STATUS, DIVERSITY AND SOCIO-ECONOMIC EFFECTS OF HOMESTEAD AGROFORESTY IN DINAJPUR, BANGLADESH

A Thesis
By

MD. RABIUL ISLAM
Registration No.: 1505244
Session: 2015 (July-December)
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MASTER OF SCIENCE (M.S.)
IN
AGROFORESTRY AND ENVIRONMENT

DEPARTMENT OF AGROFORESTRY AND ENVIRONMENT
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR

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Submitted to the Department of Agroforestry and Environment, Hajee Mohammad Danesh Science and Technology University, Dinajpur in partial fulfillment of the requirements of the degree of

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Approved as to style and contents by

(Md. Abu Hanif)	**(Dr. Md. Shoaibur Rahman)**
Supervisor	Co-Supervisor

(Prof. Dr. Md. Shafiqul Bari)

Chairman of Examination Committee
&
Chairman
Department of Agroforestry and Environment
Hajee Mohammad Danesh Science and Technology University, Dinajpur.

December, 2016

Dedicated
To My
Beloved Parents

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ABSTRACT

Homestead agroforestry is a traditional agroforestry system practiced all over the country. An explanatory survey was conducted to investigate the present status, species diversity and socio-economic effect of homestead agroforestry in the Northern region of Bangladesh. To conduct the study ten unions of Biral upazila under Dinajpur district were surveyed during June to July, 2016. The data of the experiment were collected on some qualitative and quantatitive characters. The result of the study reveals that, *Eucalyptus camadulensis* is most diverse species among the different species planted by the respondents in their homestead followed by *Mangifera indica* and *Swietenia mahogoni*. The Relative density (RD), abundance (A) and relative abundance (RA) were highest in *Eucalyptus* (37.38, 34.71, 33.82) while lowest in *Tamarindus indica* (0.15, 1, 0.97). Similarly, Important Value Index (IVI) was highest in *Eucalyptus camadulensis* (74.64 percent) followed by 49.63 percent in *Mangifera indica* and lowest in *Tamarindus indica* (1.61%). However, *Mangifera indica* is the most frequent species (90). Among the livestock and poultry, pigeon (7.87) was the most domesticated poultry followed by hen (6.05) and duck (5.96) and lowest was in goat (2.29). The Shannon Index value was 2.523 and evenness 0.645. Furthermore, homestead agroforestry improves socieo-economic condition of the respondents by ensuring income, meting daily basic needs of the family and provides ecological stability. The homestead agroforestry management practices were mostly done by family members. However, the respodents advised that emphasis should be given by the authority in the availability of good quality seeds/seedlings for plantation in the homesteads and applying more scientific knowledge for management.

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INTRODUCTION

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INTRODUCTION

1.1 General Background

Bangladesh is one of the densely populated countries of the world. It is agro-based economy which situated in the North-Eastern part of South Asia with a tropical to sub-tropical climate. At present the population of Bangladesh is about 152.25 million in the area of 1,47,570 sq. kilometer with growth rate is 1.37% per annum and the total forest area of the nation covers about only 17% of the land (BBS, 2013). However, according to the Forest Master Plan and Surveys conducted by multinational donor agencies, only 6% or a total of 0.769 million hectares land of the territory has actual tree coverage (Anonymous, 1999). But to have benefits of the nature, any state should have at least 25% of her land covered with forests.

Agroforestry as a land use system that integrates trees, crops and animals in a way that is scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farmers (Nair, 1979). It is a way to practice agriculture without deteriorating agro-ecosystem services while maintaining or improving productivity, stability or in other words sustainability. Agroforestry practices helps to overcome this deteriorating environment of the traditional agriculture. Among different agroforestry system, homestead agroforestry is a very popular systems practiced all over the country.

Homestead agroforestry (synonym—home garden) system is very important in the economy of Bangladesh. Trees and other woody species grown in the homesteads are a significant source of food fodder, fuel wood and timber. Most of the vegetable products consumed in the country are coming from the homesteads. There are about 25.49 million of homesteads in our country covers about 0.80 million hector of lands (BBS, 2010). 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. The government of Bangladesh has already undertaken initiatives to bring bare land area under tree cover through various social forestry projects. Although homestead agroforestry is considered one of the most effective land use systems that can buffer against desertification and ensure livelihood adaptation (Alam, 2008; CEGIS, 2006; Rahman *et al.*, 2006), few initiatives to promote homestead agroforestry are currently in effect. This is principally

due to the lack of baseline information that is essential to designing well-planned and science based programs. Homestead agroforestry of Bangladesh are described as a multistoried vegetation of shrubs, bamboos, palms, and trees surrounding homesteads that produce materials for a multitude of purposes—including fuel, shelter, structural materials, fruit and other foods, fodder, resins, and medicines (Douglas, 1981). Trees in the homesteads, often called, "homestead forests", play an important role in rural economy as well as national economy of Bangladesh. Homestead is the most plant diversified ecosystem in Bangladesh. On the other hand plant diversity plays an important role for maintaining ecological balance as well as environmental stabilization. So plant diversified condition is desirable for sound environment.

While research on climate change implications of different agroforestry systems is well-advanced (Montagnini and Nair, 2004; Albrecht and Kandji, 2003; Varchot *et al.*, 2007), there are only few instances of such attempts in home garden literature (Kumar, 2006). Similar trends are also observed in northern part of Bangladesh. A number of studies on homestead agroforestry are available (Alam and Furukawa, 2008; Rahman *at al.*, 2005(a); Rahman, *et al.,* 2006(a); Rahman *et al.,* 2006(b); Leuschner and Khaleque, 1987), but all were conducted in regions where climate and agro-ecology is very different from the northwestern region. Kabir and Webb (2008) studied home garden biodiversity in the southern Bangladesh where soil is salty and climate is relatively humid. Similarly, Rahman *et al*., 2005(b) explored the role of homestead agroforestry in household economy in central Bangladesh.

But, unfortunately due to lack of baseline information from the northern regions, we still do not have a full understanding of the role of homestead agroforestry or a similar land use system in mitigation of and adaptation to dry climate (Alam, 2008). Hence, considering that there is a lack of realistic information and knowledge on the structural characteristics and biodiversity of home gardens in northern region, where climate shows distinct spatial and temporal variability, this study provides valuable information for homestead agroforestry. The researcher tried to evaluate species richness and their structural characteristics, spatial, temporal and vertical distribution, management techniques, utilization and farmers' preferences and attitudes for promotion and development of home gardens. By gathering baseline data on the composition of homestead agro-forest hopefully it will help policy makers and practitioners as well as farmers to improve productivity and mitigation strategies in this drought-prone region.

Considering the above all the facts it is expected that this study will be able to generate valuable information on the existing homestead agroforestry and its impacts on social and economic aspects of local people livelihood in the Biral upazila of Dinajpur district. Moreover, it would be possible to arrive at some concrete recommendations for further developmental steps to be taken for effective homestead agroforestry in northern part of Bangladesh and more especially in the study area.

1.2 Statement of the Problem

The forestry situation in Bangladesh reveals a dismal picture. Bangladesh has about 17 percent of forestland (BBS, 2010) but the actual tree covered area is only 6 to 7 percent at present (Islam and Sato, 2010), which is decreasing at an alarming rate due to overpopulation growth. Moreover, forests in Bangladesh have declined by 2.1 percent annually over the last three decades due to deforestation, illegal logging and harvesting. So, it might be difficult to fulfill the requirements of the people's demand for fuel, fodder, timber and other necessities with the existing forest resources in Bangladesh. On the contrary, the demand of food crops has been increasing rapidly due to ever increasing population in Bangladesh. However, the country has only 7.63 million hectares of arable land and per person arable land is 0.05 hectares (World Bank, 2011). Due to over growing population, per capita land area is decreasing at an alarming rate of 0.005 ha/capita/year since 1989 (Hossain and Bari, 1996). In this regards, agroforestry can play a pivotal role to improve the present situation. In such circumstances, traditional land use pattern should be converted into sustainable land use, which will permit maintenance of productivity combined with conservation of the resources. Agroforestry might be the best land-use system for sustainable livelihood in Bangladesh to cope with the present situation. It is a land based production system that is directly related to food security, employment, income opportunities and environmental issues.

Therefore, it is necessary to assess the agroforestry system that is suited with the present condition and what type of effects done on the respondents. So, the researcher made an attempt to identify the real consequences of agroforestry to changes of the respondent socioeconomic status. Considering the above circumstances, the present study was undertaken taking the following research questions:

a) What is the present status of homestead area?
b) What is the scenario of tree species density/diversity?

c) What are the vertical species compositions in the homestead area?
d) What is an existing agroforestry practice in the farmers' level?

1.3 Specific Objectives

Objective helps the researcher to get into the right way. Meaningful, clear-cut and achievable objectives are the key to success in all kinds of research. The research work was conducted with the following objectives:

a) To find out the present status of homestead area in northern region of Bangladesh
b) To determine the diversity of species (flora and fauna) in the study area
c) To assess the effect of homestead agroforestry on socioeconomic status of the area
d) To identify the problems of respondent in practicing homestead agroforestry

1.4 Assumptions of the Study

An assumption has been defined as the supposition that an apparent fact or principle is true in the light of the available evidence (Goode and Hatt, 1952). An assumption is taken as a fact or believed to be true without proof. The researcher made following assumptions while undertaking the study.

1. The social and cultural environment of the study area was well aware of to the researcher who acted as an interviewer. Therefore, the data collected by the researcher were free from bias and the respondents furnished their opinions without any hesitation.
2. Views and opinions furnished by the respondents included in the sample were the representative views and opinions of the whole population of the study area.
3. The respondents selected for the study competent to satisfy the quarries of the research and their responses were reliable and valid.
4. The respondents were capable of furnishing proper responses to the questions included in the interview schedule.
5. The findings of the study will have general application to other parts of the country where the physical, geographical, socio-economic and natural conditions do not differ much from the study area, and thus, the findings of the study would be useful for planning and execution of the program of extension service.

1.5 Limitations of the Study

In order to conduct the research in a meaningful and manageable way, it became necessary to impose some limitations in certain aspects of the study. Considering the time, money, labor and other necessary resources available to the researcher, the following limitations have been observed throughout the study:

1. The study was confined to Biral upazila of Dinajpur district.
2. There were many people in the study area, but only the people who were involved in homestead agroforestry were considered for this study.
3. Population for the present study was kept confined within the heads of farm families in the study area, because they were the decision makers in their respective families.
4. Characteristics of the respondents were many and varied but only six characteristics were selected for investigation in this study.
5. For information about the study, the researcher depended on the data furnished by the randomly selected respondents during interview with them.

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

This chapter deals with review of past researchers related to this investigation. The reviews are conveniently presented based on the major objectives of the study. This chapter presents a brief review of the post studies and opinion of researchers having relevance to this investigation which were gathered from different sources like literature, journals, thesis, reports, newspaper, CD search and periodicals. The literatures were collected and compiled for better and clear understanding of the present study and described under the following headings-

2.1 Concept of agroforestry

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

Partha (2009) has reported that CARE assisted Road side agroforestry program bring a change in the socioeconomic status of the participants through increasing income generating capacity and using the waste land of the road side. The program also improved the overall environmental condition and prevented the soil erosion.

Pulok (2008) identified a total of five agroforestry practices viz. Palmyra palm - rice based agroforestry practices, pond size agroforestry practices, MPTs plantation the border of rice field, aile based agroforestry practices and homestead agroforestry practices in the study area. He recommended that the selection and introduction of fast growing trees and multipurpose tree species are suitable for agroforestry practices for socioeconomic improvement of the farmers.

Hafizul (2007) stated that well planned and well managed agroforestry can play an important role in solving acute problem of food, fuel, fodder, soil fertility and ecology. He also concluded that agroforestry system practices are highly profitable and play significant role in improving the economical status of the farmers.

Das and Das (2005) stated that home gardens are traditional agroforestry systems with complex structure and multiple functions. To understand the system, the socio-economic and biophysical aspects of home gardens in Dorgakona village, Barak Valley, North East India were studied. Since home gardens are also important sites for in situ on-farin conservation, the role of the rural people in the management and preservation of biodiversity in their traditional home gardening systems will be examined. The home garden size ranges from 0.02 to 1.20 ha with an average of 0.30 ha. The total number of species encountered in the home gardens will be 122, with fruits as the dominant use component. The home gardens are the sites of conservation of a large diversity of plants both wild and domesticated, because of their uses to the households. Thus the home gardens were found to be complex systems with plant diversity conserved through their use.

2.2 Concept of homestead agroforestry

Nahar (2009) observed that the average size of the homestead in the study area was 0.12 ha which increased with the increased of farm size. The homestead production system was found to be poor due to management practices. It was also observed that the major problem of planting new trees in the homestead was damaged by grazing animals (80%) followed by unavailability of space (61%); damaged by flood (55%), Jack of good quality seeds (64%) and insect pest infestation (56%). There is enough scope it improve productivity in the homestead by replacing the existing tree species with the improved and/or exotic ones, planting trees in planned ways and improving management practices.

Sadaat (2007) observed a total of 62 different tree species recorded in the homestead of the study area. The overwhelming majority (53%) of the landless and marginal farmers grew up to 20 trees in their homestead.

Yoshino and Anodo (1999) conducted a study entitled “Homestead (Bari-Bhiti) utilization and management in DakshinChamurai village located in the floodplain of the tributary of the Jamuna River in Bangladesh." It come out from the study that in the whole village, 1245 species (82 species from perennial plant and 43 species of annually grown plant) were observed and 13 each plant had various uses. Seventy species were used as food materials about 80 species were used for fuel, 48 species were as medicines, eight species were used as fodder, eight species as livestock medicine, 24 species were as timber and 17 species as material for various tools, three species were use soil protection,

and other uses such as hedge, child's play, ornamentals, etc. for the villager daily needs. One plant was used for 2.5 purposes on the average among all the plants and 2.8 among the perennialplants. Multiple uses were conspicuous for the indigenous and common species to the locality, indicating the presence of a close relationship with the living environment of the village.

Ninaz (1998) reported that homestead is an area of land in which the household has its own dwelling unit. It refers to home and adjoining land occupied by a family for the purpose like small scale agricultural production, home-up keeping, health, sanitation and nutrition.

Hague (1994) showed that trees of the homesteads can be given suitable structure of the canopy as desired by the house owners under which vegetables, spices and some ornamental herbs, shrubs can be raised.

Perera and Rajapakse (1991) distinguished that four canopy layers, the tallest being over 10m,third layer 2.5-10m,second layer 1-2.5m and first layer is less than 1m in Kandyan homegarden.

Abedin and Quddus (1990) recorded 28 different tree species in the homesteads of the Barind Tract in Rajshahi district. *Mangifera indica* and *Phoenix sylvestris* were the most dominant species, whereas *Artocarpu sheterophyllus* was only of minor occurrence. They also mentioned that the average tree density was higher in Patuakhali and Rangpur (1.5 and 1.4 trees/10m2, respectively) than in Rajshahi (0.7) where the annual rainfall is the lowest in Bangladesh.

Abedin and Quddus (1990) conducted a study at six agro-ecologically different locations of Bangladesh and reported that the small homesteads, owned by the marginal and small farmers, have 20-21% area under housing, 29.37% under tree coverage and 9-14% under vegetable cultivation. In bigger homesteads owned by big farmers, about 16% land is under housing, 33% under tree coverage and 12% under vegetable cultivation.

Stoler (1987) reported that homegarden cultivation occupies only 8% of total working time of man and insignificant amount of time for women.

Haq (1985) reported that the average area of Bangladesh homesteads 0.1 to 1.0 ha depending on the locality and financial condition of the house owner.

2.3 Benefits of homestead agroforestry

Akter *et al.*, (2013) mentioned that farmers considered trees as savings and insurance against risk of crop failure and low yield, as well as assets for their children. Some farmers stated that tree would contribute toward expenses for marriage of their daughters.

Mamun (2009) observed that the role of rural women practicing homestead afforestation activities was measured on the basis of this performance and scores obtain through 10 statements, each of those put against a 4 point scale.

Moontasir *et al.,* (2009) studied about different agroforestry practices for socio-economic improvement of the farmers in Comillasadar. The findings revealed that majority (40.75%) of the farmers belong to medium category possessed medium (21-30 trees) number of diversified tree species. The majority 33.33% of the farmers had low attitude regarding contribution of diversified tree species for their socioeconomic condition, where 25.92% was found to large category respectively. Within 40 different tree species, the high relative density of the study area was Mango (21.34%), Betel-nut (12.89%) and Jackfruit (8.73%) respectively.

Khan (2007) suggested that agroforestry might be considered to be practiced whenever trees and agricultural crops are grown in mixture, provided that the combined widths of the rows of agricultural crops do not exceed the heights of the forest trees at maturity.

Tolunay *et al.*, (2007) observed that traditional agroforestry practices of west Mediterranean region of Turkey. Each agroforestry practice will be determined and classified in the agroforestry systems. Many of the agroforestry production patterns are being seen as a traditionally in the entire region. Results showed that, agroforestry application in the region studied can be put in major agroforestry practices like, agricultural systems, alley cropping, multilayer tree gardens, multipurpose trees on crop lands, home gardens, trees in soil conservation and reclamation, shelter belts and windbreaks, silvopastoral systems; trees on range land or pastures, protein banks, plantation crop with animals, agro-silvopastoral systems; home garden involving animals, multipurpose woody hedgerows, apiculture with trees, aqua forestry, multipurpose woodlots. As an agroforestry practice, shifting cultivation and taungya are

determined in the region; however, both practices are not applicable, because of causing forest degradation.

Bennett *et al.,* (2006) reported that the home gardens occur in most parts of Ghana and are of immediate use to household members for food and health requirements. Home gardens are generally multi-storied and multi-purpose. Informal discussion with farmers, interviews and structured questionnaire methods were used to gain information on home gardens in four agro ecological zones in Ghana. Home gardens ranged in size from 0.1 to 1.0 hector. In terms of structure, home gardens were found to be multi-storied, usually with three or four layers. Species diversity varied among the different agro ecological zones in the study.

Roy *et al.,* (2005) reported that significantly gap between traditional cultivation methods and improved systems in socio-economic terms. Improved agroforestry systems provide approximately double income per capita in comparison to traditional methods. More intensified cash crop cultivation in the highlands of the East Usambara also results in double income compared to that in the low lands. However, people are sensitive to risks of changing farming practices. Encouraging farmers to apply better land management and practice suitable cultivation of cash crops in combination with multipurpose trees would be relevant in improving their economic situation in the relatively short term. The markets of most cash crops are already available. Improved agroforestry methods could ameliorate the living conditions of the local population and protect the natural reservoirs from human disturbance.

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

Unini, *et al.,* (2004) conducted a study the land cover categories interpreted and napped include 4 classes of agricultural land (low land predominantly agriculture, and upland with moderate on scanty agriculture), built up area, and water bodies. The changes in land cover were not only from natural to manmade but also in the reverse order. The manifestations indicate a process of conversion of non- agricultural land (forest and scrub) to agricultural land which was later given up (with some reversion to scrub). The biomass per unit area of each category was estimated using base measurement. The

category wise and total biomass of the study area was computed and the annual increment of the biomass derives. The residual portion of the annual increment after estimating the rural requirement was found to more or less match with the estimated annual wood and fuel wood use by the metropolis.

Vankatash *et al.,* (2003) found that in tropical home gardens species diversity is generally believed to be very high. Home gardens reached high levels of developments in terms of plant diversity, labor input and income derived from garden in region where population densities are high and create a forest like multistory canopy structure. Moreover, species diversity sue, shape and plant density also vary from place to place depending on cultural, ecological and socio-economic factors.

Tewari *et al.* (2003) reported that the homestead agroforestry has been practiced throughout the central Himalayan region for a very long time. However, the structure of agroforestry system is more than a simple combination of woody and herbaceous components on the same unite of land. This subsistent strategy has evolved under the constraint and opportunities peculiar to the region and has permitted the rural folk to thrive in an environment of inherently low productivity. It features interaction among five component (i) crop fields (ii) a private land support system (iii) a forest support system (iv) livestock (v) man in the uniquely specific socio economic cultural setting of the region.

Sing *et al.,* (2003) reported that medicinal plants are integral part of rural and urban lifestyle, but many of them medicinal plants species have reached endangered already and threatened because of over exploitation of forests, uncontrolled grazing and fire. India, nearly 175 million ha of land is degraded, 93 million ha of which is wasteland. This land is not suitable for growing agricultural crops economically but can be effectively used for growing medicinal plants after proper management.

Awal *et al.,* (2002) observed that homestead tree and vegetable practices earned substantial income for all categories of farmers. The women were involved in the household decision making process to a great extent. The evidence was more spectacular in aspects like family planning, education of children, poultry rearing, plantation of trees and vegetables.

Miah and Hossain (2001) conducted a study of Narsingdi district of Bangladesh about indigenous knowledge on homestead forestry and they explored that the households were engaged to tree planting programs (*Azadiracht aindica* with *Artocarpus heterophyllus*), forestry products and services, women involvement, spacing of plantation, tending and cultural operations and problems in the homestead forestry. The study also reveals some important indigenous management techniques, which may be used along with the scientific management technique to sustainably manage the homestead forestry resources in Bangladesh.

Haque and Roy (2001) observed that the practice of producing trees in crop field is pre-historic in Bangladesh but due to tremendous increase in cropping intensity many farmers now reluctant planting trees in crop field as they believe that the trees significantly reduce crop yield by their shading and root competition. There are possibilities to raise various species of trees in crop fields in such a fashion that without much affecting the yield of field crops rather than the immediate total benefit of the systems is higher than that of sole cropping.

Awal *et al.*, (2000) observed that homestead fruit and vegetable practices earned substantial income for all categories of farmers. The women were involved in the household decision making process to a greater extent. The evidence was more spectacular in aspects like family planning, education of children, poultry rearing, plantation of fruits and vegetables and marriages of sons and daughters.

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

Hocking (1998) observed that due to pruning of shoot and root the tree yield was reduced by 41% and crop (rice, wheat, jute and pulses) yield by 7%. It was also observed that eucalyptus affected crop yield by 12% but the species had highest wood production. While economic analysis was made, the species showed most profitable compared to all other species.

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

Hossain and Bari (1996) reported that generally wives (39.8%) were more involved than husbands (34.8%) in the application of manure (decomposed leaves, household wastes, cow dung, etc.) and fertilizers to homestead vegetable gardens. However, this pattern was prominent amongst landless and marginal farm categories but husbands were more involved in soil fertility management than wives on small, medium and large farms.

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

Halladay and Gilmoure (1995) mentioned that the homestead have multiple functions in relation to everyday human life and environment and also act as a bridge between all living beings and non-living environment. The man values derived from home garden are foods, energy for domestics use, source of nutrients, fodder for domestic animal, medicinal products, timber for house construction, and a pleasant environment for dwellers.

Heywood and Tatson (1995) reported that worldwide concern about the extent to which biodiversity is being lost at the same time a growing appreciation of the importance of this diversity, whether measured in economic, social, aesthetic or moral terms. Wild species, in-situ conservation is supposed to be the normal way of protection and the ex-situ only the emergency.

Rahman (1995) showed that the consequences of homestead crop production under homestead agroforestry (HAF) practices on the family income and women's status. The data from HAF practicing households reveal that these farms earned substantial income and production gains. The women of the households gained in terms of higher social status. The gender status in particular improved significantly on these households as evidenced by the increased participation of HAF practicing women in decisions making on crucial socio-economic matters in the households.

Rebeka (1994) studied about economic aspects of homestead enterprises in some selected areas of Jessore district. She estimated that total cost of production of vegetables produced in homestead area was Tk. 1226.44 while gross and net return per household

was Tk. 1753.83 and 527.39, respectively. Per household total cost of production of fruits and other perennials was Tk. 947.32 while gross and net return per household was Tk. 10555.65 and 9608.33, respectively. Per household total cost of livestock and poultry enterprise was tk. 10860.13 while gross and net returns per household were Tk. 15012.42 and 4152.42, respectively. Maximum net return was earned from fruits and other perennials production.

Halim and Hossain (1994) observed that the vegetable raising did not generate any significant income within homestead because the space for vegetable production was very limited and most of the homestead areas were shaded by the tree.

Hague (1994) showed that trees of the homesteads can be given suitable structure of the canopy as desired by the house owners under which vegetables, spices and some ornamental herbs, shrubs can be raised.

Alison (1994) mentioned that the species density (number of species per hectare) was declining with increasing garden size in homestead agroforestry.

Nair (1993) stated that today there is a consensus of opinion that agroforestry is practiced for a variety of objectives. It represents, as depicted in an interface between agriculture and forestry and encompasses

Sultana (1993) stated that homestead vegetables and fruits form an integral part of the family diet and a part of them inter the commercial market. Although every member of the family has some contribution, the major labor impute was seed preservation, land preparation, transplanting, watering and harvesting are done by women. Men usually help in fertilizer and pesticide application.

Shalaby (1991) conducted a study in Egypt which revealed that women were engaged in gardening to supplement incomes and to provide food for family. About 30% of the farmers did not buy vegetables from the market and claimed to be self-sufficient in this product.

Fernandes and Nair (1990) mentioned that homestead represent a land-use systems involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within

the compounds of individual house, the whole crop -tree-animal unit being intensively managed by family labor.

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

Dewees (1989) reported that fuel wood consumption is related to its economic cost and supply. It is not a static variable which can be extrapolated only from population growth rates. Energy consumption to development must be evaluated by balanced energy consumption with other variables and cost which influence demand, such as income, price and substitution effects.

Halim and Islam (1988) reported that the crucial role played by rural women in homestead agricultural production and studied the constraints that impeded is power proper development.

Pearson and Stevens (1989) reported that the energy problem as choice between energy shortages, with their attendant loss of production or comfort, and the sacrifices to be made elsewhere to overcome the energy shortage and the increased harshness of the consequences of the choices which create the crisis dimension of the fuel wood problem.

Ninez (1987) defined home gardens as a small scale production system supplying plant and animal consumption and utilitarian items either not obtainable, affordable, or readily available through retail markets, field cultivation, hunting, gathering, fishing and wage earning.

Leuschner and Khaleque (1987) stated that the homestead agroforestry system is very important in the economy of Bangladesh. Agroforestry is a term that invariably brings up the homestead to be forefront and in a country like Bangladesh, the very act of concentrating on the homestead areas would cover more than the fourth of all matters concerned with agroforestry at large.

Agarwal (1986) pointed that the crisis of fuel wood relates to its country especially, zone specificity and its rural urban implications. Wood provides less than 1% of the energy in

most developed countries as compared to more than 90% in the majority of developing countries. So it is clear fuel wood crisis exits in developing world.

According to FAO (1986) homestead is one of the most elaborate systems of indigenous agro-forestry found most often in tropical and sub-tropical areas where subsistence land use systems predominate.

Byron (1984) mentioned that trees from home gardens were estimated to produce about 65 to 70% of timber and both 90% of fuel wood and bamboo consumed in Bangladesh. Fuel is a basic for human nourishment and is essential to make food suitable for human consumption.

Michon *et al.,* (1983) and Soemarwoto and Conway (1991) stated that home garden agroforestry maintains high levels of productivity, stability, sustainability and equitability.

Lundgren and Raintree (1982) stated that agroforestry is a collective name of all land use systems and technologies where woody perennials are deliberately grown on the same land management units as agricultural crops and/or animals in some form of spatial arrangement or temporal sequence.

Douglas and Hart (1973) stated that trees are integral part of homestead as well as nature. Trees provide direct and also indirect benefits to human being and to the nature. It has the great potentials for feeding men and animals, regenerating soil, restoring water systems, controlling floods and droughts, creating more benevolent micro-climates and more comfortable and stimulating living conditions for humanity.

2.4 Species composition in the homesteads of Bangladesh

Chandra (2011) studied on species richness and tree diversity in the homestead and he found that a total of 75 different tree species was recorded in the homestead of the study area of which Jackfruit, Mango, Eucalyptus, Akashmoni and Guava were dominant species.

Belali (2011) studied on homestead agroforestry and species composition in Sonargaon upazila of Narayangonj district. He stated that the homesteads in Sonargaon upazila of Narayangonj district are cluster with nearly 78 different tree species, 11 crop species and

on average 25.75 tree species were found in homestead. There are the habitats for many herbs, shrubs and creeper species.

Yasmin *et al.*, (2010) observed that a total of 68 different tree species recorded in the homestead, cropland and on the bank of pond of the study area of which Akashmoni, Jackfruit, Coconut, Mango, Neem, Eucalyptus and Bokain were dominant. On an average 22.75 and 4 tree species were found in homestead and cropland area respectively.

Jahan (2010) identified that a total of 50 different tree species was recorded in the homestead area of which Jackfruit, Betel nut, Rain tree, Mango, Mahogani and Banana were dominant species.

Mahamud (2010) studied on species composition and its diversity in the homesteads and found that a total of 69 different tree species was recorded in the homestead of the study area of which Akashmoni, Mahogani, Jackfruit, Coconut and Papaya were dominant species.

Shabuj *et al.*, (2010) observed that a total of 32 different tree species recorded in the homestead area of which Jackfruit, Eucalyptus, Ipil-lpil, Mango, Neem and Mahogany were dominant species. On an average 21.25 tree species were found in homestead. Ten different agroforestry practices were identified from the study area within four layers.

Tangang *et al.,* (2004) stated that agroforestry systems have been maintain as a part of rural survival over generations, with the multi-story vegetation structure and diverse type of plant composition. In the present study, plant species composition and diversity of the traditional agroforestry systems practiced by different ethnic groups in Acronychal Pradesh, India were evaluated. The total number of tree shrubs and herbs species recorded is 41, 22, and 35 respectfully.

Nahar (2000) reported that the extent of participation of rural women in homestead vegetable cultivation, post-harvest activities, poultry raising and goat rearing were 42 percent, 62 percent, 54 percent and 47 percent, respectfully age of the rural women and no significant relationship with their participation in homestead agriculture activities. It has also mentioned that majority of the respondents possessed moderate level of knowledge about homestead agriculture management systems, while innovativeness and extension tendency was lower.

Mosabber and Niar (1999) studied about the floristic composition and socio-economic aspects of rural homestead forestry. They found that home gardens are located close to houses and characterized by a mixture of annual and perennial species. The proximity of natural forests and the availability of timber in local markets also have been seen to influence the propensity to plant timber and fuel wood species in home gardens. Fruit trees dominate the gardens, followed by fuel wood species.

Hocking (1998) observed that due to pruning of shoot and root the tree yield was reduced by 41% and crop (rice, wheat, jute and pulses) yield by 7%. It was also observed that eucalyptus affected crop yield by 12% but the species had highest wood production. While economic analysis was made, the species showed most profitable compared to all other species.

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

Millat-e-Mustafa (1996) conducted a vegetation survey in four physiographic region of Bangladesh viz. deltaic, dry land, hilly and plain regions. He recorded that in total of ninety two perennial species from home garden of Bangladesh. The highest number of species were recorded in deltaic region (67) followed by plain (56) and hilly region (56), and the lowest in the dry land region (46). He also mentioned that, in the dry land region, adverse environmental condition (such as low rainfall, intense heat and low soil fertility) restricts the variety of species that could be grown.

Mohiuddin and Chowdhury (1997) studied about tree diversity and economic returns in homestead agroforestry and they found that there were more tree species diversity producing timber and forests. They also observed that there was a clear sharing of tasks among family members. Farmers spent only 4.8-12.2% of their total labor in home garden management.

Hossain and Bari (1996) reported that generally wives (39.8%) were more involved than husbands (34.8%) in the application of manure (decomposed leaves, household wastes, cow dung, etc.) and fertilizers to homestead vegetable gardens. However, this pattern

was prominent amongst landless and marginal farm categories but husbands were more involved in soil fertility management than wives on small, medium and large farms.

Hague (1996) mentioned that most of the native fruits, country vegetables, fuel wood and timber come from homestead and marginal lands attached to or nearby homesteads. Use of indigenous tree species, the potentiality of agroforestry for environmental improvement and in sustaining incensement of food and forest products in the savanna region needs to be exploited.

Halim and Hossain (1994) observed that the vegetable raising did not generate any significant income within homestead because the space for vegetable production was very limited and most of the homestead areas were shaded by the tree.

Alison (1994) mentioned that the species density (number of species per hectare) was declining with increasing garden size in homestead agroforestry.

Nair (1993) stated that today there is a consensus of opinion that agroforestry is practiced for a variety of objectives. It represents, as depicted in an interface between agriculture and forestry and encompasses mixed land use practices. These practices have been developed primarily in response to the special needs and conditions of tropical developing countries that have not been satisfactorily addressed by advantage in environmental agriculture or forestry.

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

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

Linda (1990) stated that the high diversity of plant species in village home gardens ensure continuous production of fruits and vegetables, fuel wood, timber, medicinal and cash crops.

Fernandes and Nair (1990) stated that the magnitude and rate of output of products as well as cash and rhythm of maintenance of the home garden system depends on species composition. The choice of species was determined to a larger extent by environmental and socio-economic factors, as well as dietary habits and local markets demands. They stated that home gardens are characterized by high species diversity and by usually three to four vertical canopy strata, thus indicating the intimacy of plant associations. The layered canopy configuration and compatible species, admixture are the most conspicuous characteristics of all home gardens. Contrary to the apparent appearance of random arrangement of species, the gardens are carefully structured systems with every component having a specific place and function. The gardens often feature low capital input and simple technology and are intensively managed by family labor. Yields are generally low but stable and sustainable.

CHAPTER 3

METHODOLOGY

CHAPTER 3

METHODOLOGY

In any scientific research, methodology deserves a very careful consideration. Methodology and procedures are the important factors in conducting a research. Appropriate methodology used in research helps to collect valid and reliable data and analyze the information purposively to arrive at correct decision. This enables the researcher to collect valid and reliable information related to the hypotheses, which can be analyzed in order to arrive at correct conclusion. The methods and procedures followed in conducting this research have been discussed in this chapter.

3.1 Location of the study

The study area is located in the northern region of Bangladesh 25º31' and 25º46' north latitudes and in between 88º26' and 88º38' east longitudes. It is bounded by Bochaganj and Kaharole upazila on the north, Dinajpur sadar upazila and West Bengal of India on the south, Dinajpur sadar upazila and Punarbhaba River on the east, Bochagoanj upazila and west Bengal of India on the west.

3.1.1 Brief description of the study area

Biral upazila proper is located approximately 10 km west of Dinajpur town. Biral upazilla covers a total area of 352.16 square kilometer; located in between 25°31' and 25°46' north latitudes and in between 88°26' and 88°38' east longs upazila and West Bengal of India on the south, Dinajpur sadar upazila and Punarbhaba river on the east, Bochaganj upazila and West Bengal of India on the west. Population total 231476; male 119333; female 112143; Muslim 167193, Hindu 60284, Buddhist 1122, Christian 31 and others 2846. Indigenous communities such as Santal, Oraon, Munda, Malo, Mahali belong to this upazila. Water bodies like Punarbhaba and Tangon rivers; Nal and Karai beel are notable. Administration Biral Thana was formed in 1915 and it was turned into an' upazila in 1984 (BBS 2001).

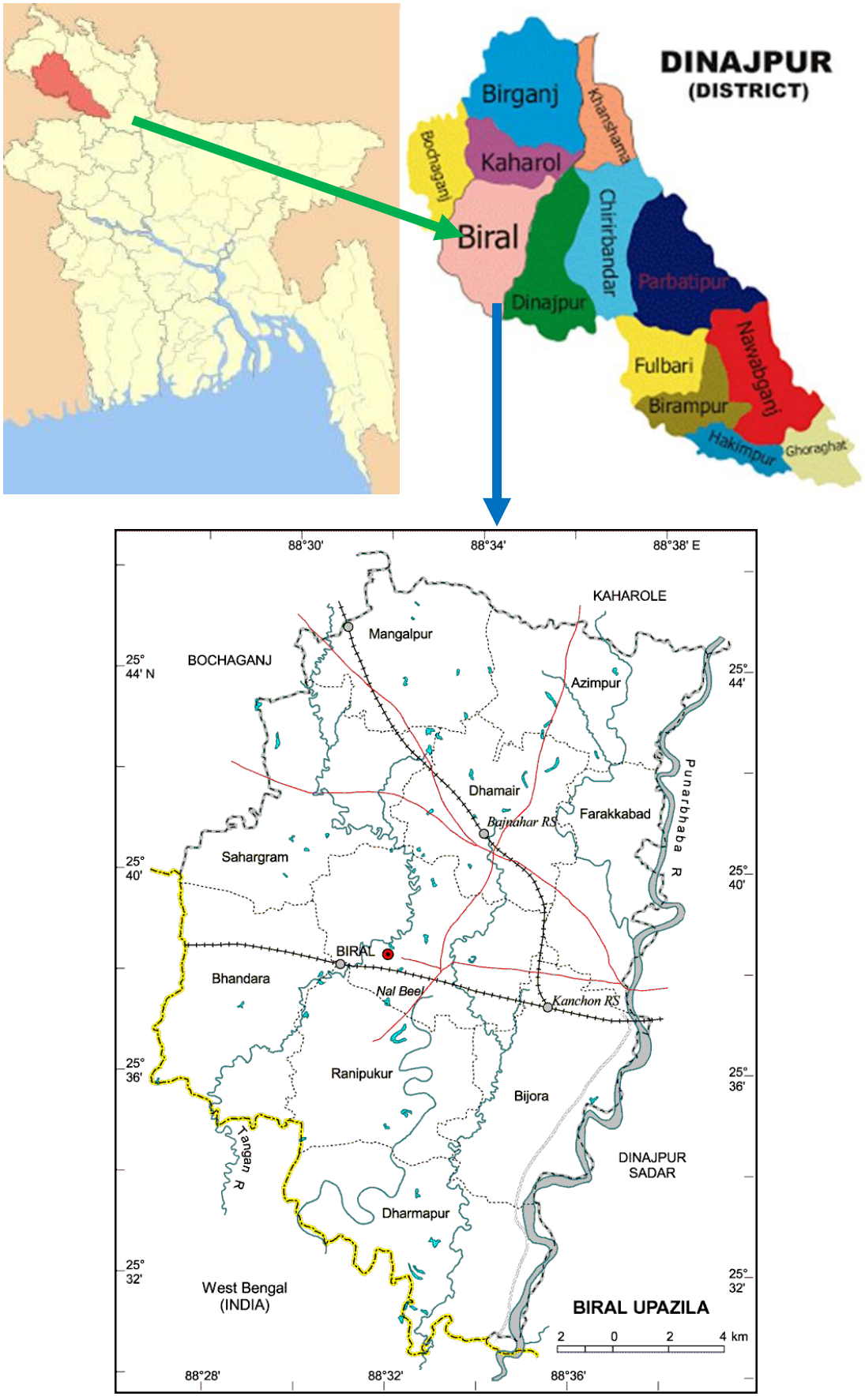

Figure 1. Map of Bangladesh showing locale of the study area Biral (Source: Wikipedia)

3.2 Site selection and sampling procedure

Biral has ten union named Azimpur, Bhandari, Birol, Bijora, Dhamair, Dharmapur, Farakkabad, Mangalpur, Ranipukur, and Sahargram those composed of total 238 villages (BBS 2001). The study was randomly conducted in twenty villages under all the unions of this upazila of Dinajpur district.

Table 3.1 Distribution of population and sample size in ten selected union

Upazila	Union	No. of farm families finally selected for data collection (sample size)
Biral	Azimpur	10
	Bhandari	10
	Birol	10
	Bijora	10
	Dhamair	10
	Dharmapur	10
	Farakkabad	12
	Mangalpur	10
	Ranipukur	10
	Sahargram	10
Total=	10	102

3.3 Time of data collection

Data were collected by the researcher himself from the sample respondents through personal interview by using interview schedule. Data were collected during June-July, 2016. Necessary co-ordination was obtained from the head of the family. Data obtained from the respondents were transferred to master sheet and then compiled to facilitate tabulation. The qualitative data were converted into quantitative by means of suitable scoring techniques.

3.4 Research instrument

An interview schedule was prepared mostly with close form questions. Simple questions and statements were included in the schedule to obtain information regarding the research topic. Open ended questions were also used to give respondents opportunity to give their opinion and suggestions regarding species management and livelihood options.

The schedule was translated in Bengali for clarification to the respondents. The schedules were pre-tested in actual field situation before using the same for final collection of data among 15 respondents of the study area. Necessary correction, additions and alternations were made in the interview schedule on the basis of results of pre-test.

3.5 Variables and their measurement techniques

A well-organized piece of research usually contains at least two important elements those are an independent variable and a dependent variable. In any scientific research, the selection and measurement of variables constitutes a significant task. In these connections the researcher reviewed the literature to widen his understanding about the nature and scope of the variables relevant to this piece of research.

The selected six (6) characteristics of the farmers namely age, level of education, family size, homestead area, communication exposure, annual income, measurement of dependent variable, structural measurement of homestead, measurement of suggestions offered by the respondents were considered as independent variables.

3.5.1 Age

The age of farmer was measured in terms of complete years at the time of interview.

3.5.2. Level of education

The level of education of a farmer was measured by the number of years of schooling. A score of one (1) was given for each year of schooling. Such as 10 for S.S.C, 12 for H.S.C and zero for no formal education.

3.5.3 Family size

The family size of a farmer was measured in terms of numbers in his family including his wife, children and those who are dependent on his family. The total number of family members was considered as the family size score of a farmer.

3.5.4 Homestead area

It was measured by the area of the raised land in which the household has its entire dwelling unit including living room, kitchen room, cattle and goat shed, farm yard court, vegetables, fruit and timber trees, backyard, bushes, bamboo bunches, pond, etc.

3.5.5 Communication exposure

The respondents' communication media was calculated through different tools.

3.5.6 Annual income

Annual income of a farmer was measured in taka on the basis of his total yearly earnings from farming, livestock, fisheries and other sources (like business, service, etc.).

3.6 Measurement of dependent variable

Effect of homestead agroforestry as perceived by the farmers was dependent variable of the study. The farmers were asked to give their opinion regarding the improvement in socio-economic aspect of their livelihood due to the contribution of homestead agroforestry. It was measured on the basis of opinion obtained from the farmers on some statements containing information on the improvement of socio-economic aspects of their livelihood. A 4-point scale: "strongly agree", "agree", "partially", and "disagree" was used to measure the effect of homstead agroforestry. The score assigned to each of the scale for measuring were 3, 2, 1 and 0 respectively.

For comparative analysis of socio-economic status of a respondent in individual homestead agroforestry system "Socio Economic Status Index" was calculated (Długosz *et al.,* 2015) by using the following formula:

Socio Economic Status Index (SESI) = P_{sa} x 3 + P_a x 2 + P_{pi} x 1 + P_d x 0

Where,

P_{sa} = Percentage of respondents with strongly agree

P_a = Percentage of respondents with agree

P_{pi} = Percentage of respondents with partially agree

P_d= Percentage of respondents with disagree

In respect of any homestead agroforestry system "Socio Economic Status Index" could range from 0 to 300, where 0 indicating no effect and 300 indicating high effect.

3.7 Structural measurement of homestead

Quantitative stand structural characteristics were analyzed using various stand structure such as Relative Density (RD), Frequency (F), Relative Frequency (RF), Abundance (A), and Relative Abundance (RA) (Mahbubul and Swapon, 2011). These characteristics were calculated by using the following formulas:

RD (%) = (Total number of individuals ofa species)/
(Total number of individuals of all species) × 100,

F (%) = (Total number of samples in which the species occur)/
(Total number of samples enumerated) × 100,

RF (%) = (Frequency of the species in the stand)/
(Sum of the frequencies of all species in the stand) × 100,

A = (Total number of individuals of the species in all the samples)/
(Total number of samples in which the species occurred),

RA (%) = (Abundance of the species in the stand)
(Sum of abundance so fall species in the stand) × 100.

3.8 Measurement of suggestions offered by the respondents

The respondents were requested to mention the suggestions. In this case an open ended question was used. Then the mentioned suggestions were ranked on the basis of number of citations on the respective areas.

3.9 Data processing and analysis

The collected data were scrutinized and edited before putting the data in the master sheets. It may be noted here that information was collected initially in local units, after checking it was converted into standard international units. The data were entered into computer by using the SPSS package program. On the basis of farm size these data were classified and presented in tabular form to realize the cost, return, homestead income and other information. Responses of the completed questionnaires were numerically coded and analyzed. In addition, graphs and tables were also used to interpret the findings.

CHAPTER 4

RESULTS AND DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSION

The present study was focused on homestead agroforestry in socio-economic aspects along with other related matters. The study considered some selected characteristics of the farmers and explored relationship with homestead agroforestry. These are described in the following sections:

In this study there were 6 selected independent variables. These were: i) Age ii) Education iii) Family size iv) Homestead area v) Source of information and vi) Annual income

4.1 Age

From questionnaire survey it was found that the age of the respondents in the study area ranged from 20 to 70 years, the mean being 45.65 and standard deviation 13.96. The highest percentage of respondents was found on as 'middle aged' (42.2) and lowest percentage on 'young aged' (26.5) shown in Table 4.1.

Table 4.1 Categorization of respondents according to their age

Categories	Respondents		Range		Mean	SD
	No.	(%)	Min.	Max.		
Young aged (≤35)	27	26.5	20	70	45.65	13.96
Middle aged (36-50)	43	42.2				
Old aged (>50)	32	31.4				
Total=	102	100				

The highest proportion (42.2%) of the farmers was middle aged, 31.4% old and 26.5% in young aged. Thus the majority of the farmers were middle aged in the study area. Similar results also found by Awal *et al.,* (2002) in their study.

4.2 Education

Education is prerequisite for receiving any kinds of modern knowledge. In this study the education of the farmers were ranged from 0-14 years of schooling with an average of 7.51 and standard deviation 5.56. The highest percentage of respondents was found on

above secondary level (37.3) and lowest percentage of respondents was found on illiterate (7.8) (Table 4.2).

Table 4.2 Educational qualification of respondents in the study area

Categories	Respondents		Mean	SD
	Number	Percent		
Illiterate (0.0)	8	7.8	7.51	5.56
Can sign only (0.5)	23	22.5		
Primary level (1-5)	9	8.8		
Secondary level (6-10)	24	23.5		
Above secondary level (>10)	38	37.3		
Total =	102	100		

In this research, 7.8% of the farmers had no education, 22.5% werecan sign only, 8.8% were on primary level, 23.5% weresecondary level and 37.3% were above secondary level.

4.3 Family size

Family size is an important atrributes for homestead managemment. From questionnaire survey it was found that the family size scores of the farmers ranged from ≤3 to >6 with an average 6.39 and standard deviation 2.15. The highest percentage of respondents was found 'medium' (50) and lowest percentage of respondents was found on 'small' (05.9) as shown in Table 4.3.

Table 4.3 Categorization of respondents according to their family size

Categories	Respondents		Mean	SD
	Number	Percent		
Small (≤ 3)	6	05.9	6.39	2.15
Medium (4-6)	51	50.0		
Large (>6)	45	44.1		
Total =	102	100		

From the above table 4.3 most of the farmers 50.0% had medium families compared to 44.1% large and 5.9% of the farmers had small families. The families which have more family member have more income as they work with their own efforts. Millat-e-Mustafa (1997) observed a clear sharing of tasks among family members.

4.4 Homestead area

In this experiment the homestead area of the respondents ranged from 0.02-0.2 hectare with an average of 1.64 and standard deviation of 0.910. The highest percentage of respondents was found 'marginal'(57.8) and lowest percentage of respondents was found on 'medium' (05.9) as shown in Table 4.4.

Table 4.4 Respondent categories on the basis of their homestead area

Categories	Respondents		Mean	SD
	Number	(%)		
Marginal (0.02 to 0.08 ha)	59	57.8	1.64	0.91
Small (0.08 to 0.14 ha)	29	28.4		
Medium (0.14 to 0.2 ha)	06	05.9		
Large (> 0.2 ha)	08	7.8		
Total=	102	100.0		

From the Table 4.4 it was revealed that among the farmers 57.8 percent was marginal, 28.4 percent was small, 5.9 percent under medium and only 7.8 percent had large homestead. Haque (1996) in his research reported that the average area of Bangladesh homesteads ranges from 0.02 to 0.2 hectare depending on the locality and financial condition of the house owner.

4.5 Sources of information about gardening

For succesful gardening it is very important to have proper scintific information about gardening. Without proper knowledge no can be succed in homegardening. There are many sources of information from where farmars can gather their knowlidge about homegardening. In this research we have made an attempt to collect the sources from where the farmers have got their information. Among the sources of information the farmer got maximum information from extension worker. The frequency of extension worker was 40 and percentage was 39.2 which was highest and the frequency of NGOs was 10 and percentage was 9.8 which was lowest than the others (Figure 2).

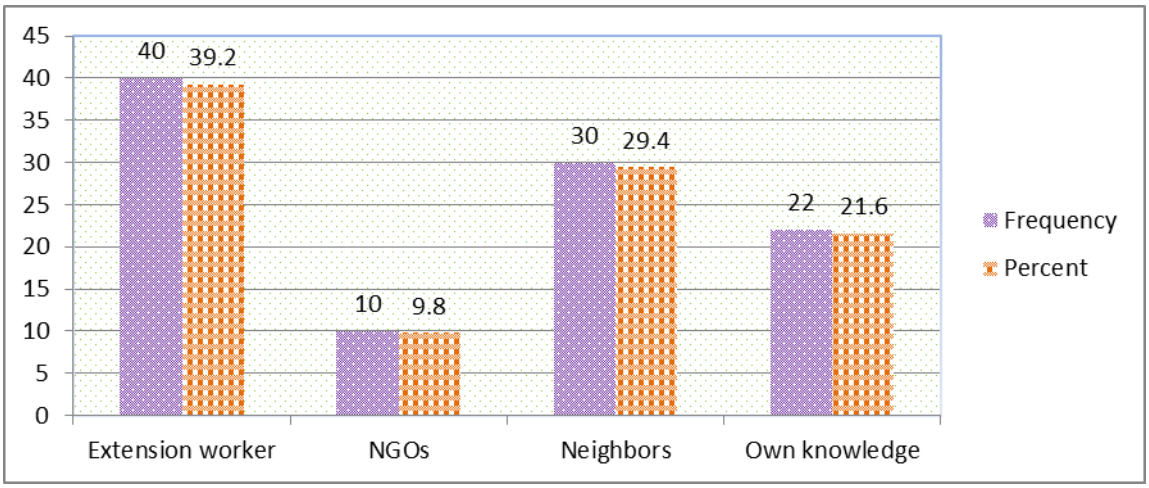

Figure 2. Sources where get information or knowledge about gardening

4.6 Annual income

The annual income of the respondents were varied from Tk. 11,800 to Tk. 5,015,000 with an average of Tk. 3,68,140. The highest percentage of respondents was found 'medium'(75.5) and lowest percentage of respondents was found on 'high income' (11.8) as shown in Table 4.5.

Table 4.5 Categorization of respondents according to their annual income (in thousand tk.)

Categories	Respondents		Range		Mean	SD
	No.	(%)	Min.	Max.		
Low income (up to 45.11)	13	12.7	11.80	5015.00	368.14	173.37
Medium (45.12-462.40)	77	75.5				
High income (>462.40)	12	11.8				
Total=	102	100.0				

4.7 Species richness and biodiversity in homestead agroforestry

A total of 25 different tree species were recorded from the total households surveyed in the homestead agroforestry of Biral upazila in Dinajpur district. The most common species were found in the homestead were mango, guava, jackfruit, coconut, betel nut, banana, lemon, papaya and eucalyptus.

Quantitative stand structure (Table 4.6) of homestead forest showed that Eucalyptus (*Eucalyptus* sp.) constituted the highest percentage (RD 37.38%) of vegetation followed by mango (*Mangifera indica*; RD 30.08%), Mahogani (*Swietenia macrophylla*; RD

19.15%), and Litchi (*Litchi chinensis*; RD 7.31%). It is interesting that only four species occupied above 90% of the homestead vegetation in terms of number. Apart from these, jackfruit (*Artocarpus heterophyllus*), neem (*Azadirachta indica*), and coconut (*Cocos nucifera*) were some of the other important species found in the homestead area. The number of native species and their number of individuals clearly dominated over exotics. Species that were common among exotics included sissoo (*Dalbergia sissoo*), mahogany (*Swietenia macrophylla*), and eucalyptus (*Eucalyptus camaldulensis*). The study result also revealed that mango and mahogani were the most frequent among the studied species having RFs value 11.08% and 10.09%, respectively. The analysis also showed that the total relative frequencies of 11 major species constituted 70.42% while the remaining 14 species constituted 29.58% (Mahbubul and Swapon, 2011). Calculated values in Table 4.6 further showed highest abundance (A) for eucalyptus (34.71), followed by mango (8.69) and betel nut (6.25).

Table 4.6 Species richness and their diversity in the study area

English name	Names	Relative Density(%)	Frequency(%)	Relative Frequency(%)	Abundance	Relative Abundance(%)
Mango	*Mangifera indica*	30.08	90	11.08	8.69	8.47
Litchi	*Litchi chinensis*	7.31	58	7.14	3.28	3.2
Betel nut	*Areca catechu*	3.85	16	1.97	6.25	6.09
Coconut	*Cocus nucifera*	4.69	50	6.18	2.44	2.38
Jackfruit	*Artocarpus heterophyllus*	6.85	70	8.62	2.54	2.47
Mahogani	*Swietenia macrophylla*	19.15	82	10.09	6.07	5.91
Eucalyptus	*Eucalyptus camaldulensis*	37.38	28	3.44	34.71	33.82
Guava	*Psidium guajava*	3.15	58	7.14	1.41	1.37
Blackberry	*Randia Formosa*	1.3	26	3.20	1.31	1.28
Banana	*Musa domestica*	5.46	16	1.97	8.88	8.65
Ata	*Annona reticulate*	0.61	16	1.97	1	0.97
Dalim	*Punica granatum*	1.0	22	2.70	1.18	1.15
Olive	*Olea europeus*	0.92	22	2.70	1.09	1.06
Khejur	*Phoenix dactylifera*	1.07	12	1.48	2.33	2.27
Boroi	*Zizyphus jujube*	2.0	38	4.68	1.37	1.33
Neem	*Azadirachta indica*	2.31	34	4.19	1.76	1.71
Badam	*Prunus dulcis*	0.85	18	2.22	1.22	1.19
Papaya	*Carica papaya*	1.46	28	3.45	1.36	1.33
Kadam	*Anthocephalus chinenesis*	2.62	14	1.72	4.86	4.73
Amra	*Sponditas pinnata*	0.69	10	1.23	1.8	1.75
Akasmoni	*Acacia auriculiformis*	3.38	36	4.43	2.44	2.38
Koroi	*Acacia spp*	1.31	24	2.96	1.42	1.38
Arjun	*Terminalia arjuna*	1.23	22	2.71	1.45	1.41
Sissoo	*Dalbergia sissoo*	1.92	18	2.22	2.78	2.71
Tentul	*Tamarindus indica*	0.15	4	0.49	1	0.97

4.8 Important Value Index (IVI %)

Before commencing the study, we hypothesized that due to adverse climatic conditions (droughty weather, low precipitation), there would be fewer species in the homegardens compared to other regions where conditions are more favorable for plant growth. However, the study area held 25 different tree species indicating a richness of biodiversity. Highest Imortant Value Index was observed in eucalyptus (74.64%) folowed by mango (49.63%) and mahogani (35.15%) where the lowest was in tentul (1.61%). Now a days, people are interested to planting eucalyptus species very much for its high growth rate and less shade producing ability. The tree species richness of the homegardens in northwest region of Bangladesh is comparable to 19 in the southwest region (Ali, 2005); 44 in Parbat, Nepal (Acharya, 2006); 34 in Andaman, India (Pandey *at al.*, 2007); and 54 in north eastern Brazil (Albuquerque *at al.*, 2005).

Table 4.7 Major Uses and Important Value Index

English Name	Scientific Name	Major Uses	Important Value Index (%)
Mango	*Mangifera indica*	Fruit, fodder, timber	49.63
Litchi	*Litchi chinensis*	Fruit, fuel wood	17.65
Betel nut	*Areca catechu*	Boat, cotton, medicinal, fuel wood	11.91
Coconut	*Cocus nucifera*	Fruit, fuel wood	13.25
Jackfruit	*Artocarpus heterophyllus*	Fruit, fodder, timber	17.94
Mahogani	*Swietenia macrophylla*	Timber, fodder, medicinal	35.15
Eucalyptus	*Eucalyptus camaldulensis*	Timber	74.64
Guava	*Psidium guajava*	Fruit	11.66
Blackberry	*Randia Formosa*	Fruit	5.78
Banana	*Musa domestica*	Fruit, fodder	16.08
Ata	*Annona reticulate*	Fruit	3.55
Dalim	*Punica granatum*	Fruit	4.85
Olive	*Olea europeus*	Fruit	4.68
Khejur	*Phoenix dactylifera*	Fruit	4.82
Boroi	*Zizyphus jujube*	Fruit	8.01
Neem	*Azadirachta indica*	Timber, medicinal	8.21
Badam	*Prunus dulcis*	Fruit, fuel wood	4.26
Papaya	*Carica papaya*	Fruit	6.24
Kadam	*Anthocephalus chinenesis*	Fruit	9.07
Amra	*Sponditas pinnata*	Fruit	3.67
Akasmoni	*Acacia auriculiformis*	Timber, medicinal	10.19
Koroi	*Acacia spp*	Timber, medicinal	5.65
Arjun	*Terminalia arjuna*	Timber, medicinal	5.35
Sissoo	*Dalbergia sissoo*	Timber, medicinal	6.85
Tentul	*Tamarindus indica*	Fruit, timber, medicinal	1.61

4.9 Status of livestock and poultry

Livestock and poultry play an important role in homestead agroforestry. The farmers earn huge amount of money from this source. The excreta of these livestock and poultry also used as a farm yard manure that enriche the homegarden soil quality. In this research work we have found that among the livestock resources, the mean values was in cow (4.24/household), goat (2.29/household), hen (6.05/household), duck (5.96/household) and pigeon (7.87/household) appeared as most available in the study area. Among the livestock and poultry, pigeon (7.87/household) was maximum rared species and goat (2.29/household) was minimum.

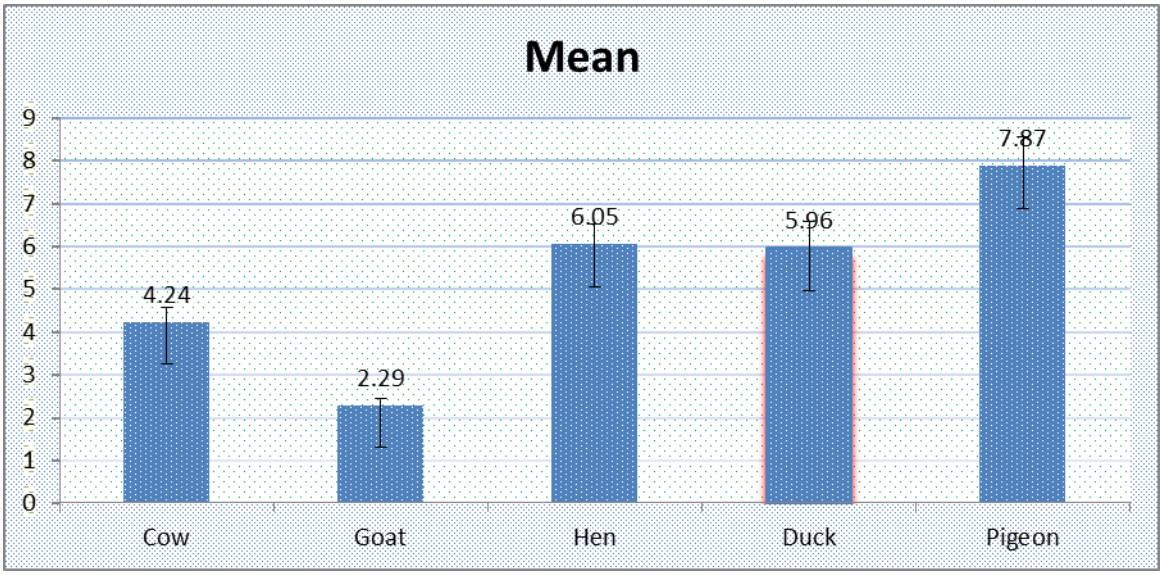

Figure 3. Livestock and poultry status in the study area

4.10 Shannon Wienner Diversity Index

Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4 (Magurran, 2004). From my study it observed the index was 2.523 and evenness 0.645 (table 4.8). The Shannon index increases as both the richness and the evenness of the community increase.

Table 4.8 Shannon wienner diversity index and evenness

Shannon index	Evenness
2.523	0.645

4.11 Management practices

Management practices are mostly practiced by family members incase of homestead agroforestry. From the below table 4.9, it was observed that among various management practices performed by the family member and others 'seed collection' is mostly (86.3 percent) done by the family members. It may be due to that seed is a important component of agriculture and all of the respondents economy is agro-based. So, they take it seriously, done by themselves and do not depends on others. But 'pesticides spray' and 'training and pruning' both are risky and tough for family member. So they mostly done it by others like fermers or labour.

Table 4.9 Performance of management practice scenario in the study area

Management practices	Family members (%)	Others (%)
Seed collection	86.3	13.7
Watering	60.9	39.1
Weeding	58.9	41.1
Manuring and Fertilization	53.9	46.1
Training and Pruning	52.9	47.1
Pesticides spray	52.9	47.1

4.12 Socio-economic effect of homestead agroforestry

In total 10 homestead agroforestry practices were considered to determine the effects of agroforestry on status, species and socio-economic condition of the respondents. For clear understanding and comprehensive analysis of homestead agroforestry effects rank order for each effect was computed by using Socio-Economic Status Index (SESI). The SESI for each agroforestry effect could range from 178.3 to 292.5 against the possible range of 0 to 300 as shown in Table 4.10.

Table 4.10 Effect of homestead agroforestry in socio-economic status of the respondents

Effect of homestead agroforestry	Extent of agreement				*SESI	*RO
	SA	A	PA	D		
Improves environmental condition	92.5	7.5	0	0	292.5	1st
Income increased due to homestead agroforestry	17.6	76.5	5.9	0	211.7	5th
Increased supply of fruits and vegetables	5.1	94.1	0	0	203.5	7th
Increased availability of fuel wood	0	94.1	5.9	0	194.1	8th
Increased availability of timber wood	5.9	94.1	0	0	205.9	6th
Increased availability of fodder crops	0	84.2	9.9	6.9	178.3	9th
Increased production of livestock	13.6	86.4	0	0	213.6	4th
Decreases air temperature	81.3	18.7	0	0	281.3	2nd
Protect from natural disaster	81.3	18.7	0	0	281.3	2nd
Increase owners social value	68.8	31.2	0	0	268.8	3rd

N.B. SA= Strongly Agree, A= Agree, PA= Partially Agree and D= Disagree; *SESI= Socio-Economic Status Index and *RO= Rank Order

'Improves environmental condition' (SESI=292.5) were mentioned by majority of the respondents as the 1st ranked effect of homestead agroforestry. The reason behind this might be that homestead agroforestry improves the environment of the surroundings of a homestead as well as the environment of the overall area. Because, due to homestead agroforestry forest area is increased as a result O_2 and CO_2 proportion of the area remain in a standard condition. 'Decreases air temperature' and 'Protect from natural disaster' were the jointly 2nd ranked effect of homestead agroforestry with SESI value of 281.3 in the rank table as mentioned by the respondents. This may due to that as forestry maintain the O_2 and CO_2 proportion so, air temperature remain in the human tolerable level. On the other side the trees surrounding the homestead protects the house from various natural calamities like storms. 'Increased availability of fodder crops' and 'Increased availability of fuel wood' were the last two effect of homestead agroforestry with SESI value of 178.3 and 194.1 respectively as mentioned by the respondent in the rank table. The tree of the homestead sometimes used as fodder as well as used for fuel purpose. That is why; they obtained the last two positions in the rank table as opined by the respondents (Table 4.10**)**.

4.13 Suggestions offered by the respondents

Many suggestions were opined by the farmers these are given in bellow:

Table 4.11 Rank order of suggestions offered by the respondents

Suggestions	Number of Citations	Percentage of respondents	*RO
The good quality seeds/seedlings should be available	65	63.73	1st
The fertilizer and plant protection materials should be available	54	52.94	2nd
The homestead owner should be trained by the GOs or NGOs about homestead agroforestry practices	52	50.98	3rd
Provide time to time suggestions by extension worker	25	24.51	4th
The number of extension worker should be increase	22	21.57	5th

N.B. *RO= Rank Order

It is observed from the Table 12 that the foremost (63.73 percent) suggestion cited by the respondents was 'The good quality seeds/seedlings should be available'. This implies that the seeds and seedlings for agroforestry should be available then the quality of agroforestry system will be good.

'The fertilizer and plant protection materials should be available' was the second most important (52.94 percent) suggestion offered by the respondents. This is due to that more the fertilizer and plant protection materials should be available the respondents will practice agroforestry more. 'The number of extension worker should be increase' (21.57 percent) was suggested by the respondents as the last suggestion (Table 4.11).

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

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5.1 Summary

The study was conducted in each union of Biral upazilla in Dinajpur district. Sites were selected purposively as the locale. A sample of 15% farm families was selected found on stratified random sampling procedure. Then 102 respondents were selected through preference sampling method. Respondents of the survey were selected based on four different farm categories. Data were collected by using pre-tested interview schedule and preference ranking. Then the collected data were summarized to meet the objectives of the study. Finally, the collected data were coded, compiled and tabular analyzed to fulfill various objectives. Data were collected through personal interview by the researcher himself from the sample respondents during June, 2016 to July, 2016. Respondents' opinion regarding impact of homestead agroforestry on socio-economic condition was the dependent variable of the study. Six selected characteristics of the farmers were taken as independent variables. The characteristics were age, education, family size, homestead size, source of information, annual income, MPTS, composition constituted the dependent variables in this study.

From questionnaire survey it was found that the age of the respondents in the study area ranged from 20 to 70 years, the mean being 45.65 and standard deviation 13.96. The highest percentage of respondents was found on as 'middle aged' (42.2) and the lowest percentage on 'young aged' (26.5). The education of the farmers in the study area ranged from 0-14 years of schooling with an average of 7.51 and standard deviation 5.56. The maximum percentage of respondents was found on above secondary level (37.3) and minimum percentage of respondents was found on illiterate (7.8). The family size was an average 6.39 and standard deviation 2.15. The highest percentage of respondents was found 'medium'(50) and the lowest percentage of respondents was found on 'small' (5.9). The homestead area of the respondents ranged from 0.02-0.2 hectare with an average of 1.64 and standard deviation of 0.910. The highest percentage of respondents was found 'marginal'(57.8) and the lowest percentage of respondents was found on 'medium' (05.9) sources of information were got highest from extension worker. The frequency of sources of information was maximum in extension worker that was 39.2

percentage. The annual income of the farmers varied from Tk. 11,800 to Tk. 50, 15,000 with an average of Tk. 3, 68,140. As ranged annual income 75.5% of the farmers were found medium income and; 12.7% and only 11.8% were found high and low income category, respondents. Mango was the most frequent species in the studies area. The frequency of mangoes was 90 and relative frequency was 11.08 which were the highest among all the species. Relative density (RD), abundance (A) and relative abundance (RA) all were found the highest in eucalyptus 37.38 (RD), 34.71 (A), 33.82 (RA), respectively and in all cases the lowest value was tentul. Important Value Index was also high in eucalyptus (74.64) and low in tentul (1.61). The highest mean value of livestock was pigeon 7.87 and lowest mean was goat in 2.29. The Shannon Index was 2.523 and evenness was 0.645. The study result was also revealed that management practices were mostly done by family members. Improves environmental condition was number one rank and increases availability of fodder crops was last number of socio-economic effect of homestead agroforestry. 'The good quality seeds/seedlings should be available' was most advisable recommendation and 'the fertilizer and plant protection materials should be available' was next recommendation from the respondents.

5.2 Conclusion

- Homestead agroforestry was a popular agroforestry practice in the study area.
- Diversity of the species were ranked as Eucalyptus > Mango > Mahogani..… > Tentul in the study area.
- Homestead agroforestry improves socieo-economic condition of the respondents by ensuring income, meting daily basic needs of the family and provides ecological stability.
- Availability of good quality seeds/seedlings was their main problem in practicing homestead agroforestry.

5.3 Recommendations

The following recommendations are made on the basis of findings of the current study:

i) More emphasis should be given in the supply and availability of good quality seeds/seedlings to the farmers for more production and income.

ii) The homestead agroforestry system can be improved by proper care and management and crops having low economic value should be replaced by high economic value.

iii) More income generating activities should be created from homestead sources. Since mango is a multipurpose fruit tree commonly found in all locations, income generating industry can be made on the basis of mango production.

iv) The efforts should be made to identify different shade tolerant vegetables and to motivate the farmers to increase the vegetable production of the study area and to cultivate them under the trees in the homestead.

v) It is strongly recommended that the interaction between farmer's and extension workers should be strengthened and the present extension services should be improved. Farm based training should be introduced.

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APPENDICES

APPENDICES

Appendix-A

Department of Agroforestry and Environment

Hajee Mohammad Danesh Science and Technology University, Dinajpur

An interview schedule on-Status, Diversity and Socio-Economic Effect of Homestead Agroforestry in Dinajpur, Bangladesh

Name of the respondent: ..... Sl. No.....
Village: ..... Union: .....
Upazila: ..... District: .....

Age (years)	Sex		Family size (no.)		Religion			
			Male	Female	Islam	Sonaton	Tribal	Others (specify)
	Male	Female						

Level of education

a. Cannot read and write ( )

b. Can sign name only ( )

c. I have passed class: .....

Homestead agroforestry and its socio-economic impacts

1. Which category of homestead size do you have? (Put tick mark below)

Category of homestead	Amount		
	Tick mark	Land available for home garden	(Local Unit: …)
Marginal homestead (>0.02-0.08 ha)			
Small homestead (<0.08-0.14 ha)			
Medium homestead (<0.14-0.20 ha)			
Large homestead (<0.20 ha)			

2. Did you get any knowledge or information from any sources? (Put tick mark below)

Extension worker	NGOs	Neighbors	Own knowledge

3. Annual income: Please mention the production and income of your family has earned last year from different sources?

Sl.	Source of income	Production (Kg)	Market price (Tk.)	Total price (Tk.)
1.	Agriculture			
2.	Service			
3.	Business			
4.	Others			
Total income =				

4. Please tell me some fruit, timber, fuel wood and fodder producing crops which have in your homestead?

S1 No.	Name of crops														
	Fruit trees			Timber trees			Fuel wood trees			Vegetables and spices			Fodder crops		
	Name	No.	Production	Name	No.	Production	Name	No.	Production	Name	No.	Production	Name	No.	Production
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															
11.															
12.															
13.															
14.															
15.															
Total															

5. Please mention the production of different products in your homestead.

Items	Income & expenditure (Tk.)		
	Expenditure (Tk.)	Income (Tk.)	Profit/loss (Tk.)
Fruits			
Timber			
Fuel wood			
Vegetables and spices			
Fodder			
Nurseries			
Livestock			
Others			
Total (Tk.)			

6. Please tell me livestock which have reared in your homestead?

Name	Cow	Goat	Buffalo	Sheep	Hen	Duck	Pigeon	Others
Tick mark								
Number (before 1 year)								
Number (present)								

7. Among the total species, please mention the species, which have medicinal value?

Sl. No.	Name of the medicinal plants	No. of plants	Uses & benefits (why you planted it)
1.			
2.			
3.			
4.			
5.			
6.			
7.			

8. Who care and manage your homestead gardening? Please mention

Management practices	Yes/ Not	Participator	
		Family members	Others
Seed collection & seed sowing/planting			
Watering			
Weeding			
Manuring and fertilization			
Training and Pruning			
Pesticides spray			
Others			

9. Please give your perceived effect of homestead agroforestry?
(Put tick mark below)

Sl. No.	Effect of homestead agroforestry	Opinion about effects of homestead agroforestry			
		Strongly Agree	Agree	partially agree	Disagree
1.	Improves environmental condition				
2.	Income increased due to homestead agroforestry				
3.	Increased supply of fruits and vegetables				
4.	Increased availability of fuel wood				
5.	Increased availability of timber wood				
6.	Increased availability of fodder crops				
7.	Increased production of livestock				
8.	Decrease air temperature				
9.	Protect from natural disaster				
10.	Increase owners social value				

10. Please give your valuable suggestions about homestead agroforestry system

a.……

b.……

c.……

d.……

e.…….

Thank you for your cooperation

.....
Signature and date of the interviewee

Appendix-B: Some pictures showing different homestead area during survey work

(a)

(b)

(c)

(d)

(e)

(f)