such as cattle, goat, etc. (36 %), not faced any problems (8 %). This problem was hindrance to improve the homestead agroforestry. Need proper homestead agroforestry knowledge about planting trees, the extension workers and also the members of NGOs can play a crucial role to overcome this problem. The respondents faced different problems that were created looser financially in the homestead agroforestry. The relationship between tree knowledge of respondent family and their knowledge of agroforestry status was 0.814**. Based on the computed ‘r’ value the relationship between tree knowledge of respondent and knowledge of agroforestry was significant at 0.01 level of significance and followed a positive relationship. The good quality seeds/ seedlings, fertilizer and plant protection should be available. Seed collection was very important component of agriculture and all of the respondents' economy was agro-based. The homestead owner should be trained by the GOs or NGOs about homestead agroforestry knowledge. Providing suggestion by extension workers, training and loan to execute GO_s and NGO_s of their char land farmer homestead agroforestry knowledge.

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LIST OF ABBREVIATION

AEO	:	Agricultural Extension Officer
AF	:	Agroforestry
BARC	:	Bangladesh Agricultural Research Council
BBS	:	Bangladesh Bureau of Statistics
BARI	:	Bangladesh Agriculture Research Institute
CHT	:	Chittagong Hill Tracts
DSN	:	District Statistics of Nilphamari
EGIS	:	Environmental and Geographic Information Services
Fig.	:	Figure
GD	:	Group Discussion
GOB	:	Government of Bangladesh
GPS	:	Global Positioning System
HSC	:	Higher Secondary School Certificate
M.S.	:	Master of Science
MDG	:	Millennium Development Goals
MSFO	:	Multi Strata Fruit Orchard
MS Excel	:	Microsoft Excel
MS Word	:	Microsoft Word
NARS	:	National Agricultural Research Systems
NGO	:	Non-Government Organization
R & D	:	Research and Development
SAAO	:	Sub Assistant Agricultural Officer
SD	:	Standard Deviation

SPSS	:	Statistical Package for Social Science
TV	:	Television
TK.	:	Taka
UAO	:	Upazila Agricultural Officer
USA	:	United State of America
USP	:	Upland Settlement Project
WL	:	Woodlot
YAS	:	Yearbook of Agricultural Statistics
e.g.	:	Example
et al.	:	And others
gm	:	Grams
ha	:	Hectare
i.e.	:	That is
km	:	Kilometer(s)
kg	:	Kilogram(s)
sq	:	Square
%	:	Percent
*	:	5 Percent Significant
**	:	1 Percent Significant

CHAPTER-I
INTRODUCTION

1.1 Background of the study

Agroforestry is the art and science of growing wood and non-woody plants together on the same unit of land for range of benefits. It is the use of land for combination of agricultural and forestry. In other word, the practice of growing tree crops or some other fast growing trees along with the main crop. Agroforestry is one of the important sustainable land management techniques, involving a combination of different agricultural, horticultural, forestry, and livestock practices. Something it is closely related to community forestry and homestead forestry.

In agroforestry systems there are both ecological and economical interactions between the different components. Agroforestry can also be defined as a dynamic, ecologically based, natural resource management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels. In particular, agroforestry is crucial to smallholder farmers and other rural people because it can enhance their food supply, income and health. Agroforestry systems are multifunctional systems that can provide a wide range of economic, sociocultural, and environmental benefits.

There are three main types of agroforestry systems:

- Agrisilvicultural systems are a combination of crops and trees, such as alley cropping or home gardens.
- Silvopastoral systems combine forestry and grazing of domesticated animals on pastures, rangelands or on-farm.
- The three elements, namely trees, animals and crops, can be integrated in what are called agrosilvopastoral systems and are illustrated by home gardens involving animals as well as scattered trees on croplands used for grazing after harvests.

Sometimes it is closely related to community forestry and homestead forestry. Although it is a traditional practice, it may be designed on more realistic and dynamic models according to land, area, and ecological conditions. Agroforestry plays a vital role in supplying not only the daily necessities of man but also in maintaining ecological balance. It is more or less an alternative to shifting cultivation, forestry in the service of agriculture; forestry farming helps solve problems of hunger, and combat desertification. It lends a new emphasis to rural and suburban development, as a socio-economic enterprise in alleviating national problems of forest conservation. It creates employment opportunities and also ensures the best utilization of different soil strata. The system of agroforestry helps to maintain natural stability by providing mutual growth among the forest trees and crop plants (Banglapedia, 2014).

The homestead agroforestry system is very important in the economy of Bangladesh. The many woody species grown in the homesteads are a significant source of fuel wood; they also provide fodder, building materials and other forms of wood. In the context of the prevailing shortage of fuel wood and excessive deforestation in Bangladesh, this homestead agroforestry system needs to be strengthened. A field survey was undertaken to assess the prospects and feasibility of initiating a programme for the improvement of homestead agroforestry systems. It showed that the prospects for improving homestead agroforestry systems are good because most respondents own their homesteads and believe there is room for more trees on them. Although they know that raising trees is relatively difficult and requires special practices, they are familiar with the government nurseries and local agricultural extension officers, and are confident about the success of the programme. Results also indicate that multipurpose trees and specific modules for involving women in the farm operations are likely to enhance success of the programme (Leuschner and Khaleque 1987).

Char a tract of land surrounded by the waters of an ocean, sea, lake, or stream; it usually means, any accretion in a river course or estuary. It includes all types of bars including both lateral (point-bars) and medial (braid-bars). In the dynamics of erosion and accretion in the rivers of Bangladesh, the sand bars emerging as islands within the river channel (island chars) or as attached land to the riverbanks (attached chars), often create new opportunities to establish settlements and pursue agricultural activities on them. A

distinction should be made between island chars, which are surrounded by water year-round and attached chars, which are connected to the mainland under normal flow. Once vegetated such lands are commonly called chars in Bangladesh (Banglapedia, 2014).

Generally, char areas have been created along the bed or basin of the big rivers. Char lands are the sandbars that emerge as islands within the river channel or as attached land to the river banks. Simply, the riverine sand and silt landmasses known as char in Bengali. On an average, 5% of Bangladeshi population as well as 6.5 million people live on the chars covering almost 5% of the total land area of the country and miserably it is narrowed as 7200 square kilometer (EGIS, 2000). Most of the char dwellers are involved in various kinds of farming systems that represent production of crops, livestock, poultry, fisheries, etc. Their production practices are different from the main land. The char dwellers invest their available resource base to enhance farm productivity. Char lands can provide high value crops that can be harvested before the first flood occurrence.

In addition to the major physical risk associated with the river, char dwellers, in particular, are marginalized from the benefits of the main land. Regardless of facing different natural hazards and calamities due to climate change, movement of the char dwellers to safer areas is not feasible because of scarcity of land. The livelihood patterns of the people in char areas are much more harsh and full of uncertainties. There are very limited and seasonal work opportunities in the char areas. People living in char lands endure in secured livelihoods. Geographical, social, immoral and political instability and insecurity pushed the char dwellers to a vicious cycle of poverty. Regular loss of lands and natural disasters often lead to migration. The major issues that the char dwellers face are inability to resist physical hazards, poor access to essential services, inadequate saving and credit options, poor access to income enhancing opportunities and services, and so on (Saifullah, 2010). However, the char dwellers always fight with the hunger, poverty, illiteracy, less farm productivity, climatic disaster, etc.

The major char inhabited districts of Bangladesh are Jamalpur, Mymensingh, Sirajgonj, Noakhali, Bogra, Rangpur,kurigram, Bhola and Patuakhali (BBS, 2006). 'CHARS' is big part of Mymensingh. A large number off populations are living in these char areas and maintaining their livelihood through char based farming systems. In the char areas, more than 60 per cent people do not own any cultivated land other than the homestead only. Therefore, for improving the livelihood of the charland people, increase

of productivity of land with introducing tree species in their charland by the association with crops and vegetables as Agroforestry practices is prime requirement (Zico et al., 2011).

Bangladesh has a long tradition of agroforestry practices. But management has always been extremely poor. Selection of plants, planting techniques, and also their utilization in most cases is poorly done, although the country is mostly dependent on the plants grown in and around human habitats. Because of the growing population, quick urbanization, and other forms of development efforts, the agroforestry practices are declining. It is reported that about 10% of homestead trees are being removed annually without replacement. Recently plantation of more tree species along the agricultural lands is being emphasized. Results of different investigations have suggested that the following trees may be grown: Babla, *Acacia nilotica*; Khair, *A. catechu*; Khair, *A. catechuoides*; Datepalm (Khejur), *Phoenix sylvestris*; Jackfruit (Kanthal), *Artocarpus heterophyllus*; Palmyra palm (Tal), *Borassus flabellifer*; Mango (Aam), *Mangifera indica* as the major trees and Shimul, *Bombax ceiba*; Silk cotton tree (Shimul), *Ceiba pentandra*; Coconut (Narikel), *Cocos nucifera*; Betel Nut (Supari), *Areca catechu*; Litchi (Lichu), *Litchi chinensis* and several species of bamboo as the minor trees along the crop lands in the Gangetic flood plain areas for fruits, timber, fuel, building materials and for some other economic products. For the high land of the tista floodplain, Neem, *Azadirachta indica*; Mango, *Mangifera indica*; Khair, *Acacia catechuoides*; Sissu, *Dalbergia sisoo*; Jackfruit, *Artocarpus heterophyllus* and some species of bamboo are recommended (Banglapedia, 2014).

Bangladesh is an agricultural country. The arable land is reducing rapidly in Bangladesh due to high population density and enormous pressure on the natural resources of the country. Under these alarming situations, using modern or new techniques must increase agricultural production as well as forest resources. Multistoried agroforestry system is one of them where incorporation of fruits, vegetables, spices and some medicinal plants in these systems can be effective and fruitful. There are about 20 million homesteads in the country, which covers about 0.3 million hectares, Most of the vegetable produced in the country are coming from these homesteads (BBS, 2008). Traditionally farmers grow different types of crops in association with trees in their homesteads. From time immemorial, a large number of diversified tree species are grown in the homesteads and

recently many exotic species are included. A holistic approach to agroforestry systems can be of great significance in this regard by:

- Integrating appropriate species of woody perennials on farmlands along with other components of the farming system not in a competitive but in a complementary way;
- Integrating herbaceous crops and livestock on forest land according to the agroforestry management schemes so as to facilitate simultaneous production of wood and food crops; and
- Employing agroforestry techniques for reclamation of degraded lands and proper utilization of "wastelands".

Char land areas are estimated to be 0.72 million hectares in Bangladesh which is about 5% of the country area and about 6.5 million people (5% of the country's population) live there (EGIS, 2000). About 64 to 97% of the char areas are cultivable. The chars are home of some of the poorest and most vulnerable people in Bangladesh. These areas are particularly prone to the effects of frequent climate shocks (floods, drought and cyclones) which increases the precariousness of poor people's lives by wiping out their assets and pushing them deeper into the poverty.

Bangladesh is trying to develop coping mechanism against natural hazards like floods, droughts, tidal-surges etc. through support of the Government. Adaptations to climate change for agricultural sectors includes the resilient crop variety, cropping pattern, irrigation techniques, sustainable land management, early warning, research, subsidies, supply of inputs etc. The potential arena for the adoption agroforestry technology and subsequent livelihood improvement can be done through adoption of multistoried agroforestry systems in Bangladesh, adoption of planned integrated homestead agroforestry, an appropriate policy intervention for adoption of suitable 10 agroforestry practices in degraded forestlands, improvement of marketing channel and institutional environment, incorporation of agroforestry in rain fed or dry farming croplands, strengthening social forestry system, capacity buildup of the farmers and strip plantation in new roads and highways.

Researchers of institutions under National Agricultural Research Systems (NARS) are engaged to innovate technologies that will be resilient to climate change and ensure

expected crop production. Finance and technology are the means to achieve adaptation and mitigation. Agroforestry practices are not new in Bangladesh. These were embedded in the traditional forest plantation activities by way of Taungya. In Bangladesh agroforestry has been practiced in various forest plantations. Agricultural crops including paddy, cotton, chilies, sesame, pigeon pea, mustard, maize, and different vegetables have been grown inside the plantations. Cropland agroforestry combines the production of agricultural crops and trees in the cropland through intercropping like boundary plantation, alley cropping, strip 9 plantation, homestead garden is most diversified agricultural crops and multipurpose trees fulfills most of the basic needs of the local population and resilient to Climate Change. In agroforestry practices, trees/plants play vital role in controlling soil erosion mainly through interception, infiltration etc.

Nilphamari district was one of the sub-divisions of Rangpur District. It was upgraded to a district in 1984. Nilphamari district is surrounded on the north by West Bengal State of India, east by Lalmonirhat District and Rangpur District, south by Rangpur District and Dinajpur District and west by Panchagarh District and Dinajpur District. It lies between 25º44' and 26º19' north latitudes and between 88º44' and 89º12' east longitudes. The total area of the district is 1546.59 sq. km. (597.00 sq. miles) of which 33.54 sq. km. (12.95 sq. miles) is riverine and 6.26 sq. km (2.42 sq. miles) is under forest. Tista Barrage Project, one of the biggest irrigation projects of the country, begins from Dalia of this district. The annual average temperature of the district varies maximum 32.3°C to minimum 11.2°C and the annual average rainfall of the district is recorded 2931 mm. Among population aged 7 years and over the literacy rate of this district is 44.4 % (Both sex) in which Male 47.6% and Female 41.1% . The major occupation of the people is farming. Among the working population 45.28% are farmers, 27.81% are farm labors, 3.42% are daily workers, 8.65% are businessmen, 6.07% are government and non-government employers, 8.77% have other occupations (DSN, 2011).

Bangladesh Agricultural University has developed three promising multistoried agroforestry system in three-layered canopy configuration. Three multistoried agroforestry models based on coconut, mango and sissoo has demonstrated beneficial effects in terms of return per unit area and may be adaptive to climate change, and otherwise production may not be high. Coconut based multistoried agroforestry system and this system is economically viable. Nut based multistoried agroforestry system;

mango based multistoried agroforestry system, Sissoo based multistoried agroforestry system with integration of vegetables, spices and medicinal plants as ground layer crops in mango based multistoried agroforestry system is clearly preferred agroforestry system. Multi Strata Fruit Orchard (MSFO) an innovative hill friendly agroforestry technology, BARI developed Homestead Agroforestry model for up scaling food security of resource poor rural farming was found promising and viable for raising production, economic return, nutrition supplementation and food security. Therefore present study observed the plant diversity, Agroforestry systems and its impact on the livelihood improvement of the farmers of char district Nilphamari. Nilphamari has an agriculture base economy. Nilphamari produces agroforestry, fruits trees, fuel trees Medicinal trees, vegetables and many seasonal crops. A huge land recovered from this riverbed for hundred years as named 'CHARS' is big part of Nilphamari. A large number off populations are living in these char areas and maintaining their livelihood through char based farming systems. Therefore, for improving the livelihood of the charland people, increase of productivity of land with introducing tree species in their charland by the association with crops and vegetables as Agroforestry practices is prime requirement. The Nilphamari district aggregate population is 1,836,234 of which males are 923,964 and females are 912,267 (BBS 2011).

The study was conducted among the two Upazila for Jaldhaka and Dimla char land area. The production and livelihood scenarios of char dwellers have been posturized in a number of literatures which are: Islam *et al.* (2014) explored indigenous survival techniques and variation in peoples' ability to adopt with flood and river erosion in char areas of Tangail district and showed that the people in the char lands with high flood proneness and low socioeconomic circumstances were more likely to fail to adopt with the conditions compared to the people in areas with high and sudden flooding; Ibrahim (2011) conducted a study on impact of agroforestry practices on livelihood improvement of the farmers of Char Kalibari area of Mymensingh district and found that, by the proper implementation of agroforestry practices with proper tree-crop combination, the people could improve their livelihood and socioeconomic status; Saifullah (2010) identified the perception of char dwellers under Kazipur upazila in Sirajganj district regarding their livelihood option and their capacity to cope with climate change and prioritize the adaptation option for reducing their vulnerability and found that the people changed cropping patterns with seasons and selected time of cultivation after prediction

of natural disaster to overcome the impact of natural disasters. The above mentioned literatures clearly indicate that most of the studies dealt with either the socioeconomic condition of the farmers in char areas or their adoption options to reduce vulnerability due to natural disasters. To minimize the research gap, the present study explores the production practices, estimates the productivity and profitability, and determines the livelihood status as a consequence of natural disasters of the char dwellers.

1.2 Objectives of the study

The estimates of socio-demographic, socio-economic, impacts of homestead and different farming systems are the important factors in formulating appropriate policy measures in order to improve the situation of char land areas. Therefore, this study was conducted with the following general and specific objectives:

General objectives

The general objectives of this study are to assess the socio-demographic and socio-economic information, tree knowledge, vegetables knowledge, agroforestry knowledge, different opinions about the impacts of homestead/ cropland/orchard agroforestry, participation in the care and management of homestead and different communication with extension worker for char areas.

Specific objectives

The specific objectives of the study are:

- To find out the present status of agroforestry in charland ;
- To find out the tree, vegetable crop diversity of char land ; and
- To asses the farmer perception about their agroforestry livelihood.

CHAPTER- II

REVIEW OF LITERATURE

The purpose of this chapter is to explain how this study is related to previous literature and how it will add to the general body of knowledge**.** The literatures reviewed in this study related to objectives are cited below:

2.1 Impact of agroforestry
2.2 Socio-demographic and economic agroforestry
2.3 Agroforestry, livelihood and environment and
2.4 Char land of agroforestry

2.1 Impact of agroforestry

Alam *et al.,* (2010) found that the empirical study was conducted of the attitudes, perceptions and preferences of owners of home gardens in Bangladesh. A wide spectrum of opinions regarding various agroforestry issues was observed. Landholders were found to maintain their home gardens mainly for subsistence, although some additional family income was derived from selling surplus products. Seedlings were mostly preferred to other planting materials. Mango was accorded the highest 'preference ranking' among the available species. The farmers expected a number of external support measures, including high quality planting materials, assured credit facilities, and access to state of the art management knowledge. Regarding the most serious constraints in home garden development, 37% identified 'financial constraint', while about 31% identified 'lack of technical knowledge' in developing home gardens. Other constraints include lack of adequate land area, lack of awareness of the socioeconomic and environmental importance of home gardening, and lack of external support. It was concluded that various perceptions, preferences and attitude of the farmers would provide a framework for future policy formulation, preparation of home garden management plans and development of home gardens in the study area and more generally in Bangladesh.

Amare *et al.,* (2018) this study investigates an under-rated and not widely recognized traditional agro- forestry practice carried out by smallholders in the highlands of Ethiopia. The purposeful retaining of indigenous trees on farmers' croplands is

recognized as separate from other agroforestry practices. Farmers cultivate indigenous trees for a variety of benefits, including livelihoods, ecosystem services and the existence of scenic and economically valued birds. The adoption of farmland agroforestry has been driven by similar household-level variables that explain the adoption of many other agro-forestry practices. However, in contrast to other agroforestry practices farmland agroforestry is not a management priority for farmers, an observation that appears due to a lack of appreciation of naturally occurring trees. Because agroforestry on farmland is declining, interventions are required that improve extension services, availability of indigenous tree seedlings and credit, support reliable legal frame- works and land titles, and foster the processing and value adding of tree products suitable for higher value uses. The occurrence of soil erosion, increasingly erratic rainfall, migration of wild animals, and a decrease in productivity of major crops in the locality were attributed to the clearance of indigenous trees and forests (70.4% of respondents). A majority of respondents (89.7%) also attributed degradation of Lake Tana through sedimentation, retreat of lake surface area and decrease in water quality to clearance of indigenous trees. Family size, total land owned and adoption of agricultural technologies were positively associated with the adoption of farmland agroforestry. A unit increase in family size increased the probability of practicing farmland agroforestry by 2.4%. Likewise, one additional hectare of land owned increased the probability of practicing farmland agroforestry by 35%. The presence of experience with the adoption of other agricultural technologies increased the probability of adopting farmland agroforestry by 13.4%. This was often related to cultivation of crops grown underneath indigenous shade trees, such as coffee, and the positive attitude and knowledge developed of the benefits of trees from the adoption of such technologies.

Grossman (2014) despite claims that plantations both enhance and undermine the quality, valuation and protection of natural forests, plantation forestry continues to expand worldwide. In Paraguay, changes in environmental policy, extension practices, and public perception of eucalypts (*Eucalyptus spp*.) have promoted a boom in plantation production of these species over the last 20 years. Smallholders, faced with the dilemma of accelerating environmental degradation juxtaposed with persistent economic need, have widely adopted eucalypt forestry due to the quick growth, low establishment cost and high commercial value of eucalypt plantations. The consequences of this recent, rapid change for smallholder land management remain

uncharacterized. Mixed methods analysis of a multiple-case study of 45 families was employed to describe the evolving ecological context of small-scale eucalypt forestry in Eastern Paraguay. This study suggests that eucalypts play a complex, potentially sustainable role in the study area. Producers have integrated agroforestry into eucalypt management and report replacing crop and cattle production with eucalypts in the mosaic of regional land-use. Eucalypts are also integral to participants' views on reforestation of deforested land and fit ambiguously into their concepts of reforestation and species' nativeness. Understanding the evolving role of eucalypts in Eastern Paraguay is of critical importance to policymakers and foresters promoting sustainable management.

Johnson and Delgado (2003) studied the Água de Gato Watershed on the island of Santiago, Cape Verde Islands, 51 farmers were surveyed regarding their attitudes and knowledge of agroforestry. The farmers identified eight constraints to agroforestry implementation, with virtually all indicating that a source of loan funds was the major concern. Space or land constraints and availability of tree seedlings were identified as constraints by 94% and 88%, respectively. Despite these concerns, 92% of the farmers expressed a willingness to adopt or improve agroforestry practices in the watershed, with 73% expressing a willingness to establish fruit trees, 53% willing to establish trees or shrubs for fuel wood, and 16% willing to plant trees for shade.

Kabir *et al.*, (2016) Investigated how the household characteristics could influence home garden vegetation characteristics for 50 randomly selected households in Kalaroa Upazila of Satkhira District, Bangladesh. The results revealed that household landholdings, income, homestead size, and time spent for home gardening were strong predictors of home garden vegetation characteristics. Economic conditions of the household, experience of the household head, and home garden investment explained 48 % of the total plant diversity. The combined effects of all significant variables explained about 57 % of the variability in species richness. The mean landholding size per household is 0.67 ha (range 0.01–2.41 ha), of which 65 % is for agriculture and 20 % for homestead (average 0.13 ha, range 0.01–0.67 ha) occupied by the dwelling house and home garden and the rest for other uses such as horticulture, woodlot, poultry, fisheries etc. Fourteen percent of the households have no agricultural lands and only 6 % have relatively larger agricultural lands.

Approximately 96 % of households have less than half a hectare of homestead land with a home garden. Household agricultural landholdings and home garden size are positively correlated with household total landholdings (r = 0.944 and 0.464 respectively).

Nath *et al.*, (2015) conducted a study among the shifting cultivation is now considered a largely unsustainable type of agro ecosystem because of declines in productivity that come with increasing population pressure, shortening of fallow periods and non-availability of alternative land. Efforts to promote the adoption of agroforestry to improve shifting cultivation systems have been increasing. This worked with villagers in three para (hamlets) to develop a participatory approach to the development of agroforestry options. On the basis of a combination of participants' preferences and expert opinion, crop combinations were selected and agri-horti-silvicul-tural agroforestry systems developed. These participants now cultivate agricultural crops continuously year-on-year on slopes formerly subject to shifting systems. The benefit-cost ratio for agricultural crops was 3:1. Seedlings are growing well and average survival rates at more than 70 %. More than 80 % participants are now interested in agroforestry, and 54 % desire to expand agroforestry to other areas. For the future development and promotion of agroforestry by tribal communities in the CHT, conclusions are drawn about modes of collaborative working with local partners.

2.2 Socio-demographic and economic agroforestry

Khan *et al.*, (2017) examines the agroforestry offers unique opportunities for increasing biodiversity, preventing land degradation, and alleviating poverty, particularly in developing countries, but factors explaining the adoption by farmers are not well understood. A survey of 524 farm households was conducted in Bhakkar district of Punjab, Pakistan to study factors that determine the adoption of agroforestry on the sand dunes in the resource-deficient region of Thal. Farmers showed variable perceptions of tree planting. A large proportion of the farmers, though less than half, felt that tree planting can protect nearby crops from dust storms (mean 0.46) and others thought that tree planting can compact the soil in the dune area, i.e. to improve the soil stability (mean 0.29). Most farmers expressed an intention to increase the cultivated area with tree planting in the future (mean 0.57). Most farmers in this study had quite

positive opinions of tree planting and border cropping; the majority of them expressed intention to increase tree planting and border cropping in the future.

Mercer *et al.*, (2005) showed that the on average, the age of the household head was 38 years, households had 4 children living at home, and the annual household income was US$1,510. Only 29% of farmer respondents had completed primary school, while only 11% had finished secondary school. The typical household had lived in Calakmul for 11 years, with 94% of respondents having immigrated to Calakmul from outside the state of Campeche. The average landholding was 48.2 ha, of which 39.7 ha was originally under primary forest cover and 8.72 ha under secondary fallow. Farmers had cleared an average 9.9 ha of forests resulting in an average of 27.6 ha per household currently under forest cover, 19 ha under fallow, and 4.8 ha in *milpa.* Since joining the *ejido*, 67% of respondents had established an average of 1.27 ha of non-agroforestry tree plantings. However, only 31% reported establishing agroforestry systems; average plot size was 1.15 ha. About 47% of respondents had previous experience with an agricultural or forestry development project, and 79% reported an interest in participating in future agroforestry development projects. The average height growth (m/year) and basal diameters (cm) of fruit and timber species by management regime following the second year of establishment. Both timber and fruit tree height growth were significantly greater on continuously cropped sites than on cleaned sites with intermittent cropping, whereas tree diameters were significantly larger on lined-cleaned sites than fully cleaned sites. There were no significant differences for timber or fruit tree survival for the different management strategies. In general, systems with fruit trees had higher establishment and maintenance costs than systems with timber trees alone. Management costs were greatest for the cleaned or open system.

Nath and Inoue (2008) this paper reports an empirical study of the Upland Settlement Project (USP) of Bangladesh which was undertaken to prevent land degradation and enhance the standard of living of the people. Planters were found to have given up shifting cultivation and adopted soil conserving agroforestry practices, and forest coverage has been increased in the project village. Interacting with project staff members, government officials and NGOs assisted planters in diversifying livelihood strategies thereby reducing dependency on project resources. Rich planters, utilizing their own capacity, expanded their income sources successfully. Poor planters still

remain wage labourers because they do not have sufficient finance and networks to invest in productive ventures. The mean expenditures across the three categories of planters were not significantly different, although middle-wealth and poor planters spent more than 90% of their money on food, and collected some vegetables from the surrounding forests. The expenditure–income figures indicate that most planters have been able to allocate money for their other needs including clothing, social events and marriages. Suggestions are made for the continuity of project functions, which involve greater participation of planters in rubber management functions, improved information flow, resolution of land tenure and greater equality in distribution of rubber revenue.

Safa (2006) this study evaluates the social forestry activities of four large NGOs, namely BRAC, Proshika, Caritas and CARE- Bangladesh, as well as national social forestry activities. By adopting a common partnership between public and private authority, property right conflicts have been resolved and rural livelihoods enhanced, and scope has been created for utilizing marginal land. The benefit sharing arrangement was contractual (participant 60% + NGOs 10% + landowners 30%). Many destitute women gained an opportunity to work and a new means to survive with much more dignity than begging. The program also increased the forest cover, with tree planting along roadsides and on other marginal land. BRAC established nurseries at each area office, producing a yearly average of 10,000-15,000 seedlings of various fruit, fuel wood and timber trees, which are sold within the community. The nursery workers are given one week of training in seedling production. Improving income and employment opportunities and enhancing overall rural socio-economic development. Social forestry activities including nursery operations have generated income and employment. Moreover, the destitute women have an opportunity to consult NGOs about their future plans which gives them the confidence to meet any difficulties in income-generating activities.

Victor *et al.*, (2004) the study examines the extent of participation of rural dwellers in plantation development through taungya farming and the degree of success of this system as an afforestation method. The farmers were predominantly illiterate, within the age bracket of 35-54 years and with small farm holdings. Twenty nine percent relied totally on food from the forest reserve for their livelihood, while 71% also had farm holdings in free areas. Land within the reserve is allocated to farmers free of charge but compensation is paid to landlords on land from free areas. A statistically significant

difference was detected in income from the two sources of farmland for the households and but not in the size of land allocated under taungya and free areas. The major problems of land tenure system are unequal distribution of land among the respondents, small land holding and landlessness. About 184 farmers are involved in taungya annually and 410 ha of Tectonia grand is has been established for the government of Ondo State.

Rahman *et al.*, (2012) found that the potential of mango-based agroforestry to improve livelihoods, using data collected by rapid rural appraisal, farmer participatory research, stakeholder analysis and a farm household survey in six representative villages in the floodplain. Farmers with the least land were found to allocate a higher percentage of their land to agroforestry, and the increased income from agroforestry compared to other agricultural systems helps reduce relative poverty. Land size per household averaged 1.35 ac, with 39% used for mango-based agroforestry, 46% for commercial agriculture (particularly monocropping of rice, wheat and sugar cane), and a further 9% for home gardens. Survey respondents were found to obtain 60% of their staple crops (paddy, wheat), 80% of vegetables (potato, tomato, bean, lady's finger, turmeric, spinach, brinjal, ginger) and 75% of fruit (mango, papaya and banana) from agroforestry. This income maintains basic household needs, providing food security and fuel wood, and contributes to healthcare, housing and sanitation conditions, and meeting educational expenses.

Rahman *et al.*, (2016) conducted a study aims to investigates the types of agroforestry system that exist in Gunning Salak Valley, West Java, Indonesia in order to characterize the differences in their basic structure and associated crop plant diversity. Five main agroforestry systems (home gardens, fruit tree system, timber tree system, mixed fruit-timber system and cropping in the forest understory) exist in the study area, and all of them exhibit a noticeable diversity in terms of both species composition and utilization. Products from farming accounted for an average 24 % of household income. This system is generally practiced on land where the farmers previously planted seasonal cash crops, including swidden cultivation fields. It is characterized by high species diversity and usually three to four vertical canopy strata of intimately mixed plant species leading to a total tree canopy cover of 35–70 %. The selection of crops for cultivation in the understory is based on their shade tolerance and these crops are established while tree

species grow up over the years with gradual canopy coverage. After harvesting of timber, they are usually not replaced by planting new timber trees. In contrast fruit trees are maintained to continue fruit production for a longer period of time.

Safa (2004) examines the effectiveness of practicing participatory forestry on the settlers' livelihood in the encroached area of the sal forest. The settlers were given degraded and encroached forest land through the program. Two major social forestry models – namely agroforestry and woodlots are included in the study. Participation in the resettlement increased household income, employment opportunities and financial and non-land assets. More than half of the respondents (55.5%) are illiterate, while 18.9% 'can write only'. The illiteracy rate is highest for the non-settler group (65%), followed by the WL then AF group. More than 40% of settlers under the literate category have only first to fifth grade (Primary level) education. The HSC (Higher Secondary School Certificate) and graduate level literacy is very low among the respondents (3.73% and 0.27% respectively). The highest proportion of the income is spent on food, as a basic necessity of daily life. These findings suggest that there is a role for extending the approach to rehabilitate other degraded and encroached forest lands in Bangladesh.

2.3 Agroforestry, livelihood and environment and

Baul *et al.*, (2013) conduct a survey was conducted to examine agro biodiversity status of farms in the Pokhare Khola watershed of Dhading district in the Middle-Hills of Nepal. A total of 53 farmland tree and one crop species from 22 families were documented. The most commonly found species were fruit and fodder species (on over 60 % farms) including banana (Musa paradisiaca), khasrato (Ficus hispida) and khanayo (Ficus semicordata). Tree density was highest (226/ha) on marginal farms (farm area $\leq$ 0.25 ha) and lowest (165/ha) on small farms (farm area 0.26–0.5 ha). For the study area as a whole, the Shannon-Wiener species diversity index was 3.26 and the species evenness index 1.89. Large farms (farm area > 1 ha) had the greatest tree species diversity (4.47 $\pm$ 0.52) and marginal farms the lowest (2.18 $\pm$ 0.37), indicating the positive relationship between farm size and species diversity. A total of six types of cereals and 18 types of vegetable crops were grown in the study area. The major livestock component of each household was chickens (average 8/household) and

goats (6/household). The mean value of livestock in the large farm category was estimated as $2235, significantly higher than that of the other three categories. A significant relationship was found between agro biodiversity and livelihoods, irrespective of annual production, and the critical role of the farmed landscape in agro biodiversity conservation was apparent.

Baul *et al.*, (2015) found that the Mangifera sylvatica Roxb. Is an underutilized wild tree species valued for its fruit, timber and medicine. It was believed to be widely grown in sub-tropical forests of Bangladesh, but nowadays can be seen only sparsely. Even though it has multiple uses, only the indigenous people in hilly areas use the fruit of this species, for cooking and making pickles. Through 16 field visits in eight forest beats, 66 individual trees were identified and their GPS (global positioning system) coordinates were recorded. A seed germination rate of 83 % at 6 weeks after direct sowing was attained. The early growth of seedlings with fertilizer treatments showed no remarkable difference with seedlings without fertilization. The seed germination rate and early growth of seedlings indicates that this species can be easily domesticated and be incorporated into small-scale plantation pro- grams. In that it has multiple use values, this species warrants promotion in small- scale forestry programs for conservation and benefiting the villagers.

Garrity (2004) examines the role of agroforestry research and development (R&D) in light of the MDGs. It reviews some of the ways in which agroforestry is substantively assisting to achieve the goals and discusses how the agenda can be realigned to further increase its effectiveness in helping developing countries to meet their MDG targets. Promising agroforestry pathways to increase on-farm food production and income contribute to the first MDG, which aims to cut the number of hungry and desperately poor by at least half by 2015. Such pathways include fertilizer tree systems for smallholders with limited access to adequate crop nutrients, and expanded tree cropping and improved tree product processing and marketing. These advances can also help address lack of enterprise opportunities on small-scale farms, inequitable returns to small-scale farmers (especially women), child malnutrition, and national tree-product deficits (especially timber). The rate of return to investment in research on tree crops is quite high (88%); but enterprise development and enhancement of tree-product marketing has been badly neglected. The products, processing, and marketing of tree

products and services, through tree domestication and the commercialization of their products is a new frontier for agroforestry R&D. A major role for agroforestry also is emerging in the domain of environmental services. This entails the development of mechanisms to reward the rural poor for the environmental services such as watershed protection and carbon sequestration that they provide to society. Agroforestry R&D is contributing to virtually all of the MDGs. But recognition for that role must be won by ensuring that more developing countries have national agroforestry strategies, and that agroforestry is a recognized part of their programs to achieve the MDGs.

Islam *et al.*, (2014) conducted a study aims to investigate soil organic carbon content in relation to tree species diversity in the home garden agroforestry system of north-eastern Bangladesh, to test the hypothesis that ho- me gardens with high species diversity contain more organic carbon in soil than those with low species diversity. A multistage random sample of home gardens was selected and observations made in sample plots of tree density, species richness, and soil pH and soil organic carbon content. Soil samples were collected at two depths (0–25, 26–50 cm) from each plot. Soil organic carbon content was found to be positively correlated with both tree density ($r = 0.93$, $P < 0.01$) and species rich- ness ($r = 0.79$, $P < 0.01$). Soil pH was not found to differ significantly across soil depth ($p = 0.67$), except that more organic carbon content was found in the deeper soil layer than the upper layer ($P < 0.05$). The study demonstrates that species-rich home garden with high tree density can sequester more carbon in soil than species- poor home gardens and thereby contribute more to climate change mitigation.

Nath and Inoue (2013) examine the livelihoods of forest villagers (Khasia ethnic people) and their contribution to forest conservation, using data from the Sylhet forest division. The forest villagers are well-endowed with all the elements of a sustainable livelihoods framework, though human capital in terms of education is not satisfactory. Strong social capital, stable natural capital and a productive market-oriented agroforestry system facilitate the generation of financial and physical capital that make the livelihoods of Khasia people sustainable. At the same time, their reciprocal contributions in terms of forest protection and plantation development sup- port forest conservation. However, some institutional issues such as insecure land tenure with regular agreement renewal problems need to be resolved for the sake of their livelihoods

and forest conservation. Lessons learned from the study can be utilized in formulating future participatory forest management schemes in the country.

Nath *et al.*, (2014) studied the homestead forests in the Teknaf Peninsula ecologically critical area of Cox's Bazar in Bangladesh have not been widely studied. Data were collected from a survey of 140 households and a vegetation survey of 70 homesteads in three sites. Villagers allocated 70 % of their homestead area for homestead forestry and alto- gather 73 plant species were recorded from the study sites. The average density was 4,000 plants/ha. The above-ground biomass was estimated 235.45 Mg/ha, equivalent to 117.73 Mg C/ha. Villagers maintain sustainability of homestead forests by planting seedlings every year and thus ensure several diameter and height classes. Homestead forests contribute substantially to household income, provide fuel wood and timber for own consumption and sale, and protect villagers during cyclones. Considering the protective role of plants against cyclones, respondents of hillside and beachside locations mentioned that they prefer coconuts (53 %) followed by supari (45 %), mango (42 %) and jackfruit (25 %) for planting at their homesteads. The reasons they cited include high survival rate of these species (85 %), strong root system that protects plants from uprooting during cyclones (72 %), strong stems which do not break easily (68 %), and low weight associated with light canopy which reduces wind load on trees (55 %) thus prevents houses from wind damage. Homestead forests thus meet the conditions to be a clean development mechanism forestry project which would provide a win–win strategy for involving small-scale farmers in climate change mitigation and adaptation initiatives, and biodiversity conservation.

Nautiyal *et al.*, (1998) conducted a study among the Village in Garhwal Himalaya was analysed in terms of energy and economic efficiency of different land use-land cover types constituting the landscape. The climate is warming temperate with mean annual temperature of 21^0C and annual rainfall of 1485 mm. About 80% of total annual rainfall is received during July to September. The parent material is represented by schistose phyletic, biotitic quartz, schist/phyletic and, in places, flaggy quartzite and Seri cite quartz schist. Soils are 30 to 80 cm deep and of sandy-loam to loamy- sand texture. .Total annual fuel wood collection in the village was 223.7 t, of which 15.3% was obtained from simultaneous agroforestry system, 47.5% from sequential agroforestry system and 37.1% from the forests. Total

annual fodder consumption in the village was 581 t, of which 21.2% was consumed through grazing and 78.8% through stall feeding. Simultaneous agroforestry system and forests provided 72.4% and 27.6%, respectively, of total fodder used in stall feeding. Fodder, fuel wood, staple food grains and vegetable production in the village was in excess of the local requirements. All the surplus fodder and fuel wood was marketed. About 33% of the food production was stored while 5.5% was marketed. Food products, fodder and fuel wood accounted for 33.38%, 52.95% and 13.67% of total annual income (Rs 1420 capita^{-1} year^{-1}), respectively. Oils and fats (mustard oil and hydrogenated oils) were imported.

Pandey *et al.*, (2016) an exploratory study was conducted in the Tehri-Garhwal district of Uttarakh and, a Himalayan State of India. Existing traditional agroforestry was found to provide ecosystem services to farmers at various scales ranging from the global to household level, contributing to the livelihoods and resilience of the farmers to climate change. The strategies of farmers for adapting to climate change include adoption of agro- forestry due to its diversified agricultural and forest products and services. The analysis suggests that policies should consider agroforestry as a tool for improving the livelihood and resilience to climate change of farmers. The analysis of the data indicates the important contribution of agroforestry to household welfare providing 42 % of fuel wood, 36 % of fodder and 56 % of leaf manure, the remaining requirements fulfilled from forests. Agroforestry contributes to the livelihood of farmers by diversification of cultivation and labour, increasing the opportunity to generate income through selling of timber and to reduce costs through provision for livestock feed and energy for households.

Rahman *et al.*, (2005) examines the species composition, diversity and economic importance of homestead forests in the household economy of central Bangladesh. The study documents 57 homestead forest species and their main usage in 90 households across three villages of Gazipur Sadar Upazila. The average household size of marginal and small landholding classes was 4.9 members while that of medium and large classes were 5.5 and 8.7 members, respectively. The average size of homestead forestland was 0.09 ha, which was 10.3% of the average total land possession. The average size of homestead forestland for the marginal landholding class was 0.05 ha while that of small, medium and large classes were 0.08 ha, 0.14 ha and 0.21 ha, respectively. It is

notable that the size of homestead forestland increases with the increase of landholding size class, but the percentage of homestead forestland in relation to total land decreases because a higher proportion of the land is devoted to agricultural crops. The average number of years of schooling was 9.2. The amount of schooling increases with increase of landholding size classes, which might be related to family wealth. The economic scope of homestead forestry can be further enhanced provided the appropriate species composition of the forest is achieved and the education of forest owners is ensured through targeted management and policy interventions.

Tita *et al.*, (2013) the purpose of this study is to understand status of agroforestry and planting trees on farmers' fields have been reported as important elements in a strategy to meet the millennium development goals of poverty reduction and climate change improvement. However, their uptake seems to be constrained by factors both internal and external to the household and related to the policy and legislative environment. This paper examines the impact of these factors on farmers' decisions to plant trees. Cameroon is used as a case to analyze whether existing policies and legislation governing trees support or discourage tree planting, using qualitative content analyses. Although their mission papers and statements suggest most national government policies in Cameroon address tree planting and agroforestry, actual legislation designed to follow up the policies mostly contradicts the poverty reduction goals. Often legislation and regulations are more conservation-oriented and do not provide a clear procedure to distinguish between products from trees found in the wild and those gathered from farmers' fields.

2.4 Char land of agroforestry

Bari (2019) examines the agroforestry as a multifunction landscaping tool in the char land area of Bangladesh. It has been estimated that 10% of the Bangladeshi population live on the char lands and that they cover 6% of the total land area of the country. Bangladesh is a country affected by floods. Regular flooding during monsoon season is a common phenomenon and the flooded lands in Bangladesh are gradually increasing. Extensive char areas have been created along the bed or basin of the Jamuna, Padma, Meghna, Brahmaputra and Tista rivers and these char landscapes are of great value for its exceptional hydro-geological setting. It is estimated that the char land

areas of Bangladesh will continue to expand every year as silt is deposited on riverbeds. Char lands are, however, less productive than adjacent mainland areas. The major reasons for this are less favorable soil conditions in some of the charland areas and uncertainties caused by erosion and frequent floods. As a result of the lower productivity, poverty incidence in char lands is higher than the national average. In addition, the geographic isolation of the char lands results in limited infrastructure, poor access to markets and services, and high transaction costs for the char dwellers. These conditions hinder public and private service providers from delivering services to people in the char land areas, leading to fewer livelihood opportunities and even lower net revenue for the agricultural production. Moreover, free cattle grazing in char land areas damage newly planted trees and other crops.

YAS (2016) conducted a study among the seasonally wet or shallowly flooded grey floodplain soils on lower ridges and in depressions with moderately well-drained, rather acid, brown loams on higher ridges. The active grey floodplain soils and non-calcareous brown floodplain soils occur mainly in Mymensingh (Kotwali, Islampur, Ishwargonj, Gouripur and Jamalpur); Dinajpur (Chirirbandar, Fulbari and Khansama); Rangpur (Nilphamari, Saidpur, Dimla, Domar, Jhaldaka, Kishoregonj, Gangachara, Mithapukur, Badarganj, Kaliganj, Hatibandha, Patgram, Palasbari and Sundargonj) and Bogra (Sherpur). Tista floodplain soils, non-calcareous brown floodplain soils on higher ridges; seasonally wet or flooded mainly silty, mixed grey floodplain soils and non-nalcareous dark grey floodplain soils on lower ridges and in depressions occurrence of place Bhurungamari, Lalmonirhat and Fulbari.

Zico *et al.*, (2011) found that the study was conducted at Char Gobadia of Mymensingh Sadar upazila of Mymensingh district to determine plant diversity and its impact on livelihood improvement and to explore their relationships with the selected characteristics of the farmers of the study area. A total of 46 different plant species were recorded in the study area. The different categories of plants as 6 timber species, 6 medicinal species, 10 fruit species, 3 fuel species, 13 vegetable species and 8 crop species were recorded. Akashmoni, eucalyptus and jackfruit were the dominant timber species. In case of medicinal plans, neem, datura and basak were the dominant species. Among fruit species betel nut, coconut, jackfruit and mango were dominant. Bokain, goraneem and gamar were mainly used as fuel wood plant species. Among the crop

species bitter gourd, bottol gourd, country bean, okra are dominant species. Chilli, jute, maize are dominant crop species. The respondents of Char Gobadia gave much priority on mahogoni, lambu, karanja and eucalyptus as timber plant species and regarding fruit plant they gave much priority to mango, lemon, guava, papaya, appel-kul, BAU-kul. For vegetable cultivation they prefer bottle gourd, radish, tomato, sweet gourd and for crop chilli, jute and rice. Average numbers of plant species/family and plant density were found 12.33 & 0.265 respectively. The relationship between the plant diversity and the selected characteristics showed that only family size and age has no significant relationship with plant diversity. Education, total land area, annual income, knowledge on agroforestry and knowledge on tree has direct relationship with plant diversity.

CHAPTER-III

METHODOLOGY

3.1 Study population and location of the study area

The study was conducted among the two Upazila for Jaldhaka and Dimla char land area of Nilphamari district in Bangladesh. The purposes for selecting this region only were the limitations of resources and time constraints. All the Upazila of the districts Nilphamari defined as the char land area of Bangladesh for this study. From the mentioned districts two char land area resident Upazila namely Jaldhaka and Dimla char land are the randomly selected sampled Upazila in this study. To keeping in view all the objectives of the study and considering the limitations on the research with respect to time, manpower and other facilities.

Dimla Upazila (Nilphamari district) area is 326.80 sq km, located in between 26°05' and 26°17' north latitudes and in between 88°52' and 89°06' east longitudes (Fig.-3.1). Total number of population is 223975; male 114453, female 109522; Muslim 198399, Hindu 25483, Buddhist 13 and others 80. Average literacy is 36.2%; male 41.7%, female 30.6%.

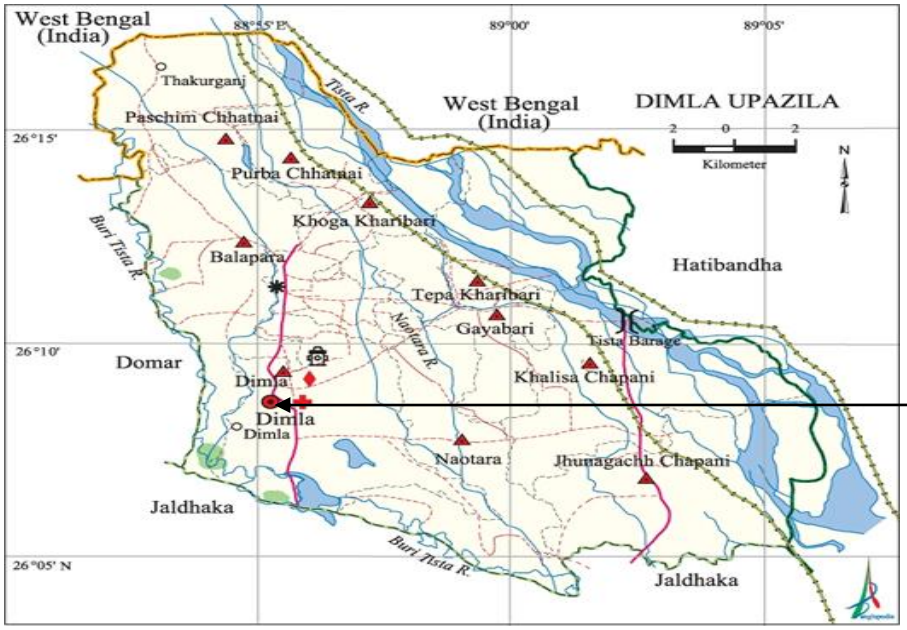


Fig.-3.1: Location of the study area. Bangladesh Population Census 2001, Bangladesh Bureau of Statistics; Cultural survey report of Dimla Upazila 2007.

Main sources of income are agriculture 75.36%, non-agricultural labourer 4.92%, industry 0.21%, commerce 8.27%, transport & communication 1.51%, service 3.05%, construction 0.46%, religious service 0.21%, rent & remittance 0.08% and others 5.93%. Ownership of agricultural land Landowner 57.37%, landless 42.63%; agricultural landowner: urban 49.74% and rural 57.97%. Sources of drinking water Tube-well 78.94%, pond 0.66%, tap 0.54% and others 19.86%. Sanitation 8.65% (rural 7.35 and urban 25.14%) of dwelling households of the Upazila use sanitary latrines and 33.80% (rural 34.80% and urban 21.20%) of dwelling households use non-sanitary latrines; 57.55% of households do not have latrine facilities (BBS 2001).

Jaldhaka Upazila (Nilphamari district) area is 303.52 sq km, located in between 25°57' and 26°07' north latitudes and in between 88°50' and 89°07' east longitudes (Fig.-3.2). Total number of population is 274736; where male 141715, female 133021; Muslim 217944, Hindu 56480, Buddhist 38, Christian 113 and others 361. Average literacy 33.0%; male 38.9%, female 26.8%.

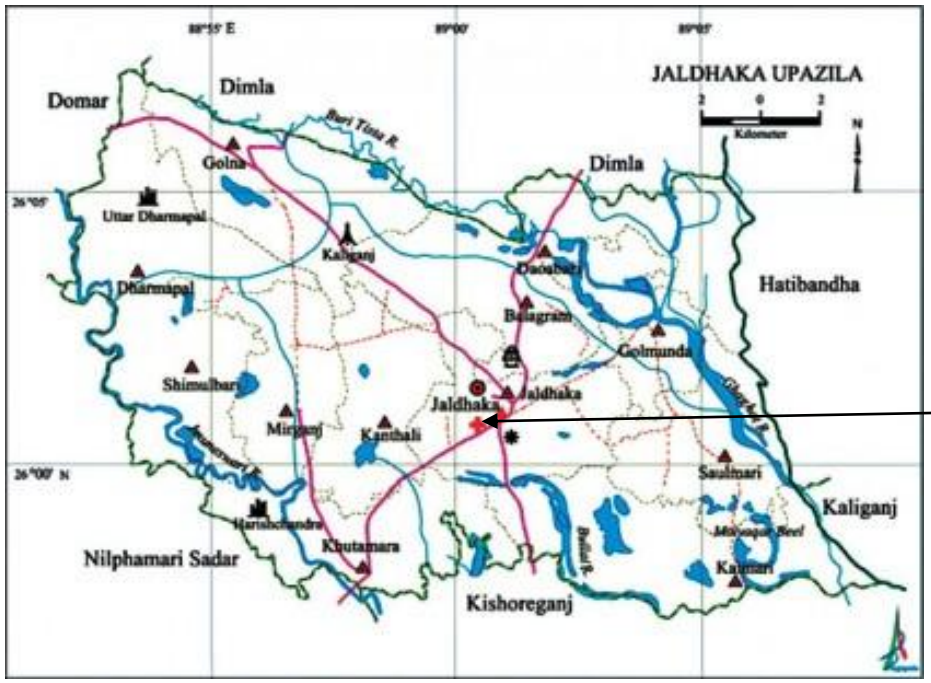


Fig.-3.2: Location of the study area. Bangladesh Population Census 2001, Bangladesh Bureau of Statistics; Cultural survey report of Dimla Upazila 2007.

Main sources of income are agriculture 80.15%, non-agricultural laborer 2.54%, commerce 8.38%, transport and communication 2.06%, service 3.05%, construction

0.52%, religious service 0.15%, rent and remittance 0.10% and others 3.05%. Ownership of agricultural land Landowner 60.09%, landless 39.91%; agricultural landowner: urban 67.04% and rural 59.67%. Sources of drinking water Tube-well 85.55%, tap 0.36%, pond 0.49% and others 13.60%. Sanitation 12.21% (rural 10.71% and urban 37.16%) of dwelling households of the upazila use sanitary latrines and 22.88% (rural 23.01% and urban 20.65%) of dwelling households use non-sanitary latrines; 64.91% of households do not have latrine facilities (BBS 2001).

3.2 Population and sampling procedure

Data has been collected from a sample rather than whole a bunch of people involved considering the limitation of time, money, and energy. The agroforestry practicing people of charland area constituted the populations for the study. A total sample of 100 (50 from each Upazila) farmers were selected randomly for data collection. In the first step one union from Dimla and Jaldhaka i.e., one char area is selected by using table of random numbers. In the second step the agroforestry practicing farmers were enlisted for the selected area. There were altogether 100 farmers selected as sample size for this study.

3.3 Preparation of survey schedule

In conformity with the set objectives of the study, a set of preliminary interview schedules/questionnaire has been designed for collection of data for the study. The interview schedule/questionnaire had been carefully designed in such a way that all factors associated with the economic organization and performance of the fat-in business could be included. Simple questions and/or statements regarding the n-basic factor were included in the schedule. The draft schedule has been pre-tested 1) interviewing some sample farmers of char area for two Upazila Dimla and Jaldhaka by the researcher himself. Thus, the final survey schedule has been prepared in a simple manner maintaining logical sequences and necessary adjustments.

3.4 Data collection and processing

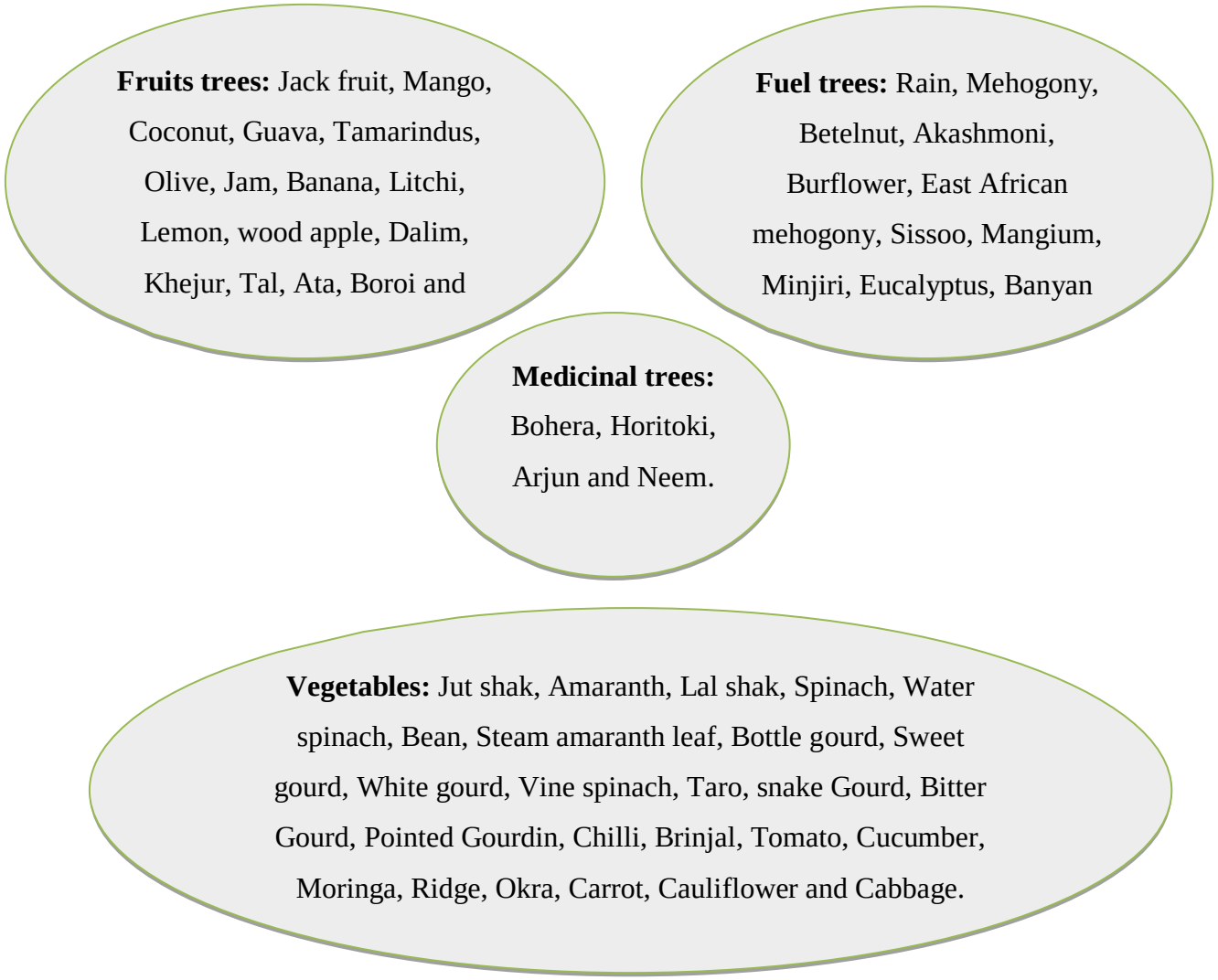
Socioeconomic, demographic, agroforestry and objectives related data collected through direct interview of the respondents using a pre-tested structured questionnaire. The

interviewers (field enumerators) recruited from the union of selected respective Upazila of char area. The field enumerators were get adequate training for collecting information. The help of leader farmers made appointments with the interviewer in advance. The researcher administered the interview schedule personally to the respondents. Co-operation has been obtained from respondents during data collection; Data were collected from 1st February to 27 May, 2019. Data collected from the respondents (samples) has been verified, complied, tabulated and analyze statistically according to the objectives of the study. In some cases, qualitative data has been converted into quantitative data by means of suitable scoring to facilitate interpretation.

3.5 Variables of the study

One of the most important things for this study was the selection of variables. Two types of variables are observed in this study viz., independent and dependent variables. Independent variables were farmer characteristics represent the independent variable in this study. Some characteristics of farmers selected for this study as independent variable which are as: age, education, occupation, family size, farm size, and annual income, knowledge about tree and different communication with extension worker, different opinion about the Impacts of homestead, management practices of homestead, problem faced in homestead practices and problem solving for tree plan.

In the present study of independent variables for aggregation of fruits trees, fuel trees, medicinal trees, vegetables in homestead items relatively others variables are as follows-



3.6 Statistical analysis

After data collection, those has been complied, tabulated, and analyzed statistically in accordance with objectives of the study. Qualitative data has been converted into quantitative one by means of suitable scoring techniques wherever necessary. Descriptive statistics such as number and percentage, frequency count, mean and standard deviation has been used in describing variables of the study. Pearson's product moment correlation co-efficiency (r) has been used in order to explore the relationship between the concern variables.

Data computerized in statistical software packages that used in calculating socio-demographic and relatively others variables indices. Statistical analysis performed using the SPSS 16.0 for Windows (SPSS, Chicago, IL, USA). MS Excel software is used for graphical representation. MS Word is used for word processing to complete thesis write up.

3.7 Field implementation and quality control of data for this study

Interviewers were involved from the respective selected Upazila having educational qualification of at least HSC and some experience in field level data collection. Interviewers were adequately trained on different aspects of the questionnaire and practical knowledge on data collection techniques. To minimize non-response and to cover all the individual members of the households, repeated visits were made to the same households.

Every filled up questionnaires were checked and rechecked to find out any lacking regarding information. In case of any wrong information from any household was detected, the respective interviewer was asked to revisit that household to correct the wrong information to maintain and ensure the quality of data.

CHAPTER-IV

RESULTS AND DISCUSSION

This chapter includes the objective oriented results obtained by using different statistical tools and their discussions. The study was conducted among the 100 respondent family of the two Upazila for Jaldhaka and Dimla char land area of Nilphamari district in Bangladesh. The study considered some characteristics of the farmers and explored relationship with variable which are as: age, education, occupation, family size, farm size, and annual income, knowledge about tree and different communication with extension worker, different opinion about the Impacts of homestead, management practices of homestead, problem faced in homestead practices and problem solving for tree plan. The salient findings are shown below in tabular and graphical form with interpretation.

4.1 Demographical status of respondent.

4.1.1 Age

The study showed that the highest number of respondents (56%) were middle aged(26-45) people and minimum (9%) were very old aged (above 60). The standard deviation was 13.05. The youngest generation was not available during data collection as they went to school. On the other hand, the middle aged people were available in their home. Majority of the respondents were middle aged category (26-45) years (56 %) which are considered as the most active and working group.(Shown in Table 4.1.1).

Table-4.1.1: Age of the charland farmer.

Variable	No. of Respondents	Levels	Percentage	Mean	SD
Age of the respondent family (years)	100	Young aged (10-25)	13.00	40.77	13.05
		Middle aged (26-45)	56.00		
		Old aged (46-60)	22.00		
		Very old aged > 60	9.00		

4.1.2 Education

The respondents were categorized into five groups mentioned in table 4.1.2. The maximum respondents (53%) were found to can sign only and the minimum (6%) respondents belonged to higher secondary level. From the study, It was revealed that illiteracy is eradicated gradually but not reached the higher level.

Table-4.1.2: Distribution of respondents according to their level of education.

Variable	No. of Respondents	Levels	Percentage	Mean	SD
Education of the respondent family	100	No schooling	9.00	3.37	4.31
		Can sign only	53.00		
		Primary	12.00		
		Secondary	20.00		
		Higher secondary	6.00		

4.1.3 Occupation

From figure 4.1.3, It was found that the highest number of respondents(52%) were engaged in agricultural works. On the other hand, the minimum number of respondents (7%) were found in associated with service category.

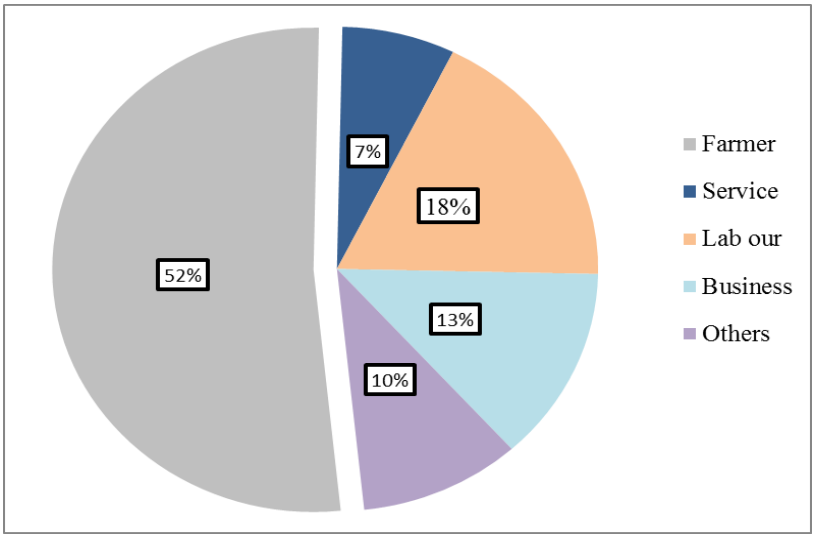


Fig.-4.1.3: Percentage distribution of occupation.

4.1.4 Family size

The family size of respondents were categorized into three groups. Among these groups, the maximum respondents (60%) had medium family size and minimum (9%) belonged to small sized family. The standard deviation was 2.025 (Table 4.1.4).

Table-4.1.4: Distribution of respondents according to their family size.

Variable	No. of Respondents	Levels	Percentage	Mean	SD
Family size	100	Small (1-3)	9.00	5.96	2.025
		Medium (4-6)	60.00		
		Large > 6 and above	31.00		

4.1.5 Homestead size

The homestead size were categorized into five groups mentioned in table 4.1.5. The maximum number of respondents (34%) were found in marginal category. The minimum number of respondents (9%) were in landless category and standard deviation was 72.87.

Table-4.1.5: Distribution of respondents according to their homestead size.

Variable	No. of Respondents	Levels	Percentage	Mean	SD
Homestead size of respondent family (decimal)	100	Landless (1-20)	9.00	66.31	72.87
		Marginal (21-40)	34.00		
		Small (41-60)	25.00		
		Medium (61-80)	18.00		
		Large > 80	14.00		

4.1.6 Annual income

The total annual income of the respondent's family is an important indicator of how much they can invest in their farm practice. The total annual income of the respondents

of the study area varied from Tk. 10 thousand to >Tk. 6 lakhs with an average of Tk. 150331 and standard deviation Tk.152713.87 in Table-4.1.6. The present study revealed that 55% respondent were found very low income (Tk. 10000-Tk.100000), 19% respondent were low income (Tk. 100001-Tk.200000), 13% respondent were medium income (Tk. 200001-Tk.400000), 9% respondent were high income (Tk. 400001-Tk.600000) and 4% respondent were very high income (>Tk. 600000). Thus, the most of respondent family of very low income (Tk. 10000-Tk.100000) indicated that agroforestry practices are usually practiced by the having comparatively higher economic standings.

Table -4.1.6: Distribution of respondents according to their annual income.

Variable	No. of Respondents	Category	Percentage	Mean	SD
Total annual income of the respondent family (Tk.)	100	Very low (10000-100000)	55.00	150331.00	152713.87
		Low (100001-200000)	19.00		
		Medium (200001-400000)	13.00		
		High (400001-600000)	9.00		
		Very high > 600000	4.00		

4.2 Knowledge of respondent of agroforestry and trees

4.2.1 Agroforestry knowledge

There were several types of questions on agroforestry practices to evaluate the knowledge of respondents. Every question was distributed by 10 marks. The total marks were Fifty (50). This fifty marks were categorized into three groups (Table 4.2.1). The research revealed that the maximum numbers of respondents (62%) had medium knowledge on agroforestry and minimum numbers of respondents (15%) had poor knowledge on agroforestry whereas standard deviation was 10.59. From the villagers, they were not well educated especially about the term of agroforestry.

Table-4.2.1: Distribution of respondents according to their agroforestry knowledge.

Variable	No. of Respondents	Category	Percentage	Mean	SD
Knowledge on agroforestry	100	Poor (1-30)	15.00	22.28	10.59
		Medium (31-50)	62.00		
		High > 50	23.00		

4.2.2 Tree knowledge

There were five different questions on tree to evaluate the knowledge of respondents. Every question was distributed by 10 marks. The total marks were fifty (50). This fifty marks were categorized into three groups (Table 4.2.2). The research revealed that the maximum numbers of respondents (74%) had poor knowledge on tree and minimum respondents (9%) had high knowledge on tree whereas standard deviation was 7.22. As data were collected from the villagers, they were not well educated as well and could not express their opinions on trees properly.

Table -4.2.2: Distribution of respondents according to their tree knowledge.

Variable	No. of Respondents	Category	Percentage	Mean	SD
Tree knowledge	100	Low (1-20)	74.00	17.96	7.22
		Medium (21-40)	17.00		
		High >40	9.00		

4.3 Care and management of homestead agroforestry

4.3.1 Care and management of homestead

Proper care and management of homestead is essential to get maximum returns. Quality seed collection is an important part of management. The participators were categorized into four groups. In case of seed collection, The highest number of respondents (58%) were farmer whereas the lowest percentage of respondents (3%) were children. They were collected seed for cultivation.

Watering is an important part of management. In case of watering in the homestead, farmer did it himself maximum (56%) in homestead whereas wife were involved by farmer in minimum (4%) to complete the watering process. Weed control enhance the growth and development of homestead plants. The researcher categorized it into four groups. In case of weed control, Maximum (54%) farmer did it himself in homestead and he did it by children which was minimum (5%) in homestead area.

Manures and fertilizers application is an important part of management. In case of manuring and fertilization, The respondents categorized into four groups. The maximum respondents (59%) who had taken care of homestead were farmer and farmer did it by wife which was minimum (4%) in homestead.

Pruning is an important part of management. The researcher categorized it into four groups according to the respondents who had taken care of homestead gardens. In case of pruning, Farmer had done it himself in maximum (58%) in homestead area and farmer did it by children which was minimum (5%) in the homestead.

Insecticides spray is an important part of management. In case of insecticide spray, farmer had done it himself maximum (56%) in homestead whereas farmer did it by children because somehow he was busy with other activities which was minimum (3%).

Table-4.3.1: Percentage distribution of participation in the care and management of homestead.

Management practices	No. of Respondents	Participator			
		Farmer (%)	Wife (%)	Children (%)	Others (%)
Seed collection of respondent family	100	58.00	7.00	3.00	32.00
Watering of respondent family		56.00	4.00	10.00	30.00
Weed control of respondent family		54.00	7.00	5.00	34.00
Maturing and fertilization of respondent family		59.00	4.00	8.00	29.00
Pruning of respondent family		58.00	7.00	5.00	30.00
Insecticides spray of respondent family		56.00	3.00	6.00	35.00

4.4 Use of homestead products of agroforestry

4.4.1 Fruits

From the table 4.4.1, It was found that the maximum farmers (57%) consumed fruit in family whereas the minimum farmers (18%) were distributed fruit to the relatives and villagers which is ranked by 1 and 3. However,(42%) farmers sold fruit in the market which is ranked by 2.

Table-4.4.1: Percentage distribution of fruit products in homestead according to their consumption, distribution and sale.

SI. NO.	Category	No. of Respondents	Homestead (%)	Rank
1.	Fruit family consumption	100	57.00	1
2.	Fruit distribution		18.00	3
3.	Fruit sale		42.00	2

4.4.2 Vegetables

From the table 4.4.2, It was recorded that the maximum farmers (86%) consumed vegetables in family because of the nutritional value of vegetable whereas the minimum farmers (12%) sold vegetables in the market to earn money. However, 14% farmers were found to distribute vegetable.

Table-4.4.2: Percentage distribution of vegetable products in homestead according to their consumption, distribution and sale.

SI. NO.	Category	No. of Respondents	Homestead (%)	Rank
1.	Vegetable family consumption	100	86.00	1
2.	Vegetable distribution		14.00	2
3.	Vegetable sale		12.00	3

4.4.3 Timber

From the table 4.4.3, It was found that the maximum farmers (92%) sold timber because of making their livelihood whereas the minimum farmers (7%) distributed timber to the relatives. However, 16% farmers only used timber for the family purpose.

Table-4.4.3: Percentage distribution of timber products in homestead according to their uses, distribution and sale.

SI. NO.	Category	No. of Respondents	Homestead (%)	Rank
1.	Timber family consumption	100	16.00	2
2.	Timber distribution		7.00	3
3.	Timber sale		92.00	1

4.4.4 Medicinal

From the table 4.4.4, It was clarified that medicinal plants were available in respondents homestead area. The maximum farmers (7%) sold medicinal plants to earn money whereas the minimum farmers (3%) distributed medicinal plant to the relatives. However, 6% farmers consumed medicine in family.

Table-4.4.4: Percentage distribution of medicinal products in homestead according to their consumption, distribution and sale.

SI. NO.	Category	No. of Respondents	Homestead (%)	Rank
1.	Medicinal plants family consumption	100	6.00	2
2.	Medicinal distribution		3.00	3
3.	Medicinal sale		7.00	1

4.5 Communication of extension service

The respondents were categorized according to receive of information(table 4.5.1). The research revealed that the maximum number of respondents (68%) didn't get any information from Upazila Agricultural Officer (UAO) about homestead agroforestry. Only 7% of the respondents had got maximum information from UAO about homestead agroforestry. The study exposed that the ideal situation was not like a real situation.

It was found that the maximum number of respondents (65%) told that they didn't get any information from Agricultural Extension Officer about homestead agroforestry. Only 4% of the respondents told that they had got maximum information from Agricultural Extension Officer about homestead agroforestry. The study exposed that the ideal situation was not like a real situation.

The research showed that the maximum number of respondents (62%) told that they didn't get any information from Sub-Assistant Agricultural Officer about homestead agroforestry. Only 5% of the respondents told that they had got maximum information from Sub-Assistant Agricultural Officer about homestead agroforestry the study exposed that the ideal situation was not like a real situation.

It was observed that maximum (56%) of the respondents told that they didn't get any information from NGOs staff about homestead agroforestry. Only 8% of the respondents mentioned that they had got maximum information from NGOs staff about homestead agroforestry. The study exposed that the ideal situation was not like the real situation.

The research revealed that the maximum number of respondents (65%) told that they didn't get any information from Group discussion about homestead agroforestry. Only 5% of the respondents told that they got their information highly on homestead agroforestry from Group discussion. The study exposed that the ideal situation was not like the real situation.

The research showed that the maximum number of respondents (62%) said that they didn't get any information from participation in field day about homestead agroforestry. Only 4% of the respondents said that they got high information from the participation in field day.

It was observed that the maximum number of respondents (60%) told that they didn't get any information from electronic media. Only 3% respondents said that they got high information from electronic media about homestead agroforestry. The study exposed that electronic media played an important role to spread knowledge about homestead agroforestry and the ideal situation was looked like the real situation.

The research revealed that the maximum number of respondents (78%) told that they didn't get any information from print media about homestead agroforestry. Only 3% of the respondents said that they got information fluently from print media about homestead agroforestry. The study exposed that respondents were not habituate to read newspaper, leaflet or bulletin because they live in village area where printing materials were not so available.

Table-4.5.1: Percentage distribution of different communication with extension worker.

Extension worker	Frequency of communication			
	Not ever (%)	Low (%)	Medium (%)	High (%)
Information from Upazila Agricultural Officer (UAO)	68.00	15.00	10.00	7.00
Information from Agricultural Extension Officer (AEO)	65.00	22.00	9.00	4.00
Information from Sub Assistant Agricultural Officer (SAAO)	62.00	20.00	13.00	5.00
Information from NGOs staff	56.00	23.00	13.00	8.00
Information from group discussion (GD)	65.00	23.00	7.00	5.00
Information from participation in field day	62.00	24.00	10.00	4.00
Information from TV, Radio	60.00	28.00	9.00	3.00
Information from newspaper, leaflet, bulletin	78.00	13.00	6.00	3.00

4.6 Species diversity in homestead agroforestry

4.6.1 Fruit trees in homestead agroforestry

From table 4.6.1, It was clarified many descriptive categories of fruit trees. The study showed that maximum respondents (95%) were cultivated mango tree species and minimum respondents (6%) stated the presence of tamarindus tree species which are ranked by 1 and 14, respectively, in their homestead.

Table-4.6.1: Percentage of fruit trees in their homestead.

SI. NO.	Tree species	Scientific name	Yes (%)	Mean	SD	Rank
1.	Jack fruit tree	*Artocarpus heterophyllus*	83.00	2.56	2.34	2
2	Mango tree	*Mangifera indica*	95.00	3.92	4.36	1
3.	Coconut tree	*Cocos nucifera*	11.00	0.17	0.55	11
4.	Guava tree	*Psidium guajava*	47.00	0.92	1.28	4
5.	Tamarindus tree	*Tamarindus indica*	6.00	0.09	0.40	14
6.	Olive tree	*Olea europaea*	13.00	0.15	0.41	9
7.	Jam tree	*Acacia acuminate*	69.00	0.37	0.60	3
8.	Banana tree	*Musa*	15.00	2.22	7.84	8
9.	Litchi tree	*Litchi chinensis*	16.00	0.30	0.86	7
10.	Lemon tree	*Citrus Limon*	16.00	0.23	0.58	7
11.	Wood apple tree	*Aegle marmelos*	19.00	0.24	0.55	5
12.	Pomegranate	*Punica granatum*	12.00	0.14	0.40	10
13.	Date palm	*Phoenix dactylifera*	8.00	0.11	0.40	12
14.	Asian palmyra palm	*Borassus flabellifer*	19.00	0.26	0.58	5
15.	Custard apple	*Annona squamosal*	7.00	0.07	0.26	13
16.	Indian jujube	*Ziziphus mauritiana*	19.00	0.26	0.61	5
17.	Spondias mombin	*Spondias dulcis*	17.00	0.25	0.61	6

4.6.2 Fuel trees in homestead

From table 4.6.2, It was clarified many descriptive categories of fuel wood trees. The study showed that maximum respondents (39%) stated that they had eucalyptus tree in their homestead because it is quick growing and economically beneficial. And minimum respondents (4%) stated the presence both of east African mehogony and banayan tree species which are ranked by 11 in their homestead.

Table-4.6.2: Percentage of respondents heavily fuel wood trees in their homestead.

SI. NO.	Tree species	Scientific name	Yes (%)	Mean	SD	Rank
1.	Monkey pod tree	*Samanea saman*	11.00	0.13	0.39	8
2.	Mehogony tree	*Swietenia*	18.00	0.54	1.51	5
3.	Betelnut tree	*Areca catechu*	17.00	2.03	8.26	6
4.	Akashmoni tree	*Acacia auriculiformis*	19.00	0.88	2.46	4
5.	Burflower tree	*Neolamarckia cadamba*	12.00	0.33	1.28	7
6.	East African mehogony tree	*Khaya anthotheca*	4.00	0.25	1.46	11
7.	Indian rosewood	*Dalbergia sissoo*	9.00	0.14	0.49	10
8.	Mangium tree	*Acacia mangium*	21.00	0.34	0.82	3
9.	Minjiri tree	*Senna siamea*	10.00	0.14	0.45	9
10.	Eucalyptus tree	*Eucalyptus globulus*	39.00	4.01	7.42	1
11.	Banyan tree	*Ficus benghalensis*	4.00	0.04	0.20	11
12.	Other trees	Maize: *Zea mays,* Mango: *Mangifera indica,* Onion: *Allium cepa,* Chiku:	24.00	0.41	0.83	2

4.6.3 Medicinal trees

From table 4.6.1, It was clarified many descriptive categories of medicinal trees. The study showed that maximum respondents (25%) stated that they had bohera tree species and minimum respondents (8%) stated the presence of neem tree species which are ranked by 1 and 4, respectively, in their homestead.

Table-4.6.3: Percentage of homestead medicine plants.

SI. NO.	Tree species	Scientific name	Yes (%)	Mean	SD	Rank
1	Bohera tree	*Terminalia bellirica*	25.00	0.42	0.87	1
2	Horitoki tree	*Terminalia bellirica*	12.00	0.19	0.60	3
3	Arjun tree	*Terminalia arjuna*	20.00	0.27	0.68	2
4	Neem tree	*Azadirachta indica*	8.00	0.18	0.82	4

4.6.4 Vegetables in homestead

From table 4.6.1, It was clarified many descriptive categories of vegetables. The study showed that maximum respondents (68%) stated that they were cultivated lal shak.

Minimum respondents (10%) stated that they were cultivated cucumber, ridge gourd and cauliflower in their homestead.

Table-4.6.4: Percentage of homestead vegetables.

SI. NO.	Vegetables	Scientific name	Yes (%)	Rank
1.	Jut shak	*Corchorus olitorius*	16.00	12
2.	Amaranth	*Amaranthus viridis*	19.00	9
3.	Lal shak	*Amaranthus gangeticus*	68.00	1
4.	Spinach	*Spinacia*	17.00	11
5.	Water spinach	*Ipomoea aquatica*	24.00	6
6.	Bean	*Tecoma stans*	11.00	17
7.	Steam amaranth leaf	*Amaranthus gangeticus*	18.00	10
8.	Bottle gourd	*Lagenaria siceraria*	34.00	3
9.	Sweet gourd	*Cucurbita moschata*	25.00	5
10.	White gourd	*Benincasa hispida*	29.00	4
11.	Vine spinach	*Basella alba*	49.00	2
12.	Taro	*Colocasia esculenta*	20.00	8
13.	Snake gourd	*Trichosanthes cucumerina*	12.00	16
14.	Bitter gourd	*Momordica charantia*	15.00	13
15.	Pointed gourd	*Trichosanthes dioica*	22.00	7
16.	Chilli	*Capsicum frutescens*	12.00	16
17.	Brinjal	*Solanum melongena*	14.00	14
18.	Tomato	*Solanum lycopersicum*	13.00	15
19.	Cucumber	*Cucumis sativus*	10.00	18
20.	Moringa	*Moringa oleifera*	15.00	13
21.	Ridge	*Luffa acutangula*	10.00	18
22.	Okra	*Abelmoschus esculentus*	12.00	16
23.	Carrot	*Daucus carota subsp. sativus*	13.00	15
24.	Cauliflower	*Brassica oleracea var. botrytis*	10.00	18
25.	Cabbage	*Brassica oleracea var. capitata*	17.00	11

4.7 Livelihood of agroforestry

Homestead agroforestry plays an important role on human life by economically, environmentally or socially. Different opinion of respondents about the impacts of homestead are discussed below:

The respondent's opinions were categorized into four groups. In case of getting fresh air, The maximum number of respondents (58%) strongly agreed that they were getting fresh

air due to increasing tree species in homestead area. Only 8% of respondents are disagreed to the point.

In case of income increase, The maximum number of respondents (34%) disagreed to the point that their income increase due to tree plantation. About 16% of respondents strongly agreed that their income increase due to tree plantation.

In case of increasing supply of fruits and vegetables, The maximum number of respondents (36%) agreed to the point that the supply of fruits and vegetables had increased due to homestead agroforestry practices in homestead area. About 16% respondents were disagreed to the point.

In case of increasing availability of fuel wood, The maximum number of respondents (33%) were partially agreed to the point that the availability of fuel wood increase due to agroforestry practices in homestead area. About 14% respondents were strongly agreed to the point.

In case of decreasing air temperature, The maximum number of respondents (34%) agreed to the point that air temperature had decreased due to homestead agroforestry practices in homestead area. Minimum respondents (18%) were strongly agreed to the point.

In case of increasing greenish view, The maximum number of respondents (35%) agreed to the point that greenish view had increased due to homestead agroforestry practices in homestead area. About 23% respondents were strongly agreed to the point.

Table-4.7.1: Percentage distribution of different opinion about the Impacts of homestead/ cropland/orchard agroforestry.

Impacts of homestead/ cropland/orchard agroforestry	Extent of villagers opinion			
	Strongly (%)	Agree (%)	Partial (%)	Disagree (%)
Getting fresh air due to increase of trees	58.00	22.00	12.00	8.00
Income increase for tree plantation	16.00	22.00	28.00	34.00
Increase supply of fruits and vegetables	29.00	36.00	19.00	16.00
Increase availability of fuel wood	14.00	31.00	33.00	22.00
Decrease air temperature	18.00	34.00	28.00	20.00
Increase greenish view	23.00	35.00	27.00	15.00

4.8 Problem faced and problem solving for agroforestry practicing in the study area.

4.8.1 Problem faced in homestead agroforestry

Results indicated that respondents faced different problems in homestead agroforestry practices. The problems were categorized into 8 groups mentioned in Figure-4.8.1. The maximum number of respondents (36%) told that they were faced problems damaged by animal such as cattle, goat, etc. The minimum number of respondents (3%) faced problem quarrel with neighbors.

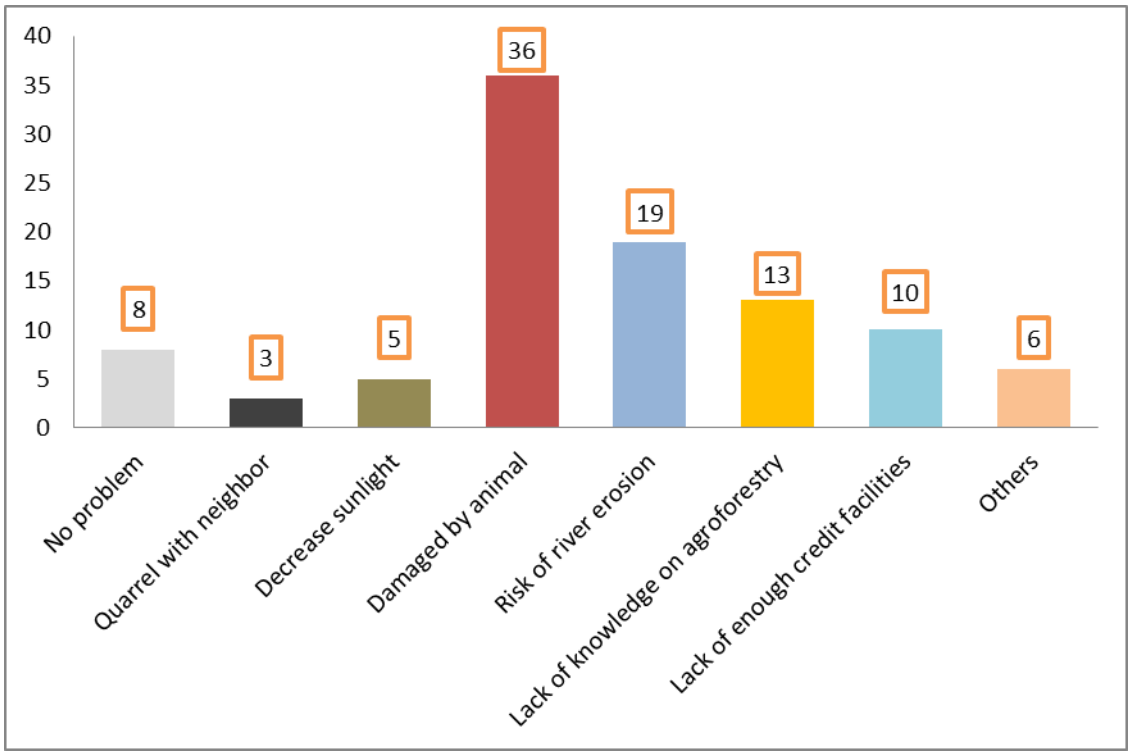


Fig-4.8.1: Problem faced in homestead agroforestry.

4.8.2 Problem solving agroforestry practicing in the study area.

Different problems solving for tree plant in homestead practiced of respondents are categorized into 8 groups mentioned in Figure-4.8.2. The research reveals that the highest percentage of respondents(29) were found that they need to control river erosion. The lowest percentage of respondents(4%) were told that they need extra fencing. To overcome this problem, The homestead owner should be trained by the GOs or NGOs about homestead agroforestry knowledge. Providing time to time suggestion by extension worker, training and loan to execute Government and Non-Government Organization.

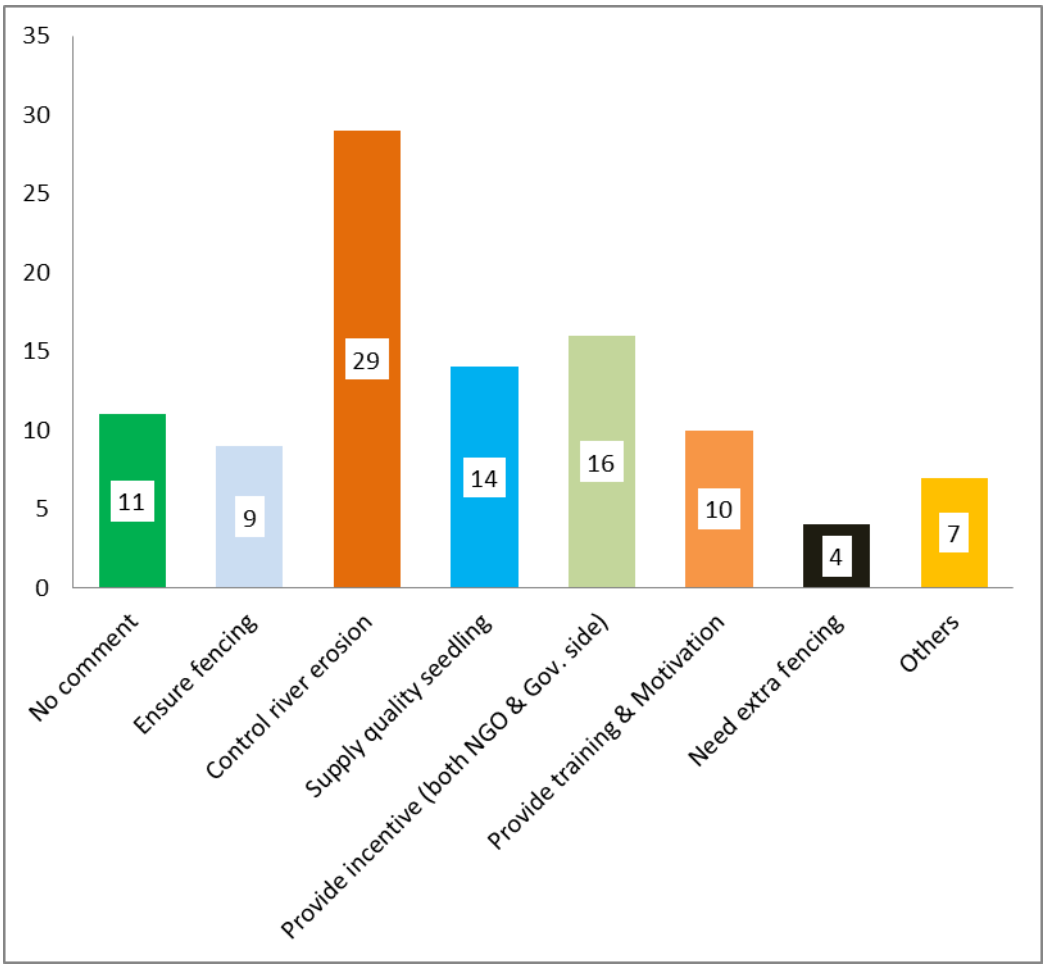


Fig-4.8.2: Problem solving for homestead agroforestry practicing in the study area.

4.9 Correlation of agroforestry knowledge

The relationship between the socio-demographic, economic and tree knowledge variables of the respondent's families with knowledge of agroforestry were examined in table 4.9.1. This section deals with the findings of the relationships between the selected dependent and independent variables of the study. Pearson's correlation of co-efficient (r) was used to determine the relationships between the selected dependent and independent variables and accept or reject the null hypothesis. Five percent (0.05) and one percent (0.01) level of significance was used as the basis for acceptance or rejection of a null hypothesis.

The computed correlation co-efficient between age of respondent family and their knowledge of agroforestry status were 0.063, education and knowledge of agroforestry status were -0.105, family size and knowledge of agroforestry status were 0.168, farm size and knowledge of agroforestry status were -0.144, annual income (Tk.) and

knowledge of agroforestry status were -0.167. Based on the computed ‘r’ value the relationship between age and knowledge on cropland agroforestry was not significant. Hence, the concerned null hypothesis could not be rejected. From the above result, it could be concluded that age, education, family size, farm size and annual income (Tk.) had no relationship with their knowledge of agroforestry.

The computed correlation co-efficient between tree know total of respondent and their knowledge of agroforestry status was 0.814**. Based on the computed ‘r’ value the relationship between tree know total of respondent and knowledge of agroforestry was significant at 0.01 level of significance with 98 degrees of freedom and followed a positive relationship. Hence, the concerned null hypothesis could be rejected i.e. if the increased of tree know total of respondent with the increased of knowledge of agroforestry.

Table-4.9.1: Correlations analysis of agroforestry knowledge.

Variables	Knowledge of agroforestry	Age of respondent family (year)	Education of respondent family	Family size of respondent family	Farm size of respondent family (percent)	Annual income of respondent family (Tk.)	Tree know total of respondent family
Knowledge of agroforestry	1	0.063	-0.105	0.168	-0.144	-0.167	0.814**
Age of respondent family (year)	0.063	1	-0.155	0.084	0.034	-0.052	0.047
Education of respondent family	-0.105	-0.155	1	-0.032	0.404**	0.688**	-0.103
Family size of respondent family	0.168	0.084	-0.032	1	0.052	-0.054	0.251*
Farm size of respondent family (percent)	-0.144	0.034	0.404**	0.052	1	0.623**	-0.131
Annual income of respondent family (Tk.)	-0.167	-0.052	0.688**	-0.054	0.623**	1	-0.197*
Tree know total of respondent	0.814**	0.047	-0.103	0.251*	-0.131	-0.197*	1
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

DISCUSSION

The above results showed that the demographic status, agroforestry and tree knowledge, management of homestead agroforestry, use of homestead products of agroforestry, Communication of extension service and Species diversity in homestead agroforestry etc. The results were revealed that the middle group was majority in responding the interview schedule than old age, very old age and young age groups. Most of the respondents were can sign only of education level (53 %) in the study areas. It was also found that major portion of the sample farmers were engaged in occupation activities (52 %). The family size of the respondent have more medium family member as they work with their own effort. The most of respondent family of very low income indicated that homestead agroforestry are usually practiced by the having comparatively higher economic standings.

It was found that the knowledge on agroforestry of highest percentage (62 %) were medium knowledge with mean 22.8 and standard deviation 10.59. The results revealed that the average tree knowledge of agroforestry 17.96 and standard deviation 7.22 respectively. More than 53 % of these charland farmers have sign only educational level; therefore they have no enough knowledge about the benefit of medicinal plants of homestead agroforestry. The highest percentage of respondents of various management practices were seed collection, watering, weed control, maturing and fertilization, pruning and insecticides spray of farmer in the study area. Seed collection is must be very important component of agriculture and all of the respondents' economy is agro-based. So, they take carefully and seriously, done by themselves and do not depend on others. Majorities (57 %) of the respondent were found fruit consumption and other rest of them was fruit distribution and sale.

Mostly 56 percent of the farmers had no information from Non-Government Organizations staff and lowest percentage of farmers (8%) had high information from Non-Government Organizations staff. It implies that the maximum respondent's families of mango tree were cultivated 95 % with rank one and minimum respondent's families of tamarindus tree were cultivated 6 % and then rank fourteen. The highest percentage of respondents was found eucalyptus tree thirty nine with rank one and lowest percentage of respondents was found east African mehogony and banyan tree and then the rank were same in the study area. Results shows that the highest percentages of respondent family

were cultivated lal shak and rank one and lowest percentage of respondents was found cucumber, ridge and Cauliflower vegetable at home and then the rank were same in the study area. The results shows that the highest percentage (36) of respondents were agree their opinion about increase supply of fruits and vegetables and the lowest percentage of respondents were disagree their opinion about increase supply of fruits and vegetables 16, in case of portion 29 percentages were strongly and 19 percentages were partial.

The respondents were faced different problems that were created looser financially in the homestead agroforestry. Most of the respondents were faced problems damaged by animal such as cattle, goat, etc. (36 %), the problem not faced any problems (8 %). This problem was hindrance to improve the homestead agroforestry. The relation between tree know total of respondent and their knowledge of agroforestry status was 0.814**. Based on the computed 'r' value the relationship between tree know total of respondent and knowledge of agroforestry was significant at 0.01 level of significance with 98 degrees of freedom and followed a positive relationship.

CHAPTER-V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The study was conducted between the two Upazila, Jaldhaka and Dimla upazila under Nilphamari district in Bangladesh. From the mentioned districts two char land area resident Upazila namely Jaldhaka and Dimla char land are the randomly selected sampled Upazila in this study. There were altogether 100 farmers selected as sample size for this study.

Results showed that the four categories of the respondents on the basis of age groups about 13% age were young aged (10-25) years, 56% age were middle aged (26-45) years, 22% age were old aged (46-60) years and 9% age were very old aged > 60 years respectively. The mean values of respondents were found 40.77 with standard deviation 13.05. Majority of the respondent family were in the age category of middle aged (26-45) years (56 percent) which are considered as the most active and working group.

Regarding education, it was found that about 9% respondents were no schooling (illiterate), 53% respondents were can sign only, 12% respondents were primary, 20% respondents were secondary and 6% respondents were higher secondary. The mean values of respondents were found 3.37 with standard deviation 4.31. Most of the respondents were can sign only of education level (53 %) in the study areas (Table 4.1.2).

It was observed that occupation of the respondents ranged 52% were farmer, 7% were service, 18% were labor, 13% were business and only 10% respondent were found to be others respectively. It is also found that major portion of the sample farmers were engaged in occupation activities (52 %).

The results was indicated that highest proportion 34 % of the respondent ware marginal (21-40) decimal and lowest homestead size compared to 25 %, 18 %, 14 % and 9 % of small (41-60), medium (61-80), Large > 80, decimal respectively . It was observed that the average homestead sizes were 66.31 decimal and standard deviation were 72.87 decimal. Clearly indicates that the homestead size was very much related to firm size (Table 4.1.5).

It was found that the knowledge on agroforestry of highest percentage of respondents was medium knowledge 62 then high knowledge 23 percentages and lowest percentage of respondents was poor knowledge 15. The results revealed that the average knowledge on agroforestry 22.28 and standard deviation 10.59 respectively.

It was found that the tree knowledge of agroforestry of highest percentage of respondents was low tree knowledge 74 then medium tree knowledge 17 percentages and lowest percentage of respondents was high tree knowledge 9. The results revealed that the average tree knowledge of agroforestry 17.96 and standard deviation 7.22 respectively.

The highest percentage of respondents of various management practices were seed collection 58 by farmer and the lowest percentage of respondents were seed collection by children 3, in case of seed collection portion 7 percentages were wife and 32 percentages were others. Seed collection is must be very important component of agriculture and all of the respondents' economy is agro- based. So, they take carefully done by themselves and do not depend on others. Among the various management practices performed by the farmers, wife, children and others of weed controlling of respondent family were mostly 54 % done by farmers and the lowest percentage of respondents of weed controlling were 5 done by children, in case of weed controlling portion 7 percentages were wife and 34 percentages were others. Regarding of respondent family among the various management practices performed by the farmers, wife, children and others of maturing and fertilizing the plants mostly 59 % done by farmers and the lowest percentage of respondents of maturing and fertilizing were 4 done by wife, in case of maturing and fertilizing portion 8 percentages were children and 29 percentages were others.

It was also observed that the medicinal distribution was lowest portion were 3% product in homestead of the respondents, above medicinal plants family consumption and medical sale was found 6 and 7 product in homestead and then lowest rank of medicinal distribution product in homestead.

The extension worker of the respondents regarding communication exposure (information from UAO, AEO, SAAO, NGOs, GD, participation in field day, TV, Radio and newspaper, leaflet, bulletin) ranged from high to not ever. The farmers were showed that majority (68 %) of the farmers had no information from Upazila Agricultural Officer and lowest percentage of farmers had high information from Upazila Agricultural Officer (7 %). The farmers were showed that majority (65 %) of the farmers had no information

from Agricultural Extension Officer and lowest percentage of farmers had high information from Agricultural Extension Officer (4 %). The farmers were showed that majority (62 %) of the farmers had no information from Sub Assistant Agricultural Officer and lowest percentage of the farmers had high information from Sub Assistant Agricultural Officer (5 %). Mostly (56 %) of the farmers had no information from Non-Government Organizations staff and lowest percentage of farmers had high information from Non-Government Organizations staff (8 %). The farmers were showed that majority (62 %) of the farmers had no information from participation in field day and lowest percentage of farmers had high information from participation in field day (4 %). The highest percentage (60 %) of the farmers had no information from TV and Radio and lowest percentage of farmers had high information from TV and Radio (3 %). The farmers were showed that majority (78 %) of the farmers had not reading newspapers, leaflet and bulletin and the lowest percentage of farmers had high information from newspaper, leaflet and bulletin (5 %).

The study showed that the jack fruit tree of respondent family were 83% cultivated; average 2.56 with a standard deviation 2.34. It was observed that the mango tree were 95 % cultivated; average 3.92 and standard deviation 4.36. About 69% were cultivated jam tree of respondents with mean 0.37 and standard deviation 0.60. The study showed that the banana tree of respondent family were 15% cultivated; average 2.22 with a standard deviation 7.84. Results shows that 16% of the litchi tree involved in the study were cultivated with average 0.23 and standard deviation 0.58. It was also observed that 19, 12 and 8 % of respondent family were cultivated with mean 0.24, 0.14 and 0.11 and standard deviation 0.55, 0.40 and 0.40 of wood apple tree, dalim tree and Khejur tree respectively. About 19 , 7 , 19 and 17 percentage of respondent family were cultivated with mean 0.26, 0.07, 0.26 and 0.25 and standard deviation 0.58, 0.26, 0.61 and 0.61 of tal tree, ata tree, boroi tree and amra tree respectively. It implies that the maximum respondent's families of mango tree were cultivated 95 % with rank one and minimum respondent's families of tamarindus tree were cultivated 6 % and then rank fourteen.

The study showed that the neem tree of respondent family were 8% cultivated; average 0.18 with a standard deviation 0.82 and rank 4. It was observed that the rain trees were 11% cultivated; average 0.13 and standard deviation 0.39 and rank 8. Regarding mehogony tree of respondent family, about 18% cultivated then the average 0.54 with a standard deviation 1.51 and rank 5. The betelnut trees were 17% cultivated; average 2.03

and standard deviation 8.26 and rank 6. About 19% were agreeing akashmoni tree of respondent family then average 0.88 with a standard deviation 2.46 and rank four.

It was found that burflower tree of respondents' family 12% were cultivated; mean 0.33 with a standard deviation 1.28 and rank 7 respectively. The east African mehogony trees of respondents' family 4% were cultivated; mean 0.25 with a standard deviation 1.46 and rank 12.It was found that sissoo tree of respondents' family 9% were cultivated; mean 0.14 with a standard deviation 0.49 and rank 10, respectively. It was observed that the mangium trees of respondents' family 21% were cultivated; mean 0.34 with a standard deviation 0.82 and rank three.

The present study of 10 % of respondent family were agreeing with mean 0.14 and standard deviation 0.45 and rank nine of minjiri tree. About 39 % of respondent families were accepted with mean 4.01 and standard deviation 7.42 and highest rank one eucalyptus trees. The results showed that 4 % of respondent families were cultivated with mean 0.04 and standard deviation 0.20 and rank 12 banyan tree. Regarding others tree of respondent family, about 24 % were cultivated then the average 0.41 with a standard deviation 0.83 and rank 2. The highest percentage of respondents was found eucalyptus tree thirty nine with rank one and lowest percentage of respondents was found east African mehogony and banyan tree and then the rank were same.

It was found that jute shak of respondents' family 16% were cultivated with rank twelve. The amaranth of respondents' family 19% were cultivated with rank nine. In this study area the highest percentage of respondents was found lal shak 68 were cultivated and highest rank one. About 17% were agreeing of respondents' family of spinach at home. It was showed that 24 % water spinach was cultivated with rank 6 of respondents' family at home. Around 11 % of respondents' families were cultivated bean at home.

In this study area of respondent, about 14% was cultivated with rank 14 brinjal at home. It was found that of respondent 13% was cultivated and rank 15 tomatos at home. Around 10 percent of respondents' families were yes and rank 18 of cucumber at home. Regarding of respondent family, about 15% was cultivated with rank 13 moringa at home.

Survey respondents were found to obtain 10% were cultivated and rank 18 ridges at home. The analysis of the data indicates the important contribution of okra, carrot,

cauliflower and cabbage were cultivated 12%, 13%, 10% and 17% with rank 16, 15, 18 and 11 of respondents family of vegetables at home respectively. Results shows that the highest percentages of respondent family were accepted lal shak and rank one and lowest percentage of respondents was found cucumber, ridge and cauliflower vegetable at home and then the rank were same.

The highest (58%) of respondents were strongly their opinion about trees increase fresh air and the lowest (8%) of respondents were disagree their opinion about trees increase fresh air, in case of portion (22%) were agree and (12%) were partial. Survey respondents were found to be revealed that most of the respondents of the selected to give their opinion about increase supply of fruits and vegetables. The results shows that the highest (36%) of respondents were agree their opinion about increase supply of fruits and vegetables and the lowest (16%) of respondents were disagree their opinion about increase supply of fruits and vegetables , in case of portion (29%) were strongly and (19%) were partial.

The respondents were faced different problems that were created looser financially in the homestead agroforestry. Most of the respondents were faced problems damaged by animal such as cattle, goat, etc. (36), the problem not faced any problems (8 %). This problem was hindrance to improve the homestead agroforestry. To solve this big issue the facilitator can took decision to benefit shearing with both land owners. On the other hand, lowest percentage were quarrel with neighbor (3 %), decrease sunlight (5 %), risk of river erosion (19 %), lack of knowledge on agroforestry (13 %), lack of enough credit facilities (10 %) and others problem (6 %) faced in homestead agroforestry. Need proper homestead agroforestry knowledge about planting trees, the extension worker and also the members of NGOs can be played a crucial role to overcome this problem.

The maximum (29%) respondents was found control river erosion where the lowest (4%) of respondent were need extra fencing, in case of portion 11 (%) were no comment, 9 (%) were ensure fencing, 14 (%) were supply quality seedling, 16 (%) were provide incentive (both NGO & Gov. side), 10 (%) were provide training & motivation and 7 (%) were others problems solving for tree plan in homestead practiced. The good quality seeds seedlings, fertilizer and plant protection should be available. The homestead owner should be trained by the GOs or NGOs about homestead agroforestry knowledge.

Providing time to time suggestion by extension worker, training and loan to execute Government and Non-Government Organization.

The computed correlation co-efficient between age of respondent family and their knowledge of agroforestry status were 0.063, education and knowledge of agroforestry status were -0.105, family size and knowledge of agroforestry status were 0.168, farm size and knowledge of agroforestry status were -0.144, annual income (Tk.) and knowledge of agroforestry status were -0.167. Based on the computed 'r' value the relationship between age and knowledge on cropland agroforestry was not significant. Hence, the concerned null hypothesis could not be rejected. From the above result, it could be concluded that age, education, family size, farm size and annual income (Tk.) had no relationship with their knowledge of agroforestry.

The computed correlation co-efficient between tree know total of respondent and their knowledge of agroforestry status was 0.814**. Based on the computed 'r' value the relationship between tree know total of respondent and knowledge of agroforestry was significant at 0.01 level of significance with 98 degrees of freedom and followed a positive relationship. Hence, the concerned null hypothesis could be rejected i.e. if the increased of tree know total of respondent with the increased of knowledge of agroforestry.

5.2 Conclusions

The results obtained support the following conclusions:

- The present study indicated that the respondents of Jaldhaka and Dimla Upazila were very positive on practicing agroforestry in their char land area. They perceived agroforestry as a profitable land use system which contributed them in many diversified ways such as: improving age, education, occupation, family size, farm size, and annual income, knowledge about tree and different communication with extension worker, different opinion about the Impacts of homestead, management practices of homestead, problem faced in homestead practices and problem solving for tree plan, etc. Their attitude and perception on agroforestry practice were very supportive to promote and upscale agroforestry in the study area. Moreover, they perceived the importance of trees immensely. These sorts of findings may conclude

that the agroforestry practice is contributing positively to reduce poverty at two Upazila for Jaldhaka and Dimla char land area of Nilphamari district in Bangladesh.

- Majority of the respondent family were in the age category of middle aged (56 %) which are considered as the most active and working group. Most of the respondents were can sign only of education level (53 %) in the study areas. It is also found that major portion of the sample farmers were engaged in occupation activities (52 %). The study showed that the average family size was 5.96 and standard deviation was 2.025. The results indicated that the medium sized family was the highest portion 60% of the respondent, while the small sized and large sized family was 9% and 31% respectively. Clearly indicates that the homestead size was very much related to firm size.

- The most of respondent family of very low income indicated that agroforestry practices are usually practiced by the having comparatively higher economic standings. The mean values of knowledge on agroforestry 22.28 and standard deviation 10.59 of the respondent family for char land area. It was found that the knowledge on agroforestry of highest percentage of respondents was medium knowledge 62 then high knowledge 23 percentages and lowest percentage of respondents was poor knowledge 15. It was found that the tree knowledge of agroforestry of highest percentage of respondents was low tree knowledge 74 then medium tree knowledge 9 percentages and lowest percentage of respondents was high tree knowledge 17. The results revealed that the average tree knowledge of agroforestry 17.96 and standard deviation 7.22 respectively.
- The highest percentage of respondents of various management practices were seed collection, watering, weed control, maturing and fertilization, pruning and insecticides spray of farmer in the study area. Seed collection is must be very important component of agriculture and all of the respondents' economy is agro-based. So, they take carefully and seriously, done by themselves and do not depend on others.

- The highest percentages of fruit consumption were found 57% with rank 1, and then fruit sale 42% and the lowest percentages fruit distribution were found 18%. Majority of the respondent were found fruit consumption and other rest of them were fruit distribution and sale. The results indicated that the timber family consumption were

16% product in homestead of the respondents, in case of timber distribution and timber sale was found seven and ninety two were accepted and with rank 3 and 1 product in homestead respectively. Results showed that the planning better management practice for conducting cost effective timber sale programs can be achieved.

- Majority (68 %) of the farmers had no information from Upazila Agricultural Officer and lowest percentage of farmers had high information from Upazila Agricultural Officer (7 %). The highest percentage (60 %) of the farmers had no information from TV and Radio and lowest percentage of farmers had high information from TV and Radio (3 %). Regarding of respondent family them to collect the sources from where the respondents have got their information from newspaper, leaflet and bulletin. Majority (78 %) of the farmers had not reading newspapers, leaflet and bulletin and the lowest percentage of farmers had high information from newspaper, leaflet and bulletin (5 %).

- Most of the respondent family were fruits trees (Jack fruit, Mango, Coconut, Guava, Tamarindus, Olive, Jam, Banana, Litchi, Lemon, Wood apple, Dalim, Khejur, Tal, Ata, Boroi and Amra), fuel trees (Rain tree, Mehogony tree, Betelnut tree, Akashmoni tree, Burflower tree, East African mehogony tree, Sissoo tree, Mangium tree, Minjiri tree, Eucalyptus tree, Banyan tree and other trees) and medicinal trees (Bohera, Horitoki and Arjun). It implies that the maximum Homstead 95 (%) of charlend area have mango tree as fruit tree specis and minimum homstead i.e., only 6 (%) have tamarindus with rank 14. In this study area the highest percentage of respondents was found eucalyptus tree thirty nine with rank one and lowest percentage of respondents was found east African mehogony and banyan tree and then the rank were same. And also were found vegetables (Jut shak, Amaranth, Lal shak, Spinach, Water spinach, Bean, Steam amaranth leaf, Bottle gourd, Sweet gourd, White gourd, Vine spinach, Taro, Snake Gourd, Bitter Gourd, Pointed Gourdin, Chilli, Brinjal, Tomato, Cucumber, Moringa, Ridge, Okra, Carrot, Cauliflower and Cabbage). Results shows that the highest percentages of respondent family were lal shak and rank one and lowest percentage of respondents was found cucumber, ridge and cauliflower vegetable at home and then the rank were same.

- The highest percentage of respondents were strongly their opinion about trees increase fresh air fifty eight and the lowest percentage of respondents were disagree their opinion about trees increase fresh air eight, in case of portion twenty two percentages were agree and twelve percentages were partial.

- The respondents were faced different problems that were created looser financially in the homestead agroforestry. Most of the respondents were faced problems damaged by animal such as cattle, goat, etc. (36 %), the problem not faced any problems (8 %). Need proper homestead agroforestry knowledge about planting trees, the extension worker and also the members of NGOs can be played a crucial role to overcome this problem. The good quality seeds/ seedlings, fertilizer and plant protection should be available. The homestead owner should be trained by the GOs or NGOs about homestead agroforestry knowledge. Providing time to time suggestion by extension worker, training and loan to execute Government and Non-Government Organization.

- The computed correlation co-efficient between tree know total of respondent and their knowledge of agroforestry status was 0.814**. Based on the computed 'r' value the relationship between tree know total of respondent and knowledge of agroforestry was significant at 0.01 level of significance with 98 degrees of freedom and followed a positive relationship. Hence, the concerned null hypothesis could be rejected i.e. if the increased of tree know total of respondent with the increased of knowledge of agroforestry.

5.3 Recommendations

- To imperative extension education programs especially targeting farming families who depend most on agroforestry income and usually lack educational opportunities. As it is evident that the study area has high unemployment, establishment of small-scale forest-based industries may also be explored as employment and income-generating household activities.
- To attachment with frequent natural calamities like river erosion, flood, etc. caused a colossal destruction to the farming, non-farming and livelihood activities of the char people. Cultivable land, household assets and agricultural enterprises (i.e., crop,

livestock, etc.) were relentlessly affected by those natural hazards. Based on the findings of the study, some indispensable policy recommendations have been arisen which are: appropriate pre-disaster and post-disaster measures as well as input subsidy and output price support to the farmers should be properly implemented by government to continue their productive activities in the crisis period and strengthen safety net programmers for enhancing their food security.

- Institutional support needs to comprise, most importantly, agricultural extension services, Upazila agricultural officer and credit facilities. There is a need for the government to design and implement an extension program to meet the extension needs of local farmers. Hence poor farmers are forced to obtain loans from local moneylenders at high interest rates, which further reduce their ability to make investments in land. Provision of both short- and long-term formal credit would enable farmers to overcome the shortage of investment funds.

- Both GO and NGO initiatives by providing credit to respondent's families without or with minimum interest are very much essential considering families are under-privileged.

REFERENCES

Alam M.; Furukawa Y. and Mika M. (2010). Perceptions, Preferences, and Attitude of Bangladesh Farmers Towards Home garden Farming Systems. Small-scale Forestry (2010) 9:213–226, DOI 10.1007/s11842-010-9111-5. Published: 1 April 2010.

Amare D.; Wondie M.; Mekuria W. and Darr D. (2018). Agroforestry of Smallholder Farmers in Ethiopia: Practices and Benefits. Small-scale Forestry https://doi.org/10.1007/ s11842-018-9405-6. Published: 30 August 2018.

Banglapedia (2014). National encyclopedia of Bangladesh.Publish on 3 September 2014.

Bari D. M. S. (2019). Agroforestry as a multifunction landscaping tool in the char land area of Bangladesh. Department of Agroforestry and Environment, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh. Agriculture for food security 2030 (AgriFoSe2030).

Baul T. K. ; Tawari K. R.; Ullah K. M. A. and Mc Donald M. A. (2013). Exploring Agro biodiversity on Farm: A Case from Middle–Hills of Nepal. Small-scale Forestry (2013) 12:611–629 DOI 10.1007/s11842-012-9234-y. Published: 10 January 2013.

Baul T. K.; Alam M. J. and Nath T. K. (2015). Mangifera sylvatica Roxb. in the Forests of South- Eastern Bangladesh: A Potential Underutilised Tree for Small-Scale Forestry. Small-scale Forestry (2016) 15:149–158 DOI 10.1007/s11842-015-9314-x. Published: 27 November 2015.

BBS (2001). Bangladesh Population Census 2001, Bangladesh Bureau of Statistics; Cultural survey report of Dimla Upazila 2007.

BBS (2006). Statistical Yearbook of Bangladesh. Bangladesh Bur. Stat. Divn., Minist. Plan. Govt. People's Repub. Bangladesh, Dhaka.

BBS (2008). Statistical Yearbook of Bangladesh. Bangladesh Bur. Stat., Stat. Divn., Minist. Plan. Govt. People's Repub. Bangladesh, Dhaka.

DSN (2011). District Statistics of Nilphamari (DSN). Bangladesh Bureau of Statistics (BBS). Statistics and Informatics Division (SID). Ministry of Planning. Government of the People's Republic of Bangladesh Parishankhan Bhaban. E-27/A, Agargaon, Dhaka-1207.

EGIS (2000). Environmental and Geographic Information Services, Dhaka, Bangladesh.

Garrity D.P. (2004). Agroforestry and the achievement of the Millennium Development Goals. World Agroforestry Centre, United Nations Avenue, P.O. Box 30677–00100, Nairobi, Kenya. Agroforestry Systems 61: 5–17, 2004. © 2004 Kluwer Academic Publishers. Printed in the Netherlands.

Grossman J. J. (2014). Eucalypts in Agroforestry, Reforestation, and Smallholders' Conceptions of "Nativeness": A Multiple Case Study of Plantation Owners in Eastern Paraguay. Small-scale Forestry (2015) 14:39–57 DOI 10.1007/s11842-014-9272-8. Published: 1 August 2014.

Ibrahim, M.K. (2011). Impact of agroforestry practices on livelihood improvement of the farmers of Char Kalibari area of Mymensingh. MS thesis, Bangladesh Agricultural University, Mymensingh.

Islam M.; Dey A. and Rahman M. (2014). Effect of Tree Diversity on soil organic carbon content in the home garden agroforestry System of north-eastern Bangladesh. Small-scale Forestry (2015) 14:91–101 DOI 10.1007/s11842-014-9275-5. Published: 14 August 2014.

Islam, M.S., Sultana, S., Saifunnahar and Miah, M.A. (2014). Adaptation of char livelihood in flood and river erosion areas through indigenous practice: A study on Bhuapur riverine area in Tangail. Journal of Environmental Science and Natural Resources, 7(1): 13–19.

Johnson J. E. and Delgado O. J. (2003). Farmer Perspectives on Agroforestry Opportunities and Constraints in Cape Verde. Small-scale Forest Economics, Management and Policy, 2(3): 343-355, 2003.

Kabir M. E.; Rahman M. M.; Rahman M. A. U. and Ando K. (2016). Effects of household characteristics on home garden characteristics in kalaroa Upazila, Satkhira District, Bangladesh. Small-scale Forestry (2016) 15:443–461DOI 10.1007/s11842-016-9332-3 Published: 30 March 2016.

Khan M.; Mahmood H. Z.; Abbas G. and Damalas C. A. (2017). Agroforestry systems as alternative land-Use options in the arid zone of Thal, Pakistan. Small-scale Forestry (2017) 16:553–569 DOI 10.1007/s11842-017-9372-3. Published: 7 June 2017.

Leuschner W. A. and Khaleque K. (1987). Homestead agroforestry in Bangladesh. Department of Forest, Virgina Polytechnic Institute and State University, Blacksburg, VA 24061, USA and Department of Sociology, Dhaka University, Dhaka, Bangladesh. Agroforestry systems 5, 139-151 (1987).

Mercer D. E.; Hagger J.; Snook A. and Sosa M. (2005). Agroforestry Adoption in the Calakmul Biosphere Reserve, Campeche, Mexico. Small-scale Forest Economics, Management and Policy, 4(2): 163-184, 2005.

Nath T. K. and Inoue M. (2008). The Upland Settlement Project of Bangladesh as a Means of Reducing Land Degradation and Improving Rural Livelihoods. Small-scale Forestry (2008) 7:163–182DOI 10.1007/s11842-008-9048-0. Published online: 8 April 2008.

Nath T. K. and Inoue M. (2013). Forest Villagers in Northeastern Hill Forests of Bangladesh: Examining Their Livelihoods, Livelihood Strategies and Forest Conservation Linkages. Small-scale Forestry (2014) 13:201–217DOI 10.1007/s11842-013-9249-z. Published: 12 September 2013.

Nath T. K.; Aziz N. and Inoue M. (2014). Contribution of Homestead Forests to Rural Economy and Climate Change Mitigation: A Study from the Ecologically Critical Area of Cox's Bazar—Teknaf Peninsula, Bangladesh. Small-scale Forestry (2015) 14:1–18 DOI 10.1007/s11842-014-9270-x. Published: 15 July 2014.

Nath T. K.; Jashimuddin M.; Hasan M. K.; Shahjahan M. and Pretty J. (2015). The sustainable intensification of agroforestry in shifting cultivation areas of Bangladesh. Agroforestry System (2016) 90:405–416 DOI 10.1007/s10457-015-9863-1. Published: 8 October 2015.

Nautiyal S.; Maikhuri R. K.; Semwal R. L.; Rao K. S. and Saxena K. G. (1998). Agroforestry systems in the rural landscape – a case study in Garhwal Himalaya, India. Agroforestry Systems 41: 151–165, 1998. 1998 Kluwer Academic Publishers. Printed in the Netherlands.

Pandey R.; Aretano R.; Gupta A. K.; Meena D.; Kumar B. and Alatalo J. M. (2016). Agro ecology as a Climate Change Adaptation Strategy for Smallholders of Tehri-Garhwal in the Indian Himalayan Region. Small-scale Forestry (2017) 16:53–63DOI 10.1007/s11842-016-9342-1. Published: 14 June 2016.

Rahman M. M.; Furukawa Y.; Kawata I.; Rahman M. M. and Alam M. (2005). Homestead Forest Resources and their Role in Household Economy: A Case Study in the Villages of Gazipur Sadar Upazila of Central Bangladesh. Small-scale Forest Economics, Management and Policy, 4(3): 359-376, 2005.

Rahman S. A.; Sunderland T.; Roshetko J. M.; Basuki I. and Healey J. R. (2012). Agroforestry for Livelihood Security in Agrarian Landscapes of the Padma Floodplain in Bangladesh. Small-scale Forestry (2012) 11:529–538 DOI 10.1007/s11842-012-9198-y. Published: 5 February 2012.

Rahman S. A.; Sunderland T.; Roshetko J. M.; Basuki I. and Healey J. R. (2016). Tree Culture of Smallholder Farmers Practicing Agroforestry in Gunung Salak Valley, West Java, Indonesia. Small-scale Forestry (2016) 15:433–442 DOI 10.1007/s11842-016-9331-4. Published: 1 April 2016.

Safa M. S. (2004). The Effect of Participatory Forest Management on the Livelihood and Poverty of Settlers in a Rehabilitation Program of Degraded Forest in Bangladesh. Department of Forest Management, Faculty of Forestry Universiti Putra Malaysia 43400 Serdang, Selangor DE, Malaysia. Small-scale Forest Economics, Management and Policy, 3(2): 223-238, 2004.

Safa M. S. (2006). The Role of NGOs in Improving Social Forestry Practice: Do They Promote Livelihood, Sustainability and Optimal Land Use in Bangladesh? School of Business Binary University College No. 1, IOI Business Park, Persiaran Puchong Jaya Selatan Bandar Puchong Jaya, 47100 Selangor, Malaysia. Small-scale Forest Economics, Management and Policy, 5(2): 207 - 229, 2006.

Saifullah, N.M. (2010). Char dwellers' adaptation to climate change. MS thesis, BRAC University, Dhaka, Bangladesh.

Tita D. F.; Tchoundjeu Z.; Speelman S.; D'Haese M.; Degrande A.; Asaah E.; Huylenbroeck G. V.; Damme P. V. and Ndoye O. (2012). Policy and Legal Frameworks Governing Trees: Incentives or Disincentives for Smallholder Tree Planting Decisions in Cameroon? Small-scale Forestry (2013) 12:489–505DOI 10.1007/s11842-012-9225-z. Published: 17 November 2012.

Victor A.J.; Adekunle and Bakare Y. (2004). Rural Livelihood benefits from participation in the Taungya agroforestry system in Ondo State of Nigeria. Federal University of Technology Department of Forestry and Wood Technology PMB 704 Akure, Nigeria. Small-scale Forest Economics, Management and Policy, 3(1): 131-138, 2004.

YAS (2016). Yearbook of Agricultural Statistics. Bangladesh Bureau of Statistics (BBS). Statistics and Informatics Division (SID). Ministry of Planning. Government of the People's Republic of Bangladesh Parishankhan Bhaban.

Zico A.; Mondol M.A.; Wadud M.A.; Alam Z. and Rahman G.M.M. (2011). Study on Agroforestry and plant diversity in the char Gobadia of Mymensingh district. Bangladesh Agricultural University Department of Agroforestry, Mymensingh -2202. J. Agrofor. Environ. 5 (2): 101-104, 2011, ISSN 1995-6983.

APPENDIX

Appendix-I. An English version of survey questionnaire

SL NO…….

Name: Union:

Father's Name: Upazila:

Village: Zila/District:

Mobile no:

Please answer the following:

1. Age
2. Equcational status

   a. Don't know
   b. Signature
   c. ……Class

3. Occupation:

a. Major……

b. Others……..

4. Members of the family:

SL No	Gender			No
1	Male	Boy	Earner	
			Dependent	
2	Female	Girl	Earner	
			Dependent	
3	Child	No of Man	Boy	
			Girl	
4	Activities among family		No of Man	
			No of Woman	
	Members	Total		

5. Amount of land

SL NO.	Type of land	Amount	
1	Dwelling house	**Local measure (Unit)**	**Hector**
2	Cropland		
3	Mortgage land		
4	Lease land		
5	Pond		
6	Moor land or waste land		
7	Sand bed		
8	Others		
	Total		

6. Annual earning

SL NO.	Source	Taka
1	From crops	
2	From Vegetable	
3	From Fuel and Woody trees	
4	From Fruit	
5	From Poultry	
6	From Domestic animal	
7	From Fish	
8	From Job	
9	From crops Business	
10	From Selling labour	
11	Others	
	Total	

7. Knowledge about trees plants:

1. Mention the name of some trees that are mosthy used?
2. Mention the name of some trees that beneficial for crops?
3. What are the crops that can cultivate along with trees?
4. Name some of the plans that can be planted at home.
5. What are the benefits of the tree.

8. What are the number if trees in the char area in the last.

i. Increased ii. Decreased iii. Not changed

9. What are the number of trees in the house in the last 5 years.

i. Increased ii. Decreased iii. Not changed

10. What type of trees in the home.

Sl No.	Name of the tree	No of tree
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
	Total	

11. Type of vegetable you plant in your home/you have?

Sl no	Name of Vegetables
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

12. Type of vegetable you plant on sand bed/you have?

Sl no	Name of Vegetables
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

15. Please mention the production of different products in your homestead/cropland/orchard.

Items	Production (use measuring unit)			
	Family consumption	Distribution	Sale	Total
Fruit trees				
Vegetables				
Timber and fuel wood				
Medicinal plants				

16. Knowledge about Agroforestry

Sl no	Question	Full no	No obtained
	Total		

20. Please give your opinion about the impacts of homestead/cropland/orchard agroforestry.

Impacts of homestead/cropland/orchard agroforestry	Extent of villagers option			
Getting fresh air due to increase of trees.	**Strongly**	**Agree**	**Partiall**	**Disagree**
Income increase for tree plantation.				
Increase supply of fruits and vegetable				
Increase availability of fuel wood				
Decrease air temperature				
Increase greenish view				

21. Who does what work on the land (Who take [participation in the care and management of homestead?)

Management practices	Yes/not	Participator			
		Farmer	Wife	Children	Others
Seed collection					
Watering					
Weed control					
Maturing and fertilization					
Pruning					
Insecticides spary					

22. How are you interacting with them? (Please put tick mark)

Extension worker/name of Agenda	Frequency of communication			
	High	Medium	Low	Not ever
Upazilla Agricultural Officer				
Agricultural Extension Officer				
Sub-Assistant Agricultural Officer				
NGOs staff				
Community Group discussion				
Participation in field day				
Watching agricultural program in TV, listening radio				
Reading leaflet, bulletin, news paper				

Thanks for your cooperation

……..

Signature of the date collector

Appendix-II (a): The physical and chemical properties of soil in Dimla Upazila under Nilphamari District

Soil characters	Physical and chemical properties
Texture	
Sand (%)	48
Silt (%	35
Clay(%	17
Textural class	Loam
CEC (meq/ 100g)	6.9
pH	4.60
Organic matter (%)	1.44
Total nitrogen (%)	0.07
Sodium (meq/ 100g)	0.07
Calcium (meq/ 100g)	2.97
Magnesium (meq/ 100g)	0.76
Potassium (meq/ 100g)	0.59
Phosphorus (µg/g)	55.97
Sulphur (µg/g)	24.47
Boron (µg/g)	0.23
Iron (µg/g)	5.32
Zinc (µg/g)	1.06

Source: Soil Resources Development Institute, Nasipur, Dinajpur (2018)

Appendix-II: (b) The physical and chemical properties of soil in Jaldhaka Upazila Under Nilphamari District.

Soil characters	Physical and chemical properties
Texture	
Sand (%)	47
Silt (%	33
Clay(%	20
Textural class	Loam
CEC (meq/ 100g)	6.9
pH	4.80
Organic matter (%)	1.30
Total nitrogen (%)	0.070
Sodium (meq/ 100g)	0.07
Calcium (meq/ 100g)	2.97
Magnesium (meq/ 100g)	1.27
Potassium (meq/ 100g)	0.22
Phosphorus (µg/g)	31.33
Sulphur (µg/g)	14.01
Boron (µg/g)	0.27
Iron (µg/g)	5.30
Zinc (µg/g)	1.46

Source: Soil Resources Development Institute, Dinajpur (2018)

Appendix III. Weather data of the experimental site during the period from November 2018 to April 2019

Months	* Air Temperature (^{0}C)			* Minimum Rainfall (mm)	* Relative Humidity (%)
	Maximum	Minimum	Average		
November 2018	26.40	15.40	20.90	18.10	78.80
December 2018	23.70	11.40	17.55	6.70	82.30
January 2019	21.20	9.30	15.25	16.50	81.50
February 2019	23.10	12.30	17.70	21.60	72.60
March 2019	31.60	14.20	22.90	58.30	62.50
April 2019	32.30	15.50	23.90	76.40	61.30

Note * Monthly average

Source: Bangladesh Meteorological Station, Rangpur

Appendix IV. Some Photographs of Experimental site

Plate: Farmers livelihood in Charland, Dimla

Plate: Farmers livelihood in Charland, Dimla

Plate: Interview with farmer at Purba Shutibari Union, Dimla

Plate: Interview with farmer at Purba Shutibari Union, Dimla

Plate: Interview with farmer at Purba Shutibari Union, Dimla

Plate: Interview with farmer at Gulmunda Union, Jaldhaka

Plate: Interview with housewife at Gulmunda Union, Jaldhaka

Plate: Interview with farmer at Gulmunda Union, Jaldhaka

Plate: Interview with farmer at Gulmunda Union, Jaldhaka

Plate: Interview with farmer at Gulmunda Union, Jaldhaka

Plate: Interview with farmer at Gulmunda Union, Jaldhaka