PLANT-BIODIVERSITY AT AJMIRIGANJ HAOR HOMESTEADS OF BANGLADESH

BY

MD. MAKSUDUL HAQUE

REGISTRATION NO. 06-02061

A Thesis
Submitted to the Department of Genetics and Plant Breeding
Sher-e-Bangla Agricultural University, Dhaka
in partial fulfillment of the requirements
for the degree
of

MASTER OF SCIENCE

IN

GENETICS AND PLANT BREEDING

SEMESTER: JULY-DECEMBER, 2012

Approved by:

(Dr. Mohammad Saiful Islam)	**(Dr. M. A. Mannan)**
Associate Professor	**Senior Instructor of DAE**
Supervisor	**Co-supervisor**

23.7.2013

(Dr. Mohammad Saiful Islam)
Chairman
Examination Committee

Department of Genetics and Plant Breeding
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka – 1207
Bangladesh.

Ref:..... Date:.....

CERTIFICATE

This is to certify that the thesis entitled, **"PLANT-BIODIVERSITY AT AJMIRIGANJ HAOR HOMESTEADS OF BANGLADESH"** submitted to the faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN GENETICS AND PLANT BREEDING,** embodies the result of a *bona fide* research work carried out by **MD. MAKSUDUL HAQUE,** Registration No. **06-02061**, under my supervision and guidance. No part of the thesis has been submitted for any other degree or 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.

.....

Dated: December, 2012
Place: Dhaka, Bangladesh

(Dr. Mohammad Saiful Islam)
Supervisor

All praises are to Almighty Allah who kindly enables the author to complete the present work

Dedicated to my

Heavenly Father

&

Beloved Mother

Whose happiness swing with any success to higher educations.

ACKNOWLEDGEMENT

*All praises due to Almighty **"Allah"** for best owing mercy upon the author and for imbibing confidence on the author to materialize the research work.*

*The author is proud to express his deepest gratitude, deep sense of respect and immense indebtedness to his research Supervisor **Associate Professor Dr. Mohammad Saiful Islam**, Department of Genetics and Plant Breeding, Sher-e-Bangla Agricultural University, Dhaka-1207, for his constant supervision, invaluable suggestion, scholastic guidance, continuous inspiration, constructive comments and encouragement during my research work and guidance in preparation of manuscript of the thesis.*

*The author expresses his sincere appreciation, profound sense, respect and immense indebtedness to respected Co-supervisor **Dr. M. A. Mannan**, Senior Instructor of Department of Agricultural Extension and Former Plant Biodiversity Management Specialist of coastal and wetland Biodiversity Management Project of UNDP for extending generous help, untiring and painstaking guidance, innovative suggestions, continuous supervision, timely instructions, inspirations and valuable suggestions during the research work and preparation of the manuscript of the thesis.*

The author would like to express his deepest respect and boundless gratitude to all the respected teachers and staffs of the Department of Genetics and Plant Breeding, Sher-e-Bangla Agricultural University, Dhaka-1207 for the valuable teaching, sympathetic co-operation and inspirations throughout the course of this study and research work.

The authors acknowledge the support of Bangladesh Academy of Science, United States Department of Agriculture and Krishi foundation for their financial support under "Modeling of year round fruit production at Haor homestead" Project fellowship in conducting the present research.

The author is grateful to Thana Agriculture Officer (UAO) and Sub-Assistant Agriculture Officer (SAAO) Ajmiriganj, Hobigonj district for his valuable advice, dynamic guidance and encouragement for execution and completion of his piece of work. Special thanks are due to farmers, who were the respondents of the study and gave their valuable time for interview during collection of data.

The author feels much pleasure to convey the profound thanks to his friends, well-wisher for their active encouragement and inspiration.

*Finally, the author express his unfathomable tributes, sincere gratitude and heartfelt indebt ness from his core of heart to his heavenly father **Enamul Haque**, his mother **Marjina Khatun**, sister Elora Pervin and brother Md. Mazidul Haque whose immensurable sacrifice, blessings, continuous inspiration and moral support opened the gate and paved the way of his higher study.*

May Allah help and protect them all.

Dated: December, 2012 ***The Author***

Place: SAU, Dhaka.

LIST OF CONTENTS

LIST OF CONTENTS (Contd.)

LIST OF CONTENTS (Contd.)

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATE

LIST OF APPENDICES

LIST OF ABBREVIATED TERMS

ABBREVIATION	FULL WORD
AEZ	Agro-Ecological Zone
APAN	Asia Pacific Advanced Network
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BSMRAU	Bangabandhu Shekh Muzibur Rahman Agricultural University
D	Diversity
DAN	Divers Alert Network
et al.	And others
Fig	Figure
FAO	Food and Agriculture Organization
HDI	Human Development Index
No.	Number
r	Correlation co-efficient
RP	Relative prevalence
SAAO	Sub assistant agricultural officer
SAU	Sher-e-Bangla Agricultural University
SD	Standard deviation
spp	Species
SPSS	Statistical Package for Social Science
UAO	Thana Agriculture Officer
UNCED	United Nations Conference on Environment Development
UNDP	United Nations Development Programme
%	Percent

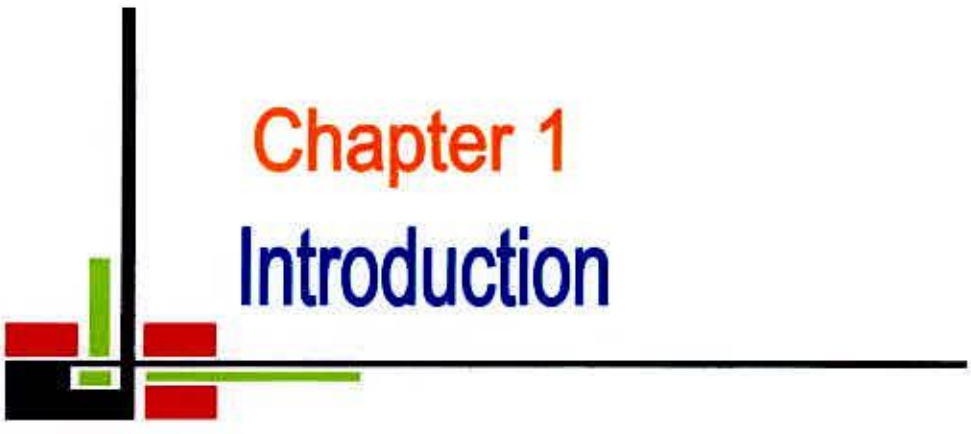
PLANT-BIODIVERSITY IN THE HAOR HOMESTEADS OF BANGLADESH

BY

MD. MAKSUDUL HAQUE

ABSTRACT

The purpose of the study was to determine the plant biodiversity and distribution of fruit, timber and vegetable species in the Haor homestead of Bangladesh and to explore the relationship between plant grower's characteristics and plant biodiversity. Ajmiriganj upazila of Hobigonj district of Bangladesh was the study area. The study covered 300 homesteads from five unions. The information was collected by using questionnaires, focused group discussion and field observations. Plant biodiversity was described by Species richness, Relative prevalence and Species diversity. Twenty seven fruits, 23 timbers, 17 summer vegetables and 12 winter vegetables species were identified. None of the plant species was found in the 100% haor homestead. Coconut and mango were found in the highest number of homestead (79%) in the study area. The relative prevalence of most common fruit plant like betel nut, banana, mango were 115.074, 63.558, 74.358 respectively while the lowest relative prevalence was observed for very rare timber species like Indian Gum Tree, Champa and Jarul. The highest species diversity was found in Mango (0.992), Coconut (0.990), Papaya (0.987) and that of lowest was found in fig, Ipil-ipil and Champa. Various kinds of problems were identified in the study area. According to the farmer's opinion, "Lack of improved plant species" was identified as the topmost problem. No relationship was observed between age of the farmers and fruit diversity, while education, family size, area of homestead, area under fruit have low and non-significant positive relationship with the plant diversity. There was no significant correlation between the demographic characteristics of the homesteads plant grower and plant Biodiversity.



Chapter 1

Introduction

INTRODUCTION

Plant-biodiversity is the plant genetic wealth of a country. Homestead represents a land use system involving deliberate management of multipurpose trees and shrubs in intimate association with seasonal vegetables (Fernandes and Nair, 1990). Economically and genetically important materials selected by both human and nature, adapted in the environment are the components of homesteads. Homesteads are the *in situ* conservation sites of wide range of plant-biodiversity.

Sometimes homesteads possess rare and important materials. Most of the homesteads of landlords are the reservoir of improved cultivars of different fruits and aesthetic plants, which are important from horticultural and breeding point of view. There is a bright scope of exploitation of such rare but quality materials. Considering the scope of study of genetic diversity of plant under homesteads and its possible use in crop improvement, the study was undertaken to determine the plant-biodiversity at homesteads of Hoar area of the country.

1.1 General Background

Bangladesh is a nation of about 152.41 million inhabitant crowded in the area of 1,47,570 sq. km. The density of population is about 964 per sq. km. makes the country most densely populated country in the world (BBS, 2011). The addition of population per year is 2.2 million with an annual growth rate of 1.3 percent (BBS, 2011). Everyday cultivable land is decreasing by converting to communication, industry and shelters. So, the positive aspect is that the number of homestead for shelter is increasing. There is little scope to increase the area for any considerable extent. Hence, effort will have to be made for increasing the production per unit area. Increased production per unit area is a crying need for Bangladesh. This is possible by converting single area into double and triple cropped area by using improved technology in production of crops and year-round homestead fruits.

There are 25.53 million homesteads in Bangladesh (BBS, 2011). Their homesteads are the main source of fruits. Where there is a home, there is a homestead. Every farm families have large or small homestead area where different types of fruits are grown.

Practical experience indicates that majority of the farmers cultivates homestead fruits in unplanned way. A large area of every homestead remain as follows because of poor plant population where as plantation of diversified fruit trees in planned way considering the harvesting period, a farmer can easily get year round fruit supply from his home garden and can get more production of fruit from their garden. Hence, fruit diversity in homestead is necessary (Sellathurai, 1997).

It is necessary to develop sound plans and procedures for plant diversification in homestead. For doing so it is first necessary to have a clear understanding of the present position of homestead plant diversity and the factors related to plant diversity in homestead of the farmers. Plant diversity and its relation with farmer's characteristics greatly helpful for planning and implementing effective plant diversification program to increase balanced food intake for the farm family.

1.2 Plant-biodiversity

Biodiversity is the contraction of biological diversity (CBD). According to CBD held at Rio de Janeiro (Brazil)", "Biodiversity" is 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. It includes diversity within species, between species and of ecosystem (UNCED, 1992).

Plant-biodiversity is the most important component of total biodiversity. It is a resource, a property and the characteristic of plant kingdom. Fundamentally, it derives from the properties of variety of macromolecules, most notably DAN and proteins (Sulbrig, 1994). Again, it is the result of interaction among the climate, organism, topography, parent soil materials, time and heredity (Agrawal, 1999).

1.3 Importance and role of plant-biodiversity

Now-a-days every major crop that is grown in the country has a very narrow genetic base, which contributed to their genetic vulnerability. The problem was first highlighted in the United States of America in 1970 with the southern corn leaf blight epidemic (Ford-Lloyd and Jackson 1986). The lateral genes for the disease were found in grass. Diverse genetic resources of sugar beet and potato are now being

searched for new sources of genes (Ford-Lloyd and Jackson 1986). In fact nothing in this universe created without purpose (Holy Quran 3: 191).

Diversity of genes within plant species increases its ability to adapt in adverse environment. Any decrease in genetic variability may lead to ecosystem instability. Plant biodiversity is instrumental to cycling and recycling of nutrients and thereby achieving the stability of the ecosystem.

1.4 Plant-biodiversity at the homesteads of Bangladesh

Farmers of Bangladesh are the owners of homesteads of different sizes. A homestead usually consists of one house, an open space and a cultivated area. Predominance of root, tuber and tree crops is some of the characteristic traits of traditional homestead in many parts of the world (Ninez, 1987). Bangladesh is not an exception. A homestead in Bangladesh is an integrated production system and stable ecosystem that maintains the plant genetic diversity biological wealth. From the conservation point of view, homesteads can be considered as the *in situ* conservation sites of wide range of plant-biodiversity.

A very few agroforestry work on homesteads being carried out so far and recorded the forest tree and fruit species in the homesteads. In a few cases vegetables were recorded as an associated component. The general components of homesteads are fruit, timber, Seasonal vegetable spices and medicinal plants. UBINIG, a non government organization tried to identify the medicinal plant species with the help of woman group and extension workers (Masher, 1995). Information regarding comprehensive survey of homestead for timbers, fruits, vegetables and spices are very few in the country.

1.5 Importance and role of homestead plant-biodiversity

The tropical forests are regarded as rich in biodiversity. Forest in Bangladesh does not exceed 5 to 6% of the total land area of the country (Basher 1999), which is far below than what is demand (25%). On-farm conservations of plant genetic resources can be defined as the continued cultivation and management of diverse set of crops by the farmers in the agro-ecosystem where those evolved. It is based on the recognition that crop genetic diversity is automatically developed and nurtured by the farmers. It

emphasizes the role of the farmers in selection and management of plant species. So, the economically and genetically important materials that have been selected by nature and adapted in the environment need to be identified for the benefit of human being. Such diversity of a particular crop in the key towards its improvement through direct selection for cultivation.

Environmental variations offer unique opportunity to select appropriate genotypes at different regions. As for example drought tolerant cultivars or landraces as predominantly present at the northern part of the country. Similarly, saline resistant materials are available at saline prone areas of southern regions.

1.6 Haors in Bangladesh

A haor is a wetland ecosystem in the north eastern part of Bangladesh which physically is a bowl or saucer shaped shallow depression. In a country where one third of all area can be termed as wetlands, the haor basin is an internationally important wetland ecosystem, which is situated in Sunamganj, Habiganj and Moulvibazar districts and Sylhet Sadar Upazila, as well as Kishoreganj and Netrokona districts outside the core haor area. It is a mosaic of wetland habitats, including rivers, streams and irrigation canals, large areas of seasonally flooded cultivated plains hundreds of haors and beels Haors are large saucer-shaped flood plain depressions located mostly in north-eastern region of the country covering about 25% of the entire region. There are altogether 411 haors comprising an area of about 8000 km^2 dispersed in the districts of Sunamgonj, Sylhet, Moulvibazar, Hobigonj, Netrokona and Kishoreganj. In Haor area three major resources viz. land, water & human resource could not be utilized in an integrated way due to its unique geographical as well as complex hydrological characteristics. The core haor area, alternatively referred to as the Haor basin or the Sylhet basin, is estimated to spread over an area between 4450 km^2 and 25000 square kilometres by experts.

1.7 Statement of the problems

Fruit is very much important to fulfill nutritional requirement of the citizen of the country. To achieve this goal, fruit trees should be planted in homestead area in planned way so that continuous fruit harvest could be done from diversified plant. To

this effect various types of fruits should be selected based on fruit ripening period so that they pave the way to get different kinds of fruits round the year. But farmers either do not considered the ripening period or consider it very poorly during fruit tree planting in the homestead area. Further they sometimes plant trees other than fruits. Even they keep tree area without planting any trees. Hence, a massive extension program needs to be implemented to developed ideal homestead garden and consequently making varieties of fruits for consumption by the family members. Implementation of any such extension program calls for an assessment of the present fruit diversity in the homestead and problems of the farmers is needed. Possibly there is no assessment of fruit diversity has been done. Therefore the present study entitled "Plant-Biodiversity at Ajmiriganj Haor Homesteads of Bangladesh" has undertaken.

1.8 Specific Objectives of the study

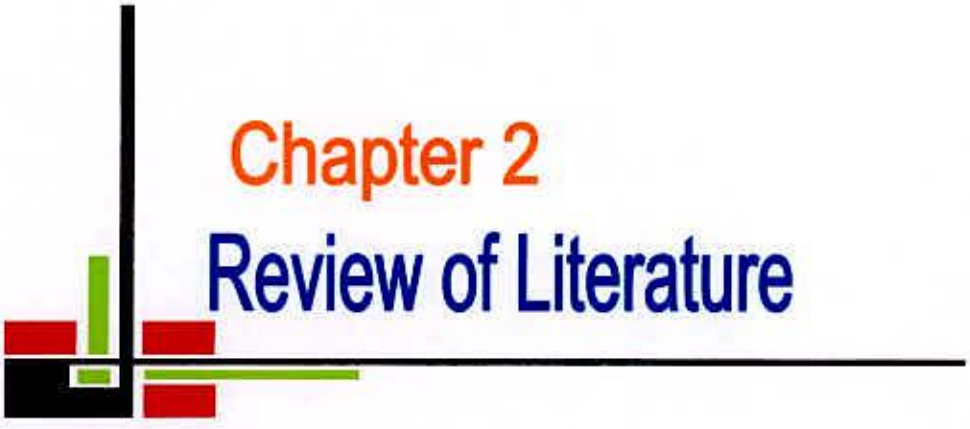
The main objective of the study is to find out the plant biodiversity at Haor homestead of Bangladesh with particular emphasized on fruit reference to Ajmirigonj Upazila under Hobigonj district. Probably no documented information regarding the variability and genetic diversity of plants of Haor homestead of Bangladesh is available. Considering the above idea in mind, present study was proposed with the following objectives:

i. To identify the plant species being grown in the Haor homesteads.

ii. To know the diversity of fruits and timber species of the Haor homesteads.

iii. To know the relationship of plant biodiversity with some selected characteristics of the homestead plant growers.

iv. To identify the problem faced by the homestead plant growers to produce fruit in Haor homesteads.



Chapter 2
Review of Literature

REVIEW OF LITERATURE

The purpose of this chapter is to review of literature having relevance to the present study. The researcher made an elaborate search of available literature for the above purpose. But there is hardly any study dealing with the biodiversity of plants in the homestead of Haor area. The researcher attempted to search the literatures on a number of studies have been conducted on the Plant biodiversity in the homestead. Therefore the findings of such studies related to the Plant biodiversity in the homestead and other partial studies have been reviewed in this chapter.

2.1 General Context of Homestead

Neiz (1987) defined homegarden as a small scale production system supplying plant and animal. Many terms have been used to denote homegarden by various authors. These includes, mixed-garden horticulture (Terra 1953), mixed garden or house garden (Stoler 1978), homegarden, Kitchengarden (Brieley 1976), Household garden (Vasey 1985), Homestead agro-forestry (Leuschner and Khaleque, 1987).

According to Fenandes and Nair (1990), the term is used here to refer to land-use practices involving deliberate management of multipurpose trees and invariably livestock within the compounds of individual houses. It can therefore be seen that homegardens display many features: the intimate mixture of diversified agricultural crops and multipurpose trees fulfill most of the fundamental needs of the local populations and their multistoried configuration and high species diversity avoid the environmental deterioration commonly associated with monoculture production system. Moreover, they have produced sustained yields for centuries in a most resource efficient way. Thus homegardens are economically efficient, ecologically sound and biologically sustainable systems of plant biodiversity as well as fruit diversity.

Michon *et al.* (1983), Soemarwoto and Conway (1991) stated that homegarden maintains high levels of fruit diversity, productivity, stability, sustainability and equitability.

2.2 Importance of Homestead

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

A homestead in Bangladesh is an integrated production system and a stable ecosystem that maintain the plant as well as fruit diversity as biological wealth. From the conservation point of view, homestead can be considered as the *in situ* conservation sites of wide range of plant as well as fruit diversity (Mannan 2000).

Akter *et al.* (1989) mentioned that farmer considered tree as savings and insurance against risk of crop failure and low yield, as well as assets for their children. Some farmers have pointed out fruit diversity would contribute toward expanses for marriage of their daughter.

Linda (1990) mentioned that the high diversity of plant species in village homegarden ensure continuous production of fruit and vegetables, fuel, timber, medicinal and cash crops.

Michon *et al.* (1983), Everett (1989) pointed out the ecological value that they represent in term of genetic diversity and preservation of species in areas where original forest resources have been largely depleted.

Ahmed (1997) in his study reported that 31 minor fruits were found in the homestead of Bangladesh. The minor fruits account for as many as two thirds of the total number of fruits found to grow in homestead.

Leuschner and Khaleque (1987) stated that the homestead system is very important in the economy of Bangladesh. In fact, the activities concentrating in the homestead areas would cover the lionshare of all matters concerned with fruit diversity at large.

Okafor *et al.* (1987) mentioned that homegarden provide numerous advantages, including conservation of fruit diversity, diversified production, risk minimization,

enhanced labor efficiency, continuous production thereby minimizing post-harvest losses due to poor storage facilities, better nutrient cycling and nutrient use efficiency than mono-cropping systems and good soil conservation due to continuous ground cover.

2.3 Species composition

Michon *et al.* (1983), Soemarwato and Conwey (1991) stated that homegardens are intensively cultivated land and have the highest diversity of species. Further Alison (1994) mentioned that species density (number of species per unit area of land) was declining with increasing garden size. Perera and Neville (1989) found in a study of West Java homegardens in the Citarum watershed an excess of 500 species in 350 gardens, with Shannon diversity indices of greater than 2.7. In other areas of West Central Java, high species counts and species diversities were also the norm, with the diversity indices higher (3.71) in Sundanse than in Javanese (2.79) homegarden. Fernandes and Nair (1990), Richard (1979) stated that the magnitude and rate of output of products as well as case and rhythm of maintenance of the homegarden system depends on species composition. Though the choice of species is determined to a larger extent by environmental and socio-economic factors, as well as dietary habits and local markets demands.

Millat-e-mustafa (1997) conducted a vegetation survey in four physiographic region of Bangladesh: deltic, hilly, dry and plain regions. He recorded in total of ninety two perennial species from homegarden of Bangladesh. The highest number of species was recorded in deltaic region (67) followed by plain (56) and hilly region (54), and the lowest in the dry land region (46). He mentioned that, in the dry land region, adverse environmental condition (such as low rainfall, intense heat and low soil fertility) restricts the variety of species that could be grown. Abedin and Quddus (1990) recorded 28 different tree species in the homesteads of the Barind Tract in Rajshashi district. *Mangifera indica* and *phoenix sylvestris* were the most dominant species whereas *Artocarpus heterophyllous* was the only of minor occurrence. They mentioned that the averagė tree density was higher in Patuakhali and Rangpur (1.5 and 1.4 trees/10 sq. meter, respectively) that in Rajshashi (0.7), where the annual rainfall is the lowest in Bangladesh. Miah *et al.* (1990) found that farmers generally prefer fruit trees to fuel/ timber species in their homestead.

2.4 Management of the homestead

The management of the traditional homestead systems has evolved as a response to many factors, cultural, economic and environmental as well as personal preferences.

The gardens often feature low capital input and simple technology and are intensively managed by family labor. Yields are generally low but stable and sustainable (Fernandes and Nair, 1990).

According to Michon *et al.* (1983), Javanese farmers have such a thorough knowledge of ecology that they can often choose the correct niche for each plant depending on the gradient of light and humidity and this seems to correspond to its ecological niche in the natural forest.

2.5 Plant-biodiversity at Homesteads

Plant-biodiversity refers to the variability among the plant kingdom and the ecosystem complex. In a sense plant-biodiversity is the plant genetic wealth of a country. It is composed of four components; genetic, systematic, ecological and cultural diversity (Heywood and Watson. 1995) as in Figure 2.1. They are intimately interlinked and attempts have been taken to unite the components in a Universal paradigm (Huston *et al.*, 1998).

In recent years much attention has been given to diversity and its conservation and utilization. Plant-biodiversity is an important component of total biodiversity. It has been estimated that there exists 5-30 million species of living forms on the Earth, of which 1.5 million have been identified including 300.000 plant species (Agrawal. 1999).

Homestead is one of the potential sources of plant genetic diversity in Bangladesh (Ninez 1987). It is the *in situ* conservation sites of a wide range of plant-biodiversity, which is characterized by the measures of species richness, relative prevalence and inter and intra species diversity (Heywood and Watson. 1995).

2.6 Diversity & Distribution

In recent years much attention has been given to biodiversity and its conservation and utilization. Plant biodiversity is the very much important component of total biodiversity (Mannan, 2000). It has been estimated that there exists 5-30 million species of living forms on our earth. Of this 1.5 million have been identified. This includes 3, 00,000 plant species (Agrawal, 1999).

In Bangladesh homesead is one of the potentialsources of plant genetic diversity as biological wealth (Ninez 1987). It is the *in situ* conservation sites of a wide range of plant biodiversity. The plant biodiversity at homestead level are characterized by the measures of species richness, relative prevalence and inter and intra species diversity (Mannan, 2000).

2.6.1 Species richness

Species richness measures the number of species within an area, giving equal strength in each species (Heywood and Watson. 1995).

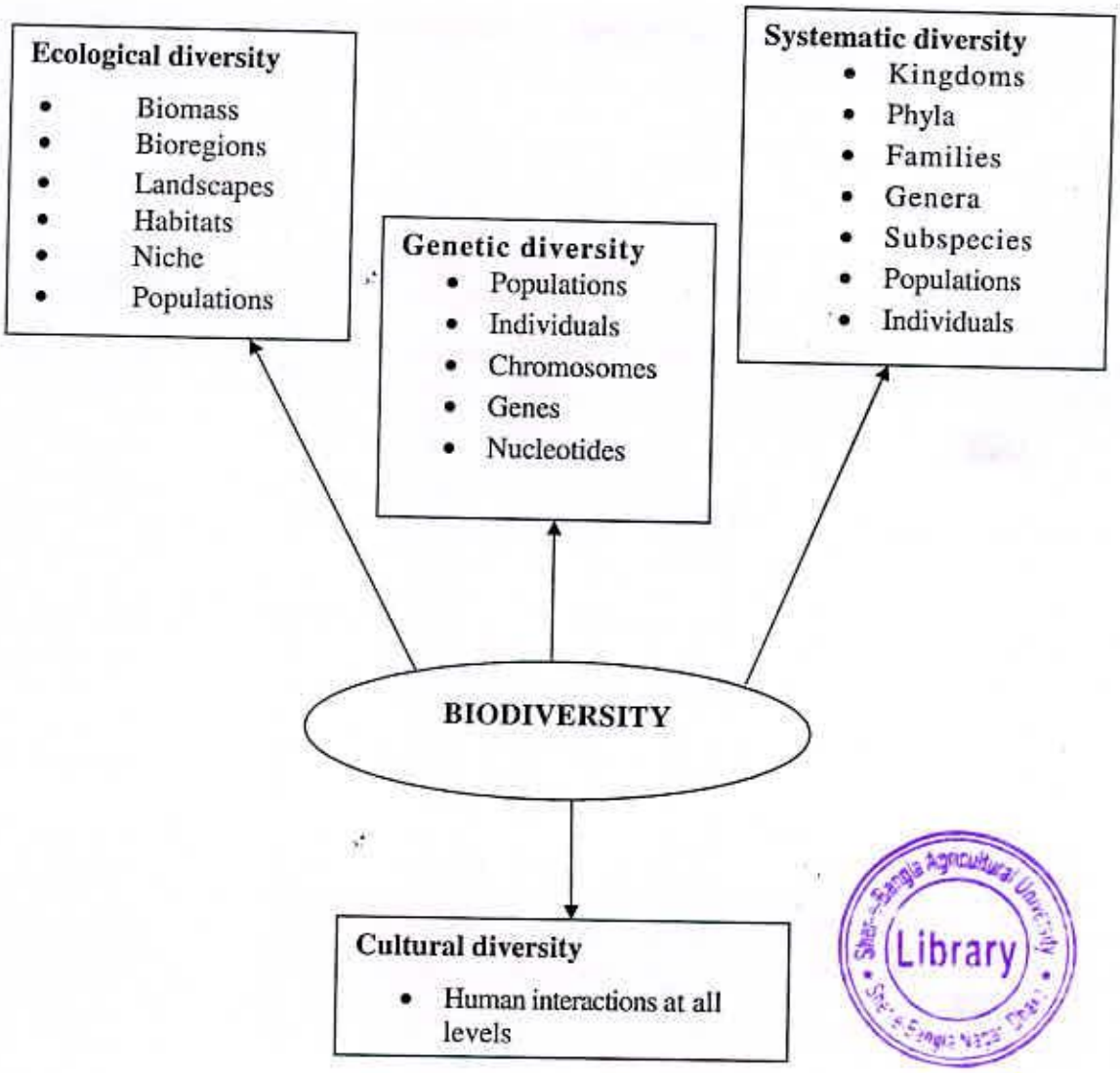


Fig. 2.1 The composition and level of biodiversity

Source: Heywood and Watson. 1995.

Kimber (1973) found 31, 31 and 67 species in three gardens in Martinique. A total of 500 species were enumerated in the homesteads of a village in Java (Michon, 1983).

Kamtuo *et al.* (1985) found 100 species in kitchen gardens and 77 species in hut gardens (temporary shelter) in the Knon Kaen province in northeast Thailand. Soemarawato (1987) listed 179 plant species in west Java homegardens.

Dynamics of species succession, plant density and composition of home garden have been intensively studied by Indonesian researchers. Total number of species in the village was 219 in dry season and 272 in the wet season i.e. an increase of almost 25 percent in the wet season (Nair, 1989).

Abedin and Quddus (1990) found 52 species in the homesteads of Tangail, 34 in Ishardi, 28 in Jessor, 20 in Patuakhali, 28 in Rajshahi and 21 in Rangpur district respectively. Jose (1991) identified 179 plant species in homegardens of Kerala.

In Srilanka, Kandyan homesteads are rice in species variation and Composition. Everett (1993) identified 143 species of woody perennials in a study of 173 gardens in eight villages in Kandy and more than 170 useful species were identified in the study sites of Kandyan forest gardens by Alison (1994).

A survey of homegardens was conducted by Kumar *et al.* (1994) in 17 selected thaluks (revenue sub-divisions) of Kerala state to explain the floristic composition and the extent of diversity. He encountered 127 woody species.

Millat-e-mustafa (1997) identified 92 perennial plant species in the homesteads at 4 different climatic regions like deltaic, dryland, hilly area and plain land.

Sellathurai (1997) identified 237 useful species in the homesteads of Yatinuwara area in Kandy district of Srilanka. Islam (1998) recorded 77 species in the homesteads of Rangpur in his study of homegarden agroforestry.

Bashar (1999) observed wide variety of plant species in the homesteads of Sadar and Kapasia Thana of Gazipur district. He found more than 136 useful species among which 44 species were recorded as fruit or food species either perennial or annual 28 timber species, 15 medicinal, 31 vegetable species and 18 ornamental species

Islam, (1998) recorded 77 species in the homesteads of Rangpur in his study of homegarden agroforestry. Sellathurai (1997) identified 237 useful species in the homestead of Yatinuwara area in candy district of Srilanka. Jose (1991) identified 179 plant species in homegarden of Kerala.

Mannan (2000) identified 114 plant species in the homestead of Bandarban, Gazipur and Naogoan. Among them 37.71% were fruit, 32.46% were timber, 24.56% were vegetables and 5.26% were spices species.

2.6.2 Relative prevalence of fruit species

Frequency of occurrence of a particular species in an area is one of the indications of its biodiversity at that area. Very minimum quantitative information regarding relative prevalence in the homesteads is available in the literature. But the studies of Barrau (1961) in the pacific. McConnell and Dharmapala (1973) in Srilanka, Sommers (1978) in Philippines, Michon *et al.* (1983) in Java, Boonkird *et al.* (1984) in Thailand have acknowledged the dominance of fruit and fruit producing species in the homesteads of respective countries. Islam and Ahmed (1987), Khaleque (1987), Alam *et al.* (1990), Dasgupta *et al.* (1990), Kar *et al.* (1990), Khan *et al.* (1990), Miah *et al.* (1990) and Momin *et al.* (1990) Made similar observations at different agroecological regions of Bangladesh.

Millat-e-Mustafa (1997) surveyed 80 homesteads of four regions in Bangladesh and found *Musa* and *Mengifera indica* in every homestead of every region. On the basis of mean dominance rank he found first five dominant species were fruit and food producing species.

Choudhury and Satter (1992) determine the relative prevalence of tree species in the High Gangues Flood Plain and found betel nut as the most prevalence in the homestead followed by coconut, jackfruit, date palm, banana, and mango. The relative prevalence values were 46.15, 10.92, 8.00, 5.89 and 4.74, respectively.

Anam (1999) surveyed 200 homesteads of four villages of two Upazillas of barind tract and found korai, raintree and mango as the most prevalent species. He also found country bean as the most prevalent vegetable species that was grown at 21% of the homesteads.

2.6.3 Species Diversity

Species diversity of plant is the variety within the plant kingdom on earth. It is measured by the total number of species and its abundance within a given area under study and is expressed by species diversity index (Mannan, 2000). Species diversity index includes both richness and relative prevalence of the species in a single statistics. The most commonly used are Shannon-Wiever index (H) of diversity (1949) and Simpson's index (D) of diversity (1949)

Diversity index has two distinct statistical components, species richness and the evenness of relative abundance. It is often described using statistical formula that combines both components. The Shannon-Wiever index (H) of diversity is derived from the information theory of Deshmukh (1986).

Species diversity index can be calculated both at Inter and Intra species level. No information is available about intra species diversity of plant at the homestead level. So information that are available regarding inter species diversity of plant at the homestead level are reviewed below.

Inter species diversity of plant at homestead level varies from place to place and influenced by the ecological and socio-economic factors. Cristanty (1985) found a diversity index of 2.79 for Javanese homesteads and 3.71 for Sudanese homesteads in Shanon-Wiever diversity scale (H).

Kumar *et al.* (1994) conducted a survey of homesteads at 17 selected Thaluks of Kerala state to know the floristic composition and the extent of diversity. Floristic diversity was higher in the smaller homesteads and decrease with increasing size of holding. Mean Simpson's diversity index (D) for the homesteads ranged from 0.251-0.739, which was 1.129-3.016 in Shannon-Wievers diversity scale (H) suggesting that floristic diversity was low to moderate.

Kumar (1994) in a study calculated Simpsons diversity index (D) from 0.459 to 0.6060 in large to small homestead of India which was 1.643 to 2.298 in Shannon-Wiever diversity scale (H).

Millat-e-Mustafa (1997) surveyed 80 homesteads of four regions namely fertile, Plain,

Hilly and Dryland. Species diversity indices were calculated in firma Shannon-Wiever diversity scale (H) which was 3.33, 2.83, 2.38 and 1.72 respectively.

Basher (1999) found Shannon-Wiever index of species diversity (H) of 2.633 4.212 and 3.245, for ornamental, medicinal, timber and fruit species biodiversity.

Kumar (1994) in a study calculated Simpson's diversity index (D) from 0.459-0.606 in large to small homestead of India which was 1.643 to 2.298 in Shannon-Wiever diversity scale (H). Mannan (2000) studied the species diversity of plants in the homestead of three agro-ecological region of Bangladesh. He found higher diversity for fruit species followed by timber and spices.

Chapter 3

Materials and Methods

MATERIALS AND METHODS

The methodology used in conducting any research is critically important and deserves careful consideration. It enables the researcher to collect valid and reliable information in terms of hypothesis or research instrument and to analyze the information properly to arrive at valid results.

3.1 Locale of the study

3.1.1 Geographical location and topography of Bangladesh

Bangladesh is situated in the north- eastern part of South Asia, between 20°34′ and 26°38′ north latitude and 88°01′ and 92°41′ east longitude. The country is bounded on the west north and northeast by India. Towards the southeast it is bordered with Myanmar and faces the Bay of Bengal on the south. It is encompasses an area of 147,570 sq. km. with the dominance of low, flat alluvial fertile land with some high land in the north and northwestern parts of the country. The most obvious physiographic characterizing the landscape is its extensive network of rivers that contribute considerably to the socio- economic life of the nation.

3.1.2 Area and location of study site

The study was conducted in Ajmiriganj upazila. It is located in the southern part of Hobigonj district. It is one of the eight Upazila of Hobigonj district. The haor basin is bounded by the hill ranges of India – Meghalaya on the north, Tripura and Mizoram on the south, and Assam and Manipur on the east. The Tippera surface lies directly to the south of the Haor Basin, and is partly low and deltaic and partly higher ground with a piedmont fringe to the east. It is located between 24°30' to 24°38' North latitude and 91°10' to 91°22' East longitude.

There are five unions in Ajmiriganj upazila. They are Ajmirigonj, Kakailcheo, Bodolpur, Jolshukha and Sibpasha. Notable here that actual area of this upazila is 225 sq. km. The following 22400 ha is only the area of main land where the union borderline could be measured. Other 4625 ha lands are recently risen "Haor" which are dispersed on various site of the upazila. The population of this Haor is approximately 107121 and the total farmer household number is 16711. The average

area of homestead is 1.34 ha. and the average size of the household is 6.41. Per-head land is 0.209 ha including "Haor".

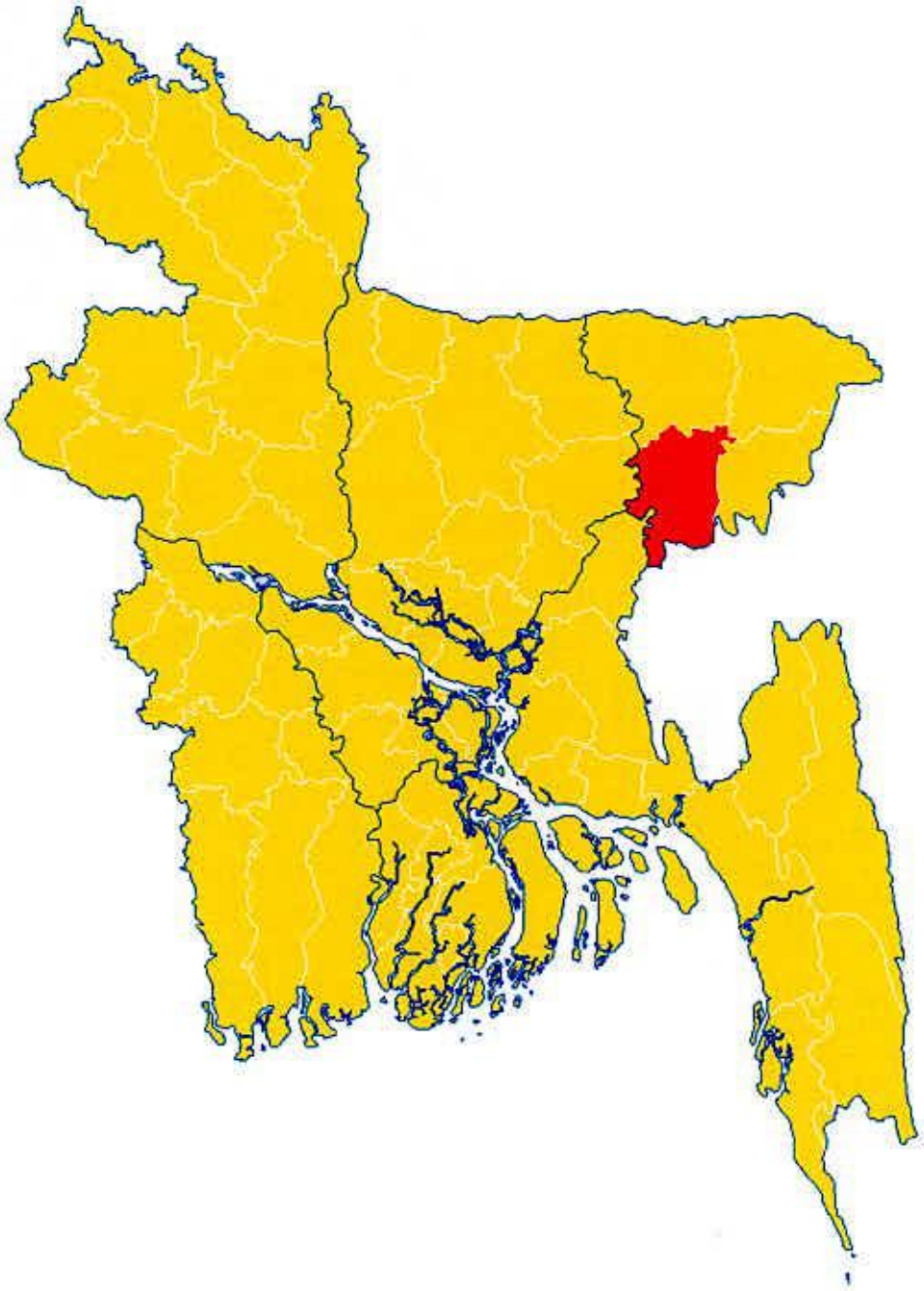


Fig. 3.1 Map of Bangladesh showing the study area of agro-ecological regions in Bangladesh (Red color indicating the study area)

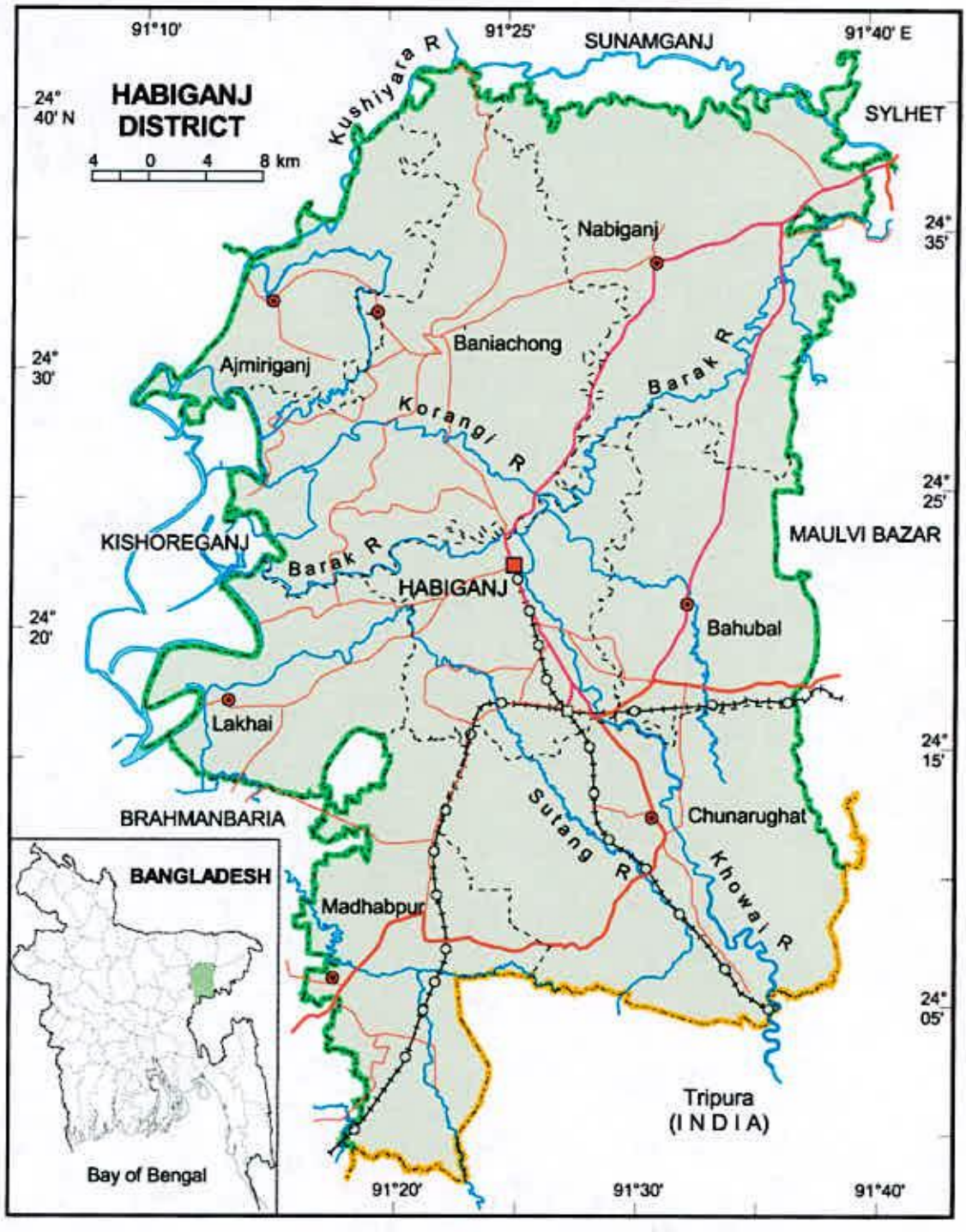


Fig. 3.2 A Map of Hobigonj district showing Ajmirigonj Upazila

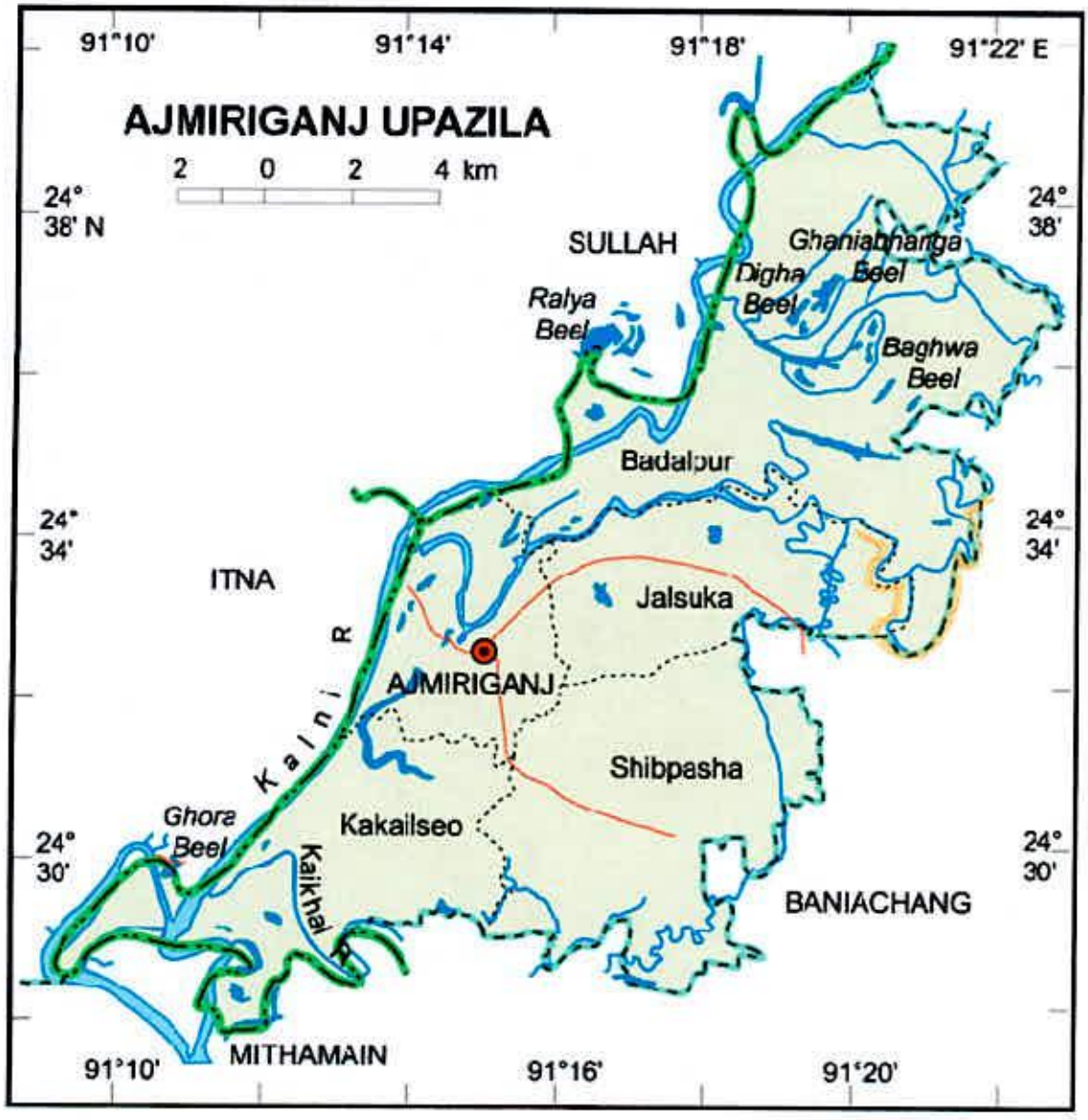


Fig. 3.3 A Map of Ajmirigonj Upazila showing five unions

The communication of the Haor with the district headquarter is very bad. Haor way is the only way to go there. Sea truck, engine boat etc has been used from long ago. There is a shipping service with Voirob. In the Rainy season, this communication became more dangerous. For this bad communication, the socio-economic condition of this Haor remains low. Most of the areas are deprived from the light of education. Inter communication of Haor is also bad.

3.1.3 Agro-ecological zone

The agro-ecological zones of Bangladesh have been identified based on soils, rainfall regime, agro-climatologic, land levels in relation to flooding and physiographic. Combining the first four levels of information, 30 agro-ecological regions have been recognized. The study area is under AEZ-19 and AEZ-21. For better understanding about the experiment site location is shown in the Map of AEZ of Bangladesh in appendix-II.

3.1.4 Soil

The soil of this Haor is medium high land and not well drained. In "Rabi" season water drained naturally from surface soil. In dry season available moisture for plant is medium. The texture of topsoil ranges from loamy to clay loam. The subsoil texture is mainly clay loam, the sub-stratum is usually clay. The pH of soil of this Haor ranges from 6.6-8.3, from neutral to basic. The organic matter content of this soil is medium. It ranges from 0.6% to 2.3% in the topsoil, slowly decreased in the subsoil. Content of Nitrogen and Zinc are low, potassium and boron are medium. But content of other elements are good.

3.1.5 Climate

The study area is located in the tropical belt and enjoys fairly equitable tropical monsoon climate. The temperature is almost uniform throughout the year. The maximum and minimum temperatures are normally recorded 32.2°c and 13.6°c respectively. The climate of the area is subtropical monsoonal with an average annual rainfall of approximately 4,000 mm. Over 80% of the rain falls during the monsoon season from June to October. Mainly three seasons are seen among the six seasons. May to October is rainy season, November to February is winter and March to April is summer season.

3.2 Measurement of independent variables

Six characteristics of the growers were selected as independent variables of this study. Procedures followed in measuring the independent characteristics are briefly describe bellow-

3.2.1 Age

The age of an individual is one of the important factors pertaining to his personality make up which can play an important role in his adoption behavior. It was operationally measured in term of actual age in years.

3.2.2 Education

Education of a respondent was measured on the basis of classes he had passed in formal educational institution. For example, if a respondent passed class-VII, his education score was 7 where as if a respondent had no reading or writing ability was given a score of zero (o).

3.2.3 Family Size

Family size of a respondent was measured in terms of actual number (dependents) of members in his family (including himself) during interview. The scoring was made by the actual number given by the respondent. For example, if a respondent had five members in his family then his score was five (5).

3.2.4 Age of the homestead

The age of an individual is one of the important factors pertaining to his personality make up which can play an important role in his adoption behavior. It was operationally measured in term of actual age in years.

3.2.5 Area of the homestead

Area of the homestead of a respondent was determined based on total area of his homestead on which he was living with his family members during the period of this study. It included the area of houses, ponds, gardens, lawns etc.

3.2.6 Fruit area of the homestead

Varieties of fruits were seen to cultivate at the various part of homesteads. It was measured with the help of family head.

3.3 Mode of study and data collection

Selected homesteads were surveyed following two methods:

a) Formal survey and

b) Informal survey and focused group discussion.

3.3.1 Formal survey

The study was carried out for a period of 6(six) months from April to September, 2011. Data for plant-biodiversity of the homesteads were collected using questionnaire (Appendix-I). Every household was visited twice, in winter and in Information was recorded through interviews of family members such as head of the family Housewife and others (Plate 1). Data were collected on:

1. Name and number of the plant species.
2. Names and number of major morphotypes per species and
3. Population per morphotypes

Populations were not recorded in case of herbaceous plants, medicinal and ornamental plants and crops like bamboos.

Plate 1: Focused group discussion with the homestead plant growers

3.3.2 Informal survey & focused group discussion

In addition to the formal survey, informal survey and group discussion were held with the help of Sub assistant agricultural officer (SAAO) and prominent and senior persons of the study area. To collect information about homesteads and plant morphotypes.

3.3.3 Data analysis

Microsoft Excel programs were used to process all collected information and in preparing charts and graph. SPSS (Statistical Package for Social Science) software was used to estimate the descriptive statistics of the data. Plant-biodiversity was described under the following heads:

1. Species richness
2. Relative prevalence of specie
3. Species diversity

3.3.3.1 Species richness

Species richness measures the number of species within an area. Homestead plants of five unions were grouped into four categories namely fruits, timber (Non-fruit trees), winter vegetables and summer vegetables. Proportions of different plant groups were also calculated.

3.3.3.2 Relative prevalence (RP) of species

Percent homestead contained a particular species is one of the component of the relative prevalence of that that particular species at that area. Percent of homesteads processing the plant species were calculated for all the species at all the regions.

Relative Prevalence (RP) of species was calculated by using the following formula:

RP = Population of the species per homestead × % Homestead with the species.

Relative's prevalence (RP) of fruit and timber species were calculated both at morphotypes and population level. This relative prevalence was used to rank the species in different regions according to Millat-e-Mostafa (1997) the mean dominance rank was determined by pooling the entire set of data of all the five unions.

3.3.3.3 Species diversity

Species diversity index of a particular species was calculated using the same formula of Simpson index (D) as follows:

$$D = 1 - \Sigma P_i^2$$

Where P_i is the proportional abundance of the i^{th} morphotypes i^{th} of a particular species, where

$P_i = N_i/N$

N_i = plant population of i^{th} morphotypes and

$N = N_1 + N_2 + N_3 + \ldots\ldots\ldots\ldots N_n$, where n is the number of morphotypes of the species.

In case of seasonal crops and vegetables frequency of homesteads containing morphotypes in the area was used instead of plant population.

3.4 Problem faced by the farmers

The farmers were asked about their problems to fruit cultivation in their homestead. The problems were listed from the pre-testing of questionnaires and then it was marked after asking the farmers.

3.5 Processing of data

The collected raw data were examined thoroughly to detect errors and omission. As a matter of fact the researcher made a careful scripting 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, which were detected by doing this corrected promptly.

Having consulted with his research supervisor the investigator prepared a detailed coding plan. All responses in the interview schedule were given numerical coded values. Local units were converted into standard units. All the individual responses to the questions of the interview schedule were transferred to a master sheet to facilitate tabulation. In case of qualitative data, appropriate scoring technique was followed to convert the data into quantitative forms. These were then tabulated in accordance with the objectives of the study.

3.6 Statistical analysis

The collected data were compiled, tabulated, coded and analyzed in accordance with the objectives of the study. Qualitative data were quantified by means of suitable scoring techniques. The statistical measures such as number and distribution were used for describing the variables of the study. In order to explore the relationships of the selected characteristics of the farmers with the fruit diversity of their homestead, the Pearson's products moment correlation was computed at five percent (0.05) and one percent (0.01) level of significance.

Chapter 4

Results and Discussion

RESULTS AND DISCUSSION

In this chapter, the findings of the study and their interpretation are presented. This chapter has been divided into seven sections. The first section deals with the individual characteristics of the homestead fruit growers, the second section deals with the Specie Richness, third section deals with the Relative Prevalence (RP), forth section deals with the fruit diversity, fifth section deals with the dandrogram of homestead. In sixth section, the relationship between fruit diversity of homestead and the characteristics of farmers have been discussed. The final section deals with the problems faced by the farmers in homestead fruit cultivation practices.

4.1 Selected characteristics of the haor homestead owners

Selected characteristics of the homestead respondents were discussed in this section.

(i) Age

(ii) Education

(iii) Family size

(iv) Age of the homestead

(v) Area of the homestead

(vi) Fruit area of the homestead

The findings on the selected characteristics of the farmers, distribution of the farmers according to their plant biodiversity.

4.2. Characteristics of the homestead plant growers

4.2.1. Age of the homestead plant growers

Age of the homestead owners was found to range from 18 to 95 years. The average age was 45.66 years with the standard deviation of 13.7. Based on their age, the homestead owners were classified into five categories as shown in Table 4.1. It was observed that 39.3% of the homestead owners belonged to the middle age, while 34.3%, 15.7% and 9.7% belonged to young age, early and pre-old age categories, respectively. It indicated that 73.6% of the growers compressed either the young or middle aged categories. This indicated that decision-making relating to homestead affairs especially in respect of homestead plant management practices in the study area may be influenced by young age and middle aged owners.

4.2.2. Education of the homestead plant growers

The average education score was found 2.54 with standard deviation 0.803. Based on education score, the growers were of four categories as shown in Table 4.1. The Table show that, about 8.3% of the homestead plant growers had no education, 41.0% have primary education, 39.3% had secondary education and about 11.3% had college & above education level. In two different studies Bashar, (1993) and Ali, (1993) also found that the highest number of cane growers were in secondary education group the finding of the study keep consistency with the studies of (Haque, 1993). The findings indicate that in the study area, the literacy rate is higher than the national average which is 44.1% (UNDP Human Development Index-HDI, 2011). Homestead respondents need to have some education in order to know about plant diversity and management. Education helps the growers to know the improved methods of cultivation by reading newspaper, leaflets, bulletins and other printing materials.

4.2.3. Family size of the homestead plant growers

The average family size of the homestead plant grower's was found 7.73 with the standard deviation 5.09. On the basis of their family size, the farmers were classified into five categories (Table 4.1). It was observed that 19.7% of the growers belonged

Table 4.1 Summary of personal characteristics of the respondents

Variables	Measurement	Observed range	Categories	Respondents number	Respondents percent	Mean	SD
Age	Years	18-95	Early age (up to 30)	47	15.7	45.66	13.7
			Young age (31-45)	103	34.3		
			Middle age (46-60)	118	39.3		
			Pre-old age (61-75)	29	9.7		
			Old age (more than 75)	3	1.0		
Education	Year	0-16	Illiterate(0)	25	8.3	2.54	0.803
			Primary(1 to 5)	123	41.0		
			Secondary(6 t0 10)	118	39.3		
			Collage& above(above 10)	34	11.3		
Family size	No of members	2-18	Very small (less than 3)	59	19.7	7.73	5.08
			Small (3-4)	119	39.7		
			Medium (5-6)	66	22.0		
			Large (7-10)	33	11.0		
			Very large (more than 10)	23	7.7		
Age of the homestead	Years	1-500	Early age (Up to 20)	90	30.0	83.77	91.5
			Young age (21-50)	72	24.0		
			Middle age (51-100)	53	17.7		
			Pre-old age (101-200)	59	19.7		
			Old age (More than 200)	26	8.7		
Area of the homestead	Decimals	0.50-400	Very small (up to 10)	25	8.3	25.79	36.6
			Small (11-30)	75	25.0		
			Medium (31-50)	115	38.3		
			Large (51-100)	59	19.7		
			Very large (more than 100)	26	8.7		
Fruit area of the homestead	Decimals	00-28	Very small (less than 0.50)	68	22.7	2.772	3.59
			Small (0.51-1.00)	75	25.0		
			Medium (1.1-2.00)	53	17.7		
			Large (2.10-3.0)	27	9.0		
			Very large (more than 3.0)	77	25.7		

to the "very small family" category compared to 39.7% who belonged to "small family" category and 11.00% to "large family" category (Table 4.1). These findings indicating that about 59.4% of the homestead respondents had small to medium family size. It was observed that more than 70% of the growers had either medium or large family (Bashar, 1993). Such findings indicate that existence of large family is not encouraged now in the community.

4.2.4. Age of the homestead

Average age of the homesteads was found 83.77 years with the standard deviation 91.5. Based on their age, the homesteads were classified into five categories (Table 4.1). It was observed that 19.7% of the homesteads were pre-old age, while 17.7%, 24.0% and 8.7% belonged to middle age, young and old age categories respectively. This depicts that young aged homestead is playing a vital role in fruit cultivation practices in the study area.

4.2.5. Area of the homestead

Average homestead size was found 25.79 decimals with a standard deviation of 36.62. The homesteads were classified into five categories (Table 4.1). Table showed that about 25.0% homesteads were small 19.7% were large and 8.3% had very small in homestead. The majority of the growers (63.30%) had the small to medium sized homestead. In respect of highest proportion, similar findings were reported by Ali, 1993 and Bashar, 1993. The homestead size encourages the respondents to having family income and to utilize newly released high yielding technologies in the homestead for getting higher yield.

4.2.6. Fruit area of the homestead

Average fruit area was found 2.77 decimals with a standard deviation of 3.59. The growers were classified into four categories according to their homestead fruit areas (Table 4.1). 22.7% of the growers had very low area for homestead fruit cultivation followed by small area (25.00%), medium area (17.7%) and large area (9.00%). The majority (47.7%) of the growers had either small or very small area for fruit cultivation in the haor area. Alam *et al.* (2005) and Uddin *et al.* (2002) observed that

fifty percent of the pineapple growers had big area for pineapple cultivation followed by media area (35 percent) and small area (15 percent).

4.3 Species richness in Haor homesteads

Almost all the homesteads had mixed vegetation with various annual and perennial trees, and seasonal vegetables. The study revealed that a wide variety of plant species was found in the study areas. More than 79 useful species were identified in the homesteads of five unions in Ajmiriganj upazila (Table 4.2). They are Ajmirigonj, Kakailcheo, Bodolpur, Jolshukha and Sibpasha. The identified fruits species is presented in the Appendix-III. Among them 34.86% were fruit (perennial and annual), 28.92% were timber, 21.35% were summer vegetables and 14.86% were winter vegetables (Table 4.2). The distribution pattern of the plant species was influenced by macro and micro environmental factors of the homesteads and needs of the family members (Uddin *et al.*, 2002). Manan (2000) reported that 114 useful species were identified in his recent study in the three regions of Bangladesh. Zaman *et al.*, (2010) reported only 28 tree species in his study in the plain area of Barind tract. Rahman *et al.*, (2009) found less number of species in each of his 3 study locations. Millat-e-Mustafa (1997) identified 92 perennial plant species at 4 sites of the country. Islam (1998) found 77 species in his study of homestead-agro forestry at Rangpur. Sellathural (1997) found 237 useful species in Yatinuwara area in kandy district of Sri Lanka. Jeso (1991) identified 179 plant species in kerala homesteads and Soemarawato (1987) listed 179 plant species in West Java homesteads. In another study, Michon (1983) enumerated 500 species in a village in Java. Bashar (1999) identified 136 useful species in the homesteads while surveyed in Gazipur.

Table 4.2 Species richness of different plant groups at Ajmiriganj upazila of Hobigonj district in Bangladesh.

Unions	Fruit species	Timber species	Summer vegetables	Winter vegetables	Total
Ajmirigonj	25	19	15	10	69
Kakailcheo	27	23	17	12	79
Bodolpur	27	22	17	10	76
Jolshukha	24	23	16	11	74
Sibpasha	26	20	14	12	72
Average	25.80	21.40	15.80	11.00	74.00
All	27	23	17	12	79
Percent	34.86	28.92	21.35	14.86	100

Fruits: Result of the study indicates that higher number of fruit species was prevailing in the homesteads. Miah *et al.* (1990) also found that homestead plant growers generally prefer fruit trees in their homesteads. Bashar (1999) found that the number of fruit species was higher than other species in each homestead of Gazipur. Momin *et al.* (1990), Abedin and Quddus (1990) and Millat-e-Mustafa (1997) also reported fruit as the prime component of homestead vegetation. Mannan (2000) found higher number of fruit species in die homesteads of banderban followed by Gazipur and Niamotpur. Present study found higher number fruits than those found in homesteads of Jessore (18 spp) by Alam *et al.* (1990) and minimum than that of kandy district of Srilanka (38 spp) by Sellathurai (1997). Basher (1999) identified more than 44 fruit species at the homestead of Gazipur.

Timber: The study revealed that timber occupied the second position on the basis of average number of species. Everett (1993) and Alison (1994) reported timber species as one of the major component of homestead vegetation. Number of timber species was found maximum in the homesteads of Ajmiriganj followed by Ajmirigonj, Kakailcheo, Bodolpur, Jolshukha and Sibpasha.

Summer vegetables: On an average, higher number of summer vegetable species was found in the homesteads next to the timber species. Bashar (1999) found vegetables as a second plant groups next to the fruit in Gazipur. Abedin and Quddus (1990). and Alam *et. al* (1990) reported vegetables as an important component of homestead with major importance. Number of vegetable species in the homesteads of Gazipur was found maximum followed by Banderban and Nianiotpur and it was then found in homesteads of Tangail (27 spp) (Momin *et al.*, 1990) and Gazipur (27 spp) (Bashar 1999).

Winter vegetables: On an average, higher number of winter vegetable species was found in the homesteads next to the summer vegetable species. Bashar (1999) found vegetables as a second plant groups next to the fruit in Gazipur. Abedin and Quddus (1990) and Alam *et. al* (1990) reported vegetables as an important component of homestead with major importance. Number of vegetable species in the homesteads of Gazipur was found maximum followed by Banderban and Nianiotpur and it was then found in homesteads of Tangail (27 spp) (Momin *et*

al., 1990) and Gazipur (27 spp) (Bashar 1999).

A wide range of fruit species were found in the study area. Twenty seven fruit species were identified in the homesteads surveyed which are commonly used for human consumption. The list of the identified fruit species was presented in the appendix-III. The total number of fruit species per homestead in five different unions is shown in appendix-III. The higher number of fruit species was found in larger homestead and less number of fruit species was found in smaller ones.

Species richness varied from one location to another and from one homestead category to another.The observed 27 fruit species were belonged to different family and 19 families was identified with these 27 species presented in appendix-IV. Among these families, Myrtaceae, Rutaceae and Palmaceae are dominant.

The number of fruit producing species was higher than other species in each home garden. The farmers concentrate on fruit species because of their subsistence and cash need. Mango, coconut, banana, guava, betel nut, papaya, lemon, black berry were cultivated in the most of the homesteads. Among them, mango, coconut, banana, guava, betel nut and lemon were the dominant species in homesteads at all locations and had the most diverse utility among all other fruit species. It was found that 79 different varieties were grown within 300 homesteads of Haor of Bangladesh. It varied upon the family choice.

4.4 Relative prevalence of species

4.4.1 Distribution of the species

Frequency of occurrence of a particular species in an area is one of the indicators of its biodiversity at that area.

Fruit: The table 4.3 showed that 27 fruit species were found in the hoar homestead. None of the plant was found in the more than 80% homesteads. Coconut was the present's fruit which was found in only 80.67% homesteads. Mango and Guava were found 79.33% and 63.67% homesteads. Papaya, betel nut and black berry were found at 51.67%, 46.67%, and 42% homesteads only and banana and lemon were found 36% homesteads rest of fruit species were found less than 26% homesteads. Burmese grape and gooseberry were found in two homesteads out of 300. It was indicates that

very small homestead of the haor area have no or key minimum space for fruit species. The highest space in Kakailcheo, Bodolpur and Sibpasha were coconut, at Ajmirigonj was mango and at Jolshukha was guava. Abedin and Quddus (1990) found mango at 95% homesteads of Tangail and at above 67% homesteads of Ishurdi, Jessore, and Rangpur. Uddin *et al.* (2002) observed that mango, jackfruit, coconut and banana were available at more than 65% homesteads of Jessore.

Plate 2: Hoar homesteads rich in coconut, mango and others fruits species

Table 4.3 Distribution of fruit species in the homesteads of Ajmiriganj upazila of Hobigonj district in Bangladesh (% homestead containing the species)

Sl. No.	Name of species	Unions					%
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Coconut (*Cocos nucifera)*	73.33	93.33	85.00	80.00	71.67	80.67
2	Mango (*Mangifera indica)*	78.33	90.00	80.00	80.00	68.33	79.33
3	Guava (*Mangifera indica)*	35.00	75.00	81.67	81.67	45.00	63.67
4	Papaya *(Carica papaya)*	16.67	61.67	85.00	38.33	56.67	51.67
5	Betel nut *(Areca catechu)*	28.33	38.33	81.67	46.67	38.33	46.67
6	Black berry *(Syzygium cumini)*	38.33	28.33	53.33	48.33	41.67	42.00
7	Banana *(Musa sp)*	11.67	38.33	48.33	26.67	55.00	36.00
8	Lemon *(Citrus limon)*	40.00	18.33	63.33	31.67	26.67	36.00
9	Jackfruit *(Artocarpus heterophyllus)*	18.33	33.33	41.67	25.00	13.33	26.33
10	Indian jujube *(Zizyphus mauritiana)*	11.67	23.33	50.00	16.67	10.00	22.33
11	Carrabolla *(Averrhoa carambola)*	13.33	8.33	38.33	18.33	21.67	20.00
12	Olive(*Elaeocarpus floribundus)*	10.00	15.00	38.33	13.33	5.00	16.33
13	Hog plum *(Spondias dulcis)*	3.33	13.33	30.00	13.33	18.33	15.66
14	Indian apple *(Aegle marmelos)*	13.33	11.67	36.67	8.33	6.67	15.33
15	Custard apple *(Anona squamosa)*	11.67	28.33	18.33	6.67	10.00	15.00
16	Elephant apple *(Dillenia indica)*	6.67	5.00	28.33	8.33	15.00	12.67
17	Litchi *(Litchi chinensis)*	13.33	20.00	18.33	10.00	1.67	12.67
18	Pomegranate *(Punica granutum)*	10.00	3.33	15.00	8.33	8.33	9.00
19	Wax jumbo *(Syzygium samarangense)*	1.67	1.67	10.00	5.00	1.67	4.00
20	Palmyra palm *(Borassus flabellifer)*	1.67	1.67	1.67	3.33	8.33	3.33
21	Date (*Phoenix sylvestris)*	5.00	1.67	3.33	1.67	3.33	3.00
22	Tamarind *(Tamarrinbus indica)*	1.67	1.67	10.00	0.00	0.00	2.67
23	Velvet apple *(Piospyros discolor)*	1.67	0.00	3.33	1.67	5.00	2.33
24	Orange *(Citrus chrysocarpa)*	8.33	0.00	0.00	0.00	1.67	2.00
25	Indian Goose Berry*(Phyllanthus embelica)*	3.33	0.00	0.00	0.00	1.67	1.00
26	Burmese grape *(Baccaurea ramiflora)*	1.67	0.00	0.00	0.00	1.67	0.67
27	Gooseberry (*Phyllanthus acidus)*	1.67	0.00	0.00	0.00	1.67	0.67

Timber: The table 4.4 showed that 23 timber plants were found in the hoar homestead. None of the plant was found in the more than 40% homesteads. Mahgany was the present's timber which was found in only 38.67% homesteads. Kadamba and golden shower were found 35.33% and 32.67% homesteads. Royal Siris, margosa tree and rain tree was found at 28.66%, 26.33% and 20.33% homesteads only and eucalyptus was found 13.33% homesteads rest of timber plant was found less than 6% homesteads. Fig, ipil ipil, champa and Indian gum tree were found in one homestead out of 300. It was indicates that very small homestead of the haor area have no or key minimum space for timber plants. The highest space in Ajmirigonj, Kakailcheo and Jolshukha were mahogany, at Bodolpur margosa tree, at Sibpasha was eucalyptus. Abedin and Quddus (1990) found neem at 33% homesteads of Rajshahi and at 35% homesteads of Rangpur.

Plate 3: Hoar homesteads rich in mahgany, kadamba and others timbers species

Table 4.4 Distribution of timber species in the homesteads of Ajmiriganj upazila of Hobigonj district in Bangladesh (% homestead containing the species)

Sl. No.	Name of species	Unions					%
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Mahgany (*Swietenia mahogany*)	31.667	56.667	38.333	40.000	26.667	38.667
2	Kadamba *(Neolamarckia cadamba)*	20.000	56.667	63.333	36.667	0.000	35.333
3	Golden Shower (*Acacia auriculifomis)*	15.000	51.667	43.333	38.333	15.000	32.667
4	Royal Siris *(Albizia julibrissin)*	30.000	8.333	56.667	36.667	11.667	28.667
5	Margosa Tree *(Azadirachta indica)*	13.333	40.000	61.667	20.000	8.333	28.667
6	Yellow cassica (*Cassica siamea*)	0.000	0.000	0.000	28.333	3.333	26.333
7	Rain Tree (*Albizzia saman*)	16.667	31.667	11.667	8.333	33.333	20.333
8	Eucalyptus (*Eucalyptus camaldulensis*)	13.333	8.333	1.667	8.333	35.000	13.333
9	Arjun (*Terminalia arjuna*)	0.000	5.000	18.333	6.667	0.000	6.000
10	Teak Tree *(Tecktona grandis)*	6.667	8.333	3.333	8.333	1.667	5.667
11	Palash (*Butea monosperma*)	6.667	1.667	5.000	5.000	5.000	4.667
12	Gamar (*Gmelina arborea*)	1.667	8.333	6.667	3.333	1.667	4.333
13	Jarul (*Lagerstromia speciosa*)	1.667	3.333	6.667	1.667	3.333	3.333
14	Coral Tree *(Erythrina orientalis)*	0.000	8.333	0.000	3.333	0.000	2.333
15	Chapalish (*Artocarpus chalasha*)	3.333	0.000	8.333	0.000	0.000	2.333
16	Silk cotton *(Bombax ceiba)*	3.333	1.667	3.333	3.333	0.000	2.333
17	Indian Red Wood (*Dalbergia sissoo*)	0.000	0.000	3.333	5.000	3.333	2.333
18	Bengal fig (*Ficus bengalensis*)	1.667	0.000	0.000	0.000	1.667	0.667
19	Krishnachura (*Delonix regia*)	0.000	0.000	0.000	3.333	0.000	0.667
20	Indian Gum Tree (*Acacia arabica*)	0.000	0.000	1.667	0.000	0.000	0.333
21	Champa (*Mechelia champaka*)	0.000	0.000	0.000	0.000	1.667	0.333
22	Ipil-ipil (*Leucaena leucocephala*)	0.000	0.000	0.000	0.000	1.667	0.333
23	Fig (*Ficus glomerata*)	0.000	1.667	0.000	0.000	0.000	0.333

Summer vegetables: The table 4.5 showed that 17 summer vegetables were found in the hoar homestead. None of the plant was found in the more than 40% homesteads. Brinjal was the present's timber which was found in only 38.67% homesteads. Eddoe and cucumber were found 31.33% and 27.67% homesteads. Ridge gourd, sweet gourd and teasle gourd were found at 22%, 12% and 11% homesteads only and snake gourd and white yem were found 8% homesteads rest of summer vegetables were found less than 4% homesteads. Hyacinth bean, bottle gourd, plantain and tomato were found in two homesteads out of 300. It was indicates that very small homestead of the haor area have no or key minimum space for summer vegetables. The highest space in Ajmirigonj, Jolshukha and Sibpasha were Brinjal, at Kakailcheo eddoe, at Bodolpur was sweet gourd. Abedin and Quddus (1990) found country bean at 95% homesteads of Patuakhali and at 48% homesteads of Tangail.

Table 4.5 Distribution summer vegetable in the homesteads of Ajmiriganj upazila of Hobigonj district in Bangladesh (% homestead containing the species)

Sl. No.	Name of species	Unions					%
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Brinjal (*Solanum melongena*)	61.667	31.667	11.667	35.000	53.333	38.667
2	Eddoe (*Colocasia esculenta*)	21.667	75.000	8.333	28.333	23.333	31.333
3	Cucumber (*Cucumis sativas*)	55.000	11.667	10.000	25.000	36.667	27.667
4	Ridge gourd (*Luffa acutagula*)	38.333	13.333	15.000	25.000	18.333	22.000
5	Sweet gourd (*Cucurbita maxima*)	11.667	1.667	13.333	15.000	18.333	12.000
6	Teasle gourd(*Momordica cochinchinensis*)	20.000	0.000	6.667	11.667	16.667	11.000
7	Snake gourd (*Trichosanthes anguina*)	16.667	0.000	3.333	8.333	11.667	8.000
8	White yem (*Dioscorea alata*)	3.333	11.667	3.333	8.333	13.333	8.000
9	White gourd (*Benincasa hispida*)	6.667	1.667	1.667	5.000	6.667	4.333
10	Sponge gourd (*Luffa cylindrical*)	1.667	3.333	5.000	3.333	0.000	2.667
11	Chilli (*Capsicum species*)	8.333	0.000	0.000	0.000	1.667	2.000
12	Red amaranth (*Amaranthus gangeticus*)	5.000	0.000	3.333	1.667	0.000	2.000
13	Giant taro (*Alocasia macrorrhiza*)	1.667	0.000	5.000	3.333	0.000	2.000
14	Hyacinth bean (*Lablab niger*)	0.000	0.000	3.333	0.000	0.000	0.667
15	Bottle gourd (*Lagenaria siceraria*)	0.000	0.000	3.333	0.000	0.000	0.667
16	Plantain (*Musa paradisiaca*)	0.000	1.667	0.000	1.667	3.333	0.667
17	Tomato (*Lycopersicon esculentum*)	0.000	0.000	1.667	0.000	0.000	0.333

Winter vegetables: The table 4.6 showed that 12 winter vegetables were found in the hoar homestead. None of the plant was found in the more than 32% homesteads. Bottle gourd was the present's timber which was found in only 31.306% homesteads. Radish and Indian spinach were found 25.939% and 24.15% homesteads. Okra, potato and red amaranth were found at 18.783%, 18.783% and 16.994% homesteads only and spinach, cabbage and bitter gourd were found 13% homesteads rest of winter vegetables were found less than 11% homesteads. Stem amaranth was found in six homesteads out of 300. It was indicates that very small homestead of the haor area have no or key minimum space for winter vegetables. The highest space in Ajmirigonj was red amaranth, at Kakailcheo radish, at Bodolpur was okra, at Jolshukha was hyacinth bean and Sibpasha were bottle gourd. Abedin and Quddus (1990) found country bean at 95% homesteads of Patuakhali and at 48% homesteads of Tangail.

Table 4.6 Distribution winter vegetable in the homesteads of Ajmiriganj upazila of Hobigonj district in Bangladesh (% homestead containing the species)

Sl. No.	Name of species	Unions					%
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Bottle gourd (*Lagenaria siceraria*)	33.333	75.000	15.000	15.000	58.333	31.306
2	Radish (*Raphanus sativus*)	21.667	85.000	6.667	5.000	48.333	25.939
3	Indian spinach (*Basella rubra*)	38.333	26.667	6.667	23.333	45.000	24.150
4	Okra (*Abelmoschus esculentus*)	43.333	18.333	18.333	18.333	35.000	18.783
5	Potato (*Solanum tuberosum*)	3.333	76.667	8.333	48.333	35.000	18.783
6	Red amaranth (*Amaranthus gangeticus*)	50.000	46.667	6.667	55.000	31.667	16.994
7	Spinach (*Spinacia oleracea*)	6.667	11.667	1.667	41.667	26.667	14.311
8	Cabbage (*Brassica oleracea* var *capitata*)	1.667	41.667	18.333	53.333	25.000	13.417
9	Bitter gourd (*Momordica charantia*)	18.333	0.000	0.000	40.000	25.000	13.417
10	Hyacinth bean (*Lablab niger*)	26.667	0.000	0.000	68.333	21.667	11.628
11	Cauliflower (*Brassica oleracea var botrytis*)	5.000	50.000	3.333	45.000	18.333	9.839
12	Stem amaranth (*Amaranthus lividus*)	0.000	26.667	0.000	15.000	3.333	1.789

4.4.2 The Relative prevalence (RP) values of common fruit and timber.

Fruit: Among 27 fruit species, common at all unions, guava was found most prevalent in the study area. On the basis of mean dominance elephant apple, hog plum, betel nut and indian goose berry ranked top followed by coconut, carrabolla and wax jumbo. The top rank in Kakailcheo, Jolshukha and Sibpasha were guava, at Ajmirigonj was betel nut and at Bodolpur was elephant apple (Table 4.7). Chowdhury and Satter (1992) found coconut as the most prevalent among the fruit species followed by jackfruit, date palm, banana and mango. The least ranked fruit species were black berry, Indian jujube and custard apple. But Rahman *et. al.* (2009) found mango as the most prevalent among the horticultural species followed by guava, jackfruit, coconut and jujube.

Plate 4: Haor homesteads top rank fruits guava, elephant apple and hog plum

Table 4.7 Ranking of fruits in different union according to their relative prevalence in the study area

Sl. No.	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Guava (*Mangifera indica)*	6	1	2	1	1	1
2	Elephant apple *(Dillenia indica)*	19	2	1	4	18	2
3	Hog plum *(Spondias dulcis)*	14	25	19	2	2	3
4	Betel nut *(Areca catechu)*	1	3	9	10	19	4
5	Indian Goose Berry *(Phyllanthus embelica)*	21	19	5	19	3	5
6	Coconut (*Cocos nucifera)*	2	4	24	18	21	6
7	Carrabolla *(Averrhoa carambola)*	18	11	6	3	8	7
8	Wax jumbo *(Syzygium samarangense)*	16	6	4	24	13	8
9	Gooseberry (*Phyllanthus acidus)*	22	23	3	7	14	9
10	Orange *(Citrus chrysocarpa)*	20	13	11	6	4	10
11	Mango (*Mangifera indica)*	3	9	13	16	9	11
12	Banana *(Musa sp)*	4	21	27	17	6	12
13	Indian apple *(Aegle marmelos)*	12	14	26	23	5	13
14	Tamarind *(Tamarrinbus indica)*	26	27	15	11	7	14
15	Litchi *(Litchi chinensis)*	11	5	22	20	17	15
16	Lemon *(Citrus limon)*	8	22	23	5	23	16
17	Velvet apple *(Piospyros discolor)*	27	16	7	12	10	17
18	Palmyra palm *(Borassus flabellifer)*	25	26	21	22	26	18
19	Burmese grape *(Baccaurea ramiflora)*	23	7	18	15	11	19
20	Olive (*Elaeocarpus floribundus)*	15	10	25	27	22	20
21	Papaya *(Carica papaya)*	9	17	8	21	25	21
22	Pomegranate *(Punica granutum)*	13	15	10	25	16	22
23	Date *(Phoenix sylvestris)*	24	20	12	14	20	23
24	Jackfruit *(Artocarpus heterophyllus)*	7	12	14	26	27	24
25	Black berry *(Syzygium cumini)*	5	18	16	9	12	25
26	Indian jujube *(Zizyphus mauritiana)*	10	24	17	8	24	26
27	Custard apple *(Anona squamosa)*	17	8	20	13	15	27

Timber: Among the 23 timber species, common at all unions, mahgany was found most prevalent in the study area. On the basis of mean dominance golden shower, yellow cassica and rain tree ranked top position followed by eucalyptus, margosa tree and arjun. The least ranked timber species were jarul, champa and Indian gum tree. The top rank in Ajmirigonj and Kakailcheo were mahgany, at Bodolpur was kadam, at Jolshukha was yellow cassica and at Sibpasha was eucalyptus (Table 4.8). Anam (1999) found koroi as the most prevalent among the timber species followed by raintree, akashmoni and mahgany.

Plate 5: Haor homesteads top rank timbers mahogany and golden shower

Table 4.8 Ranking of timber in different union according to their relative prevalence in the study area

Sl.No.	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Mahgany (*Swietenia mahogany*)	1	1	2	2	2	1
2	Golden Shower (*Acacia auriculifomis*)	3	2	4	3	4	2
3	Indian Red Wood (*Dalbergia sissoo*)	15	18	11	9	8	3
4	Yellow cassica (*Cassica siamea*)	16	19	19	1	14	4
5	Rain Tree (*Albizzia saman*)	2	3	6	7	3	5
6	Eucalyptus (*Eucalyptus camaldulensis*)	5	6	15	8	1	6
7	Margosa Tree (*Azadirachta indica*)	7	5	3	16	6	7
8	Arjun (*Terminalia arjuna*)	17	11	7	10	16	8
9	Teak Tree (*Tecktona grandis*)	9	7	12	6	9	9
10	Krishnachura (*Delonix regia*)	18	20	20	20	22	10
11	Coral Tree (*Erythrina orientalis*)	19	8	16	11	17	11
12	Chapalish (*Artocarpus chaplasha*)	10	16	8	17	20	12
13	Royal Siris (*Albizia julibrissin*)	4	9	5	4	5	13
14	Palash (*Butea monosperma*)	8	13	13	12	7	14
15	Kadam (*Anthocephalus cadamba*)	6	4	1	5	15	15
16	Bengal fig (*Ficus bengalensis*)	20	15	17	18	21	16
17	Silk cotton (*Bombax ceiba*)	11	14	14	14	18	17
18	Fig (*Ficus glomerata*)	12	10	9	13	11	18
19	Gamar (*Gmelina arborea*)	13	17	18	19	10	19
20	Ipil-Ipil (*Leucaena leucocephala*)	21	21	21	21	12	20
21	Jarul (*Lagerstroemiaflos reginae*)	14	12	10	15	19	21
22	Champa (*Michelia champaca*)	22	22	22	22	13	22
23	Indian Gum Tree (*Acacia arabica*)	23	23	23	23	23	23

4.4.3 Relative prevalence of species

The relative prevalence of fruit species found in 300 homesteads of this study area. Species found at least one homestead in each region were screened out. Only 27 fruit and 23 timber species were found common at all regions.

Fruit: Among 25 fruit species, commoc at all unions, betel nut was found most prevalent at Bodolpur and Jolshukha both at morpholypes and population level, but at Sibpasha. Banana and mango were most prevalent considering the morpholypes and ranked second considering the population. On the basis of mean dominance betel nut ranked top followed by banana, coconut, papaya, and guava and so on. The least ranked fruit species was gooseberry (Table 4.9). Anam (1999) also found mango as the most prevalent among the horticultural species followed by guava, jackfruit, coconut and jujube. Chowdhury and Satter (1992) found coconut as the most prevalent among the fruit species followed by jackfruit, date palm, banana, and mango. Mannan (2000) also observed mango as the most prevalent among the fruit species followed by jackfruit, guava, jujube and coconut in Bangladesh. Ecological factor is one of the determinants of species grown in the farms. Besides the ecological reasons, the socio-economic conditions of the homesteads were a major determinant of the species-mix prevailing in a home garden. There were minor differences in relative prevalence of less common species but significant differences of most common species among the farm categories. Especially farmers were giving the preference to grow for particular fruit species in their homesteads. The decision of which trees to grow depended on a combination of price and yield, the location of the farm in terms of ecological zone and consumption center.

Table 4.9 Relative prevalence of different fruit species in the study area

Sl. No.	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Betel nut *(Areca catechu)*	75.60	54.54	206.01	174.69	64.53	115.074
2	Banana *(Musa sp)*	31.86	58.05	109.89	51.30	120.69	74.358
3	Mango *(Mangifera indica)*	61.83	62.91	48.06	86.94	58.05	63.558
4	Coconut *(Cocos nucifera)*	65.88	86.67	51.84	66.42	38.88	61.938
5	Papaya *(Carica papaya)*	7.29	22.14	62.64	28.35	30.78	30.240
6	Guava *(Mangifera indica)*	14.04	37.8	34.02	23.49	17.82	25.434
7	Jackfruit *(Artocarpus heterophyllus)*	13.50	35.64	26.73	8.91	4.86	17.928
8	Lemon *(Citrus limon)*	12.69	9.99	22.14	12.96	18.36	15.228
9	Black berry *(Syzygium cumini)*	16.20	9.45	21.06	13.23	11.61	14.310
10	Indian jujube *(Zizyphus mauritiana)*	3.78	9.18	17.01	7.29	2.43	7.938
11	Elephant apple *(Dillenia indica)*	0.81	1.08	7.83	7.83	2.16	3.942
12	Olive *(Elaeocarpus floribundus)*	1.62	3.24	10.53	3.24	0.81	3.888
13	Indian apple *(Aegle marmelos)*	2.43	1.62	11.34	2.43	1.35	3.834
14	Litchi *(Litchi chinensis)*	3.51	5.94	4.05	2.7	0.27	3.294
15	Hog plum *(Spondias dulcis)*	1.62	2.97	5.67	2.7	2.7	3.132
16	Custard apple *(Anona squamosa)*	1.35	4.86	2.97	3.51	1.89	2.916
17	Pomegranate *(Punica granutum)*	2.16	0.54	3.51	1.35	2.16	1.944
18	Wax jumbo *(Syzygium samarangense)*	1.62	1.35	4.59	1.89	0.27	1.944
19	Tamarind *(Tamarrinbus indica)*	0.00	0.00	2.97	0.00	1.35	0.864
20	Carrabolla *(Averrhoa carambola)*	1.08	0.81	0.27	0.81	0.00	0.594
21	Date *(Phoenix sylvestris)*	0.00	0.27	1.89	0.27	0.00	0.486
22	Velvet apple *(Piospyros discolor)*	0.00	0.00	1.89	0.27	0.00	0.432
23	Orange *(Citrus chrysocarpa)*	0.81	0.54	0.00	0.27	0.00	0.324
24	Palmyra palm *(Borassus flabellifer)*	0.00	0.27	0.27	0.81	0.00	0.270
25	Indian Goose Berry *(Phyllanthus embelica)*	0.54	0.00	0.00	0.00	0.27	0.162
26	Burmese grape *(Baccaurea ramiflora)*	0.00	0.27	0.00	0.00	0.27	0.108
27	Gooseberry *(Phyllanthus acidus)*	0.27	0.00	0.00	0.00	0.27	0.108

Timber: Among the 19 timber species, common at all unions, mahgany was the most prevalent at Jolshukha and golden shower was at Kakailcheo both at morpholypes and population level. But at indian red wood was most prevalent based on morphotypes and mahgany was most prevalent based on population. On the basis of mean dominance the golden shower occupied the highest position followed by indian red wood, yellow and rain tree. The best ranked timber species was mahogany (Table 4.10). Anam (1999) found as the most prevalent among the timber species followed by rain tree and mahogany.

Table 4.10 Relative prevalence of common Timber species found in the homestead of Ajmiriganj upazila of Hobigonj district in Bangladesh

Sl. No.	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Mahgany (*Swietenia mahogany*)	72.833	148.278	58.778	130.667	65.778	64.166
2	Golden Shower (*Acacia auriculifomis*)	16.750	63.722	50.556	75.389	12.750	41.378
3	Indian Red Wood (*Dalbergia sissoo*)	0.000	0.000	0.389	2.917	0.444	9.818
4	Yellow cassica (*Cassica siamea*)	0.000	0.000	0.000	164.694	0.000	7.358
5	Rain Tree (*Albizzia saman*)	21.944	53.833	10.694	9.028	53.333	6.176
6	Eucalyptus (*Eucalyptus camaldulensis*)	8.222	4.167	0.111	6.667	99.750	4.189
7	Margosa Tree (*Azadirachta indica*)	4.222	23.333	51.389	0.000	1.250	2.134
8	Arjun (*Terminalia arjuna*)	0.000	0.250	9.472	1.333	0.000	0.920
9	Teak Tree (*Tecktona grandis*)	1.444	1.667	0.333	10.833	0.056	0.863
10	Krishnachura (*Delonix regia*)	0.000	0.000	0.000	0.000	0.000	0.644
11	Coral Tree (*Erythrina orientalis*)	0.000	1.250	0.000	0.278	0.000	0.622
12	Chapalish (*Artocarpus chaplasha*)	0.111	0.000	0.694	0.000	0.000	0.542
13	Royal Siris (*Albizia julibrissin*)	15.500	0.972	31.167	42.778	2.722	0.344
14	Palash (*Butea monosperma*)	2.444	0.028	0.333	0.250	0.500	0.280
15	Kadam (*Anthocephalus cadamba*)	6.333	46.278	66.500	25.667	0.000	0.192
16	Bengal fig (*Ficus bengalensis*)	0.000	0.028	0.000	0.000	0.000	0.096
17	Silk cotton (*Bombax ceiba*)	0.111	0.028	0.167	0.111	0.000	0.062
18	Fig (*Ficus glomerata*)	0.028	0.000	0.000	0.000	0.056	0.016
19	Gamar (*Gmelina arborea*)	0.028	0.694	0.556	0.111	0.028	0.016
20	Ipil-Ipil (*Leucaena leucocephala*)	0.000	0.000	0.000	0.000	0.028	0.011
21	Jarul (*Lagerstroemiaflos reginae*)	0.028	0.111	0.556	0.028	0.000	0.010
22	Champa (*Michelia champaca*)	0.000	0.000	0.000	0.000	0.028	0.008
23	Indian Gum Tree (*Acacia arabica*)	0.000	0.000	0.000	0.000	0.000	0.001

4.5 Species Diversity

Species biodiversity of fruit species varied from region to region and species to species. To know the plant biodiversity, species diversity was calculated considering the five unions as a whole. It might help to understand the fruit diversity in respect of Ajmiriganj.

Fruit: Species diversity of fruit was varied from 0.00 to 0.992 in the study area. Mango and coconut were found highly diverse fruit species which was 0.992 and 0.990, respectively. The second highest species diversity was found in papaya (0.987), papaya and guava and 7 species of fruits were having a low diversity in this study area. The highest fruit species diversity in Ajmirigonj and Kakailcheo were mango, at Bodolpur, Jolshukha and Sibpasha were coconut (Table 4.11). Mannan (2000) studied the species diversity of plants in the homestead of three agro-ecological region of Bangladesh. He found higher diversity for fruit species followed by timber and spices.

Plate 6: Haor homesteads fruit diversity rich in mango, coconut and others fruits

Table 4.11 Species diversity of Fruit in the homesteads of five unions in the study area

Sl. No	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Mango (*Mangifera indica*)	0.960	0.969	0.958	0.958	0.961	0.992
2	Coconut (*Cocos nucifera*)	0.951	0.944	0.964	0.969	0.966	0.990
3	Papaya (*Carica papaya*)	0.859	0.964	0.956	0.932	0.948	0.987
4	Guava (*Mangifera indica*)	0.783	0.940	0.961	0.960	0.927	0.986
5	Banana (*Musa sp*)	0.835	0.938	0.946	0.878	0.958	0.986
6	Black berry (*Syzygium cumini*)	0.846	0.885	0.905	0.945	0.935	0.978
7	Hog plum (*Spondias dulcis*)	0.611	0.843	0.930	0.840	0.880	0.973
8	Jackfruit (*Artocarpus heterophyllus*)	0.835	0.909	0.905	0.836	0.852	0.971
9	Lemon (*Citrus limon*)	0.572	0.789	0.927	0.883	0.840	0.966
10	Indian jujube (*Zizyphus mauritiana*)	0.765	0.863	0.906	0.700	0.716	0.962
11	Olive (*Elaeocarpus floribundus*)	0.778	0.889	0.897	0.861	0.444	0.960
12	Custard apple (*Anona squamosa*)	0.800	0.926	0.876	0.627	0.816	0.960
13	Betel nut (*Areca catechu*)	0.811	0.941	0.868	0.798	0.928	0.960
14	Indian apple (*Aegle marmelos*)	0.864	0.833	0.904	0.716	0.720	0.957
15	Pomegranate (*Punica granutum*)	0.813	0.500	0.757	0.720	0.813	0.943
16	Litchi (*Litchi chinensis*)	0.817	0.798	0.791	0.600	0.000	0.942
17	Wax jumbo (*Syzygium samarangense*)	0.722	0.720	0.685	0.653	0.000	0.903
18	Carrabolla (*Averrhoa carambola*)	0.750	0.667	0.000	0.444	0.000	0.893
19	Tamarind (*Tamarrinbus indica*)	0.000	0.000	0.793	0.000	0.800	0.883
20	Elephant apple (*Dillenia indica*)	0.667	0.750	0.875	0.250	0.750	0.858
21	Velvet apple (*Piospyros discolor*)	0.000	0.000	0.694	0.000	0.000	0.750
22	Palmyra palm (*Borassus flabellifer*)	0.000	0.000	0.000	0.444	0.000	0.720
23	Indian Goose Berry (*Phyllanthus embelica*)	0.500	0.000	0.000	0.000	0.000	0.667
24	Orange (*Citrus chrysocarpa*)	0.835	0.500	0.000	0.000	0.000	0.667
25	Date(*Phoenix sylvestris*)	0.835	0.000	0.245	0.000	0.000	0.519
26	Gooseberry (*Phyllanthus acidus*)	0.000	0.000	0.000	0.000	0.000	0.500
27	Burmese grape (*Baccaurea ramiflora*)	0.000	0.000	0.000	0.000	0.000	0.000

Timber: Species diversity of timber species ranged from 0.000 to 0.987 in the study area. Kadamba and Margosa Tree were found highly diverse fruit species which was 0.987 and 0.986, respectively. The second highest intra species diversity was found in mahogany and golden Shower (0.980) and 4 species of timber were having a low diversity in this study area. The highest timber species diversity in Ajmirigonj and Bodolpur were margosa tree, at Kakailcheo and Jolshukha were Kadamba, at Sibpasha was mahogany (Table 4.12). Minimum to moderate diversity index values of timber species indicates moderate species diversity among the timber species.

Plate 7: Haor homesteads rich in plant bio-diversity (timber species)

Table 4.12 Species diversity of Timber in the homesteads of five unions in the study area

Sl. No.	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Kadamba (*Neolamarckia cadamba*)	0.886	0.964	0.953	0.955	0.000	0.987
2	Margosa Tree (*Azadirachta indica*)	0.950	0.949	0.961	0.000	0.765	0.986
3	Mahgany (*Swietenia mahogany*)	0.907	0.946	0.924	0.861	0.920	0.980
4	Golden Shower (*Acacia auriculifomis*)	0.826	0.946	0.928	0.922	0.835	0.980
5	Royal Siris (*Albizia julibrissin*)	0.918	0.816	0.949	0.915	0.776	0.975
6	Rain Tree (*Albizzia saman*)	0.869	0.933	0.813	0.711	0.896	0.973
7	Eucalyptus (*Eucalyptus camaldulensis*)	0.834	0.689	0.000	0.740	0.888	0.948
8	Gamar (*Gmelina arborea*)	0.000	0.800	0.720	0.500	0.000	0.918
9	Indian Red Wood (*Dalbergia sissoo*)	0.000	0.870	0.408	0.625	0.469	0.916
10	Arjun (*Terminalia arjuna*)	0.000	0.667	0.868	0.653	0.653	0.915
11	Teak Tree (*Tecktona grandis*)	0.757	0.764	0.278	0.815	0.000	0.900
12	Yellow cassica (*Cassica siamea*)	1.000	0.000	0.000	0.881	0.000	0.881
13	Palash (*Butea monosperma*)	0.698	0.000	0.625	0.667	0.611	0.869
14	Jarul (*Lagerstromia speciosa*)	0.997	0.500	0.720	0.000	0.000	0.864
15	Bengal fig (*Ficus bengalensis*)	0.000	0.000	0.750	0.000	0.000	0.857
16	Coral Tree (*Erythrina orientalis*)	0.000	0.790	1.000	0.480	0.000	0.847
17	Chapalish (*Artocarpus chalasha*)	0.500	0.000	0.720	0.000	0.000	0.844
18	Silk cotton (*Bombax ceiba*)	0.500	0.000	0.898	0.000	0.000	0.813
19	Krishnachura (*Delonix regia*)	0.997	0.000	0.750	0.000	0.000	0.800
20	Indian Gum Tree (*Acacia arabica*)	0.000	0.000	0.000	0.000	0.000	0.000
21	Champa (*Mechelia champaka*)	0.000	0.000	0.000	0.000	0.000	0.000
22	Ipil-ipil (*Leucaena leucocephala*)	1.000	0.000	0.000	0.000	0.000	0.000
23	Fig (*Ficus glomerata*)	1.000	0.000	1.000	0.000	0.000	0.000

Summer vegetables: The values of species diversity index of common summer vegetable species are shown in Table 4.13. Like fruits and timber, species diversity of different summer vegetable species varied from 0.000 to 0.985 in the study area. Sweet gourd and brinjal were found highly diverse fruit species which was 0.985 and 0.981 respectively. The second highest species diversity was found in ridge gourd and white gourd (0.980) and 8 species of summer vegetable were having a low diversity in this study area. The highest summer vegetables species diversity in Ajmirigonj was sweet gourd, at Kakailcheo and Jolshukha were ridge gourd, at Bodolpur was white gourd, at Sibpasha was cucumber (Table 4.13).

Table 4.13 Species diversity of summer vegetable in the homesteads of five unions in the study area

Sl. No.	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Sweet gourd (*Cucurbita maxima*)	0.965	0.847	0.814	0.925	0.940	0.985
2	Brinjal (*Solanum melongena*)	0.955	0.887	0.807	0.898	0.929	0.981
3	Ridge gourd (*Luffa acutagula*)	0.921	0.956	0.796	0.927	0.908	0.980
4	White gourd (*Benincasa hispida*)	0.943	0.820	0.871	0.923	0.893	0.980
5	Cucumber (*Cucumis sativas*)	0.869	0.000	0.710	0.849	0.941	0.969
6	Sponge gourd (*Luffa cylindrical*)	0.893	0.000	0.494	0.610	0.831	0.947
7	Chilli (*Capsicum species*)	0.303	0.738	0.494	0.759	0.883	0.937
8	Teasle gourd (*Momordica cochinchinensis*)	0.695	0.000	0.000	0.653	0.823	0.922
9	Giant taro (*Alocasia macrorrhiza*)	0.745	0.000	0.000	0.000	0.000	0.797
10	White yem (*Dioscorea alata*)	0.000	0.278	0.000	0.460	0.000	0.732
11	Bottle gourd (*Lagenaria siceraria*)	0.000	0.000	1.000	0.000	0.499	0.723
12	Red amaranth (*Amaranthus gangeticus*)	0.000	0.000	0.661	0.490	0.000	0.713
13	Plantain (*Musa paradisiaca*)	0.000	0.626	0.000	0.000	0.000	0.626
14	Snake gourd (*Trichosanthes anguina*)	0.835	0.000	0.863	0.872	0.308	0.620
15	Eddoe (*Colocasia esculenta*)	0.552	0.000	0.000	0.000	0.000	0.592
16	Hyacinth bean (*Lablab niger*)	0.000	0.000	0.426	0.000	0.000	0.426
17	Tomato (*Lycopersicon esculentum*)	0.000	0.000	0.000	0.000	0.000	0.000

Winter vegetables: The values of species diversity index of common winter vegetable species are shown in Table 4.14. Like fruits and timber, species diversity of different summer vegetable species varied from 0.000 to 0.986 in the study area. Bottle gourd and Indian spinach were found highly diverse fruit species which was 0.986. The second highest species diversity was found in Okra (0.981) and Radish (0.980). The highest winter vegetables species diversity in Ajmirigonj was hyacinth bean, at Kakailcheo was bottle gourd, at Bodolpur was cabbage, at Jolshukha was indian spinach, at Sibpasha was radish (Table 4.14).

Table 4.14 Species diversity of winter vegetable in the homesteads of five unions in the study area

Sl. No.	Name of species	Unions					Total
		Ajmirigonj	Kakailcheo	Bodolpur	Jolshukha	Sibpasha	
1	Bottle gourd (*Lagenaria siceraria*)	0.905	0.956	0.673	0.960	0.963	0.986
2	Indian spinach (*Basella rubra*)	0.896	0.904	0.745	0.962	0.956	0.986
3	Okra (*Abelmoschus esculentus*)	0.924	0.891	0.574	0.912	0.940	0.981
4	Radish (*Raphanus sativus*)	0.893	0.889	0.662	0.956	0.967	0.980
5	Potato (*Solanum tuberosum*)	0.494	0.940	0.780	0.955	0.942	0.978
6	Cabbage (*Brassica oleracea var capitata*)	0.000	0.936	0.900	0.864	0.920	0.978
7	Cauliflower (*Brassica oleracea var botrytis*)	0.658	0.953	0.480	0.894	0.858	0.976
8	Hyacinth bean (*Lablab niger*)	0.908	0.000	0.000	0.941	0.912	0.973
9	Bitter gourd (*Momordica charantia*)	0.904	0.000	0.000	0.886	0.931	0.970
10	Red amaranth (*Amaranthus gangeticus*)	0.736	0.935	0.665	0.951	0.926	0.964
11	Stem amaranth (*Amaranthus lividus*)	0.000	0.937	0.000	0.631	0.444	0.951
12	Spinach (*Spinacia oleracea*)	0.541	0.697	0.000	0.912	0.915	0.914

4.6 Contribution of different species

4.6.1 Contribution of different fruit species

Fig. 4.1 indicates the relationship among the fruit species in relation to their contribution to the diversity. Fruit species in the upper portion of the dendrogram contributed minimum and fruit species in the lower portion of the dendrogram contributed maximum to the diversity. Indian Goose berry was flowed by Burmese grape, palmyra plam, orange while fruit species. Betel nut rest flowed by banana, mango, coconut. If we ignore 20% difference among fruit species. We found two clusters among the fruit species, of which betel nut contribute one cluster and rest 26 species contribute the another one.

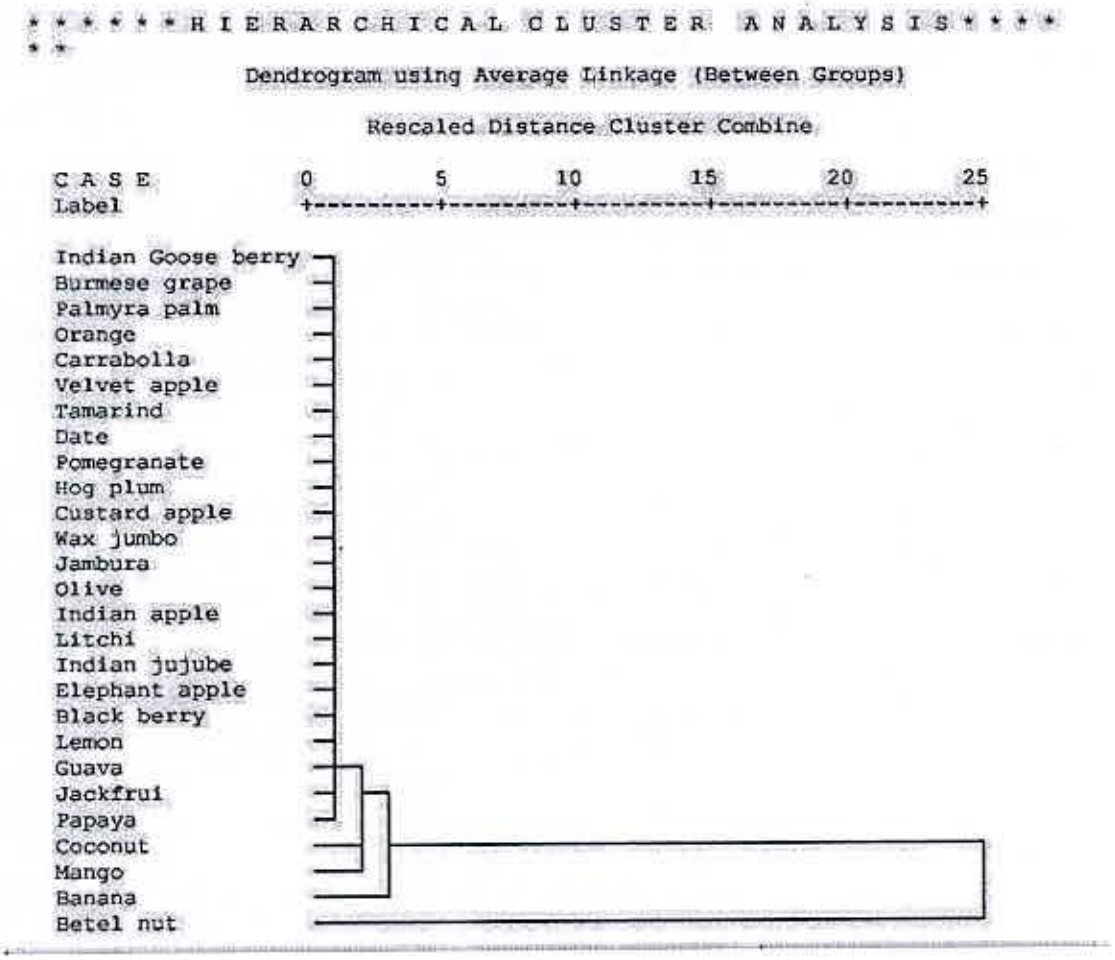


Fig. 4.1 Dendrogram showing the relationship among the fruit species in relation to their contribution to diversity

4.6.2 Contribution of different timber species

Fig. 4.2 indicates the relationship among the timber species in relation to their contribution to the diversity. Timber species in the upper portion of the dendrogram contributed minimum and species in the lower portion of the dendrogram contributed maximum to the diversity. Ipil ipil was flowed by fig, Indian gum tree, chapalish while timber species. Mahgany rest flowed by eucalyptus, rain tree, golden shower and royal siris. If we ignore 20% difference among timber species. We found six clusters among the timber species, of which mahogany, eucalyptus, rain tree, golden shower and royal siris contribute five clusters and rest 18 species contribute another one. Ipil ipil contributed lest while mahgany contributed most in the diversity of timber species.

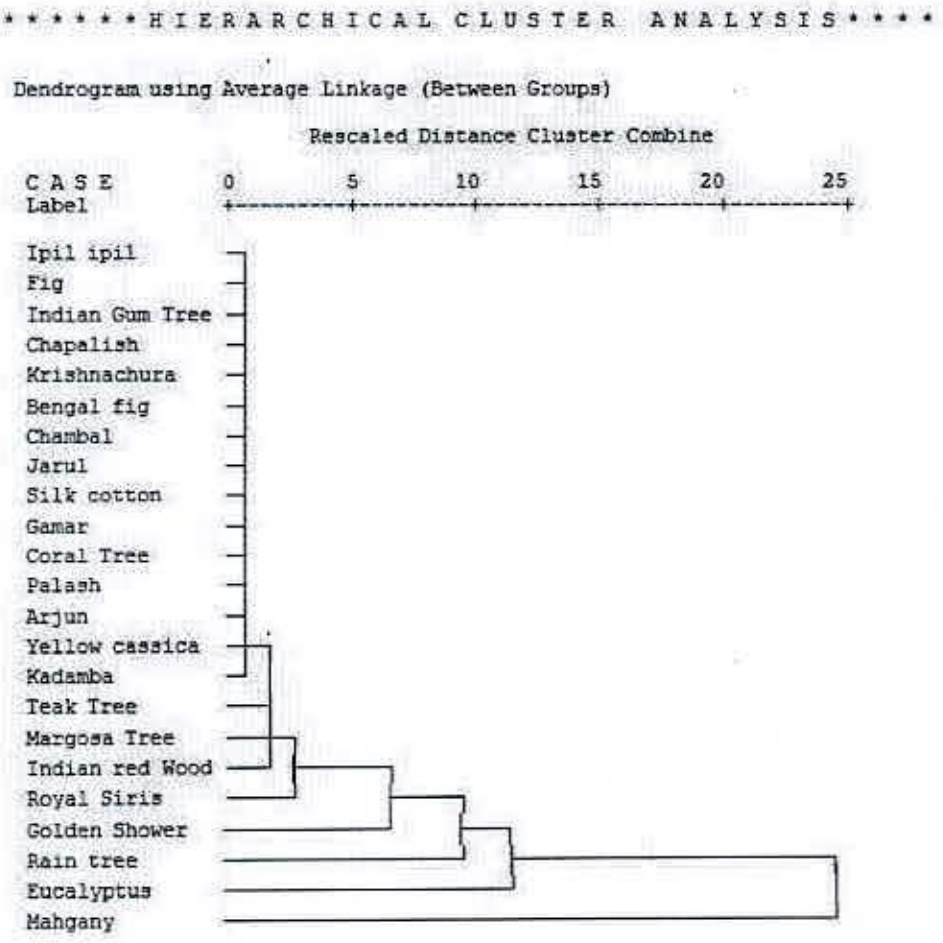


Fig. 4.2 Dendrogram showing the relationship among the timber species in relation to their contribution to diversity

4.6.3 Contribution of different summer vegetable species

Fig. 4.3 indicates the relationship among the winter vegetable species in relation to their contribution to the diversity. Fruit species in the upper portion of the dendrogram contributed minimum and fruit species in the lower portion of the dendrogram contributed maximum to the diversity. Hyacinth bean was flowed by tomato, plantain, bottle gourd while summer vegetables species. Snake gourd rest flowed by brinjal, ridge gourd, red amaranth, chilli and cucumber. If we ignore 20% difference among summer vegetables species. We found six clusters among the summer vegetable species, of which Snake gourd, brinjal, ridge gourd, red amaranth and chilli contribute five clusters and rest 11 species contribute another one. Hycinth been contributed lest while Snake gourd contributed most in the diversity of winter vegetable.

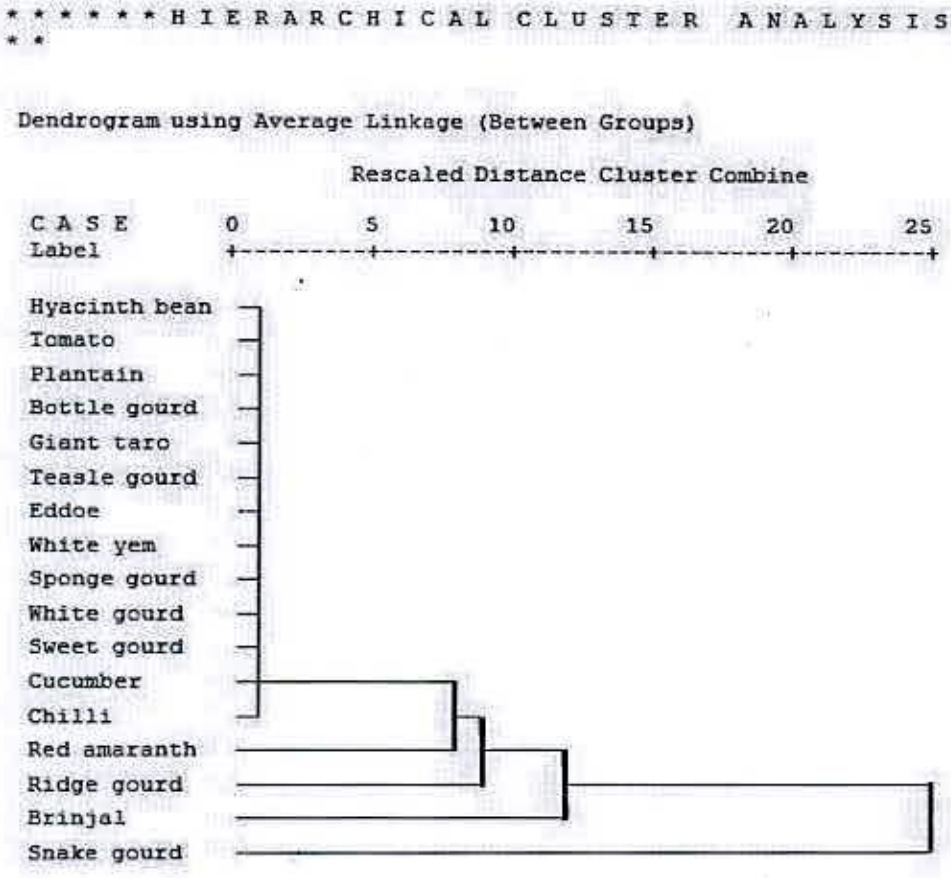


Fig. 4.3 Dendrogram showing the relationship among the summer vegetable species in relation to their contribution to diversity

4.6.4 Contribution of different winter vegetable species

Fig. 4.4 indicates the relationship among the summer vegetable species in relation to their contribution to the diversity. Summer vegetable species in the upper portion of the dendrogram contributed minimum and summer vegetable species in the lower portion of the dendrogram contributed maximum to the diversity. Bean was flowed by bitter gourd, botter gourd, okra while winter vegetables species. Red amaranth rest flowed by spinach, potato and radish. If we ignore 20% difference among summer vegetables species. We found four clusters among the winter vegetable species, of which red amaranth, spinach and potato contribute three clusters and rest 9 species contribute another one. Been contributed lest while red amaranth contributed most in the diversity of winter vegetable.

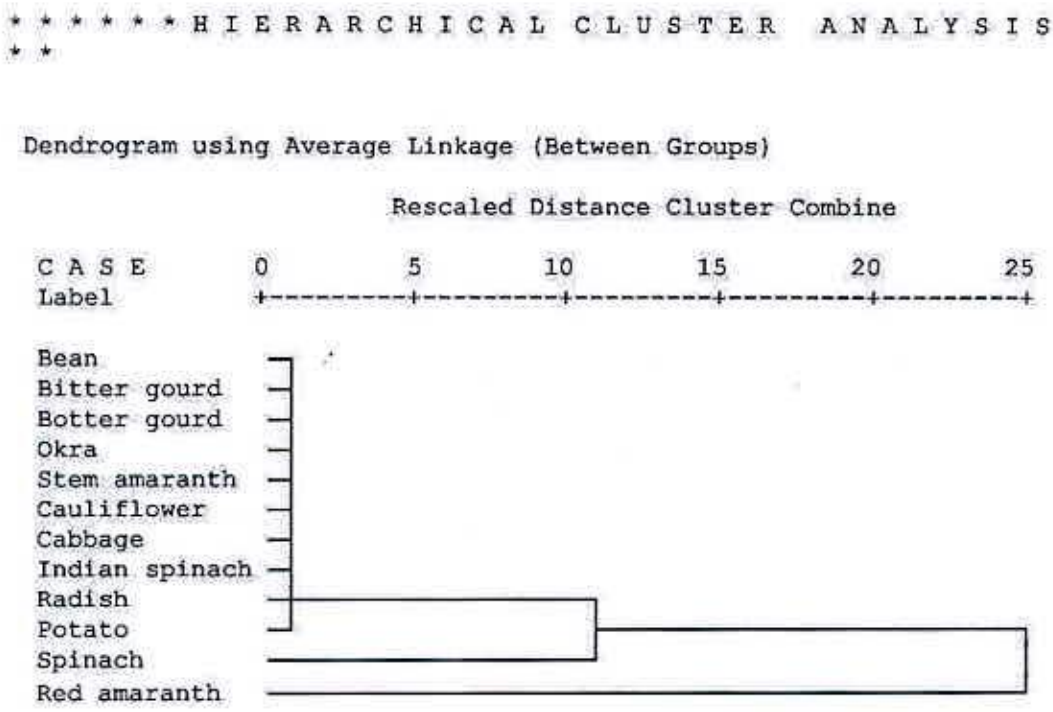


Fig. 4.4 Dendrogram showing the relationship among the winter vegetable species in relation to their contribution to diversity

4.7 Relationship between the selected characteristics of the homesteads and plant biodiversity in their homestead:

Co-efficient of correlation was computed in order to explore the relationship between the selected characteristics of the homesteads and plant biodiversity in their homestead. As mentioned earlier, the 6 (six) characteristics of the household were included in the independent variables of the study. The Characteristics were: age, education, family size, age of the homestead, area of the homestead and fruit area. The dependent variable was fruit diversity in homestead.

To explore the relationships, Pearson's product moment correlation co-efficient (r) was used to test the null hypothesis concerning the relation between any two variables. Five percent (0.05) level of probability was used as the basis of rejection of a null hypothesis. The relationship between selected characteristics of the households and fruit diversity in their homesteads was presented in Table 4.15.

Table 4.15 Correlation between dependent and independent variables

Dependent variables	Independent variables	Diversity in homestead
Plant biodiversity	Age	0.000 ^{ns}
	Education	0.081 ^{ns}
	Family size	0.070 ^{ns}
	Age of the homestead	0.000 ^{ns}
	Area of the homestead	0.053 ^{ns}
	Fruit area	0.063 ^{ns}

*=Significant at P<0.05; **=Significant at P<0.01; ns = Not Significant

4.7.1 Age and plant biodiversity at homestead

The relationship between age of the house head and plant biodiversity in their homestead was examined. Coefficient of correlation between the concerned variables was found to be 'r' = 0.000 as shown in Table 4.15. This led to the following observations regarding the relationship between the two variables under consideration.

- Firstly, the relationship showed a neutral trend.
- Secondly, no relationship was found to exist between the two variables.

The findings demonstrated that the age of the house head had no relationship with the plant biodiversity in their homestead.

4.7.2 Education and plant biodiversity at homestead

The relationship between education of the house head and plant biodiversity in their homestead was examined. The co-efficient of correlation between the concerned variables were found to be 0.081 as shown in Table 4.15. This led to the following observation regarding the relationship between the two variables under consideration.

- The relationship showed a positive trend.
- Low relationship was found between the concerned variables.
- The computed value of 'r' (0.081) was found
- The relationship ($r = 0.081$) between the two variables was not significant.

The findings indicate that the education of the house head had positive significant relationship with plant biodiversity of their homestead. The growers who had higher education had a tendency to grow various kinds of plants in their homestead. This might be due to their knowledge about the nutritious value of different plants and their importance for human health and environment.

4.7.3 Family size and plant biodiversity at homestead

The relationship between family size and plant biodiversity in their homestead was examined. Computed value of the co-efficient of correlation between the family size and fruit diversity at homestead was found to be 0.070 as shown in Table 4.15. The following observations were recorded regarding the relationship between the two variables on the basis of co-efficient of correlation.

- The relationship showed a tendency in the positive direction between the concerned variables.
- A very low relationship was found to exist between the two variables.
- The relationship (r = 0.070) between the two variables was not significant.

The findings imply that the researcher concluded that the family size of the farmers had no significant relationship with plant biodiversity in their homestead.

4.7.4 Age of the homestead and plant biodiversity at homestead

The relationship between age of the homestead and plant-biodiversity in their homestead was examined. Coefficient of correlation between the concerned variables was found to be 'r' = 0.000 as shown in Table 4.15. This led to the following observations regarding the relationship between the two variables under consideration.

- Firstly, the relationship showed a neutral trend.
- Secondly, no relationship was found to exist between the two variables.

The findings demonstrated that the age of the house head had no relationship with the plant biodiversity in their homestead.

4.7.5 Area of the homestead and plant biodiversity at homestead

The relationship between area of the homestead and plant biodiversity in homestead was examined. Computed value of the coefficient of correlation between homestead size of the owners and plant biodiversity in their homestead was found to be 0.053 as

shown in Table 4.15. The following observations were recorded regarding the relationship between the two variables on the basis of the co-efficient of correlation.

- The relationship showed a tendency in the positive direction between the concerned variables.
- Low relationship was found to exist between the two variables.
- The relationship (r = 0.053) between the two variables was not significant.

The findings imply that the researcher concluded that the homestead size of the farmers had no significant relationship with plant biodiversity in their homestead. The findings indicate that farmers of a large homestead also don't have enough tendencies to grow various types of fruit in their homestead. Most of the cases, they liked to cultivate some common plant in their homestead to get more benefit. But they didn't want to understand that the cultivation of various types of plant in their homestead is more beneficial in respect of commercial and nutritional value.

4.7.6 Fruit area and their plant biodiversity at homestead

The relationship between fruit area and their fruit diversity was examined. Computed value of the co-efficient of correlation between area under fruit area and their plant biodiversity was found to be 0.063 as shown in Table 4.15. The following observations were recorded regarding the relationship between the two variables on the basis of the co-efficient of correlation.

- The relationship showed a very low tendency in the positive direction between the concerned variables.
- Low relationship was found to exist between the two variables.
- The relationship (r = 0.063) between the two variables was not significant

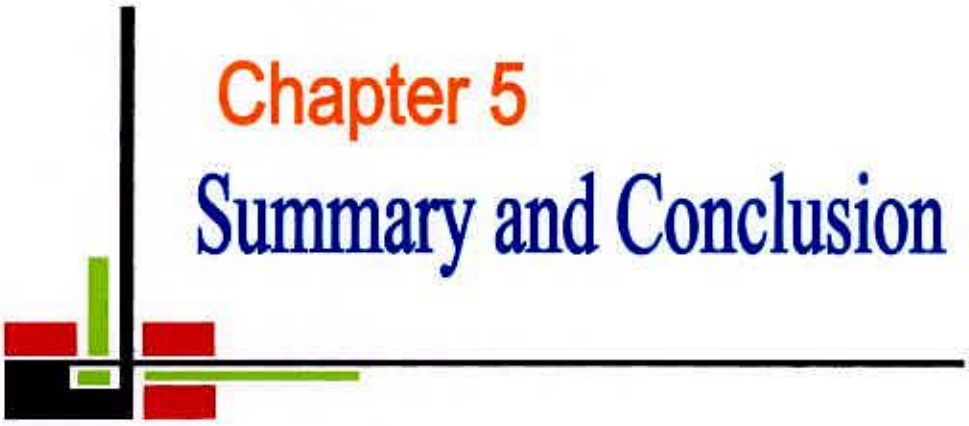
The findings imply that the researcher concluded that the area under fruit cultivation had no significant relationship with the plant biodiversity in homestead. The findings indicate that a large area under fruit cultivation cannot ensure a good plant biodiversity.

4.8 Problem faced by the farmers

The homestead fruit growers were asked about the problem faced by them in fruit cultivation. Various kinds of problems were identified. Among these problems, some are mostly dominant to others. On the basis of the statement of the respondents, seven problems were recorded to be the barrier of fruit cultivation in the homestead. Lack of improved plant species was the most serious problem as cited by the growers. Almost 90.33% respondents told it as a great problem. It was observed that there is no modern nursery in Ajmirigonj upazila. For this most of the people make seedlings in own home or collect from other local sources. Lake of knowledge was serious problem (85.67%) to the growers. Attack of insect and disease (84.67%) was identified as another serious problem by the respondents. Especially coconut, mango, guava, papaya etc are mostly attacked by the insect and disease. For this reason, farmers don't want to cultivate this fruits as commercial purposes. Less space at homestead for plantation was identified as a common problem (64.33%) for the area. Ajmirigonj is situated at the coastal area. For this Ajmirigonj is attacked by the flood for several times in every year. Fruits especially banana, papaya etc are damaged by these natural calamities. Lack of balanced fertilizer, organic fertilizer and pesticide application were seen as a problem. 64% of the respondents express it as a problem. Cattle raid was seen as the problem that was ranked sixth (49%). Most of the cases homesteads were seen to be busy in field crop cultivation. For this, they don't have enough time to take care the fruit garden. Flood the plants died was a big problem (40.67%) in fruit cultivation. Most of the areas of the homesteads are used as homesteads, ponds, dairy, poultry etc. These animals usually destroy the fruit trees. Farmers get quick return from these animals. For this they keep importance in these purposes. Lack of enough storage capacity was seen a important problem for the study area. There is no modern cold storage to preserve the fruits. Therefore, fruits cannot be stored in off season. Lack of activities by the agricultural officers was mentioned as a problem. They spend most of their times in field crop cultivation. They don't have any special program for fruit cultivation.

Table 4.16 Problem faced by the farmers in the study area

Problems	Frequency	Percent	Rank
Lack of improved plant species.	271	90.33	1
Lack of Knowledge of the plant growers.	257	85.67	2
Insect and disease attack.	254	84.67	3
Less space at homestead for plantation.	193	64.33	4
Lack of balanced fertilizer, organic fertilizer and pesticide application.	192	64	5
Cattle raid.	147	49	6
Plants died for flood.	122	40.67	7



Chapter 5

Summary and Conclusion

SUMMARY AND CONCLUSION

5.1 SUMMARY

A respondent's participatory survey of homestead flora was conducted at Azmirigonj to find out the status and magnitude of plant-biodiversity at the Haor homesteads level of Bangladesh. The study area was five unions of Habigonj district like Ajmirigonj, Kakailcheo, Bodolpur, Jolshukha and Sibpasha. Three hundred homesteads were surveyed during April to September, 2011. In this study an attempt has been made to identify different plant species being grown in the homestead to study the plant biodiversity and distribution and to identify the problem faced by the farmer and to recommend a suitable homestead production system. Pre-tested questionnaires were used for the survey.

A total of 79 plant species were identified in the homesteads of the study area, which did not include medicinal plants. Relative prevalence was estimated for all the species. Species diversity was calculated as Simpson's diversity Index. Among the plant species recorded 27 fruits, 23 timbers, 17 summer vegetables and 12 winter vegetables. Only 24 fruit, 19 timber, 14 summer vegetables and 10 winter vegetables species were common to all the five unions. In an average timber ranked second to fruit. The study revealed that the highest types of species (27) were found in the large farm category where as the lowest number of species (10) were found in the small farm category.

Among these, the most prevalent species were guava, mahogany, brinjal and red amaranth in fruit, timber, summer vegetables and winter vegetables group respectively. Based on mean dominance rank most prevalent species were guava, mahogany, brinjal and red amaranth in fruit, timber, summer vegetables and winter vegetables group, respectively.

Species diversity indices varied among both union and plant groups. Highest diversity was recorded for fruits followed by timber, winter vegetables and summer vegetables. Species diversity of mango, kadamba, sweet gourd and bottle gourd were found maximum in these plant groups, respectively. Area under fruit cultivation have low and positive relationship with the plant biodiversity but not significant.

The major problem faced by the homestead plant grower's in fruit tree establishment was "Lack of improved plant species" which was reported by 90.33% of the

respondents. "Lack of Knowledge of the plant growers" was also another common constraint as respond by 85.67% respondents.

5.2 CONCLUSION

There is a need to intensify the land use in order to support the increasing population. As population increasing number of homestead is also increasing. We should utilize our 25.53 millions homesteads to produce fruit, timber, summer vegetable and winter vegetable. We will attain the self-sufficiency in fruit, timber and vegetable by proper use of haor homestead.

Seventy nine plant species were identified in the homesteads of Ajmiriganj upazila of Bangladesh. Relative prevalence of most common plants were very high while. Highest species diversity was found in mango, coconut, papaya, kadamba, sweet gourd and bottle gourd followed by black berry, hog plum, margosa tree, brinjal, and okra etc. Coconut and Mango were found in 79% homesteads which were most diverse fruit in the study area. Various kinds of problems were identified in the study area. According to the farmer's opinion, "Lack of improved plant species" was identified as the topmost problem.

Homestead plant growers depend on the naturally growing plant on the homestead. To increase plant population in the homesteads, their appropriate management should be practiced. Wide range of plant-biodiversity existed in the Haor homesteads of Bangladesh. Plant species was the highest followed by vegetables in the homesteads. There was no correlation between the geographical diversity and morphological diversity.

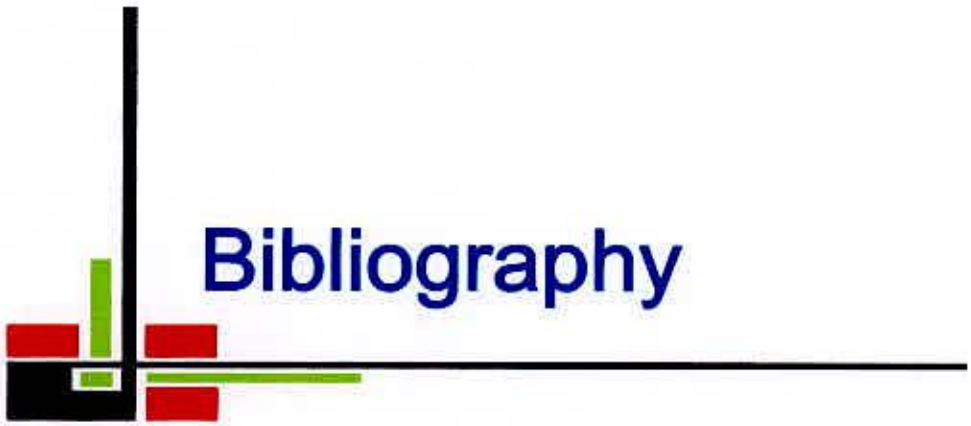
5.3 RECOMMENDATIONS

In spite of the immense scope and prospects of the homesteads, no systemic program has so far been under-taken to improve their plant biodiversity of haor homestead. In order to bring a positive change in plant biodiversity the haor homesteads, the following recommendations are made on the basis of the findings of the study:

1. A massive program is suggested to be taken by the relevant authority to assess the plant-biodiversity at homestead level of all agro-ecological

regions of Bangladesh. Such assessment may help to identify superior plant species preferred by the farmers.

2. Development of appropriate small scale nursery, particularly for helping homestead planting is advocated.
3. It is very important to give high research priority to improve the indigenous fruit for homestead plantation and improvement of fruit diversity.
4. The government and Non-Government organizations should take some program to motivate the farmers to increase the fruit diversity in their homestead by planting various kinds of fruit sapling.



Bibliography

BIBLIOGRAPHY

Abedin, M.Z. and Quddus, M.A. (1990). Household fuel situation, homegardens and agroforestry practices at six agro-ecologically different locations of Bangladesh (Abedin *et al.* eds.) Proceedings of a national workshop held 17-19 July 1988 in Joydebpur, Bangladesh. BARI/RWEDP/WINROCK. pp. 19-53.

Ahmed, F.U. (1997). Minor fruits in homestead agroforestry. **In:** Agroforestry : Bangladesh perspective, Alam *et al.* (eds.) APAN/NAWG/BARC. pp. 165-169.

Agrawal, K. C. (1999). Biodiversity Agro botanical. Vyas nagar, New delhi.

Akter, N.S., Abedin, M.Z. and Quddus, M.A. (1989) . Why farmers grow trees in agricultural field: some thought, some results. **In:** Research Report 1988-89. On Farm Research Division, Jessore, Bangladesh Agricultural Research Institute. pp. 161-178.

Alam. M.S. and Masum K. M. (2005). Status of homestead biodiversity in the offshore island of Bangladesh. *Res. J. of Agri. and Bio. Sci.* **1**(3): 246-253.

Ali, M.K., (1993). Farmer's responses to spaced transplanting technology of sugarcane. M.Sc. thesis, Department of agriculture extension education, Bangladesh Agricultural University, Mymensingh.

Alison, J.S. (1994). Acquisition indigenous ecological knowledge about forest gardens in kandy district, Srilanka. A post graduate thesis, School of Agricultural and Forest Science, University of Wales, Bangor, UK.

Anam, K. (1999). Homestead agroforestry in the level Harrod track: A diagnostic study. M.S. thesis. Department of Agroforestry and Enviornment. Bangabandhu sheikh Mujibur Rahman Agricultural University, Salna, Gazipur, Bangladesh.

Anand. I. J and Rabat. D. S. (1984). Genetic diversity. Combining ability and heterosis in brown mustard. *Indian J. Genet.* **44**: 226-234.

Barrau, J. (1961). Subsistence agriculture in Polynesia and Micronesia. Bishop Museum Bulletin 223, Honolulu, Hawaii.

Bashar, M. A. (1999). Homegarden agroforestry: Impact on biodiversity conservation and household food security (A case study of Gazipur district. Bangladesh). An M. Sc. thesis. Agricultural University of Norway.

Bashar, M. K. (1993). Adoption of intercropping in sugarcane cultivation. M.Sc. thesis, Department of agricultural extension education, Bangladesh Agricultural University, Mymensingh.

BBS, (2011). Statistical year book of Bangladesh, Bangladesh Bureau of Statistics. Ministry of Planning. Dhaka.

Boonkird, S. A., Fernandes. E. C. M. and Nair. P. K. R. (1984). Forest villages: an agroforestry approach to rehabilitating forest land degraded by shifting cultivation in Thailand. *J. of Agrofor. sys.* **2**: 87-102.

Brierley, J.S. (1985). West Indies kitchen gardens: A historical perspective with current insights from Grenada. *J. of Food and Nutrition Bull.* **7**(3):52-60.

Chowdhury, M. K. and Satter. M. A. (1992). Agroforestry practice in traditional farming system of Bangladesh. A report prepared for BARC/Winrock Intl., Dhaka, Bangladesh.

Cristanty, L. (1985). Homegardens in tropical Asia. A special reference to Indonesia. Paper presented at the first international workshop on tropical homegardens. Institute of Ecology Padjadjaran University, Bandung, Indonesia.

Dasgupta, S., Rahman. M. M, Rahman. M. L. and Azad. A. K. (1990). Agroforestry status in homestead area of Vaskarkhilla FSR site, Kishoreganj. **In:** Homestead plantation and agroforestry in Bangladesh. By M. Z. Abedin, C. K. Lai and M. O. Ali (eds.). BARI, Joydebpur, Bangladesh.

Deshmukh, I. (1986). Ecology and Tropical Biology. Palo Alto, California: Blackwell Scientific Publications.

Duglas, J.S. and Hart, R.A. dej. (1973). Forest farming walking, London.

Everett, Y. (1993). Hierarchical aggregation patterns of forest gardens in Montane landscape in Sri Lanka. Ph. D thesis. University of California, Berkeley.

Fernandes, E.C.M. and Nair, P.K.R., (1990). An evaluation of the structure and function of tropical homegardens. *Ind. J. of Agri. Sys.* **21**: 279-310.

Fishbeak, G. (1981). The usefulness of gene banks-perspectives for the breeding of plants **In:** UPOV Symposium: the use of genetic resources in the plant kingdom.

Ford-Lloyd. B. and Jackson. M. (1986). Plant Genetic Resource: an introduction to their conservation and use. Edward Arnold. 3 East Read Street, Baltimore. Maryland, 21202, U.S.A.

Haque. M.E., Hasan, S. S. and Khalil, M. I. (2004) .Use of sources by the farmers in receiving information related to cultivation of modern variety of rice. *Bang. J. of Ext. Edu.* **16** (20): 33-38.

Haque, M.M., (1993). "Adoption of improved practices in sugarcane cultivation by sugarcane growers of sripur thana under gazipur district". M.S thesis, department of agricultural extension education. Bangladesh Agricultural University, Mymensingh.

Heywood, V. H. and R. T. Watson. (1995). Global biodiversity assessment. Published for the United Nations Environment. Cambridge University Press. pp. 5-105.

Huston, M. A., Deangelis. D. L. and Post. W. M. (1988). New computer models unify ecological theory. *J. of Bio. Sci.* **38**: 682-691.

Islam, N. M. (1998). Homegarden agroforestry in Bangladesh; A case study in rangpur district. M. Sc. thesis, Agricultural university of Norway.

Islam, M. M. and Ahmed. D. (1987). Analysis of homestead production and utilization systems. **In:** Farming system research report 1986-87, Ishurdi, RARS, BARI. pp. 89-150.

Jeso, D. (1991). Homegarden of Kerala M. Sc. Thesis, Agricultural University of Norway.

Kamtuo. A., K. Letral and Wilariat. A. (1985). Traditional homegardening in Hinland village: Khan Kahn province, Northeast Thailand. **In**: proceeding of the first International Workshop on Tropical Homegradens. Bandung. Indonesia UN University and Institute of Ecology, Padjadjaran University.

Kar, N. K., Islam. S. M. F. Rahman, S. Abedin. M. Z, Musa. M. A and Khair. A. B. M. A. (1990). Homestead plantation and agroforestry systems in Barind tract of Bangladesh. **In**: Homestead plantation and agroforestry in Bangladesh. By M. Z. Abedin C. K. Lai and M. O. Ali (eds.). BARI, Joydebpur, Bangladesh.

Kimber, C. T. (1973). Spatial pattering in the dooryard gardens of Puerto Rico. *J. of Geo.Rev.* **6**: 6-24.

Khaleque, K. (1987). Homestead forestry practices in Bangladesh. **In:** Agroforestry for rural needs. Proceedings of the workshop of the IUFRO project group 1.15, pp. 1-12. India.

Khan, A.W. (1991). A background paper on forest conservation: a report prepared for national conservation strategy of Bangladesh. Dept. of Forestry. Govt. of Bangladesh, Dhaka.

Khan, M.S., Hossain. M.A.M, Abedin. M.Z. and Islam M.A. (1990). Agroforestry and Homestead plantation systems in non-saline tidal flood plain area in southern Bangladesh. In: M.Z. Abedin, C.K. Lai and M.O. Ali (eds.), Homestead plantation and agroforestry in Bangladesh. BARI, Joydevpur, Bangladesh.

Kumar, B. M. (1994). Homestead agroforestry a promising traditional land use system of the humid regions of Peninsular, India. **In:** Agroforestry: tradition and innovations by P. Narain, K. S. Dadwal and R. K. Singh (eds.). ICAR-UNDP. Advance center for agroforestry, central soil and water conservation research and training institute. Dehra dan, India.

Kumar, B. M., George S. J. and Chinnamani S. (1994). Diversity, structure and standing stock of wood in the homegardens of Kerala in peninsular, India. *Ind. J. of Agri. Sys* **25**(3): 243-264.

Leuschner, W.A. and Khaleque, K. (1987). Homestead Agroforestry in Bangladesh. *Agrofo. Sys.* **5**:139-151.

Linda, C. (1990). Homegarden in the tropical Asia, with special reference to Indonesia. **In**: Kathleen, L. and Mark, B. (ed.). Tropical homegarden. United nation University Press. pp. 9-21.

Mannan, M. A. (2000). Plant biodiversity in the homestead of Bangladesh and its utilization in crop improvement. Ph. D thesis, Bangabandhu Shekh Muzibur Rahman Agricultural University, Gazipur, Bangladesh.

Mazhar. F. (1995). Nayakrihi andolon: and initiative of the Bangladesh peasents for better living In Using diversity: enhancing and maintaining genetic resources On-Farm.by L. Sperling and Michael Loevinsohn IDRC Baugh, New Delhi, India.

Miah, G., Abedin. M. Z, Khair. A. B. M. A, Shahidullah. M. and Baki. A. J. M. A. (1990). Homestead plantation and household fuel situation Ganges floodplain of Bangladesh. **In:** Abedin M. Z., C. K. Lai and M. O. Ali, (eds.). Homestead plantation and agroforestry in Bangladesh. pp. 120-135. BARI, Joydebpur, Bangladesh.

Michon, G. (1983). Village forest gardens in west Java. *In*: Plant research and agroforestry. Pp: 13-24. by P. A. Huxley (ed.). International Centre for Research in Agroforestry, Nairobi, Kenya.

Michon, G., Bompard, J. Hecketseiler, P. and Ducutillion, C. (1983). Tropical forest architectural analysis as applied to agroforestry in the humid tropics. The example of traditional village agroforestry in West Java *Agroforestry System.* **1**: 117-129.

Mcconnell, D. J. and Dharmapala. A. K. E. (1973). The economic structure of kandyan forest gardens farms. UNDP/SF/FAO Diversification project. April 1973.

Millat-e- Mustafa, M. (1997). Tropical homegardening : An overview. **In:** Alam, M. K. Ahmed, F. U. and Amin, R. S. M. (des). 1997. Agroforestry: Bangladesh perspective. BARC, NAWG, APAN, Dhaka.

Millat-e-Mustafa, M. (1997). Floristics and indigeneous management technique of homegardens in Bangladesh. **In:** Agroforestry Bangladesh Perspective, Alam *et al.* (eds.). APAN/NAWG/BARC. pp. 34-63.

Momin, M. A., Abedin. M. Z, Amin. M. R, Islam. Q. M. S. and Haque. M. M. (1990). Existing homestead plantation and household fuel use pattern on the flood-prone Tangail region of Bangladesh. **In:** Abedin M. Z., C. K. Lai and M. O. Ali, (eds.). Homestead plantation and agroforestry in Bangladesh. Pp. 136-148. BARI, Joydebpur, Bangladesh.

Niez, V. (1987). Household gardens: Theoretical and policy considerations. *Ind. J. of Agri. Sys* **2**: 167-186.

Okafor, J.C. and Fernandes, E.C.M. (1987). The compound farms (Homegardens) of South Eastern Nigeria : A predominant agroforestry system involving food and fruit tree with crops and small livestock. *Agroforestry Systems.* **5**:153-68.

Oldrield. M. L. and Alcorn. J. B. (1987). Conservation of traditional agro-ecosystems. *J. of Bio.* **37**: 199-208.

Perera, A. and Rajapakse. N. (1989). A baseline study of Kandyan forest garden of Srilanka: Structure, Composition and utilisation. Papopresented at the international conference on agroforestry, University of Edinburgh, July 1989. pp.13.

Rahman M.L., Hasanuzzaman. M. and Islam. M.K. (2009). Fruit distribution and diversity in the homestead of a southern island of Bangladesh. *Adva. in Bio. Res.* **3** (5-6): 208-214.

Ramanujam, S., Tiwary A. S. and Mehra. R. B. (1974). Genetic divergence and hybrid performance in Mungbean. *Theor. Appal. Genet.* **44** (5): 211-214.

Richard, P.W. (1979). The tropical rain forest Cambridge University Press, Oxford. pp. 424

Sellathural, P. (1997). Homegarden agroforestry and sustainability in Kandy district, Srilanka. M. Sc. Thesis. Agricultural University of Norway.

Shannon, C. E. and Wiever. W. (1949). The mathematical theory of communication. University of Illionis Press. Urbana, Illionis.

Simpson, E. H. (1949). Measurement of diversity. Nature 163, 688.

Soemaorwato, O. and Conway. G.R. (1991). The Javanese homegardens. *J. Far. Sys. Res. Ext.* **2**(3) 95-117.

Sommers, P. (1978). Traditional homegardens of selected Philippines households and their potential for improving human nutrition. M. Sc. Thesis, University of Philippines, Los Banos, Philippines.

Sulbrig. O. T. (1994). Biodiversily: an introduction. Biodiversily and Global Change. by O. T. Sulbrig. 11. A van Eden and P. G. W. I van Oordt. IUSB. Paris, France.

Stoler, A. (1978). Garden use and household economy in rural Java. *Bull. of Indon. Eco. Stu.* **14**(2):85-101.

Terra, G.J.A. (1954). Mixed garden horticulture in Java. *Mala. J. of Trop. Geo.* **1**:33-43.

Tindall, H. D. (1988). Vegetables in the Tropics. Macmillan Education Ltd. London. pp. 268.

Uddin. M.S., M. J. Rahman; M. A Mannan; S. A. Begum; A.F.M.F. Rahman and M.R. Uddin. (2002). Plant biodiversity in the homesteads of saline area of southeastern Bangladesh. Pakistan Journal of Biological Sciences **5**(60):710-714.

UNCED, (1992). United Nations Conference on Environment Development of the United Nation, Rio de Jenero, Brazil. June 14 , "Agenda 21".

UNDP, (2011). United Nation Development Programme of the United Nation, Human Development Index, Web address: http://hdrstats.undp.org/en /countries /profiles/BGD.html

Vasey, D.E. (1985). Household gardens and their niche in port Mores by, Papua New Guinea. *J. of Food and Nut. Bull.* 7(3) : 37-43.

Zaman S., Siddiquee. S.U.and Katoh. M. (2010). Structure and diversity of homegarden agroforestry in Thakurgaon District, Bangladesh. *The Open For. Sci. J.* **3**: 38-44.

Appendices

APPENDIX

Appendix-I: English Version of the Interview Schedule

DEPARTMENT OF GENETICS AND PLANT BREEDING

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

DHAKA -1207

An Interview schedule for a Research Study Entitled: **PLANT-BIODIVERSITY AT AJMIRIGANJ HAOR HOMESTEADS OF BANGLADESH**

Household Code No.			

Part A: Owner/Respondents Details

Sl.	Question	Answer	Code
01	Owner of the household or respondent's	Name : Village:	
02	Union	1. Ajmirigonj 2. Kakailcheo 3. Bodolpur 4. Jolshukha 5. Sibpasha	
03	Sex	1. Male 2. Female	
04	Age	Year	
05	Education	1. Illiterate 2. Primary 3. Secondary 4. Collage & above	
06	Occupation	1. Agriculture 2.Busnes 3. Service 4. Labor 5. Others	
07	Population of the Household	Male	
		Female	
		Total	

Information of Household

Sl	Question	Answer	Code
08	Ownership of the Household	1. Single 2. Joint	
09	Age of the Household	Year	

10	Area of the Household	Yard	Pond	House	Livestock	Vegetation	Others		
11	Fruit area of the Household (Decimal)								
12	Livestock in the Homestead	Cow	Buffalo	Goat	Sheep	Duck	Chicken	Others	

Cultivation & Production information

Sl	Question	Answer	Code
13	Rezones of fruit cultivation	1. Only for consolation 2. For Sale 3. For consolation & Sale 4. Others (Specify)	
14	How do you select fruit verity	1. recommendation from agricultural office 2. Own Choice 3. Relative recommendation 4. Hot ever Available	
15	How do you planting materials	1. Recommended Methods 2. Own Systems 3. Relative recommendation 4. Knowing from Radio/TV	
16	Do you do the management fruit trees	1. No 2. Sometimes 3. Yes, In proper way	
17	Do you fertilize the fruit trees?	1. Yes 2. No	
18	Do the fruit trees affected by insects?	1. Yes 2. No	
19	Do the fruit trees infected by dieses?	1. Yes 2. No	
20	Do you apply pesticides?	1. Yes 2. No	
21	Yearly income (in taka) from the fruit tress		
22	Name the fruit trees whose will above to produce fruit throughout their	Sl. No. / Name 1. 2.	

		3.		
		4.		
		5.		
		6.		
		7.		
		8.		
		9.		
		10.		

23. **Fruit trees present at the homesteads**

Sl	Name	Number	Use	Age wise number			
				5 Year	10 Year	15 Year	>15 Year
	Aam						
	Jaam						
	Kathal						
	Kool						
	Narikel						
	Khejur						
	Peara						
	Lichu						
	Lebu						
	Paypay						
	Taal						
	Jamrul						
	Kamranga						
	Jolpai						
	Amloki						
	Anarosh						
	Bel						
	Aata						
	Deua						
	Gub						
	Chalta						
	Dalim						
	Amra						
	Tetul						
	Shupari						

24. **Timber trees present at the homesteads**

Sl	Name	Number	Use	Age wise number			
				5 Year	10 Year	15 Year	>15 Year
	Acacia						
	Akashi						
	Akashmoni						
	Arjun						
	Babla						
	Badhi						
	Bpt						
	Bhalka bash						
	Kadam						
	Champa						
	Chandon						
	Mander						
	Datoi						
	Eucalyptus						
	Gamari						
	Ipil-ipil						
	Jarul						
	Jiga						
	Karancha						
	Koroi						
	Krishnachura						
	Mahogani						
	Mahal bash						
	Minjiri						
	Muli bash						
	Neem						

Sl	Question	Answer	Code
25	Who plan the above trees	1. Grand Father 2. Grand Mother 3. Father 4. Mother 5. Self 6. Wife 7. Brother 8. Sister 9. Son 10. Daughter	

26. Vegetable of the homestead

Summer vegetable			Winter vegetable		
Sl	**Name**	**Production (Kg)**	**Sl**	**Name**	**Production (Kg)**
1	Bagun		1	Badha kopi	
2	Chalkumra		2	Borboi	
3	Chicinga		3	Data	
4	Dundul		4	Derosh	
5	Kakrol		5	Ful kopi	
6	Kalmisak		6	Lalsak	
7	Karala		7	Mitha alu	
8	Kumra		8	Mula	
9	Lau		9	Palongsak	
10	Mankachu		10	Puisak	
11	Mete alu		11	Tomato	
12	Mukhi kachu		12	Seam	

27. Name ten fruits you like	
Sl	Name
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

28. **Which problem have you faced in fruit cultivation?**

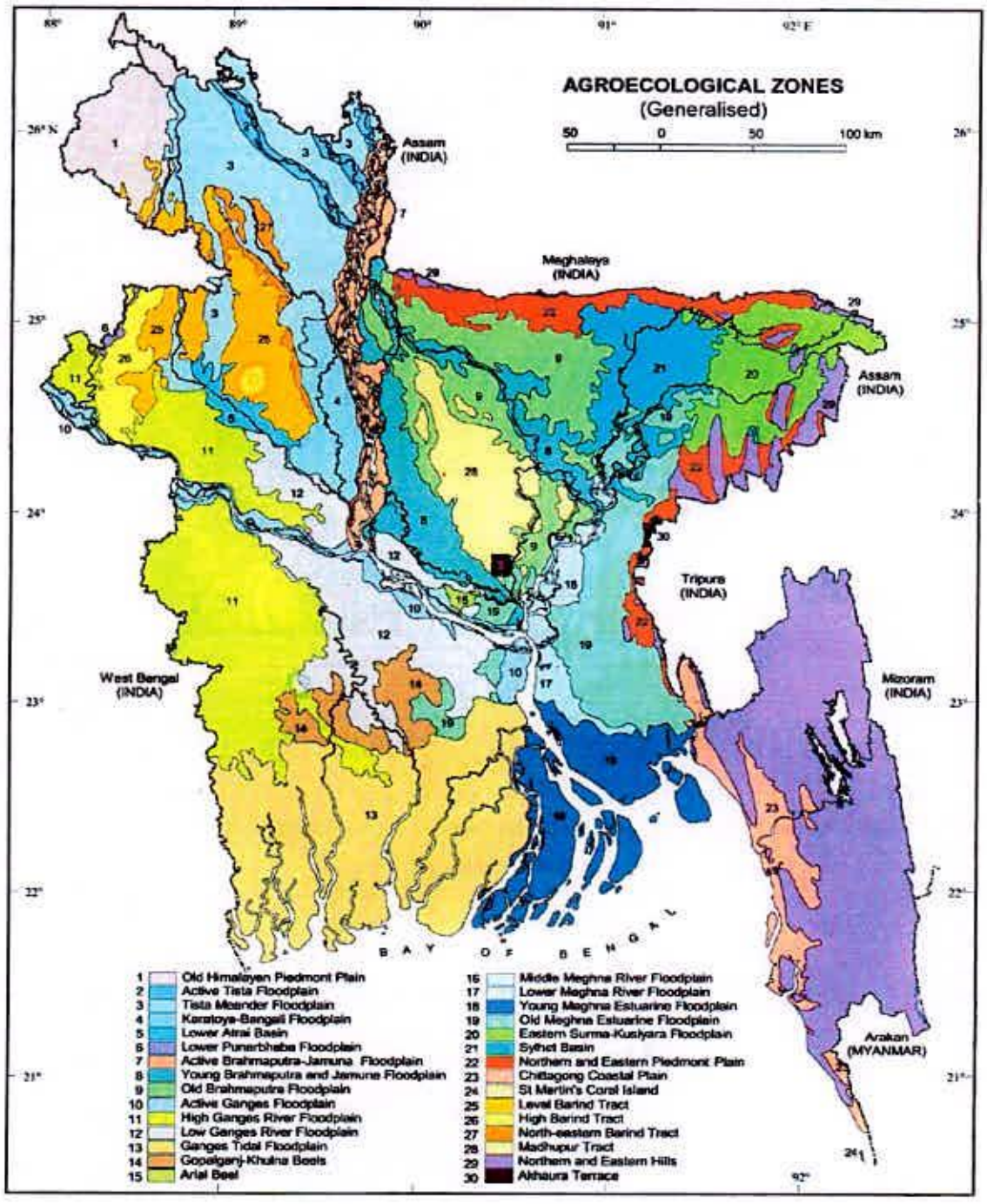
Sl	Problem	Solution
1.		
2.		
3.		
4.		

29. Signature of the responded _____

Thank you for providing information

30.Signature Enumerator _____

Appendix II. Map showing the experimental site



Appendix III. Species richness of fruit in the study area.

English Name	Local Name	Scientific Name	Family
Banana	Kola	*Musa sp*	Musaceae
Betel nut	Supari	*Areca catechu*	Palmaceae
Black berry	Jam	*Syzygium cumini*	Myrtaceae
Burmese grape	Lotkon	*Baccaurea ramiflora*	Phyllanthaceae
Carrabolla	Kamranga	*Averrhoa carambola*	Agerrhoaceae
Coconut	Narikel	*Cocos nucifera*	Palmae
Custard apple	Ata	*Anona squamosa*	Annonaceae
Date	Khejur	*Phoenix sylvestris*	Palmaceae
Elephant apple	Chalta	*Dillenia indica*	Dilleniaceae
Gooseberry	Arboroi	*Phyllanthus acidus*	Euforbiaceae
Guava	Peara	*Psidium guajava*	Myrtaceae
Hog plum	Amra	*Spondias dulcis*	Anacardiaceae
Indian apple	Bel	*Aegle marmelos*	Rutaceae
Indian Goose Berry	Amloki	*Phyllanthus embelica*	Euforbiaceae
Indian jujube	Kul	*Zizyphus mauritiana*	Rhamnaceae
Jackfruit	Khathal	*Artocarpus heterophyllus*	Moraceae
Lemon	Lebu	*Citrus limon*	Rutaceae
Litchi	Lichu	*Litchi chinensis*	Sapindaceae
Mango	Aam	*Mangifera indica*	Anacardiaceae
Olive	Jalpai	*Elaeocarpus floribundus*	Elaeocarpaceae
Orange	Komla	*Citrus chrysocarpa*	Rutaceae
Palmyra palm	Tal	*Borassus flabellifer*	Palmaceae
Papaya	Papaya	*Carica papaya*	Caricaceae
Pomegranate	Dalim	*Punica granutum*	*Punicaceae*
Tamarind	Tetul	*Tamarrinbus indica*	Fadaceae
Velvet apple	Gab	*Piospyros discolor*	Ebenaceae
Wax jumbo	Jamrul	*Syzygium samarangense*	Myrtaceae

Appendix IV. Families with number of species observed in the study area.

Family name	Species number	Family name	Species number
Myrtaceae	3	*Elaeocarpaceae*	1
Palmaceae	3	*Fadaceae*	1
Rutaceae	3	*Moraceae*	1
Anacardiaceae	2	*Musaceae*	1
Euforbiaceae	2	*Palmae*	1
Agerrhoaceae	1	*Phyllanthaceae*	1
Annonaceae	1	*Punicaceae*	1
Caricaceae	1	*Rhamnaceae*	1
Dilleniaceae	1	*Sapindaceae*	1
Ebenaceae	1		