HOMESTEAD PLANT BIODIVERSITY STATUS IN DUMURIA UPAZILA OF KHULNA DISTRICT

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HOMESTEAD PLANT BIODIVERSITY STATUS IN DUMURIA UPAZILA OF KHULNA DISTRICT

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*This is to certify that thesis entitled, "**HOMESTEAD PLANT BIODIVERSITY STATUS IN DUMURIA UPAZILA OF KHULNA DISTRICT**" submitted to the **Faculty of Agriculture**, Sher-e-Bangla Agricultural University, Dhaka in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (MS)** in **HORTICULTURE,** embodies the result of a piece of bona fide research work carried out by **RUMANA AKTER, Registration No. 07-02252** under my supervision and guidance. No of part of the thesis has been submitted for any other degree of diploma.*

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

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ABSTRACT

The survey study was conducted at Dumuria upazila of Khulna district to determine the status of homegardens and homestead owners' perceptions on biodiversity conservation through homegardening and to explore its relationship with the selected characteristics of the homestead owners. One hundred and ten homestead owners were chosen randomly and used for collecting data during the period from 23 November 2012 to 14 February 2013 for the study. An interview schedule with simple technique and visual observation was used for survey. A total of 69 different tree species was recorded in the homesteads of study area *viz. Areca catechu* L., *Azadirachta indica*, *Swietenia macrophylla* King, *Cocos nucifera* L., *Musa* spp., *Mangifera indica* L., *Artocarpus heterophyllus* Lam., *Pouteria sapota* (Jacq.) Moore., and *Samanea saman* (Jacq.) Merr. were dominant species. The study revealed that the species richness was the highest in Chuknagar village (H′= 8.09) according to Shannon-Weaver index. About half (48.2%) of the homestead owners had standard perception on biodiversity conservation through homegardening followed by 45.4% had moderate perception and only 6.4% had poor perceptions. Pearson's product moment correlation coefficient (r) was used for statistical analysis along with the usual descriptive statistical parameters. Out of eleven selected characteristics *viz.* Farm size, Annual family income, Extension media contact, Training received and problems faced by the homestead owners showed significant relationships with the biodiversity perceptions of homestead owners, while no such relationship was observed with age, education, homestead size, gardener type, credit received, species composition of homegarden.

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LIST OF ABBREVIATIONS

Abbreviation	Full Word
BBS	Bangladesh Bureau of Statistics
UN	United Nations
FAO	Food and Agriculture Organization of United Nations
DAE	Department of Agricultural Extension
a.s.l.	Above sea level
CV	Co-efficient of Variation
d.f.	Degrees of Freedom
DAE	Department of Agricultural Extension
et al.	And others (at elli)
etc.	Etcetera
e.g.	Example
ha	Hectare
i.e.	That is
km	Kilometer
NGO	Non-Government Organization
viz.	Namely
%	Percent

CHAPTER I
INTRODUCTION

The people are increasingly detached from nature due to several reasons like population growth, deforestation, land fragmentation, urbanization, etc. Once largely forested, Bangladesh now has a forest cover of less than 11% (AIS, 2014). Deforestation and fragmentation have resulted in greatly reduced biodiversity and have created major challenges for conservation of biodiversity. Despite governmental interest to increase the protected forest area, conservation of biodiversity in Bangladesh will require major contributions from private, managed patches outside natural and protected area systems.

Bangladesh possesses a glorious tradition of agroforestry system practiced by her farming communities. It has so long been centered on the farmer's unique understanding of growing crops, rearing livestock and fishes and plantation of different varieties of trees and plants in and around homestead.

The importance of homegardens for the production of food, medicine and other useful products for human beings is widely recognized; consequently, regular attempts to improve the productivity of this widespread agro-ecosystem have usually been initiated with specific objectives in mind.

In Bangladesh the forest area is only 10% (FAO, 2012), which is very far away from its target (at least 25%). The government forest area is drastically decreasing. To meet the need of fuel, people are using woods as their main fuel source. Lands are barrenned to cultivate food crops. Trees are cut to make different commodities, thus the forests are decreasing. It is agroforestry system which can prevent the deforestation and increasing the rate of aforestation.

Bangladesh is one of the most densely populated countries of the world having about 150.25 million people in its 147570 km^2 of area. The country has a total area of 14.4 million ha of which land covers 13.62 million ha and river 0.78 million ha. There are 9.25 million ha of cultivated land and about 1.9 million ha of forest area in Bangladesh (Anon., 2011). About 70% of the population lives in the rural areas in 15.4 million households spread over 89.000 villages. There are only 399589 has of homestead land (about 4.33% of total cultivated land) having 0.03 ha per household. Marginal, small, medium and large households have an average of 0.01, 0.02, 0.04 and 0.07 ha of homestead land, respectively. Due to shortage of agricultural land, homestead agroforestry practices may be a good strategy for survival and existence of the general people because of secured supply of food and petty cash.

According to an estimate in Bangladesh 65-70% of fruits, 60% fuel wood, 80% bamboo (FAO, 2011) supplied from homegardens. So it might be the most productive source of income of homestead owners.

Homegardening is a traditional agroforestry system (Wiersum, 2004) and a common feature in many tropical countries, and often exhibit remarkable variability in composition and structure (Albuquerque *et al*. 2005, Peyre *et al*., 2006). Homegardens are maintained by at least 20 million households and cover an area of 270,000 ha in Bangladesh (Salam *et al*., 2000). Therefore represent one possible strategy for biodiversity conservation. Indeed, the limited research on Bangladeshi homegardens has revealed diverse floristic composition and complex garden structure (Ahmed and Rahman, 2004; Ali, 2005).

Species diversity in a homegarden can range from less than five (Withrow-Robinson and Hibbs, 2005) to more than 100 (Hemp, 2006), and therefore can be important islands of diverse plants. Yet systematic study tends to suffer from low sample sizes (*i.e*., few homegardens sampled), or limited taxonomic treatment (*e.g.*, surveying only

trees), so the capacity of homegardens to contribute to biodiversity conservation in Bangladesh remains understudied.

Historical reasons *viz*. feudalism, colonial rule and the population explosions along with lack of awareness of mass people combined with improper management the forest resources of Bangladesh have appreciably been dwindling and gone below the expected level. This has been resulting not only serious ecological imbalance causing recurrent flood, droughts, environmental pollution, but also decreasing the production of necessary plant products such as food, fodder, fuel materials, timber etc.

This research therefore explored and quantitatively assessed the total botanical diversity and structural characteristics of 110 homegardens. The present study envisages assessing homestead production system with respect to concept of homegardening in Dumuria Upazila of Khulna District. The study area (Khulna district) is under the southern part of Bangladesh. It is one of the densely populated districts of Bangladesh. It was once a forest rich area but deforestation and degradation of land due to salinity are severe in some places of Khulna district now-a-days.

It was expected that this study will be able to generate valuable information on the exiting homestead agroforestry system and identify gaps in biodiversity conservation through homestead production, economic and environmental upgradation of the farmers. On the basis of existing homegarden situation and prevailing gap, it would be possible to arrive at some concrete recommendations for further developmental steps to be taken for effective homegarden practices in Bangladesh and more specifically in the Khulna district.

The present study was undertaken with the following objectives:

i) To identity the different tree species being grown in the homestead of target area

ii) To determine the relation between different traits of farmer and tree diversification

iii) To evaluate the opinion of the farmers regarding biodiversity conservation through homegardening and problems faced by them.

CHAPTER II

REVIEW OF LITERATURE

This study was mainly concerned with plant diversity of the homesteads under different level of the farmers and their livelihood of Dumuria upazila of Khulna district in Bangladesh to assume the reality at the grass root level.

The researcher made an elaborate search of available literature for this research. Available literature was extensively reviewed to find out relevant work in Bangladesh as well as in abroad. The information on biodiversity and homegarden related to this research is voluminous. Thus only the most relevant information to this study was reviewed in this chapter. The reviews were conveniently enucleated based on the major objectives of the study.

2.1 Concept of Biodiversity and Homegarden

2.1.1 Biodiversity

Biodiversity is a cornerstone of developed and developing economies. Without healthy concentrations of biodiversity, livelihoods, ecosystem services, natural habitats, and food security can be severely compromised.

According to the AIS (Agricultural Information Service) published Krishi Diary (2014), in present time Bangladesh experienced less than 11% forest area. But once it was largely forested with a huge number of plant species. As the forest area is decreased many species are extinguished and many are in endangered condition.

Beaumont *et al.* (2011) stated that biodiversity conservation and the maintenance of associated ecosystem services are vital for human well-being. However, over 75% of Earth's terrestrial biomes have shown alteration as a result of anthropogenic activities. Species diversity is one of the most intuitive and widely adopted measures of biodiversity at both ecological and biogeographic scales.

Sahney *et al.* (2010) concluded that measuring diversity at one level in a group of organisms may not precisely correspond to diversity at other levels. However, tetrapod (terrestrial vertebrates) taxonomic and ecological diversity shows a very close correlation.

Gardner *et al.* (2009) found that habitat degradation, fragmentation, and overex-ploitation have contributed to the loss of biodiversity around the world. The impacts of these changes on biological systems are manifested as shifts in phenology, interactions, species distributions, morphology and net primary productivity.

Bhagwat *et al.* (2008) revealed that maintaining and creating habitats in human dominated landscapes can help to conserve a large proportion of biodiversity. The same result was also founded by Acharya (2006).

Trewhella *et al.* (2005) suggested that awareness building campaigns, publications, and educational programs are methods to increase public support for using native species in homegardens.

Garrity (2004) revealed that in tropical landscapes, more than 90 % of biodiversity resources are found in human dominated landscapes.

Kevin and Spicer (2004) defined most straightforwardly, biological diversity or biodiversity is ‘the variety of life’, and refers collectively to variation at all levels of biological organization.

Campbell (2003) stated that, biodiversity involves diversity of species, genetics and habitats. But there is a fourth source of biodiversity – molecular biodiversity – without which evolution cannot occur, either in the origin of a new species, its survival and development, or its eventual extinction.

Hodgkin (2001) found that a homegarden will seldom host more than a few hundred plants even of the most important crops and the population size is highly variable depending on the species. Because of such variation in terms of inter-and intra-specific diversity, scientists generally agree that a representative conservation unit should include not one but a number of gardens in multiple agro-ecological zones, thus capturing a significant representation of the overall diversity for any given species.

Hawksworth (1996) defined "biological diversity" as "the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems".

According to Tilman (1996) biodiversity refers to the number of species in a given area, the genetic diversity of those species and also the diversity of life forms, and it plays a role in stabilizing community and ecosystem processes.

According to Wilcox (1984) genetically biodiversity can be defined as the diversity of alleles, genes, and organisms. They study processes such as mutation and gene transfer that drive evolution.

2.1.2 Homegarden

Abebe *et al.* (2010) found that homegardens are essentially man-made and reflect the wisdom of the traditional culture and ecological knowledge that have evolved over the years.

Eyzaguirre and Linares (2010) described homegarden as a well-defined, multi-storied and multi-use area near the family dwelling that serves as a small-scale supplementary food production system maintained by the household members, and one that encompasses a diverse array of plant and animal species that mimics the natural eco-system.

Mamun *et al.* (2010) stated that in a typical homestead threshing ground, cow shed, pond, vegetable and cash crop garden etc. are shared by surrounding families. Traditionally people are growing trees, shrubs, herbs and vegetables as a mixed crop in their homestead based on their generation old experiences and manifold needs. The special arrangement of different tree species around the house, taking into account needs for wind breaks, shade, family enclosures and open spaces as the distribution of different shrubs and annual vegetables in different microfiches are quite appropriate and time proven.

Moreno-Calles *et al.* (2010) defined homegardens as important agroforestry systems developed by numerous human cultures worldwide. Characteristically located attached to peoples' houses, these systems are commonly formed by a variety of plant and animal species either wild and domesticated, whose composition and structure are continually transformed according to plans designed by humans that manage them.

Ahsan (2008) identified three land types namely highland and medium highland and medium low land in Dumuria upazila of Khulna district. The textural classes of soil found were clay loam, clay and peat soil. Seven soil groups *viz.* gopalpur, ishudi, gihur, bajoa, barisal, harta and satla were identified. Seven major cropping patterns were found in the upazila. Total 215 soil samples were collected and analyzed and found that the soils of the upazila are deficient in almost all essential nutrient elements except S, Zn,Ca, Cu, Fe and Mg, Mn.

Kabir and Webb (2008) revealed that compared with other published studies across the world, homegardens in southern Bangladesh exhibited high species richness.

Odebode (2006) stated that homegardening refers to the cultivation of a small portion of land which may be around the household or within walking distance from the family home.

Hemp (2006) and Withrow-Robinson and Hibbs (2005) calculated the species number in the homegardens of Thailand and Chagga in Tnazania, respectively. They found that the species number can range from less than five to more than hundred.

Albuquerque *et al*. (2005) remarked that homegardens are a common feature in many tropical countries, and often exhibit variability in composition and structure.

Altieri (2004) stated that homegardens, low-intensity agroforestry plots, and abandoned temperate orchard meadows all tend to have high levels of biodiversity, and are known to be important for the conservation of agrobiodiversity.

Kumar and Nair (2004) documented that homegardens are variously named in English language as agroforestry homegardens, backyard gardens, farmyard, roof top garden, homestead farms, gardens. They also summarized the shared perception by referring homegarden as intimate, multi-story combinations of various trees and crops, sometimes in association with domestic animals, around homesteads, and added that homegarden cultivation is fully or partially committed for vegetables, fruits, and herbs primarily for domestic consumption.

Wiersum (2004) defined homegardening as a traditional agroforestry system where a clearly bounded piece of land immediately surrounding the dwelling house is cultivated with a mixture of perennials and annuals.

Engels (2002) claimed that homegarden was the traditional life supporting system in rural areas and some urban areas in many countries.

According to Ninaz (1998) homestead refers to home and adjoining land occupied by a family for the purposes like small scale agricultural production, home up keeping, health, sanitation and nutrition.

Haque (1996) 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.

Fresco and Westphal (1988) specified homegardens as a cropping system composed of soil, crops, weeds, pathogens and insects that converts resource inputs *viz.* solar energy, water, nutrients, labor, etc. into food, feed, fuel, fiber and pharmaceuticals.

Niñez (1987) studied that globally homegardens have been documented as an important supplemental source contributing to food and nutritional security and livelihoods. Food production on small plots adjacent to human settlements is the oldest and most enduring form of cultivation.

According to FAO (1986) homegardens are one of the most elaborate systems of indigenous agroforestry, found most often in tropical and subtropical areas where subsistence land use systems predominate.

2.2 Biodiversity Conservation through Homegardening

Homegarden is a traditional component of the rural ecosystem that has been practiced for a long time by farmers. In Bangladesh where natural forest cover less than 10%, homegardens which are maintained by at least 20 million households and cover an area of 270,000 ha *i.e.* 2% of the country's total land area and 10% of the total primary forest area (FAO, 2012), represent one possible strategy for germplasm conservation. Deforestation and fragmentation have resulted in greatly reduced biodiversity and have created major challenges for conservation.

Agbogidi and Adolor (2013) claimed that crop diversity is maintained in homegardens when it meets producers' needs. It may be maintained over long periods and in this sense, it may be said to be conserved *"in situ"*. However, conservation is rarely (if ever) the actual objective. Farmers who maintain diversity do so because they find it beneficial. Thus, any evaluation of *in situ* conservation of crop diversity in homegardens has to place the desired conservation objectives (the amount of diversity maintained, the duration of maintenance etc.) in the context of farmers' production objectives.

Cruse-Sanders *et al.* (2013) documented that homegarden systems are also areas where domestication is experimented and agricultural practices are commonly tested there before carrying out them into parcels in fields out of the villages. Since homegardens are spaces of resources, management techniques, and human cultural processes these systems are considered as important reservoirs of biocultural heritage.

Larios *et al.* (2013) hypothesized that since native plant species are continually introduced to homegardens by people, plant diversity harboured in these systems would be proportional to the natural diversity existing in local forests, and also similar to the proportion of native plant species found in homegardens at regional level.

Parra *et al.* (2012) revealed that homegardens commonly are reservoirs of agro biodiversity but also they may maintain native natural biodiversity, including genetic diversity of species occurring wild in forests.

Jose (2011) suggested that homegardens as a conservation tool needs to be exploited further.

Muzaffar et al. (2011) claimed that there has been a lack of concern about ecosystem restoration compounded with primitive and ineffective forest practices and on-going deforestation.

Akhter *et al.* (2010) found that homegardens are increasingly recognized as ecosystems for *in situ* conservation of agro-biodiversity. In Bangladesh where natural forest cover is less than 10%, homegardens, which are maintained by at least 20 million households, represent one possible strategy for biodiversity conservation. The conservation of cultivated plants in homegardens not only preserves a vital resource for humankind but also provides significant economic and nutritional benefits for the rural poor.

Blancas *et al.* (2010) documented that homegardens, harbour high native biological diversity and could be key targets for policies of biodiversity conservation at regional level.

Altieri (2009) found one of the greatest challenges of the contemporary human societies is therefore how to achieve optimum productivity without losing diversity of components and functions of homegarden systems.

Jose (2009) found that in tropical homegardens species diversity is generally believed to be very high. Homegardens reached high levels of development in terms of plant diversity, labor input and% income derived from garden in region where population densities are high and create a forest like multi story canopy structure. Moreover, species diversity, shape and plant density also vary from place to place depending on cultural, ecological and socio economic factors.

Camou-Guerrero *et al.* (2008) found that different indigenous cultures in Mesoamerica have conserved traditional ecological knowledge and forms of natural resources management, which represent thousands of years of adaptation of human groups to particular surrounding environments and confer to them a high potential contribution for sustainable socio-ecological systems and biodiversity conservation.

Rizvi (2007) concluded that a number of developing countries in the world remain far behind in executing plans aimed at reversing species loss, due to the rapid growth of unplanned urbanization. Several of these developing countries also happen to be the richest in terms of biodiversity. More and more local decision makers are presently realizing that all of the resources that keep human settlements productive, healthy, and economically viable must be considered, especially the variety of living organisms, ecosystems, and natural processes that underpin the survival of human beings.

Ashley *et al.* (2006) analyzed the policy terrain affecting agroforestry around protected areas in five very different contexts across Sub-Saharan Africa finding both expected and unexpected similarities. Across the sites in Uganda, Cameroon Mali, the study revealed a rougr policy terrain for agroforestry systemic market constrains, contradictions between development approaches and conservation objectives, and inconsistencies in institutional and regulatory frameworks. Making the conservation landscape approach more effective will require that both agriculturists and conservation planners have much greater appreciation for the conservation and livelihood potential of agroforestry.

Kumar and Nair (2006) stated that complex, diversified and highly traditional rooted part of plant biodiversity conservation and utilization is found in homegardens.

Montagnini (2006) stated that in Bangladesh, homegardens are the most widespread agroforestry system and therefore may represent the only large-scale managed system with potential for biodiversity conservation in the country.

Peyre *et al*. (2006) revealed that yet very little attention has been given to what extent managed landscapes could hold biodiversity value in Bangladesh.

Torquebiau and Penot (2006) stated agroforestry system as more probably ecologic-ally sustainable when allows biodiversity conservation and maintenance of water and soil, which in turn favors diversity of biotic interactions buffering changes in

temperature and humidity, maintenance of nutrients cycling, efficient use of light and waste management determining wellbeing of people that manage them.

Abebe (2005) concluded that some physical and socioeconomic factors influence farm level species richness and density of trees. Farms located near roads had a lower number of tree species, and lower diversity. The number of trees farm^{-1} and ha^{-1} increased with distance to major roads, suggesting that further from the roads farms is less exploited. Also species evenness decreased with distance from the roads. Within the altitudinal limits (1520-2040 m a.s.l.), the total number of trees as well as their density increased with altitude.

Ali (2005) as well as Ahmed and Rahman (2004) concluded that the Bangladeshi homegardens conceived a diverse floristic composition and complex garden structure. A limited research has done on this regards and it is a crying need to research extensively to find out the actual status of species diversification around the homegarden.

Mendez and Bacon (2005) documented that in managed landscapes, tree-dominated habitats such as natural forest patches or agroforests such as homegardens often show promise for biodiversity conservation, so in Bangladesh, tree-dominated patches may also be important for conservation of plant biodiversity. People have been cultivating, managing, and conserving diverse plants in and around their houses for alternative sources of forest products and services, supporting the idea that these managed patches could be of significant conservation value.

Rahman (2005) found through ranking different extents that majority (49%) of the famers had medium agricultural adaptation while 34.3% had low adaptation and 16.7% had high adaptation.
Tangjang and Arunachalam (2004) stated that agroforestry systems have been maintained as a part of rural survival over generations, with the multi-storey vegetation structure and diverse type of plant composition. In the present study, plant species composition and diversity of traditional agroforestry systems practiced by three different ethnic groups in Arunachal Pradesh, India were evaluated. The total numbers of trees, shrubs and herbs species recorded were 41, 22 and 35, respectively. Overall, the plants have been distributed contagiously (83.19%). Shannon's diversity index varied between 0.73 and 1.22 for tree species and between 0.98 and 1.08 for the herbaceous species.

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 unit of land. This subsistence 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 components: (1) crop fields (2) a private land support system (3) a forest support system (4) livestock (5) man in the uniquely specific socioeconomic-cultural setting of the region.

IPGRI (2002) reported that ‘homegarden’ system is an important reservoir of unique genetic diversity has more recently led to more study of this system in order to obtain a better understanding of the role of homegardens in the management and conservation of genetic diversity *in situ.*

Sadhana *et al.* (2002) reported that five trees suitable for agro forestry systems that is Babla (*Acacia nilotica*), Neem (*Azadirachia indica*), Mahua (*Madhuca longifolia*), Arjun (*Terminalia arjuna*) and Bohera (*Terminalia belericd*) which were found to be effectively used by the respondents in the form of various indigenous health practices for curing their different health related problems.

Salam *et al*. (2000) found that homegardens are maintained by at least 20 million households and cover an area of approximately 270,000 ha (2% of the country's total land area and 10% of the total primary forest area) in Bangladesh and therefore represent one possible strategy for biodiversity conservation.

Ahmed (1997) found 31 minor fruits in the homesteads in Bangladesh. The minor fruits account for as many as two-thirds of the total number of fruits found to grow in homesteads.

Maxted *et al.* (1997) stated that there has been little exploration of the economic, sociocultural and environmental variables influencing farmers' attitudes toward maintaining crop diversity on-farm, and therefore little understanding of farmers' willingness to get involved. Though it has been less studied and remains less well understood, the genetic diversity of crop land races is conserved within traditional farming systems.

Wood and Lenne (1997) revealed that there has very little institutional attention drawn especially for on-farm conservation relevant to homegarden in Sri Lanka, even in global agenda it is a topic of recent interest and past neglect. There is substantial relevant information which has been collected for other reasons for example, by anthropological studies or during farming systems research about biological conservation.

CHAPTER III

METHODOLOGY

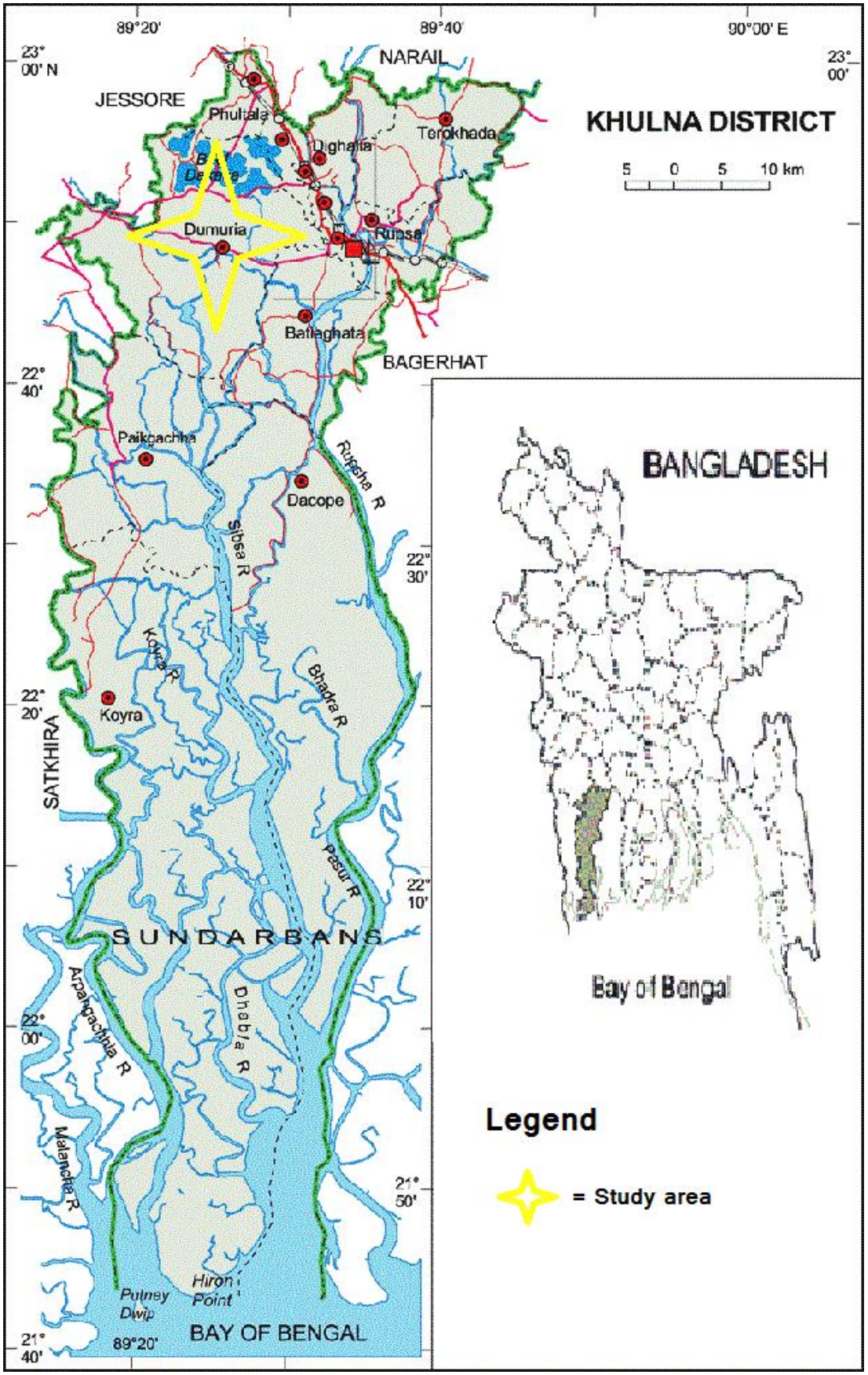
The methodology used in conducting any research is critically important and deserves careful consideration. It is impossible to conduct research work smoothly without proper methodology and it is also very difficult to address the objectives with a scientific manner. It requires a very careful consideration on the part of the researcher to collect valid and reliable data in terms of hypothesis or research instrument and to analyze the same properly for meaningful conclusion. A sequential description of the methodologies was followed in conducting this research work has been presented in this chapter.

3.1 Geographical Location of the Study Area

The study was conducted in five villages of Dumuria Upazila under Khulna district (Fig. 1). The study area is located in the southern part of Bangladesh. The distance of Khulna from Capital Dhaka is 190 km. It is bounded on the north by Phultala Upazila of Khulna and Jessore district, on the west by Batiaghata Upazila and City Corporation, on the south by Paikgacha Upazila, on the east Satkhira district. The Dumuria Upazila is situated between $22^{o}39'$ and $22^{o}56'$ north latitude and between $89^{o}15'$ and $89^{o}32'$ east longitudes. It has an area of 447.97 sq. kms. Location of the study area is shown in the map illustrated on page (Fig. 2).

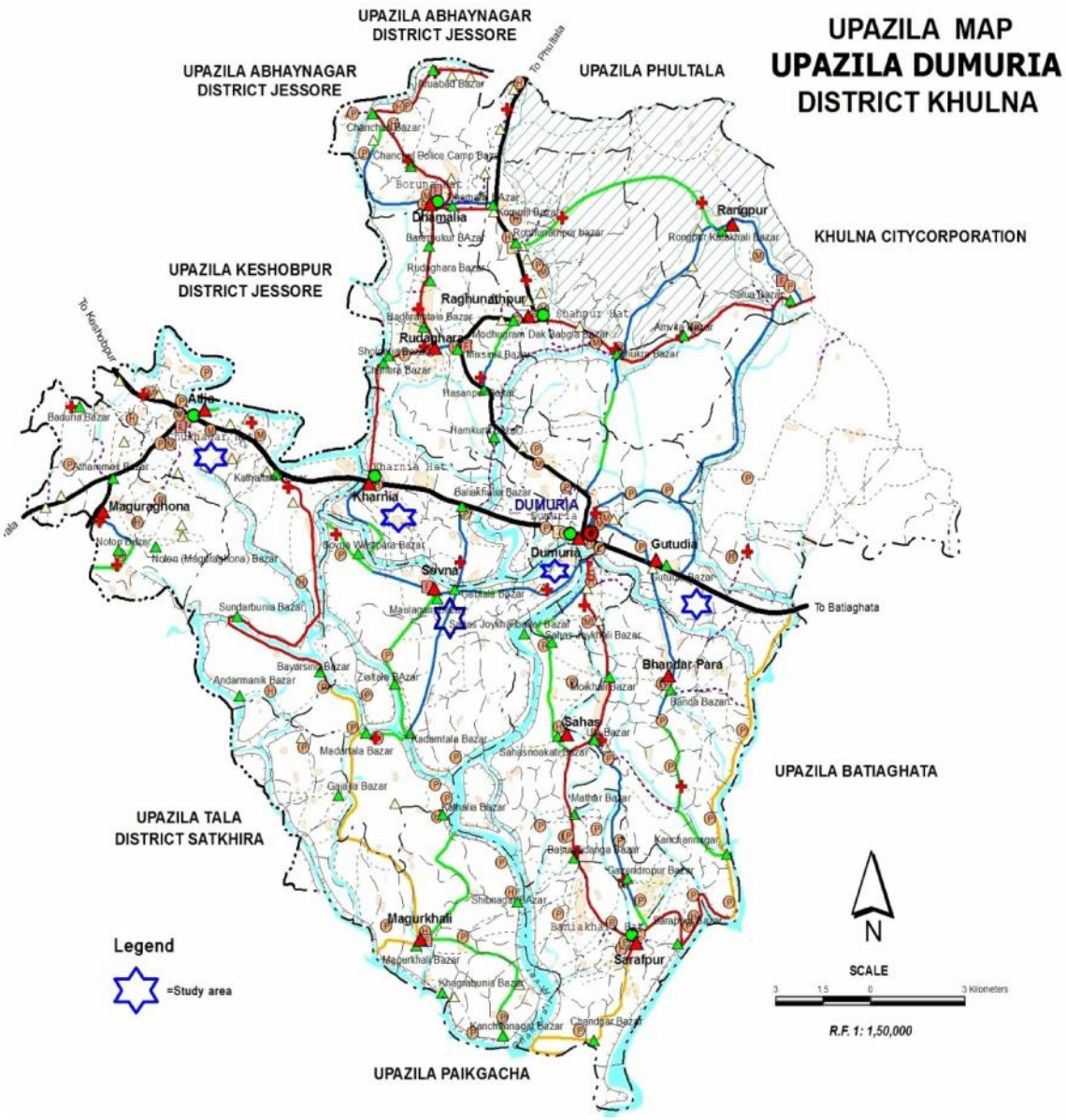
3.2 Physiography of Study area

Dumuria upazila is situated in the north- western part of Khulna district. It lies under the AEZ no. 11, 13 and 14 (Ganges flood plain, Ganges tidal flood plain and Mixed Gganges tidal flood plain and Gopalgong-Khulna bills).



Source: http://www.lged.gov.bd/

Figure 3.1: A map of Khulna district showing Dumuria upazila.



Source: http://www.lged.gov.bd/

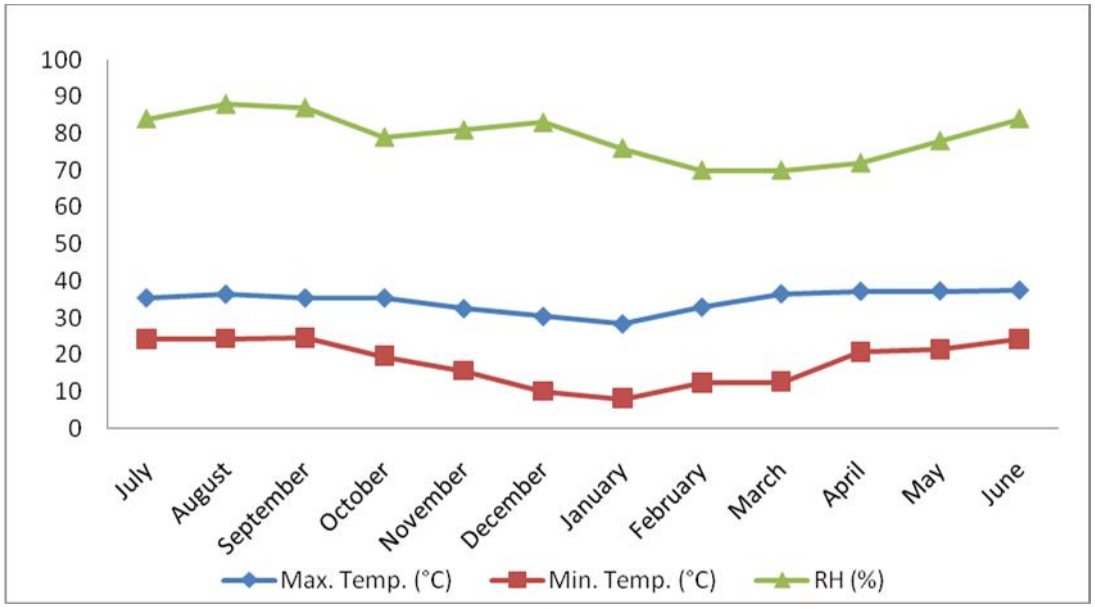
Figure 3.2: A map of Dumuria upazila indicating the study area.

3.3 Soils

In Dumuria upazila major land type recognized was medium highland comprising 61.3% of total area followed by miscellaneous land comprising 22.1% of the total area. Major textural class also identified was clay covering 39.1% of total area followed by peat soil (25.8%). Seven soil groups were identified *viz.* gopalpur, ishudi, gihur, bajoa, barisal, harta and satla (Ahsan, 2008). In medium highland barisal covers major area (33.3%) while in peat soil harta covers major area (14.2%).

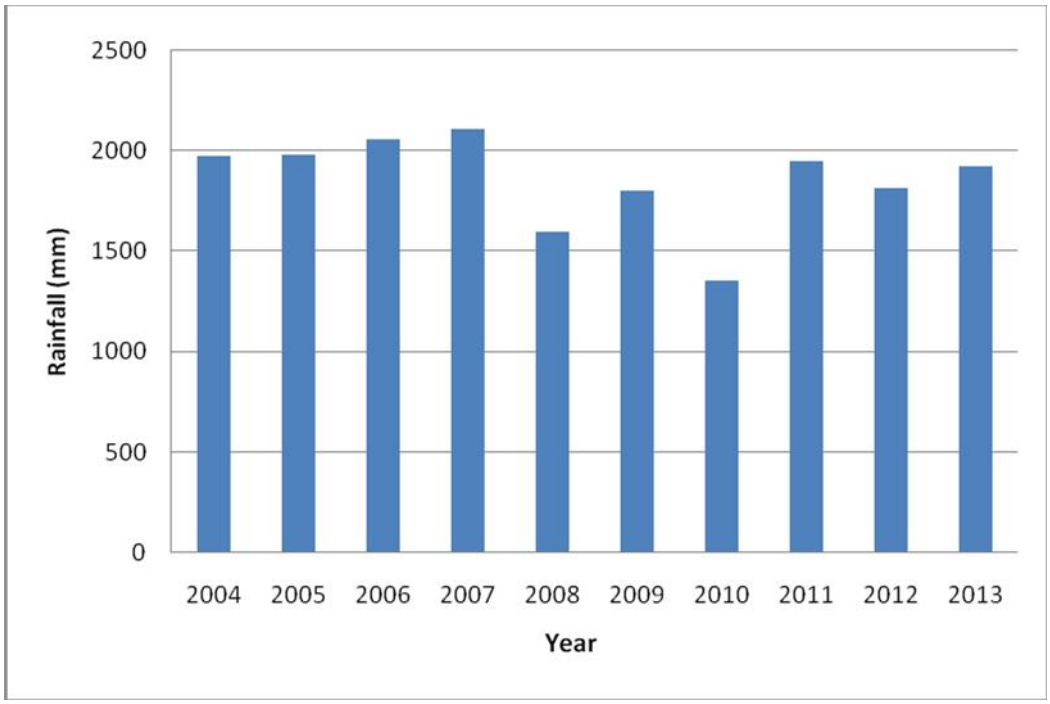
3.4 Climate

The climate of the Khulna district is humid and pleasant. It is humid during summer and pleasant in winter. The summer begins from the middle of March and continues till the middle June. The rainy season starts from the middle of June and continues till the end of September. Khulna has an annual average temperature of 26.3°C and monthly means varying between 8°C in January and 37.4°C in May (Fig. 3.3). Annual average rainfall of Khulna is 1857.7 mm (Fig. 3.4). Approximately 86% of the annual average rainfall occurs between June and September (Fig. 3.5).



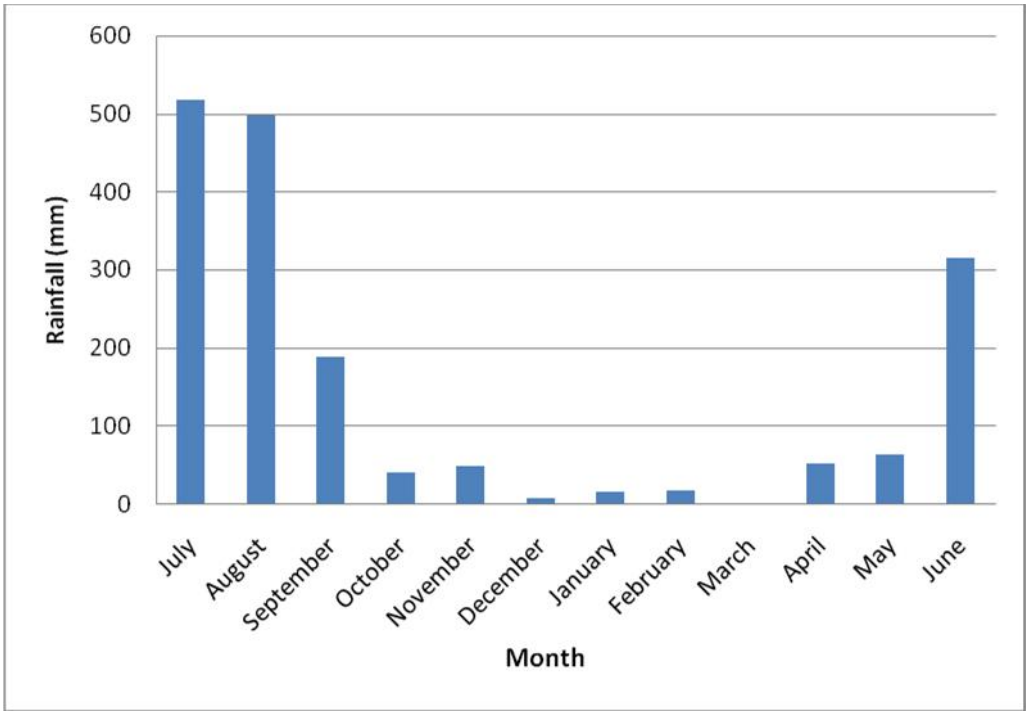
Source: Bangladesh Meteorological Department

Figure 3.3: Average monthly temperature (°C) and relative humidity (%) of the study site (2012-13)



Source: Bangladesh Meteorological Department

Figure 3.4: Average annual rainfall for the years 2004- 2013 in the study site



Source: Bangladesh Meteorological Department

Figure 3.5: Month wise rainfall of the study site (2012- 2013)

3.5 Method of investigation

The homestead owners of Bangladesh do not usually maintain records and accounts of their farm operations. So, the survey method was followed to achieve the objectives of this study. To minimize errors, several repeated visits were made to collect data properly.

The steps followed in the present study are selection of the area, specific records of the relevant factors, sampling technique, period of investigation, preparation of the interview schedule, rapporting with respondents, collection of data, processing and analysis of data.

3.5.1 Selection of the study area

For homestead plantation, study of site selection is an important step of the study. Keeping in view all the objectives of the study and considering the limitations on the research with respect to time, manpower and other facilities, the research work was carried out in Dumuria upazila of Khulna district. The Dumuria upazila is rich in natural vegetation compared to other areas of Khulna district.

Five villages under Dumuria upazila namely Gutudia, Shobhona, Kharnia, Gabtala and Chuknagar were purposively selected on the basis of practicing homestead agroforestry for this study. Among the farm families of the village agriculture was the major occupation, a few were service holder, farms labors and others were businessman. The selection of the study area, however, was based on the following main considerations:

i) The study site had available homegardens as one of the major production systems.

ii) The site was the representative of Khulna district of Bangladesh.

iii) Co-operation from the homestead owners was expected to be high and therefore, reliable data could be collected.

In this study, a stratified random sampling technique was followed to select the sample homestead owners. Homestead owners were classified into the following four groups on the basis of farm size in terms of ha. These categories were as follows:

i. Large : Who owned land above 2.00 ha
ii. Medium : Who owned land in between 1.01- 2.00 ha
iii. Small : Who owned land in between 0.51- 1.00 ha
iv. Marginal : Who owned land in between 0.03- 0.50ha

The homestead owners who own land less than 0.03 ha were identified and eliminated from the list. They do not maintain homegardens because most of their lands are occupied by their houses. A sample of 110 households was selected, from five villages with equal probability to each farm category by stratified random sampling. A list of different farm categories was obtained from respective Upazila Agriculture Office, as the Sub-assistant Agriculture Officers from that office were following that

list for their works. The collected list was verified through survey the villages and discussion with the households. Two young local people were haired from the study area for helping.

3.5.2 Preparation of survey schedule

In conformity with the set of objectives of the study, a set of preliminary survey schedules was designed for collection of data for the study. The survey schedule was carefully designed in such a way that all factors associated with the economic organization and performance of the farm business could be included. Simple questions and/or statements regarding their basic factors were included in the schedule. The draft schedule was pretested by interviewing some sample homestead owners of selected area by the researcher herself. Thus, some parts of the draft schedule were improved, rearranged and modified in the light of the actual and practical experiences gained by the researcher from the pre-testing. Thus, the final survey schedule was prepared in a simple manner maintaining logical sequences and necessary adjustments.

3.5.3 Period of data collection

The researcher made all possible effort to explain the purpose of the study to the respondents to get valid and pertinent information. The interviewer made appointments with the leader homestead owners in advance to get proper help. The researcher administrated the interview schedule personally to the respondents. Rapport was established with the respondents though informal discussion regarding objectives of the interview. Co-operation was obtained from respondents during data collected from 23rd November 2012 to 14th February 2013.

3.5.4 Sampling Procedure

All the crop cultivators of Gutudia, Shobhona, Kharnia, Gabtala and Chuknagar villages were considered to be the population of the study. An up-to-date list was prepared with the help of Sub-assistant Agriculture Officers (SAAO) which was comprised of 1109 homestead owners with about 3000 total population. A randomly selected sample size was drawn at the rate of approximately 10% comprising 110 homestead owners and a reserve list of 10 homestead owners was prepared to be interviewed in time of need. The distribution of the population and sample including the reserve list is shown in Table 3.1.

Table 3.1 Distribution of population and sample of homestead owners in the study area

Name of village	Total no. of population	Sample drawn	Reserve list
Gutudia	218	21	2
Shovona	228	23	2
Kharnia	229	23	2
Gabtala	223	22	2
Chuknagar	211	21	2
Total	1109	110	10

Source: Upazila Agriculture Office, Dumuria

3.6 Methods of Data Collection

Information was collected from both primary and secondary sources. These were gathered by survey as well as non survey methods. The survey sources include interviews through a pretested interview schedule, key informant and homestead owners' group discussions while non-surveys include the information through field survey, direct observations and secondary sources. Both qualitative and quantitative data were collected. The questionnaire was pre-tested with 5 households in selected upazila and necessary modifications were done.

3.7 Operationalization of variables

3.7.1 Variable selection

Success of a research to a considerable extent depends on the successful selection of the variables. Irrational, inappropriate and inconsistent selection of variables may lead to misleading and unfruitful results. The researcher keeping all these in mind took adequate care in selecting the variables of the study. Before the onset of the study the researcher visited the study area several times and talked to the homestead owners intimately. Moreover, by staying in the study area for some time, she was able to observe the actual condition of homegardens owned by the homestead owners. Based on this practical knowledge, side by side an extensive literature review and discussions with relevant experts and academicians, eleven independent and one dependent variable were selected for this study.

3.7.2 Measurement of Independent variables

The independent variables of the study were the attributes or characteristics of the respondents. To keep the research manageable, eleven independent variables were selected. The way of the selected variables were measured discussed below:

3.7.2.1 Age

The age of the respondents was measured in terms of actual years from their birth to the time of interview on the basis of his statement. A score of one (1) was assigned for each years of his age. It appears in item no. 1 in the interview schedule. Homestead owners are categorized as:

Young:	up to 35 years
Middle age:	36 to 50 years
Old:	51 or above

3.7.2.2 Education

Education of a respondent was measured in terms of years of schooling completed by them. For example if a respondent can sign his/her name he/she was given 0.5; if he went to school for 1 year and passes class one, his education score was given 1 (one). Thus '2' was given for two years of schooling and so on. '10' was given to those respondents who completed SSC or higher. A respondent who did not go to school and did not know reading and writing was given 0 (zero). This variable is placed in item no. 2 in the interview schedule.

3.7.2.3 Farm size

The farm size of the respondents was computed in has using the following formula:

$$FS = A_1 + A_2 + {}^1/_2 (A_3 + A_4) + A_5 + A_6$$

Where,

FS = Farm size
A_1 = Inherited

A_2 = Purchased

A_3 = Own land given to others as half share basis

A_4 = Land taken from others as half share basis

A_5 = Govt. allocated

A_6 = Others

Farm size is shown in item no. 3 in the interview schedule.

3.7.2.4 Homegarden size

It was measured by the area of the raised land in which the household has its entire dwelling living room, cow shed, farm yard court under vegetable, fruit and timber trees, backyards, bushes, bamboo brunches, pond etc. It is shown in item no. 4 in the interview schedule. These categories were as follows:

i. Large : Who owned land above 0.4 ha
ii. Medium : Who owned land in between 0.21- 0.4 ha
iii. Small : Who owned land in between 0.1- 0.2 ha

iv. Marginal : Who owned homestead area below 0.1 ha

3.7.2.5 Gardener type

It represents the habit of gardening of the respondents and scored as 1= Beginner, 2= Advanced, 3= Expert. Status means the present condition of garden compared to past and shown in item no. 5 in the interview schedule.

3.7.2.6 Credit received

Credit received of a respondent was measured in terms of the amount of money received by the respondent as loan from different sources. A score of one was given for each thousand taka. This variable appears in question no.6 of the interview schedule (Appendix-I).

3.7.2.7 Annual income

In measuring this variable the total yearly earning of the family members from farm and other sources (business, services etc.) of an individual respondent was measured in Taka. A score of 1 (one) was given for every one thousand taka. Score was given on the basis of their responses to the queries relating to farming and non-farming sources of income as obtained under item no. 7 in the interview schedule.

3.7.2.8 Extension media contact

In this study, the Extension media contact score was computed for each respondent on the basis of the extent of his contact with 10 selected media as ascertained from their responses to item no. 8 in the interview schedule. A four-point rating scale ranging from "no contact to frequent contact" was developed for this purpose. The scoring technique used for computing the extension media contact score of respondent is given below:

Extent of extension media contact	Score assigned
Not at all	0
Rarely	1
Occasionally	2
Frequently	3

Extension media contact score was determined by summing the scores of all the 10 information sources (extension media) included in item no. 11 in the interview schedule. Extension media contact score could range from 0 to 30, where zero (0) indicated no media contact and 30 indicated highest level of media contact.

3.7.2.9 Training received

It was measured by the total number of days a respondent received training on different subject matters in their entire life. The number of days of training received was considered as their training received score. Item no. 9 of the interview schedule was used to ascertain the training received by the respondent.

3.7.2.10 Problem confrontation

Problem was measured in one way such as, using of closed form of questions as shown in item 9 of the interview schedule. The homestead owners were asked to give their opinion on 15 elected problems, which were identified during pre-testing of the questionnaire along with their extent of problem in homegardening. A four point scale was used for computing the problem confrontation score of a respondent. The weights were assigned 0 for "not at all" 1 for "low" 2 for 'medium' and 3 for 'high'.

The weights of responses of all the problems they faced were added together to obtain the problem confrontation score, thus the problem confrontation score of the respondents could range from 0 to 45, Zero (0) indicating no problem and 45 indicating highest score.

"Constraints faced in homegarden" score for each of 110 farmers of Dumuria upazila, an effort was also made to compare the relative faced in homegarden. A Homegardening Barrier Index (HBI) was developed to fulfill this objective using the following formula (Rahman, 2005):

$HBI = N_1 \times 3 + N_2 \times 2 + N_3 \times 1 + N_4 \times 0$

Where,

HBI = Homegardening Barrier Index (HBI)
N_1= Number of homestead owners faced 'high' problem in homegardening
N_2= Number of homestead owners faced 'medium' problem in homegardening
N_3= Number of homestead owners faced 'low' problem in homegardening
N_4= Number of homestead owners faced 'no problem at all' problem in homegardening

The HBI for each of the problem faced in homegardening ranged from 0 to 330 (Rahman, 2005).

3.7.2.11 Species composition of homegardens

Number of diversified tree species observed in homegarden was the main focus of the study. On the basis of this main aspect the researcher gained knowledge by visiting the study area and discussing with homestead owners before collection of data. Tree species are the important components of homestead flora. Predominating plant species (fruits, timber, palms, crops, vegetables and others) observed in the study area was calculated in homestead and it was express by numbers. In each garden each specimen of all perennial species with their local name, age and individual number was recorded by asking the owner of the garden and counting by author with the help of assistants. In case of banana, bamboo and pineapple every plant was also treated as individual like other plants. The plant species found in the homegarden was identified in the field. The plant species that could not be identified in the field were later identified at Forestry Division of Bangladesh Agricultural Research Council, Dhaka.

3.7.3 Measurement of dependent variables

Impact of homegarden as perceived by the homestead owners was the dependent variable of the study. It consists of role of homegarden on biodiversity conservation and change in livelihood of the homestead owners. The role of homegarden is measured on the following ways.

3.7.3.1 Homestead owners' perceptions on biodiversity conservation through homegardening

The positive effect of homegarden on biodiversity conservation may thus be defined as a favorable change in our surroundings occurred wholly or largely due to the result of direct or indirect combination of agroforestry of the homestead, the change might have affect on the biological, physical and social kingdom.

The positive effect of homegarden on biodiversity conservation was measured on the basis of opinion given by the selected homestead owners. A 4-point modified scale such as strongly agree, agree, no answer and disagree was used to measure to extent of agreement of homestead owners with the statement. The score assigned to each of the scale for measuring the extent of agreement was 3, 2, 1 and 0 respectively for each of the 12 statements. The scale of individual consequence with it's considering score such as, 3 for "strongly agree" 2 for "agree" 1 for "no answer" and 0 for "disagree". Finally adding all the frequency counts of each of the cell of the scale and the value was calculated.

However, besides having calculated the "extent of perception of plant biodiversity conservation" score for each of 110 respondents, an effort was also made to compare the relative perception of plant biodiversity conservation. A Perception of Biodiversity Conservation Index (PBCI) was developed to fulfill this objective using the following formula (Rahman, 2005):

$PBCI = N_1 \times 3 + N_2 \times 2 + N_3 \times 1 + N_4 \times 0$

Where,

PBCI = Perception of Biodiversity Conservation Index (PBCI)

N_1= Number of farmers expressed 'strong' perception on plant biodiversity conservation

N_2= Number of farmers expressed 'medium' perception on plant biodiversity conservation

N_3= Number of farmers expressed 'no' perception on plant biodiversity conservation

N_4= Number of farmers expressed 'negative' perception on plant biodiversity conservation

The PBPI for each of the Perception of Biodiversity Conservation ranged from 0 to 330 (Rahman, 2005).

3.8 Key Informant Survey

Local people having an idea of the village area and having fair knowledge of homegardens, such as progressive homestead owners, development workers, school teachers, chairmen of the union councils were interviewed by unstructured conversation. Some information was also collected by discussion with the local government authority and Upazila Agriculture Officer.

3.9 Group Discussion

Group discussions with the homestead owners were done on particular issues like; constraints related to the homegarden productivity, new plantation programme, etc. This method was also used to identify the preferred tree species by the homestead owners for future plantation in their homegardens.

3.10 Secondary Data

Secondary data was collected from relevant literature, from BARC, BARI, SRDI, previous research work done by the research stations, informal interviews of the researchers, village extension workers, school teachers, local leaders and staff of the Agriculture Extension Department.

3.11 Processing of Data

3.11.1 Editing

The collected raw data were examined thoroughly to detect errors and omissions. As a matter of fact the researcher made a careful scrutiny of the completed interview schedules to make sure that they were entered as complete as possible and well arranged to facilitate coding and tabulation. Very minor mistakes were detected by doing this which were corrected promptly.

3.11.2 Coding and tabulation

Having consulted with her research supervisor and co-supervisor the investigator prepared a detailed coding plan. Numerical figures were converted from Bangla to English and data were then coded into a coding sheet. In case of qualitative data, suitable scoring technique was followed by putting proper weightage against each of the traits to transform the data into quantitative forms. These were then tabulated in accordance with the objectives of the study.

3.12 Categorization of Data

Following coding operation, the collected raw data as well as the respondents were classified into various categories to facilitate the description of the independent and dependent variables. These categories were developed for each of the variables by considering the nature of distribution of the data and extensive literature review. The procedures for categorization have been discussed while describing the variables under consideration in chapter 4.

3.13 Analysis of Data

For the purpose of analysis the collected raw data were tabulated by arranging them into columns and rows. Analysis was performed using some statistical treatments as described below:

Such statistical measures as number, frequency count, percentage, range, mean, standard deviation, and co-efficient of variance were used in describing the selected dependent and independent variables.

Shannon-Weaver index was used to determine the species richness. The index is used to characterize the species diversity in community. It is calculated through formula

$H' = -\sum_{i=0}^{S} p_i \ln p_i$

Where,

S = the number of species in the community,

i = the number of species

p_i = the proportional abundance of species (number of species *i* divided by total numbers in the community).

Relative prevalence (RP) of tree species was determined by multiplying the number of trees per farm by the percentage of farms containing that species. It was calculated by the following equation (Michon *et al.*, 1983).

Relative prevalence (RP) = $\frac{n_i}{A} \times \frac{f_i}{F}$

Where,

n_i = Number of specimen species *i* on homegarden,

A = Area of homegarden,

f_i = Number of homegardens on which species *i* is found,

F = Total number of homegardens.

In order to test the formulated hypothesis of the study, Pearson's product-moment correlation co-efficient (r) was used. Through this statistical treatment, nature of relationship between the dependent and independent variables was determined.

3.14 Hypothesis

The research hypothesis was put forward to test the relationship between the homestead owners' perceptions on biodiversity conservation through homegardening and each of 11 selected characteristics of the homestead owners. The null hypothesis is, "There is no relation between the homestead owners' perceptions on biodiversity conservation through homegardening and each of the selected characteristics of the homestead owners". The selected characteristics were age, education, farm size, homestead size, gardener type, credit received, annual family income, extension media contact, training received, problem faced by homegardeners and species composition of homegardens.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter explains the results of the research study. It includes homegarden status of the study site, general plant diversity in the area and changes in homegardens, selected characteristics of the homegardeners and their perceptions towards biodiversity conservation through homegardening, and the constrains faced in homegardening.

Data obtained by observation and from homestead owners by interview were measured, analyzed, tabulated and statistically treated according to the methodology of the study. The selected characteristics of the homestead owners and their perceptions towards biodiversity conservation through homegardening were discussed in this chapter under different separate tables and figures. The tables showed the descriptive statistics of the studied variables.

4.1 Homestead owners' perceptions on biodiversity conservation through homegardening

The recent time is an era of smart farming. Our farmers are also taking the challenges with adopting new technologies. Besides, they have a rich knowledge about sustainable agriculture and integrated farming system. Though the term 'Biodiversity' is not familiar to them, they have the basic knowledge about it and most of them are concerned about its importance. The average score of homestead owners' perceptions on biodiversity conservation through homegardening was 28.52 with a standard deviation of 6.75. Based on the observed scores, the farmers were classified into three categories as shown in table 4.1.

Table 4.1 Homestead owners' perceptions on biodiversity conservation through homegardening

Categories	Homestead owners		Mean	SD
	Number	%		
Poor (up to 15)	7	6.4	28.52	6.75
Moderate (16-30)	50	45.4		
Standard (above 30)	53	48.2		
Total	110	100		

Data presented in the Table 4.1 indicated that the highest proportion (48.2%) of the homegardeners had standard perceptions on biodiversity conservation through homegardening as compared to 45.4% had moderate and 6.4% had poor knowledge.

4.2 Perception of Biodiversity Conservation Index (PBCI)

Homegardeners perception related to biodiversity conservation is presented in Table 4.2.

After calculated the "Perception of Biodiversity Conservation" scores for each of 80 respondents, and effort was also made to compare the relative impacts. Impacts score for each statement was calculated by using Perception of Biodiversity Conservation Index (PBCI) and it has been arranged in rank order according to their extent of perceived level which appears in Table 4.2. The PBPI could range from 0 to 330 (Rahman, 2005), where 0 indicating no perception and 330 indicating maximum perception of a single statement on Perception of Biodiversity Conservation as observed by the homestead owners in Dumuria upazila.

Table 4.2 Statement-wise score of perception of plant biodiversity conservation

Perceptions	Homestead owners (N=110)				Perception of Biodiversity Conservation Index (PBCI)	Rank order
	Strongly agree	Agree	No answer	Disagree		
Increase the greenish view due to plantation	32	62	16	0	236	2
Increase the use of OM due to increase no. of plants	14	76	20	0	214	7
Increase soil moisture conservation	11	76	23	0	208	8
Getting fresh air due to increased no. of plants	35	65	10	0	245	1
Relatively decreasing the global warming	10	33	60	7	176	11
Decrease soil erosion	11	61	38	0	193	10
Decreasing the pollution of farm environment	34	28	39	9	197	9
Decrease insect attack in crop field	13	37	54	6	167	12
Improve soil texture & structure in homestead	13	29	68	0	165	13
Balancing biodiversity	22	66	22	0	220	5
Source of conserving local variety	24	76	10	0	234	3
Cultivation of spices & condiments in shady place	18	81	11	0	227	4
Provide shade and improve microclimate	19	68	23	0	216	6
Reduce natural disaster	25	48	26	11	197	9
Increase the intensity of wind breaks	21	58	29	2	208	8

The most clear perception of homegardeners of Dumuria upazila was “Getting fresh air due to increased no. of plants” (245) regarded as top in ranking order followed by next five perceptions based on their descending order of ranking were “Increase the greenish view due to plantation (236)”, “Source of conserving local variety (234)”, “Cultivation of spices & condiments in shady place (227)”, “Balancing biodiversity (220)” and “Provide shade and improve microclimate (216). The Table 4.6 also shows that the last three least clear perceptions were “Relatively decreasing the global warming (176)”, “Decrease insect attack in crop field (167)” and “Improve soil texture & structure in homestead (165)”.

4.3 Selected Characteristics of the homestead owners

The descriptions of each of the individual characteristics are presented below. **Table 4.3: Basic statistical values of the selected characteristics (N = 110)**

Characteristics	Measuring unit	Categories	Homestead owners		Mean	SD
			N=110	%		
Age	Actual Years	Young aged (up to 35)	20	18.2	46.91	9.69
		Middle aged (36-55)	51	46.3		
		Old (>55)	39	35.5		
Education	Year of schooling	No education (0)	18	16.4	3.39	2.84
		Can sign only (0.5)	24	21.8		
		Primary (1-5)	43	39.1		
		Secondary or higher (6-10)	25	22.7		
Farm size	Actual (in ha)	Marginal (0.03-.5)	45	40.8	0.85	0.71
		Small (0.51-1)	29	26.4		
		Medium (1.01-2)	29	26.4		
		Large (above 2)	7	6.4		
Characteristics	**Measuring unit**	**Categories**	**Homestead owners**		**Mean**	**SD**
			N = 110	**%**		
Home stead size	Actual (in ha)	Marginal (below 0.1)	41	37.3	0.24	0.22
		Small (0.1-0.2)	27	24.5		
		Medium (0.21-.4)	22	20		

		Large (above 0.4)	20	18.2		
Gardener type	Scores	Beginner (1)	36	32.7	1.86	0.71
		Advanced (2)	53	48.2		
		Expert (3)	21	19.1		
Credit received	('000' Tk.)	No (0)	37	33.6	3.74	3.46
		Low (upto 15)	73	66.4		
Annual Family income	Income ('000' Tk.)	Low (up to100)	100	90.9	67.39	25.12
		Medium (above 100)	10	9.1		
Extension media contact	Score	Low (up to 10)	47	42.7	10.80	3.49
		Medium (above 10)	63	57.3		
Training Received	Scores (1 for 1 day)	No (0)	48	43.6	0.99	0.98
		Low (1-3)	62	56.4		
Problems faced by homegardeners	Score	Low (up to 15)	25	22.7	24.86	8.89
		Medium (16-30)	46	41.8		
		High (above 30)	34	35.5		
Species composi-tion of homegarden	Numbers	Low (up to 15)	65	59.1	14.95	7.01
		Medium (16-30)	40	36.4		
		High (above 30)	5	4.5		

4.3.1 Age

Age of the homegardeners was measured by the actual years of their life time. It was ranged from 28 to 70 years with an average of 46.91 years and standard deviation of 9.69 (Table 4.4). On the basis of their age, the homegardeners were classified into three categories.

Table 4.4 Distribution of the homestead owners according to their age

Categories	Homestead owners		Mean	SD
	Number	%		
Young aged (below 35 years)	20	18.2	46.91	9.69
Middle aged (35-50 years)	51	46.3		
Old aged (above 50 years)	39	35.5		
Total	110	100		

Data presented that the highest proportion of 46.3% of the homegardeners was in the middle age, 35.5% old and only 18.2% was in young stage category.

4.3.2 Education

The education level of the homegardeners was measured by their year of schooling and was ranged from 0 - 10 with an average of 3.39 and standard deviation of 2.84 (Table 4.5).

Table 4.5 Distribution of the homestead owners according to their level education

Categories	Homestead owners		Mean	SD
	Number	%		
No education (0)	18	16.4	3.39	2.84
Can sign only (0.5)	24	21.8		
Primary (1-5)	43	39.1		
Secondary or higher (6-10)	25	22.7		
Total	110	100		

Table showed that 39.1% of the homegardeners had primary level education whereas 16.4% of them were illiterate and 21.8% can sign only. 22.7% of them were completed secondary or higher level of education.

4.3.3 Farm size

In the study area the farm size was measured with the total land cultivated by the farmer. Data was collected in local unit and then converted in ha. The farm size ranged from 0.03-3.44 ha with an average of 0.85 ha and the standard deviation of 0.71 (Table 4.6).

Table 4.6 Distribution of the homestead owners according to their farm size

Categories	Homestead owners		Mean	SD
	Number	%		
Marginal (0.03-.5)	45	40.8	0.85	0.71
Small (0.51-1)	29	26.4		
Medium (1.01-2)	29	26.4		
Large (above 2)	7	6.4		
Total	110	100		

Among the farmers as showed in the table 40.8% was marginal, 26.4% was small and 6.4% was large farm holder. The medium category also constitutes 26.4%.

4.3.4 Homestead size

The homestead size of the farmer was measured with the area covered by their living rooms, kitchen, cattle shade, adjacent ponds and surrounded raised area. The homestead size ranged from 0.016-0.85 ha with an average of 0.24 ha and standard deviation of 0.22 (Table 4.7).

Table 4.7 Distribution of the homestead owners according to their Homestead size

Categories	Homestead owners		Mean	SD
	Number	%		
Marginal (below 0.1)	41	37.3	0.24	0.22
Small (0.1-0.2)	27	24.5		
Medium (0.21-.4)	22	20		
Large (above 0.4)	20	18.2		
Total	110	100		

Among the homestead owners, 27% had small (0.1-0.2 ha), 20% had medium (0.21-0.4 ha) and 18.2% had large (above 0.4 ha) homesteads and while marginal (below 0.1 ha) was 37.3%. Some ideal homesteads are shown in Plate 1.

4.3.5 Gardener type

In the study area different types of gardeners were observed. According to their gardening experience farmers are categorized in different types. The type ranges from 1 to 3 with an average of 1.86 and the standard deviation of 0.71(Table 4.8).

Table 4.8 Distribution of the homestead owners according to Gardener type

Categories	Homestead owners		Mean	SD
	Number	%		
Beginner (1)	36	32.7	1.86	0.71
Advanced (2)	53	48.2		
Expert (3)	21	19.1		
Total	110	100		

Among the evaluated homestead owners 32.7% was beginner and only 19.1% was expert, whereas most of them are advanced type of homegardener that constitutes 48.2%.

4.3.6 Credit received

In the study area homestead owners shows tendency of borrowing money in small amount. The credit received scores of the homestead owners ranged from 0 to 15 thousand taka with a mean of 3.74 and standard deviation 3.46. On the basis of credit received, the respondents were classified into two categories as shown in Table 4.9.

Table 4.9 Distribution of the homestead owners according to Credit received by them

Categories ('000')	Homegardeners		Mean	SD
	Number	%		
No (0)	37	33.6	3.74	3.46
Low (upto 15)	73	66.4		
Total	110	100		

Data shown in Table 4.9 revealed that majority (66.4%) of homestead owners had received low credit compared to those, who (33.6%) had received no credit.

4.3.7 Annual family income

The annual family income was measured by adding all type of earning by the household members. The annual income of the homestead owners ranged from 35.8 to 144 thousand taka with a mean of 67.39, standard deviation 25.12. On the basis of annual income, the homestead owners were classified into three categories as shown in Table 4.10.

Table 4.10 Distribution of the homestead owners according to their annual family income

Categories ('000')	Homestead owners		Mean	SD
	Number	%		
Low (up to100)	100	90.9	67.39	25.12
Medium (above 100)	10	9.1		
Total	110	100		

Data shown in Table 4.10 revealed that majority (90.9%) of respondents had low annual income compared to medium (9.1%) annual income.

4.3.8 Extension media contact

The farmers of the study area show a medium type of intimacy with the extension media. Observed extension contact score of the homestead owners ranged from 0 to 17 against possible range of 0 to 30. The mean of extension contact score was 10.80 with standard deviation 3.49. Based on the extension contact score, the homestead owners were classified into two categories shown in Table 4.11.

Table 4.11 Distribution of the homestead owners according to their Extension media contact

Categories	Homestead owners		Mean	SD
	Number	%		
Low (up to 10)	47	42.7	10.80	3.49
Medium (above 10)	63	57.3		
Total	110	100		

Data presented in Table 4.11 indicate that the highest proportion (57.3%) of respondents had medium extension contact, while 42.7% had low extension contact. The finding of this study indicates that the farmers in the study area had low to medium extension contact. It could be concluded that extension agent or media of the study area were not available to the respondents. So, the respondents gained knowledge on homegardening by their innovative experience or cosmopolite behaviors.

4.3.9 Training Received

Though a good share of the homestead owners are concerned about training, most of them do not have any idea about training about homegarden and biodiversity related training. Training received scores ranged from zero (0) to 3, the mean being 0.99, standard deviation 0.98. Based on the training received scores, the farmers were grouped into two categories (Table 4.12).

Table 4.12 Distribution of the homestead owners according to Training Received by them

Categories	Homestead owners		Mean	SD
	Number	%		
No (0)	48	43.6	0.99	0.98
Low (1-3)	62	56.4		
Total	110	100		

Table 4.12 shows distribution of the homegardeners according to their training received. The data indicate that majority (56.4%) had low training experience compared to 43.6%, had no training experience.

4.3.10 Problems faced by homegardeners

The problems faced by the homegardeners were measured with a predetermined scale score. Problem faced scores of the homegardeners ranged from 10 to 39 with a mean of 24.86 and the standard deviation of 8.89. The respondents were classified into three categories on the basis of their problems faced (Table 4.13).

Table 4.13 Distribution of the homestead owners according to Problems faced by them

Categories	Homestead owners		Mean	SD
	Number	%		
Low (up to 15)	25	22.7	24.86	8.89
Medium (16-30)	46	41.8		
High (above 30)	34	35.5		
Total	110	100		

Data in Table 4.13 revealed that the highest proportion 41.8% had medium problem, compared to 35.5% had high problem while only 22.7% had low problems. This finding again revealed that most (77.3%) of the respondents faced medium to high problem in homegardening. The major problem of planting new trees on homestead was the damage by animal which was reported by 57.3% of the homegardeners. Scarcity of space was another common constraint reported by 43.6% of respondents.

On the average of 35.5% farmer stated that trees create difficulties in post harvest operations of field crops by obstructing sunlight and air to the homestead area where threshing and drying is done. However, this problem was reported as a major problem mostly by medium and large homestead owners.

4.3.11 Species composition of homegarden

The study survey recorded 69 plant species from the set of 110 surveyed homesteads (Appendix-III). Important species are enlisted in Table 4.15. Among the total species, 53.62%, trees, 23.18% shrub, and 24.6% herbs. Amongst the recorded species, 13 trees, 11 herbs and shrubs species were found common in most of the homesteads. Thereafter, out of the recorded species based on conservation status, two species; namely, *Piper chaba* and *Terminalia chebula* are vulnerable, *Pteris cretica* near threatened, *Boehmeria nivea*, *Cinnamomum tamala* are not evaluated, and the rest of the species are of least concern in the context of Bangladesh.

There is a range of different approaches to describing the amount of biodiversity present in a homegarden or group of homegardens. Whichever methods are used, the three most important features that are measured are the richness, evenness and distinctness of the characteristics. Richness is a measure of the number of different types, while evenness describes their distribution within and between the different populations (cultivars, homegardens, areas etc.). Distinctness provides useful additional information on how different the types are and can be particularly important for assessing whether some populations or areas have unique types.

Richness, evenness and distinctness can, with suitable adjustments, be measured using almost any characters, which seem to be biologically or genetically meaningful. A first approach might be simply to record the numbers of local cultivars and the extent to which the same ones occur in different homegardens.

Numbers and identities of local cultivars present in homegardens provide an obvious starting point to determining the amount of diversity. However, some caution may be needed in analyzing such data. The names given by farmers may be different for the same local cultivar or the same for different cultivars. This has been demonstrated in specific farming situations but similar information for homegardens is lacking. It may be more difficult to obtain a clear classification of local cultivars and their identity in homegarden production systems than it is in other farming systems. Sizes of populations are much smaller and cultivar identity may be more personalized or more casual. There is evidence from farming situations that, even when names differ, farmers recognize the same important distinguishing attributes between local cultivars. In such cases, these characters can be used to establish identities and determine numbers and patterns of distribution of local cultivars, providing that the analysis frameworks developed for traditional farming situations are valid for homegarden systems.

However, in this study the number of tree species in homegarden ranged from 5 to 40 (Table 4.14) with an average value of 14.95 and standard deviation of 7.01. Based on the species composition in their homegardens farmers are categorized into three groups.

Table 4.14 Distribution of the homestead owners according to Species composition of homegarden

Categories	Homestead owners		Mean	SD
	Number	%		

Low (up to 15)	65	59.1	14.95	7.01
Medium (16-30)	40	36.4		
High (above 30)	5	4.5		
Total	110	100		

The table showed that 59.1% of the homegardeners grew up to 15 tree species. 36.4% grew 16 to 30 tree species and only 4.5% of the respondents grew above 30 number of tree species.

Out of identified tree species Betel nut, Mahogony, Coconut, Banana, Mango, Jackfruit, Sapota, and Rain tree were dominant in the homestead (Fig. 4.1). Without these Khejur, Peara, Neem, Eucalyptus, Papaya, Jujube etc. are also common species of the selected area. However, all species recorded from the homegardens were useful for nine different purposes (Table 4.15). Most species were used for food (36% of all species) followed by medicine (22%), fuelwood and timber (20%), ornamental (14%), and fodder (8%) (Fig. 4.2). Among all species 45 % were multipurpose 80% of the ten most important tree (90%), herb (70%), and climber (80%) species were multipurpose (Table 4.15). Approximately half of the most important plants were native.

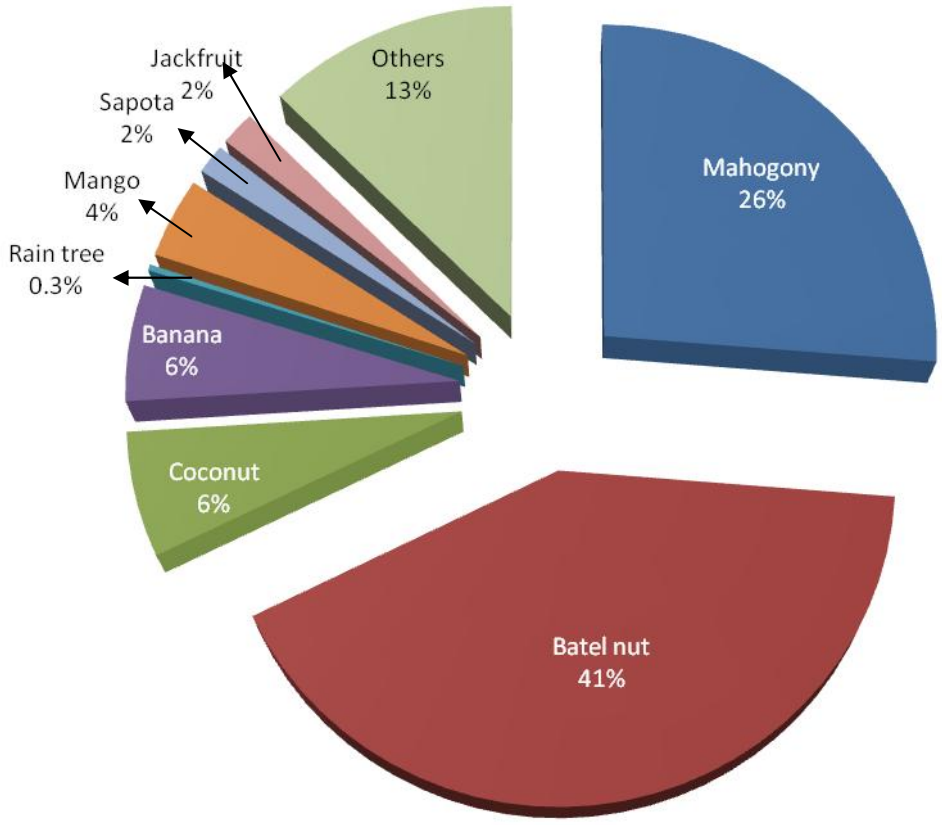


Figure 4.1: Observed species dominance in homegardens of the study area

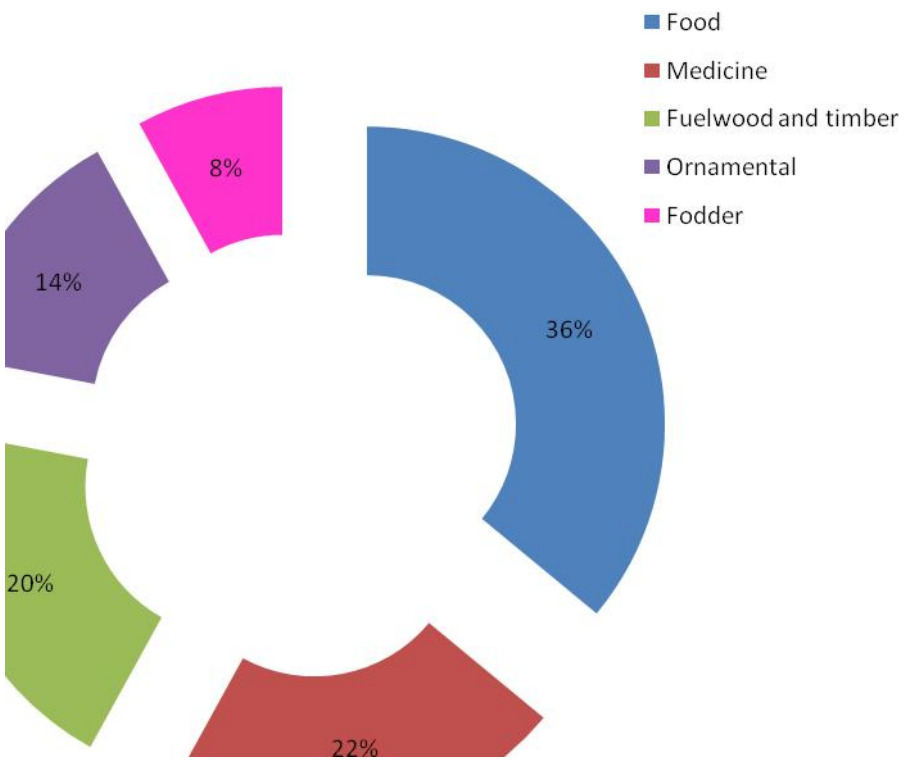


Figure 4.2: Observed species diversity according to their use in homegardens of the study area

Table 4.15 The ten most important species of trees, shrubs, herbs, and climbers (woody and nonwoody) in homegardens of study area

Botanical name	Local name	Family	Origin	Uses
Trees				
Cocos nucifera L.	Narikel	Palmae (Arecaceae)	N	1,4
Mangifera indica L.	Am	Anacardiaceae	N	1, 2, 4, 6,7
Areca catechu L.	Superi	Palmae (Arecaceae)	E	2,6
Psidium guajava L.	Peara	Myrtaceae	E	1, 2,4
Swietenia macrophylla King	Mahogany	Meliaceae	E	2,6
Artocarpus heterophyllus Lam.	Kanthal	Moraceae	E	1, 2,6
Phoenix sylvestris Roxb.	Khejur	Palmae (Arecaceae)	N	1, 2, 4,9
Pouteria sapota (Jacq.) Moore.	Safeda	Anacardiaceae	N	1,2
Ziziphus jujube Mill.	Kul	Rhamnaceae	N	1,2,4
Samanea saman (Jacq.) Merr.	Rain Tree	Mimosoideae	E	4,6
Shrubs				
Citrus limon (L.) Burm.f.	Kagojee Lebu	Rutaceae	E	1,2

Table 4.15 (Continued)

Botanical name	Local name	Family	Origin	Uses
Eupatorium odoratum L.	Assam Lata	Asteraceae	E	3
Clerodendrum inerme (L.) Gaertn.	Bon Jui	Verbenaceae	N	3
Capsicum annuum L.	Morich	Solanaceae	E	2,8
Bougainvillea brachycarpa Heimerl	Bagan Bilash	Nyctaginaceae	E	5
Justicia adhatoda L. Nees	Bashok	Acanthaceae	N	3
Lawsonia inermis L.	Mendi	Lythraceae	E	9
Codiaeum variegatum (L.) Blume	Pata Bahar	Euphorbiaceae	E	5
Glycosmis pentaphylla (Retz.) DC.	Daton Gach	Rutaceae	N	4
Cestrum nocturnum L.	Hasnahena	Solanaceae	E	5

Table 4.15 (Continued)

Herbs

Musa spp.	Kola	Musaceae	E	1, 2,7
Alocasia indica (Lour) Koch	Man Kachu	Araceae	N	1, 2

Botanical name	Local name	Family	Origin	Uses
Xanthosoma nigrum (Vell.) Mans.	Dosta Kachu	Araceae	E	1, 2
Colocasia nymphaeifolia Kunth	Buno Kachu	Araceae	N	1
Bambusa balcooa Roxb.	Balco Bans	Gramineae	N	2, 4, 6,7, 9
Curcuma longa L.	Holud	Zingiberaceae	N	2, 3, 8,12
Amorphophallus paeoniifolius (Denn.) Nicol.	Ol Kachu	Araceae	N	1,2
Heliconia metallica	Kolaboti	Musaceae	E	3,5
Pandanas utilis	Keya	Pandanaceae	N	3
Lactuca sativa	Lettuce	Compositae	E	5

Table 4.15 The ten most important species of trees, shrubs, herbs, and climbers (woody and nonwoody) in homegardens of study area

climbers (woody and nonwoody)

Basella alba L.	Pui Shak	Basellaceae	E	1,2
Dioscorea alata L.	Mete Alu	Dioscoreaceae	N	1,2
Cucurbita maxima Duchesne *ex* Lmk.	Mishti Kumra	Cucurbitaceae	E	1,2

Botanical name	Local name	Family	Origin	Uses
Benincasa hispida (Thunb.) Cogn.	Chal Kumra	Cucurbitaceae	E	1,2
Lagenaria siceraria (Md.) Standl.	Lao	Cucurbitaceae	E	1,2
Hoya verticillata (Vahl.) G. Don	Pargacha	Asclepiadaceae	N	3
Cucumis sativus L.	Shosha	Cucurbitaceae	E	1,2
Cissus quadrangularis L.	Harjora Lata	Vitaceae	N	3
Lablab perennans DC.	Shim	Papilionoideae	E	1,2
Piper abbreviatum Opiz	Chui	Piperaceae	N	2,8

Native species are denoted with 'N' and exotic species with 'E.'
For uses, 1 = food, 2 = commercial (used to earn cash from the sale of surplus products after subsistence consumption, not an end use), 3 = medicinal, 4 = fuelwood, 5 = ornamental, 6 = timber, 7 = fodder, 8 = fiber, and 9 = religious/ceremonial.
RF is relative frequency of the species that represent the relative importance of the species in their respective life form.

4.4 Food plant species

Household food plants included 28 species of which 46% were fruits, 36% were vegetables, 9% spices/culinary crops, 7% root/tuber crops, and 2% beverage crops. Food plant species in homegardens comprised 70% biennial/perennials and 30% annuals. Their habits were identified as 30% trees, 21% shrubs, 42% herbs/herbaceous vines and 7% woody vines (Fig. 4.3). The majority of vegetable plants (68%) consisted of annual/biennial herbs, while 98% of fruit plants were found as perennials and 61% of them were trees.

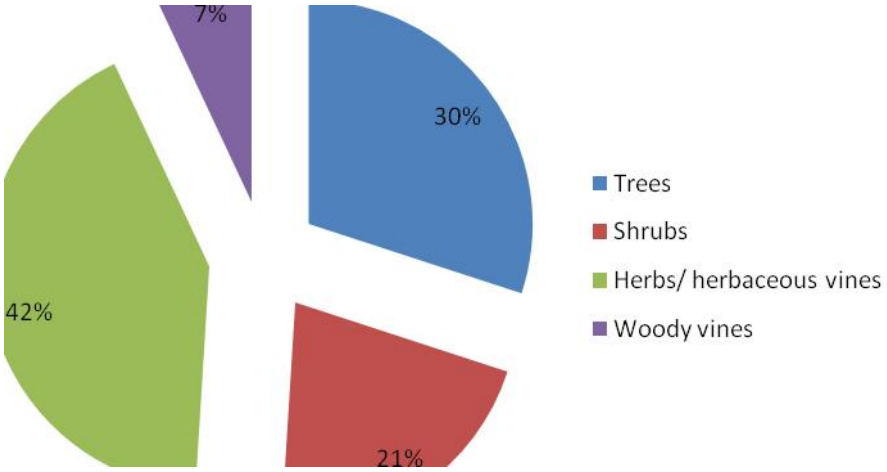


Figure 4.3: Habits of food plant species observed in the homegarden of the study area

4.5 Medicinal plant species

Different medicinal plants are grown at different micro site of the homestead. Among the different sites of the homesteads, large numbers of medicinal plant species were recorded during the study. The medicinal plants that frequently observed are Neem, Ghretakumari, Patharkuchi, Bashak, Bohera, Amloki, Akanda, Ulatkambal, Fonimonsha, Bishporobi, Arjun, Horitoki and Tulshi. It was observed from the study that shrub or herb type medicinal plants were grown inside the homestead boundary. Neem, Pipul, Chatian, Arjun, Amloki, Bohera and Horitoki were found to grow in the boundary of the homestead.

4.6 Rare and common plant species

During the last 2 decades (1992-2012) this trend has changed dramatically. With the introduction of a more open national economic policy, local systems were altered rapidly. Homegardens also changed in their appearance and responsibility especially areas closer to cities. Homegardens became modernized landscape filled with introduced economical plants rather than locally adopted useful plants as these plants provided economic benefits to the household and the market for such plant was increased. Those economical plants consumed much more inputs for maintenance of their competitive nature. This created a kind of imbalance in the local equilibrium, consuming high amount of inputs. The most of food plants were still maintained adequately, *Carica papaya*, one of the most common fruit in the homegarden was reported only in 15 gardens. It was found that *Carica papaya* was highly damaged by recent epidemic condition caused by *Paracoccus marginatus* (papaya mealy bug).

Number of other plant species has also been severely destroyed. However more than 60 homegardens in the study area maintained at least some of the crops essential for their daily needs including leafy vegetables, chilies, banana, lime, and coconut.

One of motivating features found in homegardens was the respondents' effort to maintain some locally available varieties which were not so common in that area. Those species were *Piper chaba* (choijhal), *Nigella sativa* (black cumin), *Amomum aromaticum* (Bengal cardamom), and *Rauvolfia serpentina* (snake root). Many of food and spice plants occurred in homegardens possessed medicinal values, but here medicinal plants were identified as its priority values given by respondents.

Six species, *Piper chaba* (choijhal), *Mangifera sylvatica* (forest mango), *Rauvolfia serpentina* (snake root), *Andrographis paniculata* (creat), *Amomum aromaticum* (Bengal cardamom), and *Calamus guruba* (rattan) appear on the IUCN Red List with a mean of four species (range: 3-5) per region. All recorded red listed species were planted except for *Mangifera sylvatica*.

4.7 Role of homegardens in plant biodiversity conservation

Homestead gardens have long been the most effective and widespread measure for biodiversity conservation in Bangladesh as due to anthropogenic pressure and land use change the natural forest has been decreasing day by day both in explicit and implicit ways leading to threats to future productivity. Generally, rural communities preferred cultivated and planted multipurpose species that can be served as fruits, vegetables and spices also used as timber. Such kind of choice is the most important factor to homestead gardens conservation in Bangladesh and plays a significant role in forest conservation since all the wood and other non-timber forest products that are harvested in the homestead gardens do not need to be collected from forests. Respondents said that homestead gardens attract a number of bird species like *Streptopelia chinensis, Psittacula krameri, Eudynamys scolopaceus, Micropternus brachyurus, Dinopium benghalense, Oriolus xanthornus, Dicrurus macrocercus, Acridotheres tristis, Corvus splendens, Turdus cafer, Orthotomus sutorius, Copsychus saularis, Nectarinia zeylonica, Anthus campestris, Passer domesticus,* and *Ploceus philippinus* to collect their food and making nest. Moreover, some animal species like squirrel, take shelter and collect their food, especially fruit like *Aegle marmelos* (Bel), *Annona squamosa* (Pineapple), *Areca catechu* (Betel nut), *Averrhoa carambola* (Carambola), *Carica papaya* (Papaya), *Carissa carandas* (Koromcha), *Cocos nucifera* (Coconut), *Dillenia indica* (Elephant apple), *Elaeocarpus floribundus* (Blueberry), *Mangifera indica* (Mango), *Phyllanthus acidus* (Gooseberry), *Phyllanthus emblica* (Amla), *Psidium guajava* (Guava), *Spondias pinnata* (Hog plums), *Syzygium cumini* (Jamun), *Tamarindus indica* (Tamarind) and *Zizyphus mauritiana* (Jujube) from the rural homestead gardens. They also mentioned that some birds play a significant role as pollinators or in the control of insect pests. At this time dispersal of seeds, also occurs by the animal, birds and helps in natural regeneration of homestead plants species since natural regeneration is the most important factor for tree diversity conservation. Study also found a number of bamboo, shrub, herb, and climber species which were largely used by the households; also, they give shelter to animal diversity.

Homegardens are commonly identified as traditional agroforestry systems with complex structure and multiple functions. On the other hand, homegardens are

considered as the sites for conservation of a large diversity of plants both wild and domesticated, because of their uses to the households (Abdoellah, 2006). Plant diversity has been conserved through their uses in homegardens. During the past three decades homegardens have gathered much research attention, due to several reasons. Mostly homegardens contain characteristics which make them an interesting model for research and the design of sustainable agroecosystems. These include high biodiversity, efficient nutrient cycling, low use of external inputs and soil conservation potential. Simultaneously, they provide a diverse and stable supply of socio-economic products and benefits to the families that maintain them. In rural areas homegardens possess the closest similarities to natural forests in their structure with having 3-4 vertical canopy layers (Das and Das, 2005).

As the importance of homegardens in the production of food, medicine and other useful products for human beings is widely recognized, regular attempts have been taken to improve the productivity of this widespread agro-ecosystem, with specific objectives for both rural and urban system (Wood and Lenne, 1997). The realization that this 'homegarden' system is also an important reservoir of unique genetic diversity has more recently led to more study of this system in order to obtain a better understanding of the role of homegardens in the management and conservation of genetic diversity *in situ* (IPGRI, 2002).

International Plant Genetic Resource Institute's mandate is "to advance the conservation and use of genetic diversity for the well-being of present and future generations" which places IPGRI's programmatic work clearly in the development context (IPGRI, 2002). So homegardening or backyard gardening is identified as one of the potential ways to maintain plant diversity and to reverse the loss of plant/biodiversity in cities and urban areas (IPGRI, 2002). It was the traditional life supporting system in rural areas and some urban areas in many countries (Engels, 2002). However, it's an innovative approach to urban dense settlements which have no space for growing crops as in rural areas (Rizvi, 2007).

Though it has been less studied and remains less well understood, the genetic diversity of crop land races is conserved within traditional farming systems (Maxted *et al.*, 1997). Diversified array of plants in present urban homegardens are inevitably contributed to use, conserve or manage genetic diversity to some extent. It can play a crucial role as a unit of on farm/in situ conservation of crops. Since urban homegardens frequently depend on preference and economic status of households, land, time, climate and labor availability, those factors may directly affect the plant diversity. There are number of other important factors to be considered on plant diversity in sub urban homegardens as it is highly influenced by households.

4.8 Perceived Importance for Conservation of Homestead Garden Species

To determine the perceived importance of homestead species conservation, farmers were interviewed using a questionnaire; asked to evaluate the importance of mentioned eight functions of trees. The results have been presented in Table 4.17. Likewise, farmers' perceived most importance for homestead plant species conservation was related to fruit and food (85%) followed by building materials (78.75%), subsistence family income (73.75%), and source of firewood (68.75%). The surveyed rural area is affected by monsoon flood every year; as a result soil erosion is a serious problem in this region. Therefore, in order to keep houses above

the water level, it is mandatory to raise houses at the highest elevations or fill the land by soil in the dry season, especially throughout the floodplain regions. As a consequence, people are usually concerned about the trees role to protect their homestead land against water-induced soil erosion by binding the soil. However, they were not concerned about ecological importance of forest. Yet the majority of the respondents graded the homestead garden as being “less important” as a means of maintaining ecological balance and soil erosion control (37.5%), followed by a source of medicinal plants (35%). So, it seems that there is still a lack of knowledge in these two categories; institutional, government and NGOs training and learning programs are necessary to facilitate knowledge.

Table 4.17: Perceived importance of homestead garden conservation in the study area

Items	Very important	Less important	Not important
Food and fruit	85	15	0
Firewood	68.75	23.75	7.5
Building materials	78.75	20	1.25
Subsistence family income	73.75	20	6.25
Medicinal plants	28.75	35	36.25
Ecological balance	28.75	37.5	33.75
Soil erosion control	51.25	37.5	11.25
Others*	36.25	17.5	46.25

***** Boundary, ornamental, spiritual purposes, and so forth.

4.9 Shannon-Weaver Diversity Index (H′) of Homestead Species

The study survey recorded 69 plant species from the set of 110 surveyed homesteads. The result of Shannon-Weaver diversity index (H′) value (Table 4.18) was calculated highest for Chuknagar (8.09) followed by Gutudia (7.95), Kharnia (7.85), Shobhona (7.80) and Gabtala (7.66). So, the species richness was highest in Chuknagar village.

Table 4.18: Shannon-Weaver diversity index of homestead plant species in the study area

Study site	Shannon-Weaver diversity index (H′)
Gutudia	7.95
Shobhona	7.80
Kharnia	7.85
Gabtala	7.66
Chuknagar	8.09

4.10 Relative Prevalence of Tree Species Grown in Homestead

A total of 69 tree species were identified in the study area. The relative prevalence (RP) of tree species found in the study area is shown Table 4.19. The most common species like *Magnifera indica, Artocarpus heterophyluus,* Azadirachta indica, *Areca catechu* and *Musa spp.* were very high while prevalence of less common species like Erythrina variegate, *Aegle mermelos* and Ficus hispida was found very low. Ecological factor is one of determinant of species grown in the farms. Besides the ecological reasons, the socio-economic condition of the household was also a major determinant of the species-mix prevailing in a homegarden. There were minor differences in relative prevalence of less common species and significant differences of most common species among the farm categories. Clearly farmers of that area prefer some species to grow in their farms. The decision of which trees to grow depends on a combination of price and yield, both depending on the location of the farm in terms of ecological zone and proximity to consumption centre.

Table 4.19: Relative Prevalence of Tree* in the Homegardens of Different homegardens

Species Name Local	Scientific Name	Relative Prevalence
Horticultural Species		
Banana	*Musa spp.*	25.27
Mango	*Magnifera indica*	22.58
Jackfruit	*Artocarpus heterophyluus*	16.28
Betel nut	*Areca catechu*	14.32
Bamboo	*Bambusa spp.*	10.23
Coconut	*Cocos nucifera*	9.30
Guava	*Psidium guajava*	7.71
Sapota	*Pouteria sapota*	5.65
Papaya	*Carica papaya*	4.31
Lebu	*Citrus limon*	3.11
Jujube	*Ziziphus mauritiana*	2.73
Pomelo	*Citrus grandis*	2.59
Jalpai	*Elaocarpus floribundus*	0.65
Bael	*Aegle mermelos*	0.17
Forest Species		
Neem	Azadirachta indica	21.43
Mehogony	Swietenia mahogany	16.22
Sisso	Dalbergia sissoo	5.36
Eucaliptus	Eucalyptus camaldulensis	3.58
Shimul	Gossypium harbacium	2.93
Kadam	Anthocephallus chinensis	2.71
Shonalu	Cassia fistula	1.94
Koroi	Albizia procera	1.59
Jiga	Trema orientalis	0.85
Pitraj	Aphanamixis polystachya	0.67
Tarul	Albizia chinensis	0.58
Raintree	Samania saman	0.43
Khoksha	Ficus hispida	0.20
Mander	Erythrina variegate	0.11

* Tree species found less than 10 in whole sample are not included

4.11 Benefits Derived from Homegardening

It was confirmed by about 87.5% of the respondents that homegardening serves as an easy source of fresh food while 69.8% indicated its usefulness in promoting better nutrition and reduction in family food budget. Homegardening was also embarked upon as a form of pleasure and hobby by 54.0% of the respondents while 42.9% believed it keeps bushes away and adds beauty to the environment (Table 4.20). A cursory observation revealed that homegardening can serve as a relief from emotional stress and mental fatigue. Gardening can be a great exercise for individual suffering from arthritis (joint pain) and stress reducer when done correctly, for maintaining joint respondents attested to the income generating potential of homegardening (Table 4.20). This is contrary to a report that homegardening generates a lot of income in the study area. It may be that majority of the homegardeners practice it for family consumption and gifts to people.

Table 4.20: Distribution percentage of respondents based on benefits derived from homegardening

Benefits	Percentage (%)
Easy source of fresh food	85.7
Reduction in family food budget	69.8
Better nutrition	69.8
Pleasure/hobby	54.0
Ease emotional stress	30.2
Relief mental fatigue	20.6
Income generation	20.6
Conservation of medicinal plants	27.0
Environmental beatification/keeps bushes away	42.9

Other benefits derivable from homegardens as discovered through personal interaction include: provision of shades for relaxation, pleasure in giving crops as gifts, serves as aesthetics, saves family unnecessary embarrassment when there is no money at hand, promotion of good health and addition of pride through the beauty of the garden. Not less than 87.3% of the respondents agreed that homegardening can lead to increase in family food supply and about 90.6% agreed that it could bring about improvement in family food consumption. This agreement supports the findings in Bangladesh and Central America, where homegardening was found to increase food supplies for families (Olajide-Taiwo *et al.*, 2010). With increment in family food consumption geared up by homegarden, there will be an improvement in the nutritional intake of the populace. This will bring a resultant reduction in the problem of malnutrition and food insecurity.

4.12 Constraints Faced in Homegardening

In the present study, homesteads gardens were largely user oriented, and market access was not fully developed. However, market access for homestead products is essential as, they sell their products easily into the market as well as other forest products. It was shown that most of the producers were selling to their neighbors or local traders. Therefore, they do not get proper price for their products. If they get

their products to the market or sell products via retailers, they will get proper prices also, which is very much important for the small household owners, therefore creating a scope for income. Many studies of tropical homestead garden have reported reduced species diversity and stem density in homestead garden with closer proximity to market for example (Olajide-Taiwo *et al.,* 2010). So, market access condition has great effect on homestead forest management; thus, further study is needed to directly test the influence of market access on the homestead gardens structure of both commercial and subsistence-oriented homestead garden in Bangladesh. However, the homestead gardens of the study area present an excellent example of all embracing multipurpose land-use system and biodiversity conservation.

After calculated the "extent of constraints faced in homegardening" scores for each of 110 homestead owners, an effort was also made to compare the relative constraints. Constraints score for each statement was calculated by using Homegardening Barrier Index (HBI) and it has been arranged in rank order according to their extent of constraints level which appears in Table 4.21. The Homegardening Barrier Index (HBI) could range from 0 to 330, where 0 indicating no constraints and 330 indicating maximum constraints of a single statement of constraints faced in homegarden.

"Low market price" was the most severe constraints (251) faced by the homegardeners of Dumuria upazila regarded as top in ranking order followed by next five problems based on their descending order of severity or ranking were "Damage by animals (213)", "Unavailability of space (208)", "No formal training (203)", "No particular model is followed for tree planting (201)" and "Lack of advice in proper time (199). The Table also shows that the last three least severe problems are "Lack of quality seeds & seedlings (182), "Difficulties in postharvest (obstacle sunlight), preservation & processing of perishable products (158)" and "Conflict with neighbors (127).

Table 4.21: Statement-wise score of constraints faced in homegardening

Constraints	Homestead owner (N=110)				Homegardening Barrier Index (HBI)	Rank order
	High	Medium	Low	Not at all		
Lack of technical knowledge	38	35	25	12	189	9
Lack of capital	27	46	23	14	196	7
Lack of credit facilities	36	23	32	19	186	10
No formal training	39	30	26	15	203	4
Lack of advice in proper time	39	24	34	13	199	6
No particular model is followed for tree planting	24	54	21	11	201	5
Unavailability of space	25	52	29	4	208	3
Lack of quality seeds & seedlings	31	28	33	18	182	13
Difficulties in postharvest (obstacle sunlight), preservation & processing of perishable products	3	54	41	12	158	14
Marketing problem of products	24	42	38	6	194	8
Low market price	57	27	26	0	251	1
Risk of insect, pest infestation	19	46	35	10	184	11
Negative effect of upper storied trees on lower storied vegetable crops	23	41	32	14	183	12
Damage by animals	30	44	35	1	213	2
Conflict with neighbors	7	18	70	15	127	15

4.13 Relationship between the selected characteristics of the homestead owners with their perceptions on biodiversity conservation through homegardening

This section deals with the relationship between selected characteristics of the homestead owners and their perceptions on biodiversity conservation through homegardening. The selected characteristics were: age, education, farm size, home stead size, gardener type, credit received, annual family income, extension media contact, training received, problems faced by the homegardeners. To explore the relationships between the selected characteristics and their perception Pearson's Product Moment co-efficient of correlation (r) has been used. The relationships of the selected characteristics of the homestead owners with their perception have been showed in Table 4.22. However a correlation matrix for all variables has been presented in Appendix-II.

Table 4.22: Computed co-efficient of correlation (r) between homestead owners' perceptions and their selected characteristics (N = 110)

Farmers characteristics	***Values of 'r' at 108 df***	***Tabulated value of 'r' at 108 df***	
		0.01	***0.05***
Age	0.055 ^{NS}	0.246	0.188
Education	0.149 ^{NS}		
Farm size	0.360**		
Home stead size	-0.041 ^{NS}		
Gardener type	-0.083 ^{NS}		
Credit received	0.099 ^{NS}		
Annual Family income	0.325**		
Extension media contact	0.479**		
Training Received	0.520**		
Problems faced by homegardeners	-0.517**		
Species composition of homegarden	-0.132^{NS}		

^{NS} non significant

** Significant at 0.01 level of significance

4.13.1 Relationship between age and perception of the homestead owners on biodiversity conservation

The relationship between age of the homestead owners and their perception on biodiversity conservation examined by testing the following null hypothesis: "There is no relationship between age of the homestead owners and their perception on biodiversity conservation". The computed value of 'r' (0.055) was found smaller than that of the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. Based on the above findings, the null hypothesis was accepted and it was therefore, concluded that homestead owners' age had no significant relationship with their perception on biodiversity conservation. So, it may be said that farmers age and their perception on biodiversity conservation were not associated, they were independent.

4.13.2 Relationship between education and perception of the homestead owners on biodiversity conservation

The relationship between education of the homestead owners and their perception on biodiversity conservation was examined by testing the following null hypothesis: “There is no relationship between education of the homestead owners and their perception on biodiversity conservation.” The computed value of ‘r’ = (0.149) was smaller than the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. Based on the above findings, the null hypothesis was accepted and it was therefore, concluded that homestead owners' education had no significant relationship with their perception on biodiversity conservation. So, it may be said that education and perception on biodiversity conservation were not associated, they were independent.

4.13.3 Relationship between farm size and perception of the homestead owners on biodiversity conservation

The relationship between farm size of the homestead owners and their perception on biodiversity conservation was examined by testing null hypothesis: "There is no relationship between farm size of the homestead owners and their perception on biodiversity conservation." The computed value of 'r' (0.360) was found greater than the table value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. Hence, the concerned null hypothesis was rejected. The relationship between the two concerned variables also showed positive trend. The findings indicated that farm size of the homestead owners had a positive significant relationship with their perception on biodiversity conservation.

4.13.4 Relationship between homestead size and perception of the homestead owners on biodiversity conservation

The relationship between the farmer's homestead size and their perception on biodiversity conservation was studied by testing the following null hypothesis: "There is no relationship between homestead size of the homestead owners and their perception on biodiversity conservation." The computed value of 'r' (-0.041) was smaller than the tabulated value of 'r' (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. Hence the concerned null hypothesis was accepted. The findings indicated that homestead owners' homestead size had no significant relationship with their perception on biodiversity conservation.

4.13.5 Relationship between gardener type and perception of the homestead owners on biodiversity conservation

The relationship between gardener type of the homestead owners and their perception on biodiversity conservation was examined by testing the following null hypothesis: "There is no relationship between gardener type of the homestead owners and their perception on biodiversity conservation." The computed value of 'r' (-0.083) was smaller than the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level probability as shown in table 4.22. Therefore, the concerned null hypothesis was accepted. Hence, there is no significant relationship between gardener type of the homestead owners and their perception on biodiversity conservation.

4. 13.6 Relationship between credit received and perception of the homestead owners on biodiversity conservation

The relationship between credit received by the homestead owners and their perception of on biodiversity conservation was examined by testing the following null hypothesis: "There is no relationship between credit received by the homestead owners and their perception of on biodiversity conservation." The calculated value of 'r' (0.099) was smaller than the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in the Table 4.22. The relationship between the two concerned variables also showed positive trend. Therefore, the concerned null hypothesis was accepted. Hence, there is no significant relationship between credit received by the homestead owners and their perception of on biodiversity conservation.

4.13.7 Relationship between homestead owners' annual family income and their perception of the homestead owners on biodiversity conservation

The relationship between homestead owners' annual family income and their perception of the homestead owners on biodiversity conservation was examined by testing the following null hypothesis: "There is no relationship between homestead owners' annual family income and their perception of the homestead owners on biodiversity conservation". The computed value of 'r' (0.325) was greater than the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. Thus the null hypothesis was rejected. The two variables also showed a positive trend. It was concluded that there was positive significant relationship between homestead owners' annual family income and their perception of the homestead owners on biodiversity conservation

4.13.8 Relationship between extension media contact and their perception of the homestead owners on biodiversity conservation

The relationship between extension media contact by the homestead owners and their perception of the homestead owners on biodiversity conservation was examined by testing the following null hypothesis: "There is no relationship between extension media contact by the homestead owners and their perception on biodiversity conservation". The computed value of 'r' (0.479) was greater than the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. Thus the null hypothesis was rejected. It was concluded that there was positive significant relationship between extension media contact by the homestead owners and their perception on biodiversity conservation**.**

4.13.9 Relationship between training received by the homestead owners and their perception on biodiversity conservation

The relationship between the homestead owners' training received and their perception of on biodiversity conservation was examined by testing the following null hypothesis: "There is no relationship between the homestead owners' training received and their perception on biodiversity conservation." The computed value of 'r' (0.520) was larger than the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. The relationship between two concerned variables also showed positive trend. Based on the above findings, the null hypothesis was rejected. It was concluded that there is a positive significant relationship between the homestead owners' training received and their perception of on biodiversity conservation

4.13.10 Relationship between Problems faced by homegardeners and their perception on biodiversity conservation

The relationship between problems faced by homegardeners and their perception on biodiversity conservation was measured by testing the following null hypothesis: "There is no relationship between problems faced by homegardeners and their perception on biodiversity conservation." The computed value of 'r' (-0.517) was found greater than the tabulated value of 'r' (0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4. 22. The relationship between the concerned variables showed a negative trend. Hence, the null hypothesis was rejected. The findings indicate that there is a negative significant relationship between problems faced by homegardeners and their perception on biodiversity conservation**.** That means higher the problems faced by homegardeners had negative perception on biodiversity conservation

4.13.11 Relationship between Species composition of homegarden of the homestead owners and their perception on biodiversity conservation

The relationship between species composition of homegarden of the homestead owners and their perception on biodiversity conservation was examined by testing the concerned null hypothesis: "There is no relationship between species composition of homegarden of the homestead owners and their perception on biodiversity conservation." The computed value of 'r' (0.132) was smaller than the tabulated value (r = 0.246) with 108 degrees of freedom at 0.01 level of probability as shown in Table 4.22. This led to the observation regarding the relationship that the null hypothesis was accepted and hence it can be concluded that species composition of homegarden of the homestead owners had no significant relationship with their perception on biodiversity conservation.

4.14 Limitations of the Study

1. The major limitation of the study was heavy reliance of the homestead owner's memory. Homestead owners do not keep any record of their farm input used and output obtained.

2. It was a very common problem that, most of the large homestead owners tried to interrupt during discussion with small or medium homestead owners as they always dominate the farming society.

3. A homegarden is a complex agroforestry system whose vital information cannot be gathered in a short time. Time constraint, was another limitation of the study.

4. Women were reluctant to give answer and they were not free to join into the discussions.

5. The only way of getting good approximation was by finding the homestead owner's approximation followed by key informant.

CHAPTER V

SUMMARY AND CONCLUSION

5.1 Summary

The study was conducted in five villages under Dumuria upazilla in Khulna district. Sites were selected purposefully on the basis of homegarden practicing mentality of the homestead owners. There are approximately 3000 farm families in these villages. A total of 110 homestead owners of the ten villages constituted the population of study. A sample of 10% farm families was selected stratified random sampling procedure. However 110 homestead owners were selected from homestead owners following stratified random sampling procedure. Therefore, these 110 homestead owners constitute the sample for this study.

In order to collect the relevant information from the homestead owners an interview schedule was carefully designed. Direct and open form question and different scales were used to obtain information. Data were collected through personal interview by the researcher herself from the sampled homestead owners during November 2012 to February 2013. The collected data were coded, compiled, tabulated and analyzed in accordance with the objectives of the study.

The study survey recorded 69 plant species. Among the total species, 53.62%, trees, 23.18% shrub, and 24.6% herbs. A few number of vegetables were found to grow in the study area but largely for own consumption. The study showed that *Zingiber officinale*, *Curcuma longa* L., *Amaranthus gangeticus*, *Colocasia esculenta*, *Basella alba* L., *Cucurbita maxima* Duchesne *ex* Lmk., *Capsicum annuum* L., *Solanum melongena*, *Raphanus sativus* and *Abelmoschus esculentus* were grown under *Magnifera indica*, *Artocarpus heterophyluus*, *Litchi chinensis* and *Swietenia mahogany* trees. The result of Shannon-Weaver diversity index (H′) showed that, the species richness was highest in Chuknagar village (8.09).

The relative prevalence (RP) of tree species found in the study area showed that the most common species like *Magnifera indica*, *Artocarpus heterophyluus*, *Areca catechu*, *Musa spp.* and *Bambusa spp.* were very high while prevalence of less common species like Erythrina variegate, *Aegle mermelos* and Ficus hispida was found very low.

Homestead owners' perception regarding impact of homegarden on biodiversity conservation was the dependent variables of the study. Eleven selected characteristics of the homestead owners were taken as independent variables. The characteristics were age, education, farm size, homestead size, gardener type, credit received, annual income, extension media contact, training received, problem faced by the homegardeners, species composition of homegarden and perceptions on biodiversity conservation through homegardening constituted the dependent variables in this study. Appropriate methods and procedures were followed to measure the independent and dependent variables of the study.

Descriptive statistics like range, mean standard deviation, frequency, percentage and rank orders were used to describe both the independent and dependent variables. Tables were presenting data for clarity of understanding. For test of hypothesis

Pearson's product moment correlation co-efficient (r) was used. 1% level of significance was used as the basis for rejecting a null hypothesis.

Out of eleven selected characteristics of the homestead owners five were markedly significant and the rest were non-significant. The significant characteristics were farm size, annual family income, extension media contact, training received, and problem faced by the homegardeners.

The findings leads to the conclusion the rest selected characteristics of the homestead owners had no significant contribution on biodiversity conservation through homegarden practices.

The major problem of planting new trees on homestead was "damage by animal" which was reported by 59.1% of the respondents. Scarcity of space was another common constraint reported by 43.6% of respondents. On the average of 34% homestead owner stated that trees create difficulties in post harvest operations of field crops by obstructing sunlight and air to the yard. However, this problem was reported as a major problem mostly by medium and large homestead owners.

The most important finding of the present study was most of the selected homestead owners feel that the homegardening in its presents form had significant role in conserving biodiversity in the study area. Therefore, there is a great scope to improve the prevailing homegardens with modern horticultural technologies and extension services for maximization the diversity of plant species in the homestead area.

5.2 Conclusion

The potential importance of domestic gardens to biodiversity has been acknowledged in the popular media for many years. This assertion is supported by a small number of studies that have demonstrated that homegardens play a substantial role in maintaining and enhancing biodiversity.

Homestead agroforestry is one of the traditional land use systems in dumuria upazila of Khulna districts like elsewhere in Bangladesh. The size of the homestead was the primary factor that determined the total species variation. The variation increased with increasing farm size from landless to large farms. The homesteads were found underutilized and there were some vacant niches that could be used for growing more trees and vegetables especially in the landless farms.

Homegardens provide good ecological and social conditions for outstanding production and contributing to conservation of diversity and evolution of plant genetic resources. They are important production system of food and other essential products. Homegardens provide a unique opportunity to clearly explain and demonstrate the importance of genetic diversity for crop improvement as well as the relevance of linking conservation with development. It also provides environments in which part of the genetic diversity for many crops species can be maintained. The contribution of homegardens to conservation is dynamic and ensures the maintenance of materials, which provide direct benefits to the owners and users of homegarden products.

5.3 Recommendations

Looking into consideration the many importance of homegardens and in order to be able to incorporate them as a complementary strategy, the author would like to recommend that

- Supply of planting materials *viz.* seed, seedlings of different species should be made available to the homestead owners.
- Innovative ideas and technologies should be diffused throughout the country. Any innovative idea should be encouraged through intensives as well as publicity.
- Basic research to improve the indigenous fruit and timber tree species, shade tolerance and shad demanding plants could be an important research topic for homegarden agroforestry research.
- It can be recommended that homestead owners should be provided with training on multi-layer gardening and others improved gardening practices.
- Suitable credit facility can be offered in such a way that trees provided as collateral and the loan paid back after harvest of the trees at the desired maturity which will give benefit to both the financial institutions and the homestead owners.
- It is further recommended that the present extension services should be strengthened to introduce superior quality planting stocks to replace the low yielding one.

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APPENDICES

Appendix-I

(English version of interview schedule)

DEPARTMENT OF HORTICULTURE

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

DHAKA-1207.

An interview schedule for a research study entitled

"BIODIVERSITY CONSERVATION THROUGH HOMEGARDENING IN DUMURIA UPAZILA OF KHULNA DISTRICT"

Serial No…….
Respondent Name:
Village:
Union:
Upazila:
District:

Please answer the following questions

1. Age: what is your present age? .....Years

2. Education: what is the level of your education?

a) Illiterate b) Can sign only c) Have passed class……

3. Farm size (Please mention your farm size)

Sl. No.	Types of land	Land area in Local Unit
1	Inherited	
2	Purchased	
3	Leased	
4	Govt. allocated	
5	Others	
Total land area in Local Unit		
Total land area in Has		

4. Distribution of homestead area:

Description	Number	Amount of area	
		Local unit	Ha
Living room			
Kitchen room			
Cowshed			
Area under vegetables			
Area for fruit trees			
Area for timber			
Area for fuel wood			
Area for mixed cropping			
Yards			
Ponds			
Fallow land			
Total			

5. Gardener type:

Beginner ☐ Advanced ☐ ; Expert ☐

6. Credit received: had you taken any credit last year?

Yes…….No……

If yes, then Please mention sources of credit with its amount

Sl.	Name of sources	Amount of credit (BDT)
1	Bank	

2	Relatives/Friends	
3	Neighbor	
4	NGOs	
5	Money lenders	
Total		

7. Household annual income

Income source	**Amount in BDT**	**Percent**
Agriculture		
Non-agriculture		
Remittance from overseas		
Remittance from urban migrants		
Remittance from seasonal migration		
Pension or ration money		
Others(with name)		
Total		100

8. Extension media contact: please indicate the extent of contact in following sources

Sl. No.	**Name of information sources**	**Extent of contact**			
		Frequently	Occasionally	Rarely	Not at all
1.	Model farmers	4 or more times/month	2-3 times/month	At least once a month	
2.	Input dealer	3 or more times/month	1-2 times/month	At least once a year	
3.	NGO worker	3 or more times/month	1-2 times/month	1-5 times/years	
4.	Sub Assistant Agricultural Officer (SAAO)	4 or more times/month	2-3 times/month	1 time/months	
5.	Scientific officer of BARI	2 or more times/month	At least 1 time/month	1-5 times/years	
6.	Participation in group meeting	3 or more times/month	1-2 times/month	At least once a year	

7.	Listening agricultural program on radio	4-7 days/week	1-3 days/week	1-3 days/month	
8.	Watching agricultural program on TV	4-7 days/week	1-3 days/week	1-3 days/month	
9.	Reading printed materials like leaflet, bulletin	1 piece/month	3-5 pieces/year	1-2 pieces/year	
10	Watching agricultural posters advertisements in newspaper	1 piece/month	3-5 pieces/year	1-2 pieces/year	

9. Training received: Have you participated in any training program on Homegardening/Agroforestry?
Yes……../ No…… If yes, furnishes the following information:

Sl. No.	Name of training course	Organization	Day (s)
1			
2			
3			

10. Problem confrontation

Sl. No.	Problems	Nature of problem			
		High	Medium	Low	Not at all
1	Lack of technical knowledge				
2	Lack of capital				
3	Lack of credit facilities				
4	No formal training				
5	Lack of advice in proper time				
6	No particular model is followed for tree planting				
7	Unavailability of space				
8	Lack of quality seeds & seedlings				
9	Difficulties in postharvest (obstacle sunlight), conservation & processing of perishable products				
10	Marketing problem of products				
11	Low market price				
12	Risk of insect, pest infestation				
13	Negative effect of upper storied trees on lower storied vegetable crops				
14	Damage by animals				
15	Conflict with neighbors				

11. No. of plant species found in the homegarden:

Name of crop	Number

a) Herbs 1. 2. 3. 4. 5. b)Shrubs 1. 2. 3. 4. 5. c) Trees 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15.	

12. Please give your perception on plant biodiversity conservation:

Sl. No	**Statements**	**Score**			
		Strongly agree	Agree	No answer	Disagree
1	Increase the greenish view due to plantation				
2	Increase the use of OM due to increase no. of plants				
3	Increase soil moisture conservation				
4	Getting fresh air due to increased no. of plants				
5	Relatively decreasing the global warming				
6	Decrease soil erosion				
7	Decreasing the pollution of farm environment				
8	Decrease insect attack in crop field				
9	Improve soil texture & structure in homestead				
10	Balancing biodiversity				

11	Source of conserving local variety				
12	Cultivation of spices & condiments in shady place				
13	Provide shade and improve microclimate				
14	Reduce natural disaster				
15	Increase the intensity of wind breaks				

Thanks for your co-operation

Signature of the interviewer with Date

Appendix - II

Correlation matrix showing inter correlations between dependent and independent variables

Variables	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
X_1	1.000								
X_2	-0.209*	1.000							
X_3	-0.136	0.001	1.000						
X_4	0.047	-0.111	-0.368**	1.000					
X_5	0.190*	-0.066	0.028	-0.227*	1.000				
X_6	0.021	-0.180	0.118	-0.118	0.073	1.000			
X_7	0.309**	0.167	0.041	0.009	-0.017	0.229*	1.000		
X_8	0.148	0.218*	0.038	-0.062	0.067	0.229*	0.598**	1.000	
X_9	0.185	0.303**	0.129	-0.055	-0.028	0.003	0.602**	0.655**	1.000
X_{10}	-0.356**	-0.182	-0.102	-0.117	0.003	-0.021	-0.719**	-0.645**	-0.722*
X_{11}	0.053	-0.079	0.006	-0.010	0.049	0.024	-0.092	-0.152	-0.119
X_{12}	0.055	0.149	0.306**	-0.041	-0.083	0.099	0.325**	0.479**	0.520*

* = Correlation is significant at 0.05 level of probability

** = Correlation is significant at 0.01 level of probability

Table value of 'r' at 0.01 = 0.186 with 108 df

X_1 = Age

X_2 =Level of education

X_4 = Homestead size

X_5 = Gardener type

X_7 = Annual Family income

X_8 = Extension media contact

X_{10} = Problems faced by home gardeners

X_{11} = Species composition of homegarden

Dependent variable

X_{12} = Farmers' perceptions on biodiversity conservation through homegardening

Appendix – III

List of plant species observed in the study area

Sl. No.	Local name	Scientific name
1.	Am	*Mangifera indica* L.
2.	Amloki	*Phyllanthus emblica*
3.	Assam Lata	*Eupatorium odoratum* L.
4.	Bael	*Aegle mermelos*
5.	Bagan Bilash	*Bougainvillea brachycarpa* Heimerl
6.	Balco Bans	*Bambusa balcooa* Roxb.
7.	Bamboo	*Bambusa spp.*
8.	Bashok	*Justicia adhatoda* L. Nees
9.	Bengal cardamom	*Amomum aromaticum*
10.	Black cumin	*Nigella sativa*
11.	Bon Jui	*Clerodendrum inerme* (L.) Gaertn.
12.	Buno Kachu	*Colocasia nymphaeifolia* Kunth
13.	Chal Kumra	*Benincasa hispida* (Thunb.) Cogn.
14.	Chalta	*Dillenia indica*
15.	Choijhal	*Piper chaba*
16.	Creat	*Andrographis paniculata*
17.	Daton Gach	*Glycosmis pentaphylla* (Retz.) DC.
18.	Dosta Kachu	*Xanthosoma nigrum* (Vell.) Mans.
19.	Eucalyptus	Eucalyptus camaldulensis
20.	Harjora Lata	*Cissus quadrangularis* L.
21.	Hasnahena	*Cestrum nocturnum* L.
22.	Holud	*Curcuma longa* L.
23.	Horitoki	*Terminalia chebula*
24.	Jalpai	*Elaocarpus floribundus*
25.	Jam	*Syzygium cumini*
26.	Jarul	Albizia chinensis
27.	Jiga	Trema orientalis
28.	Kadam	Anthocephallus chinensis
29.	Kagojee Lebu	*Citrus limon* (L.) Burm.f.
30.	Kamranga	*Averrhoa carambola*
31.	Kanthal	*Artocarpus heterophyllus* Lam.
32.	Keya	*Pandanas utilis*
33.	Khejur	*Phoenix sylvestris* Roxb.
34.	Khoksha	Ficus hispida
35.	Kola	*Musa* spp.
36.	Kolaboti	*Heliconia metallica*
37.	Koroi	Albizia procera
38.	Kul	*Ziziphus jujube* Mill.
39.	Lao	*Lagenaria siceraria* (Md.) Standl.
40.	Lettuce	*Lactuca sativa*

Appendix – III (Continued)

Sl. No.	Local name	Scientific name
41.	Mahogony	*Swietenia macrophylla* King

42.	Man Kachu	*Alocasia indica* (Lour) Koch
43.	Mander	Erythrina variegate
44.	Mendi	*Lawsonia inermis* L.
45.	Mete Alu	*Dioscorea alata* L.
46.	Mishti Kumra	*Cucurbita maxima* Duchesne *ex* Lmk.
47.	Morich	*Capsicum annuum* L.
48.	Narikel	*Cocos nucifera* L.
49.	Neem	Azadirachta indica
50.	Ol Kachu	*Amorphophallus paeoniifolius* (Denn.) Nicol.
51.	Papaya	*Carica papaya*
52.	Pargacha	*Hoya verticillata* (Vahl.) G. Don
53.	Pata Bahar	*Codiaeum variegatum* (L.) Blume
54.	Peara	*Psidium guajava* L.
55.	Pitraj	Aphanamixis polystachya
56.	Pomelo	*Citrus grandis*
57.	Pui Shak	*Basella alba* L.
58.	Rain tree	*Samanea saman* (Jacq.) Merr.
59.	Rattan	*Calamus guruba*
60.	Safeda	*Pouteria sapota* (Jacq.) Moore.
61.	Shim	*Lablab perennans* DC.
62.	Shimul	Gossypium harbacium
63.	Shonalu	Cassia fistula
64.	Shosha	*Cucumis sativus* L.
65.	Sisso	Dalbergia sissoo
66.	Snake root	*Rauvolfia serpentina*
67.	Sorifa	*Annona squamosa*
68.	Superi	*Areca catechu* L.
69.	Tentul	*Tamarindus indica*

Gutudia

Shobhona

Plate 1: Ideal homesteads in Gutudia and Shobhona

Kharnia

Chuknagar

Plate 2: Ideal homesteads in Kharnia and Chuknagar