PLANT SPECIES DIVERSITY OF HOMESTEAD MICROSITES OF GAZIPUR DISTRICT OF BANGLADESH

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JULY, 2017

PLANT SPECIES DIVERSITY OF HOMESTEAD MICROSITES OF GAZIPUR DISTRICT OF BANGLADESH

BY

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Reg. No.: 11-04637

A Thesis

Submitted to the Department of Agroforestry and Environmental Science,
Sher-e-Bangla Agricultural University, Dhaka
In partial fulfillment of the requirements
for the degree
of

MASTER OF SCIENCE (MS)

IN

AGROFORESTRY AND ENVIRONMENTAL SCIENCE

SEMESTER: JANUARY - JUNE, 2017

APPROVED BY:

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CERTIFICATE

This is to certify that the thesis entitled "PLANT SPECIES DIVERSITY OF HOMESTEAD MICROSITES OF GAZIPUR DISTRICT OF BANGLADESH" submitted to the Department of Agroforestry and Environmental Science, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in AGROFORESTRY AND ENVIRONMENTAL SCIENCE, embodies the result of a piece of bonafide research work carried out by HAIDER ALI, Registration No. 11-04637 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated: June, 2017

Dhaka, Bangladesh

(Prof. Dr. Md. Forhad Hossain)
Supervisor


Dedicated To
My Beloved Parents

ACKNOWLEDGEMENT

Alhamdulillah, all praises are due to the almighty Allah Rabbul Al-Amin for His gracious kindness and infinite mercy in all the endeavors the author to let her successfully complete the research work and the thesis leading to the degree of Master of Science in Agroforestry and Environmental Science.

The author would like to express her heartfelt gratitude and most sincere appreciations to her Supervisor Professor Dr. Md. Forhad Hossain, Department of Agroforestry and Environmental Science, Sher-e-Bangla Agricultural University, Dhaka, for his valuable guidance, advice, immense help, encouragement and support throughout the study. Likewise grateful appreciation is conveyed to his Co-Supervisor Professor Dr. Ferzana Islam, Department of (Agroforestry and Environmental Science, Sher-e-Bangla Agricultural University, Dhaka, for her constant encouragement, cordial suggestions, constructive criticisms and valuable advice to complete the thesis.

The author would like to express his deepest respect and boundless gratitude to chairman Prof. Dr. Nazmun Naher and all the respected teachers of the Department of Agroforestry and Environmental Science, Sher-e-Bangla Agricultural University, Dhaka, for their valuable teaching, sympathetic co-operation, and inspirations throughout the course of this study and research work.

The author wishes to extend his special thanks to his class mates and friends and roommates for their keen help as well as heartiest co-operation and encouragement during experimentation.

The authoress is deeply indebted and grateful to his parents, brothers, sisters, and sister in law relatives who continuously prayed for her success and without whose love, affection, inspiration and sacrifice this work would not have been completed.

Finally the author appreciates the assistance rendered by the staff members of the Department of Agroforestry and Environmental Science and central farm, Sher-e-Bangla Agricultural University, Dhaka, who have helped her lot during the period of study.

The Author

PLANT SPECIES DIVERSITY OF HOMESTEAD MICROSITES OF GAZIPUR DISTRICT OF BANGLADESH

ABSTRACT

The study was carried out to study the plant species diversity in homestead microsites in two upazillas of gazipur district of Bangladesh during the period from February to July 2016. Two Upazillas were selected identically and one union was selected from each upazilla and two villages were selected randomly from each union. The selected four villages were Ashapur and Benupur (Kaliakoir upazila), Maona and Lakshumpur (Sreepur upazila) for data collection. Homeyard, frontyard, backyard, approach road and boundary were considered as microsites of homestead. A total of 40 homesteads (10 from each village) were interviewed by using a pre-tested questionnaire to collect the necessary information. Respondents were classified into 4 different farm categories i.e, landless, small, medium and large. Data on different microsites of homestead as tree resources, their distribution, management level and constraints across the production units were collected and analyzed. Results revealed that most of the respondents were middle aged (52.50%) having primary education (40%) with agriculture as their occupation (50%). Boundary was identified as the most developed segment of the microsites. In homeyard, papaya was the most prevalent species (3.06). In frontyard and approach road, betelnut (4.26) and coconut (3.20) respectively were the most prevalent species. In backyard and boundary, mango (3.90 and 5.30 respectively) was the most prevalent species. Among the microsites, an average of 15.48, 26.73, 30.95, 12.14 and 33.60 trees per farm was recorded at homeyard, frontyard, backyard, approach road and boundary, respectively. The average tree composition consisting of fruit, timber and medicinal plants were 55.70, 39.51 and 4.78, respectively. The tree diversity index varied among different microsites where the highest value was obtained in the homeyard (2.285) and the lowest was in frontyard (1.886). Equitability was the highest in homeyard (0.78), followed by backyard (0.72), boundary (0.70), approach road (0.66) and frontyard (0.62).

LIST OF CONTENTS

LIST OF CONTENTS (Cont'd)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

%	=	Percentage
AEZ	=	Agro-Ecological Zone
BBS	=	Bangladesh Bureau of Statistics
cm	=	Centimeter
e.g.	=	exempli gratia (L), for example
et al.,	=	And others
etc.	=	Etcetera
FAO	=	Food and Agricultural Organization
GM	=	Geometric mean
i.e.	=	id est (L), that is
M.S.	=	Master of Science
m^2	=	Meter squares
No.	=	Number
^oC	=	Degree Celceous
SAU	=	Sher-e-Bangla Agricultural University
WHO	=	World Health Organization

CHAPTER I

INTRODUCTION

Majority of the rural people in Bangladesh depend on natural resources for their livelihoods. Land, water, forests, and livestock are the sources of livelihoods. The rural economy depends on productivity of the natural resources which is initimately linked with the biodiversity in the ecosystem. Biodiversity means the variability among living organisms from all sources and the ecological system of which they are a part which also includes diversity within the species, between species and ecosystem. Bangladesh is a rich repository of plant genetic pools and has been the abode of 5,000 species of higher plants. Bangladesh consists of 87363 thousand villages (BSS, 2007) with each village encompassing a few hundreds of homesteads. They constitute the centre of socioeconomic activities and traditional cultural heritage of village (Khan, 1977).

Among the plant resources, many species are treated as "Life support species". This diversity of species in the homesteads plays a very important role for the livelihoods of millions living in the rural area of Bangladesh. The homestead in Bangladesh is one of the most important natural resources containing a huge number of diversified plant species and it is perhaps the most important production unit of Bangladesh. These homesteads accounted for 21.90 million in the rural areas and occupied about 0.54 million hectares of land (BBS, 2001) and this land is decreasing at the rate of $5m^2$ /ha/year (Anam, 1999). The size (average) of the rural homestead is very small (0.02 ha) but varies widely according to ecological region and socio economic status of the farmers. A good number of vegetables are grown in the homesteads. A large number of higher plants have also been recorded in homesteads in rural areas.

Homestead agroforestry could provide one of the best options to conserve the

diverse range of biodiversity. Homestead agroforestry is an age-old practice and an integral part of traditional farming system. It is a complex agroforestry system where different plant species, including crops/vegetables are grown in association with trees in mixture with or without livestock or fish. Homestead agroforestry practice, being a multi-strata production system where diverse plant species arc grown in intimate association with or without animals could be a potential option for conservation of biodiversity.

Homestead Agroforestry microsites play a vital role in the economy of Bangladesh. Trees and other woody species grown in the homesteads are a significant source of food fodder, fuel wood and timber. Most of the vegetable produced consumed in the country are coming from the homesteads.

Homestead microsites also included livestock, poultry and fisheries activities. There are about 25.49 million of homesteads in our country covers about 0.80 million ha of lands (BBS, 2010). Trees in the homesteads, often called, "homestead forests", cattle and goats, ponds, vegetables etc. as microsites of homestead play an important role in rural economy as well as national economy of Bangladesh. Homestead is the most plant diversified ecosystem in Bangladesh. Plant diversity plays an important role for maintaining ecological balance as well as environmental stabilization. So diversity in plant species is desirable for sound environment. Homegarden, the most stable resource, plays an important role in Bangladesh economy and provides nearly 50 percent cash flow to the rural poor (Ahmed *et al.*, 1999). Collectively, home garden production system contributes about 70 percent fruit, 40 percent vegetable, 70 percent timber and 90 percent firewood and bamboo requirement of Bangladesh (Miah and Ahmed, 2003). A typical homestead consists of different sites. Hussain and Mian (2004) have categorized it into five micro-sites. These are approach road - a passage or gateway leading to the homestead; front yard - the place connected to the approach road or the outer part of the homestead connected with the approach road; home

yard - the open place in front of the living room; backyard - the sites behind the household or interior place of the homestead; boundary - the borderlines or demarcation lines of a homestead. In fact, micro-sites represent the smallest production units having similar configuration of land and serves specific purposes.

2. Objectives

Considering the above facts present study was undertaken to satisfy the following objectives-

(i) To observe the socio-economic characteristics of the farmers in the study area;

(ii) To examine the distribution of plant species and other components of different microsites of homestead; and

(iii) To investigate the relative prevalence and plant diversity in different microsites of homestead.

CHAPTER II

REVIEW OF LITERATURE

Homestead microsites are considered an important factor for our livelihood program. Microsite of the homestead has immense importance in the livelihood activities of the households. Several researches were worked on this aspects but it is not enough for any recommendation. Some findings on this aspects are reviewed here under the following headings:

2.1 Importance of homestead

Doglas and Hart (1973) stated that trees are integrating part of homegarden as well as nature. Trees provide direct and also indirect benefits to human being and to nature. It has the great potential for feeding men and animals, for regenerating the soil for restoring water system, for controlling floods and droughts, for crating more benevolent micro elements and more comfortable and stimulating living for humidity.

Akter *et al.* (1989) mentioned what farmer also 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 tree would contribute toward expenses for marriage of their daughter.

Ahmed (1999) 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.

2.2 Homestead agroforestry

Homestead is one of the most elaborate systems of indigenous agroforestry, found most often in tropical and subtropical areas where subsistence land use system predominate.

Fernandos and Nair (1990) stated that the term home garden could be anything for growing vegetables behind houses to complex the multistoried systems. They defined the term as land use practices involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual house, the whole crop-tree animal unit being intensively managed by family labour.

Various authors used different terms to denote this practice and these include for example mixed garden horienlture (Terra, 1954), home garden (Rainasay and wilresum, 1976), kitchen garden (Brierly, 1976), household garden (vasey 1985) and homestead agroforestry (Leusheher and khaleque, 1987). Camacho (1987) stated homestead as lands, ponds, houses, plants and animals, which are in continuous interaction with the farmer and his family for full filling some of his daily household needs.

However all these definitions demonstrate that homestead is a dwelling place as well as a production unit of horticultural cops, agroforestry, livestock and fisheries under integrated farming system in which continuous interactions take place among man, livestock, trees, soil, water other biotic and abiotic factors.

2.3 Different microsites of homestead

Recent studies and analyses have shown that the homestead production is based on different micro-sites. In fact, micro-sites represent the smallest production units having similar configuration of land and serves specific purposes. The strong argument in favour of this subdivision is that the homestead is not a homogenous system and what is suitable for approach road may not be suitable for backyard, and similarly, what uses are feasible along the boundary may not be feasible at the home-yard. This makes new thinking and orientation for the researchers, academicians and development workers. Hussain and Mian (2004) divide the homestead into several production units/microsites -

Boundary: It is a border line of a homestead that makes it homesteads as an independent. Boundary planting within the homesteads is the most developed segment of the homestead plantation, though a great variation occurs depending on boundary to boundary. Generally tall trees were found in the homestead like mango, coconut, betelnut mahagony were planted in the boundary.

Home yard: The home yard of an active farming household remains mostly free, since the place is used for agriculture processing work, whereas the homeyard of the households not involved in the agricultural activities use the homeyard for planting trees of their choices. A variety of species and sometimes combination of species are also found within the homeyard. Generally Guava, mango, Jackfruit, betel nut, coconut, Dalim, Kamranga etc are planted in homeyard.

Front yard: The front yard place remains mostly vacant, since the place is used

as entrance, possible gathering, for agricultural work etc. Only a few scattered trees could be found at some places. Sometimes, seedlings are raised in the front yard covering most of the area. Generally mango, Jackfruit, Jujube, palm species are found in the front yard.

Back yard: At the backyard, within the boundary of the homesteads, Coconut, Betel nut, Mango, jackfruit and some timber species including naturally grown species are found. At the backyard of the household a small vegetable production area, in the proximity of the kitchen of the household can be found.

Pond site: Along the pond sides, sometimes row of trees are planted. These rows of trees are planted along the margin of the pond. Generally mango, litchi, Jackfruit, betel nut, Sajna, Sonalu, are found in the pond site.

Approach road: It is a gateway of homestead. Some have the individual approach road and some have the common approach road. It is used to enter the family members or transportation.

2.4 Plant biodiversity

Plant biodiversity refers to the variability among the plant kingdom and the ecosystem complex. In a broad 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.*, 1988).

In recent years, much attention has been given to biodiversity and its conservation and utilisation (Mannan 2002). 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).

2.5 Species diversity

Species diversity is the basic unit of biodiversity. It is made up of populations. The species may be defined as a group of similar organisms that interbreed or shares a common lineage of descent. Species diversity is the variety of living organisms on earth. It is measured by the total number of species within a given area under study. Species diversity can be expressed by species diversity index. Species diversity index includes both richness and relative abundance of the species in a single statistics. The most commonly used are Shannon-Wiever index (H) of diversity (1949), and Simpsons 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). There are two types of species diversity (I) Intra and (11) Inter. No information was available about intra species diversity of plant at homestead level. So, information that one available

regarding inter species diversity of plant at the homestead level are reviewed here. Christiny (1985) found a diversity index of 2.79 for Javanese homestead and 3.71 for Sudanese homestead in Shanon-Wiever diversity index.

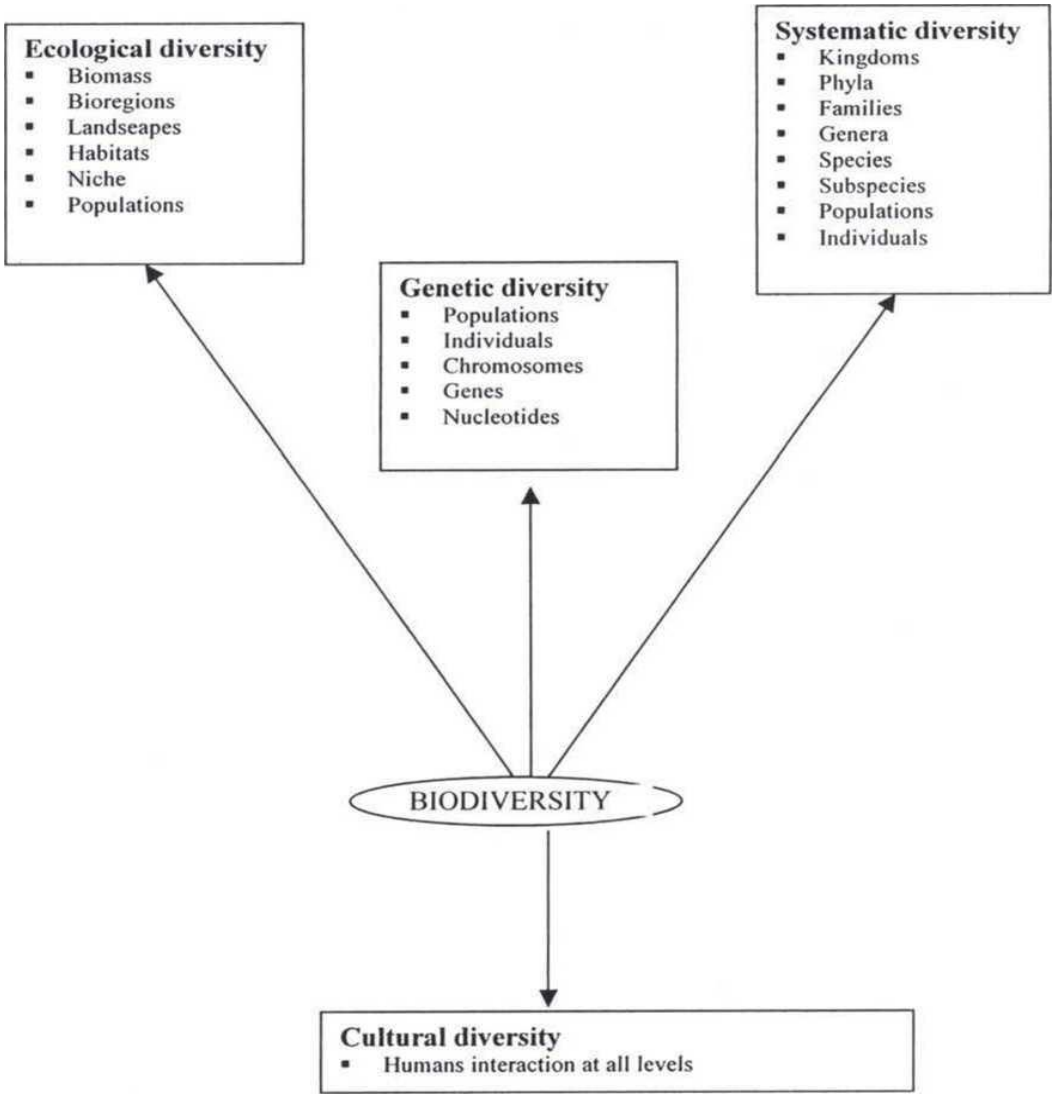

Figure 2.1. The composition and level of biodiversity.

Source: Hevwood and Watson, 1995

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 decreased with increasing size of homesteads. Mean Simpson's diversity index (D) for the homesteads ranged from 0.251-0.739 which was 1.129 to 3.016 in Shannon-Wiever diversity scale (H) suggesting that floristic diversity was low to moderate.

Kumar (1994) in a study calculated Simpson's diversity index (D) from 0.459 to 0.606 in large to small homestead of India which was 1.643 to 2.298 in Shannon-Wiever diversity scale (II).

Millat-e-Mustafa (1997) surveyed 80 homesteads of four regions namely Deltaic, Plain, Hilly and Dryland and species diversity indices were calculated using Shannon- Wievcr diversity scale (I I) which were 3.33, 2.83, 2.38 and 1.72, respectively.

Bashar (1999) stated Shannon-Wievcr index of species diversity (II) of 2.633, 2.696, 3.212, and 3.245, for ornamental, medicinal, timber and fruit species, respectively in a study of Gazipur District. Basak (2002) from a study of 15 districts of four physiographic regions across Bangladesh found that the large farm category, the highest diversity index (Simpson's diversity index D=2.I6 and land less farm category the lowest (D=1.63). On the basis of different zones, diversity was the highest (D=3.16) in Cox's Bazar district and the lowest (D= 1.91) in Mymensingh.

2.6 Species richness

Species richness in not an adequate measure of the biodiversity of organisms. It measures the number of species within an area, giving equal weight to each species (Heywood and Watson, 1995). 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. Bashar (1999) observed wide variety of plant species in the homesteads of Sadar and Kapasia Thana of Gazipur district and found more than 136 useful species among which 44 species were recorded as fruit/food species either perennial or annual, 28 timber species. 15 medicinal 31 vegetable species and 18 ornamental species.

2.7 Species consumption

Species diversity and plant diversity vary from place to place, influenced by ecological and social economic factors. A total of 100 species were found in homestead garden in Kacr province in northeast Thailand (Kamtuo *et al.* 1985). Everett (1993) identified 143 species of woody perennials in a study of 173 gardens in eight villages at Kandy in Srilanka.

Millat-e-Mustafa (1997) conducted a vegetation survey in four physiographic regions of Bangladesh: dry land, hilly and plain regions. He recorded in total of 92 perennial species from home garden of Bangladesh. The highest numbers of species were recorded in deltric region (67) followed by plain (56) and hilly region (54) and the lowest in the dry land region (46).

2.8 Equability

Equability means equality or evenness in which individuals are distributed among the species. These, for a given richness (S), diversity (D) increase with equitably (E) and for a given equability diversity increases with richness. It is possible for a species "rich" but not highly equitable. Basak (2002) found that the large farm category had the highest equability (E=0.43) and landless farm category had the lowest equability (E=0.33). On the basis of different zones, equability of tree type were the highest (E=0.63) in Cox's Bazar district and the lowest (E=0.32) in Mymensingh.

2.9 Relative prevalence

To indicate the abundance and species richness of a tree species, it is important to measure the relative prevalence (RP). There are variations in species of trees grown in different parts of the country (Chowdhury and Salter, 1992; Abedin and Quddus, 1990; and Momin *et al*., 1990).

Chowdhury and Satter (1992) determined the relative prevalence of tree species in the Ganges Floodplain bioecological zone. In that studies they found that the most prevalent species in homestead was Date palm and plamyra palm followed by battle nut, coconut, Jack fruit, banana, mango, mchagony, bamboo and guava. The most common species in the crop fields were date palm, sissoo, palmyra palm, babla, coconut and battle nut.

The findings of the above literature revealed that every segment of the homestead microsite of the homestead has immense importance in the livelihood activities of the homestead in order to ensure optimum use of all available resources of the

homestead. Bangladesh has been classified into 12 broad bioecological zones with a view to make bio-diversity strategy and action of Bangladesh. Among them, Ganges Floodplain is one of the important bio-ecological zone which covers many areas of Bangladesh and rich in vegetation particularly homestead vegetation. But no systematic work has been done on microsite level homestead biodiversity in Ganges Floodplain bio-ecological zone of Bangladesh. With this view the present study was undertaken.

CHAPTER III

MATERIALS AND METHODS

According to plant biodiversity concept the entire farm and homestead is the integral unit for production and consumption. Usually, all components like tree and fruits, pond, cattle and goats, poultry, vegetables etc. are the form the homestead agroforestry system.

The present study is based on primary data, which was collected by using survey method. This method completely relies on the memory of the respondent farmers, because they do not keep any records of their day to day farming activities. Appropriate methodology enables the researcher to collect valid and reliable information to analyze the information properly in order to arrive of correct conclusion.

The researcher collected other related information from different literatures such as journals, thesis, reports and newspapers. The information were collected and compiled for better and clear understanding of the present study.

3.1 Selection of the study area

The selection of the study area is one of the most important parts of any socio-economic research. The selection of the study area was mainly guided by the objectives of the study and the possible co-operation needed from the desired respondent. The study was carried out in Gazipur district. Two opazillas were selected identically and one union was selected from each upazilla and two villages were selected randomly from each union.

Data were collected from 4 villages namely-Ashapur, Benupur, Maona and Lakshumpur. Ashapur and Benupur villages are under Kaliakoir upazila and Maona and Lakshumpur villages are under Sreepur upazila.

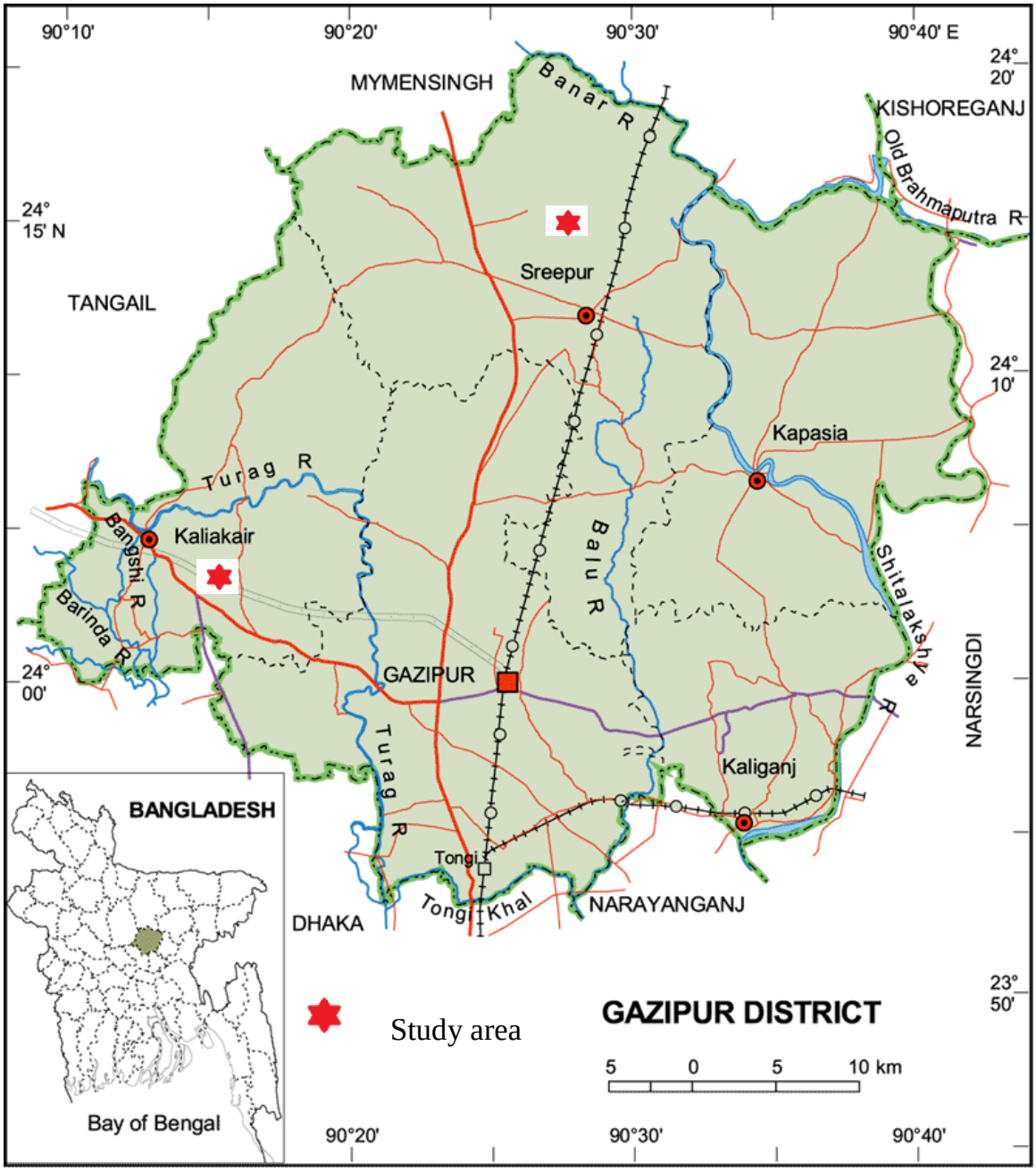

Fig. 1. Map of Gazipur district showing study area

3.2 Data collection procedure

Structured questionnaire was used to collect desired information. The questionnaire was pretested with 10 households to make necessary modification before beginning the final survey in 40 households. All homesteads were visited by the researcher himself to collect necessary information.

The respondents farmers were categorized based on the farm size as follows:

Farm category	Farm size (Decimal)
Land less	<25
Small	25-100
Medium	100-175
Large	> 175

From each category, 10 homesteads were selected for data collection.

3.3 Formal survey

Data were collected from the selected villages of Gazipur district and desired information were recorded through interviews with household members. In most cases, the head of the households was male. Wife of the farmer was also present and contributed during interview. In addition to the formal survey, some information especially numbers of tree, spatial or temporal arrangement, height of the trees, girth of the trees, clean bole height, homestead land use pattern and species diversity etc. were measured by physically and visual observation.

3.4 Informal survey

Group discussions were held with the different ages of farmers including female to verify the information regarding the study and to collect other necessary information. Some information was also collected in consultation with DAE personnel, forest department and district administration, school teachers and others. Problems related with homestead productivity, tree plantation programme,

future suggestions, recommendations etc. were discussed with these groups. Data were collected from February to July 2016.

3.5 Variables of the study

3.5.1 Dependent variable: Plant biodiversity in homestead microsites is the only dependent variable.

3.5.2 Independent variable: Age, educational qualification, farm size, age of homestead, occupation, homestead land ownership, existing agroforestry system etc. are considered as the independent variables of the study.

3.5.2.1 Age

The age of a respondent is one of the important factors pertaining to his personal characteristic which can play an important role in his adoption behavior. The age of respondent was measured by counting the actual years from his birth to the time of taking interview. It was measured in terms of actual years. No fraction of year was considered. A score of one (1) was assigned for each years of age.

3.5.2.2 Education

Education was the most important factor to understand the modern homestead practice. It measured by the number of classes passed by a respondent. Zero (0) for no schooling, one (1) score was assigned for each year of schooling. For example, if a respondent passed class VIII his education score was 8.

3.5.2.3 Occupation

Occupation of a farmer was measured by the number of respondents involved with income generation by which different category as service, business etc. number of respondents was counted according to their occupation.

3.5.2.4 Farm size

Farm size was calculated as the size of his farm (including homestead crops and other crop production) on which he continued his farming operations during the period of study. It included the area of farm owned by him in homestead.

3.6 Species diversity index

To measure the abundance and diversity of different plant species among the different farm categories and at different microsites, species diversity index were calculated by using Simpson's diversity index (D).

$$D = \frac{1}{\sum_{i=1}^{s} Pi^2}$$

Where, Pi is the proportion of total individuals in the i^{th} spices.

$Pi = n/N$

n is the number of individuals in the i^{th} species,

N is the total number of the individuals of all species in the community,

s= Species richness.

3.7 Relative prevalence of species

To indicate the importance and species richness of different plant species in homesteads, a relative prevalence (RP) of species was calculated by using following formula.

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

Relative prevalence of all types of trees was calculated by using the above formula.

3.8 Equitability

Equitability means equality or evenness. Diversity index depends on species richness and equitability. Equitability can itself be quantified by expressing Sompson's diversity index, D, as a proportion of maximum possible value D would assume if individuals were completely evenly distributed among the species.

In fact, Maximum possible value, D max = S

$$\text{Thus Equitability, } E = \frac{D}{D_{max}} = \frac{D}{S}$$

Equitability assumes a value between 0 and 1.

3.9 Secondary data

Secondary data were collected from different sources according to the requirement of the present study. Secondary information were collected from Bangladesh Bureau of Statistics (BBS), District and Upazilla Agricultural Extension Office, Department of Agroforestry and Environment, SAU, previous research, survey report, and Department of Agricultural Extension Directorate.

3.10 Data analysis

Collected data were compiled, coded, tabulated for processed and analyzed in accordance with the objectives of the study. The SPSS 15.0 computer software was used to analyze the data. Descriptive statistics like range, number and

percentage and as well as average were calculated in explaining the descriptive data.

3.11 Limitation of the study

This type of study needs more than one year and number of researcher should also be more. The constraints are:

1. Supportive information was difficult to obtain due to limited work in this field.
2. The study was conducted only Gazipur district, which is not sufficient for a confirmed recommendation.
3. In accomplishing the objectives, the researcher had to depend on the information supplied by the respondent.
4. Population of the study was confined within the heads of the farm families.

3.12 Assumption of the study

The following assumptions were in mind of the researcher at the time of study.

1. To select respondents and to furnish proper response, competent questions were included in the questionnaire.
2. The data collected from respondent was the representative ones of whole population of the study area.
3. Information supplied by the respondent was the representative ones of whole population of the study area.
4. The selected areas were considered as a typical one representing the other area.
5. The findings of the study were expected to be useful for ideal and sustainable homestead agroforestry program.

CHAPTER IV

RESULTS AND DISCUSSIN

The findings of the present study have been presented and discussed in the following sections. The presentation follows a logical sequence based on the objectives of the study.

4.1 Demography

There are many interrelated attributes that effect the decision making belaviour of an individual. In this section, some of these attributes of the respondents have been discussed.

4.1.1 Age

The respondents were classified into three age groups on the basis of their age, such as young (up to 35 years), middle (35-50 years) and old age (above 50 years). Under the present study, the age of the respondents ranged from 26 to 64 years. It was indicated that 52.50% of the respondents were in the middle aged group whereas old and young aged respondents belongs to 35% and 12.50%, respectively (Table 1), which indicated that the maximum respondents were middle aged farmer.

Table 1. Distribution of the respondents according to age group

Age group	Age level (Years)	Number of respondents	Percent
Young	Up to 35	5	12.50
Middle	35-50	21	52.50
Old	Above 50	14	35.00
Total		40	100

4.1.2 Education

There is no doubt about importance of education to make decision which helps the farmers better entrance to the relatively technical information. So, the adoption of modern technology depends on education levels of the farmers. Under the present study, the respondents were categorized into four education levels. These were illiterate (no schooling), primary level (Class I-V), secondary level (Class VI-X) and above secondary level (college and university) (Fig. 2). It was found from the study that the maximum respondents were under primary education (40%) whereas 27.50% respondents had no formal education while, 25 and 7.50% farmers had secondary and above secondary level of education, respectively. Results indicated that a major portion of the respondent farmers (40.00%) had primary level education among the entire respondents.

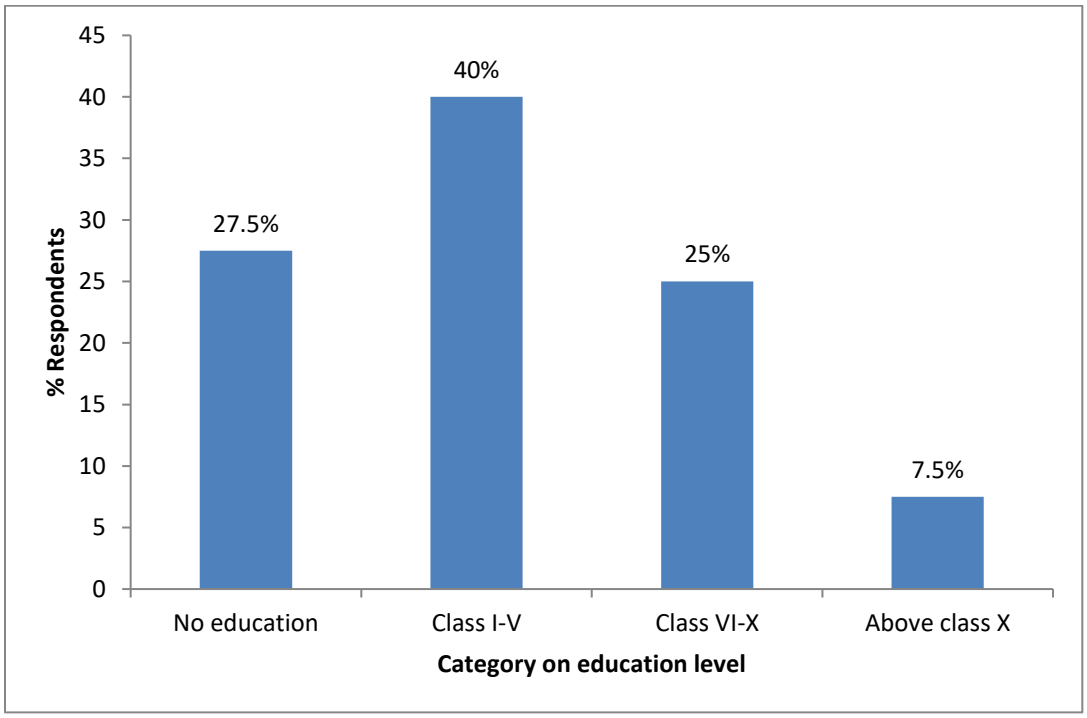

Fig. 2. Distribution of the respondents according to education status

4.1.3 Occupation

Based on the occupation of the respondents, it was found that 45 percent of the respondents relay on agriculture for their livelihood, while 30.00 and 17.50% respondents had main occupation of service and business, respectively (Table 2). On the other hand, only 7.50% respondents were involved other than agriculture or business or service. Results indicated that most of respondents (45%) had agriculture as their main occupation whereas minimum respondents were involved in other occupations (7.5%).

Table 2. Distribution of the respondents according to their occupation

Category	Number of respondents	Percent
Agriculture	18	45.00
Business	7	17.50
Service	12	30.00
Others	3	7.50
Total	40	100

4.1.4 Farm size

Household average land holding is presented in Fig. 3. Among the farm categories, it was found that total homestead land holdings of the respondents increased manifold as the farm size increase. The finding showed that the homestead land holdings of the landless group was 40 percent, while it decreased to 27.50% and 22.50% regarding small and medium size category respondents according to homestead land size owner. Only 10% of the respondents owned large category according to land size owner. Therefore, it can be stated that most of the respondents was under landless category where the lowest percent respondents was under large homestead category.

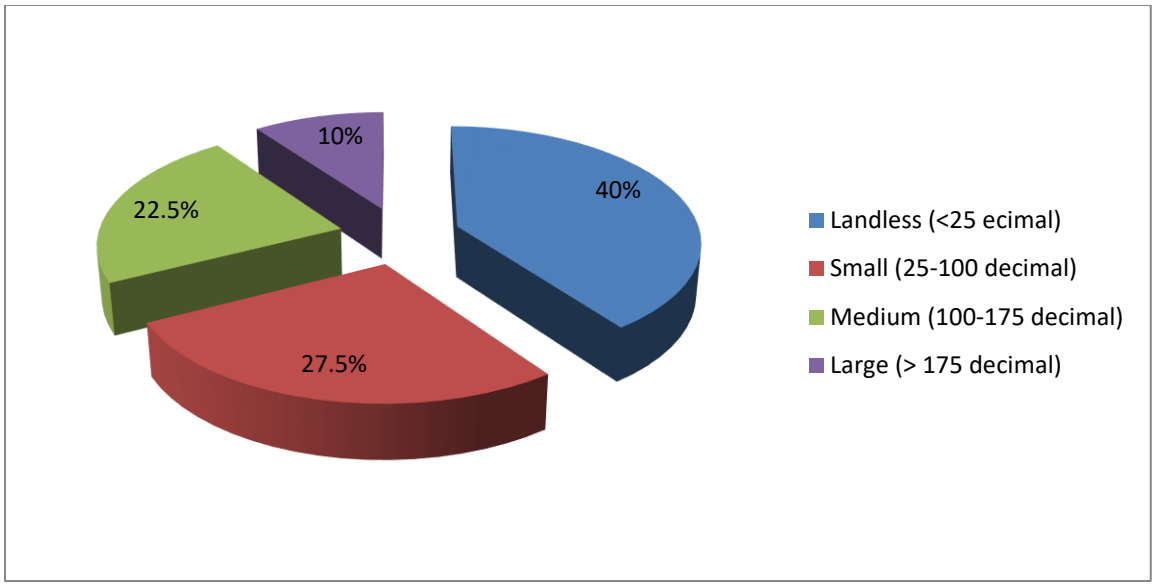

Fig. 3. Distribution of the respondents according to their land size

4.1.5 Characteristics of homestead

In the study area, it was shown that 55.00 percent households was above 10 years old where 27.50 percent homestead household was less than 5 years old which was lowest. Only 27.50 percent homestead belongs to 5-10 years aged (Table 3).

In terms of land type, 82.50 percent homesteads were in medium high land and 17.50 percent were in high land. On the other hand, 70.00 percent homesteads were developed on loam soil, while 30.00 percent were on sandy loam soil (Table 3).

Table 3. Characteristics of the homestead according to age of homestead, land type and soil type

Characteristics of the Homestead		Number of respondents	Percent
Age of homestead	< 5 years	7	17.50
	5-10 years	11	27.50
	Above 10 years	22	55.00
Land type	Medium high	33	82.50
	High	7	17.50
Soil type	Loam	28	70.00
	Sandy loam	12	30.00

4.1.6 Existing agroforestry system

Existing agroforestry system was categorized based on tree (T), crop (C), fish (F) and livestock (L) (Table 4). Among the existing agroforestry system, it was found that the highest portion of the respondents (37.50%) were habituated under T+C+L agroforestry system where 32.50 percent were under T+C+F+L. The lowest portion of the respondents (10%) were under the agroforestry system of T+C followed by the respondents under T+C+F (12.50%). Similar observation was also found by Camacho (1987). He stated homestead as lands, ponds, houses, plants and animals, which are in continuous interaction with the farmer and his family for full filling some of his daily household needs.

Table 4. Agroforestry system of the homestead according to homestead components

Homestead component	Distribution of the respondents	
	Number	Percent
T+C+F+L	13	32.50
T+C+F	5	12.50
T+C+L	15	37.50
T+C	4	10.00
Others	3	7.50
Total	40	100.00

T = Tree, C = Crop, F = Fish, L = Livestock

4.2 Homestead's microsites

4.2.1 Area of homestead with different microsites

According to Hussain and Mian (2004) homestead is divide into several production units/microsites such as homeyard, frontyard, backyard, approach road, boundary etc. under the present study, homestead microsites of selected areas were also considered as different units like homeyard, frontyard, backyard, approach road, boundary. The area of different microsites of homestead varied within same farm category and among the different farm categories as well. Among the farm categories, large and landless farmers had the maximum and the minimum land area of the entire microsites.

But the variation was not so distinct among small, medium and large farm categories. Landless farmer had remarkably smaller land area at all the microsites compared to the other farm categories (Table 5).

In case of homeyard, the average 6.80 decimal area belonged by the large farmer, which was followed by 6.40 decimal by medium, 6.10 decimal by small and only 1.82 decimal by landless farmers.

The average area of frontyard for the large farm category was 6.59 decimal, while the land holding for this microsites of medium, small and landless categories were 7.88, 7.36 and 2.72 decimal, respectively.

In the backyard, large farmers had maximum area (10.3 decimal), which was followed by medium (9.52 decimal), small (8.44 decimal) and landless (3.2 decimal) farmers, respectively.

Similarly, the large farmers had maximum area of approach road (2.10 decimal), while it was 1.74, 1.52 and 0.66 decimal for medium, small and landless farm categories, respectively (Table 5).

On the other hand, the average area of boundary side for the large farm category

was 34.60 decimal, while the land holding for medium, small and landless farm categories were 22.50, 14.74 and 3.60 decimal, respectively.

Among the different microsites, the highest average land area was found in the boundary site (18.86 decimal) followed by backyard (7.865 decimal), frontyard (6.59 decimal), homeyard (5.28 decimal) and approach road (1.505 decimal), respectively.

Table 5. Distribution of the homestead area according to different microsites

Farm category	Area occupying by different microsites (decimal)				
	Homeyard	Frontyard	Backyard	Approach road	Boundary
Landless	1.82	2.72	3.2	0.66	3.60
Small	6.10	7.36	8.44	1.52	14.74
Medium	6.40	7.88	9.52	1.74	22.50
Large	6.80	8.40	10.3	2.10	34.60
Average	5.28	6.59	7.865	1.505	18.86

4.2.2 Utilization of microsites

Recent studies and analyses (Hussain and Miah, 2004) have shown that the homestead production is based on the different microsites. In fact, microsite represents the smallest production unit having similar configuration of land and serves specific purposes. The strong argument in favor of this subdivision is that the homestead is not a homogenous system and what is suitable for approach road may not be suitable for backyard, and similarly, what uses are feasible along the boundary may not be feasible at the home-yard. This makes new thinking and orientation for the researchers, academicians and development workers to divide the homestead into several production units/microsites i.e., homeyard, frontyard, backyard, approach road and boundary. According to Hussain and Mian (2004) homestead microsites can be used with different plant or animal diversity which fulfill human needs at different ways.

4.2.3 Utilization of homeyard

In homeyard, an average of 15.48 trees were identified of which maximum i.e. 56.70% was fruit trees, while 34.89 and 8.40% were timber and medicinal species, respectively (Table 6). In this microsites, total number of trees per homestead increased as the farm size increase where 21.10, 18.50, 13.00 and 9.30 trees were found in large, medium, small and landless farm categories, respectively.

Table 6. Distribution of fruit, timber and medicinal plant species of homestead at homeyard according to farm categories

Types of plant	Number of fruit, timber and medicinal plant species per homestead at homeyard under different farm categories					
	Landless	Small	Medium	Large	Average	Percent
Fruit	5.20	7.50	10.60	11.80	8.78	56.70
Timber	3.60	4.30	6.40	7.30	5.40	34.89
Medicinal	0.50	1.20	1.50	2.00	1.30	8.40
Total	9.30	13.00	18.50	21.10	15.48	100

4.2.4 Utilization of frontyard

The study revealed that there was an average of 26.73 trees per farm in the frontyard of which 65.00, 29.84 and 5.14 percent were fruit, timber and medicinal plants respectively. Similar to the other microsites, total number of trees per farm increased with the increase of farm size, and maximum tree per farm (36.40) was recorded in large farmer which was followed by medium (28.90) small (22.60) and landless (19.00), respectively (Table 7).

Table 7. Distribution of fruit, timber and medicinal plant species of homestead at frontyard according to farm categories

Types of plant	Number of fruit, timber and medicinal plant species per homestead at frontyard under different farm categories					
	Landless	Small	Medium	Large	Average	Percent
Fruit	11.20	14.30	19.60	24.40	17.38	65.00
Timber	6.80	7.10	7.80	10.20	7.98	29.84
Medicinal	1.00	1.20	1.50	1.80	1.38	5.14
Total	19.00	22.60	28.90	36.40	26.73	100

4.2.5 Utilization of backyard

In backyard, an average of 30.95 trees per farm were found, among them, maximum (17.93) were timber trees which occupied 57.92 percent of the total trees of the backyard followed by fruit trees (11.43) and medicinal plants (1.60), respectively. Among the different farm categories, number of trees per farm increased with the increase of farm size and the maximum trees per farm (41.30) was observed in the large farm category and the minimum number of trees per farm (22.00) was observed in landless farm category (Table 8). Small and medium farmers had 26.10 and 34.40 trees per farm, respectively. Among the categories of tree species, number of timber trees were remarkably higher than fruit and medicinal plants in backyard because farmers usually keep more timber trees in the backyard to protect their homestead against strong wind as timber trees are more tolerant against storm. Moreover, the thief is more active in the backyard to take away of the fruits.

Table 8. Distribution of fruit, timber and medicinal plant species of homestead at backyard according to farm categories

Types of plant	Number of fruit, timber and medicinal plant species per homestead at backyard under different farm categories					
	Landless	Small	Medium	Large	Average	Percent
Fruit	6.80	8.20	14.40	16.30	11.43	36.91
Timber	14.60	16.50	18.00	22.60	17.93	57.92
Medicinal	0.60	1.40	2.00	2.40	1.60	5.17
Total	22.00	26.10	34.40	41.30	30.95	100

4.2.6 Utilization of approach road

In the approach road, an average of 12.14 trees were identified of which 63.03 percent were fruit tree, 33.98 percent timber tree and only 2.99 percent medicinal plant, respectively (Table 9). Among the different land holding farmers, number of trees in this site was minimum in landless farmer (2.30), while small, medium and

large farmers had 11.75, 15.90 and 18.60 trees per farm, respectively. Lower number of tree species in resource poor farmers was due to limited space in the homestead.

Table 9. Distribution of fruit, timber and medicinal plant species of homestead at approach road according to farm categories

Types of plant	Number of fruit, timber and medicinal plant species per homestead at approach road under different farm categories					
	Landless	Small	Medium	Large	Average	Percent
Fruit	2.00	8.00	9.40	11.20	7.65	63.03
Timber	0.20	3.50	6.00	6.80	4.13	33.98
Medicinal	0.10	0.25	0.50	0.60	0.36	2.99
Total	2.30	11.75	15.90	18.60	12.14	100

4.2.7 Utilization of Boundary

An average of 33.60 trees consisting of different species were identified in the boundaries of homestead of which 62.50, 34.38 and 3.13 percent were fruit, timber and medicinal plants, respectively. Among the different farm categories, number of trees (fruit, timber and medicinal) per farm increased with the increase of farm size, where the maximum number of trees per farm (48.00) was recorded in large farm, while in the medium, small and landless farms the numbers were 40.10, 24.00 and 22.30, respectively (Table 10). Among the different categories of tree species, fruit tree was dominated one followed by timber and medicinal plants irrespective of farm sizes.

Table 10. Distribution of fruit, timber and medicinal plant species of homestead at boundary according to farm categories

Types of plant	Number of fruit, timber and medicinal plant species per homestead at boundary under different farm categories					
	Landless	Small	Medium	Large	Average	Percent
Fruit	13.60	14.00	26.40	30.00	21.00	62.50
Timber	8.20	9.00	12.50	16.50	11.55	34.38
Medicinal	0.50	1.00	1.20	1.50	1.05	3.13
Total	22.30	24.00	40.10	48.00	33.60	100

4.2.8 Total number of trees per homestead

Total number of trees including medicinal plants per homestead varied according to the size of the homestead and the maximum number of trees per homestead was recorded in the large farm group (165.40) followed by medium (137.80), small (97.45) and landless (74.90) farm groups, respectively (Table 11). However, the average number of trees considering all the farm categories per homestead was 118.89. Among the different plant categories, fruit tree was found to dominate over timber and medicinal plants, while, the number of medicinal plants per homestead was the least. The average number of fruit, timber and medicinal plant per homestead was 66.23, 46.98 and 5.69, respectively (Table 11).

Table 11. Distribution of total fruit, timber and medicinal plant species of all homestead microsites according to farm categories

Types of plant	Total number of fruit, timber and medicinal plant species per homestead under different farm categories					
	Landless	Small	Medium	Large	Average	Percent
Fruit	38.80	52.00	80.40	93.70	66.23	55.70
Timber	33.40	40.40	50.70	63.40	46.98	39.51
Medicinal	2.70	5.05	6.70	8.30	5.69	4.78
Total	74.90	97.45	137.80	165.40	118.89	100

4.3 Relative prevalence (RP) of tree species across the microsites

In the homeyard, a total of 9 different fruit species were identified, among them, papaya was the most prevalent species (3.06) followed by coconut (2.76), guava (2.20) and dalim (2.15). Mango, jackfruit, amra, jujube and betelnut were the other prevalent species (Table 12). In case of timber species, the most prevalent timber species was mahagony (1.26) followed by ipleiple (1.73) and kadam (0.63). Koroi and sisso were the other prevalent species. Among the medicinal plants grown in the homeyard, neem was the most prevalent (0.92) followed by arjun (0.74) and tulsi (0.72).

In the frontyard, a total of 12 different fruit species were identified, and among them, betelnut was the most prevalent species having relative prevalence of 4.26 and followed by coconut (3.50). Mango, jackfruit, dalim, jambura, litchi, papaya and sajna were the other most prevalent species (Table 12). In case of timber trees, a total of 6 different timber species were identified and the most prevalent species was sissoo (3.32) followed by gamar, and the other prevalent species were kadam, mehogony, koroi, and segun. Among the medicinal plants, neem was the most prevalent species (0.70) followed by arjun (0.53), tulsi (0.30) and aloevera (0.22).

In the backyard of homestead, a total of 13 different fruit species were identified, among them, mango was the most prevalent species having relative prevalence of 3.90, followed by betelnut (3.52), coconut (2.25) and jackfruit (2.12). The other fruit species were coconut, jam, date palm, amra, pineapple, bel, lebu, jambura, litchi and tetul (Table 12). Among the identified timber species, mahagony was the most prevalent species (5.10), followed by raintree (2.10), akashmoni (2.06). Sisso, babla, segun, simul and kadam were the other timber species (Table 12). In this microsite, neem was the most prevalent species (0.77) followed by arjun, and ulot kombol.

In the approach road, a total of 7 different fruit species were identified, and among them, coconut was the most prevalent species (3.20) followed by betelnut (2.60). The other prevalent fruit species were palmyra palm, date palm, jujube, papaya and guava (Table 12). In this microsite, there was a total of 5 timber species, where ipleiple was the most prevalent species (2.55) followed by mehogony (1.85), koroi (1.54) and akashmoni (1.52). In case of medicinal plants, 2 species were identified and arjun was the most prevalent species (0.64) followed by neem (0.18).

Boundary plantation was the most developed segment of the studied homestead. In the boundary, a total of 10 different fruit species were identified, among them, mango was the most prevalent species whose relative prevalence was 5.30 followed by coconut (3.85), betelnut (2.77), palmyra palm (2.53) and date palm (2.30). The other tree species were jackfruit, jam, jujube and litchi and sajna (Table 12). In case of timber tree, a total of 8 different species were identified and the most prevalent species was mahogony (4.36) followed by rain tree (3.12) and sisso (2.10). Koroi, akashmoni, segun, ipil-ipil and simul were the other tree species. Among the medicinal plants grown in the boundary, neem was the most prevalent species (0.50) followed by arjun and aloevera.

Chowdhury and Salter (1992), Abedin and Quddus (1990), and Momin *et al.* (1990) also observed considerable variations in species of trees grown in different homestead microsites. Chowdhury and Satter (1992) also determined the relative prevalence of tree species in the Ganges Floodplain bioecological zone and concluded that the most prevalent species in homestead was date palm and plamyra palm followed by battle nut, coconut, Jack fruit, banana, mango, mchagony, bamboo and guava.

Table 12. Relative prevalence of tree species in different microsites

Common name	Scientific name	**Relative prevalence (RP)**				
		Homeyard	Frontyard	Backyard	Approach road	Boundary
Fruit species						
Mango	*Magifera indica*	1.25	1.05	3.90	--	5.30
Coconut	*Cocos nueifera*	2.76	3.50	2.25	3.20	3.85
Jackfruit	*Arlocarpus heterphyllus*	1.05	1.26	2.12	--	0.80
Palmyra palm	*Borassus flabellifer*	--	--	--	0.30	2.53
Jam	*Syzgium cumini*	--	--	0.72	--	1.30
Date palm	*Phoenix sylveslris*	--	--	0.50	0.60	2.30
Amra	*Spondias mangifera*	1.10	0.75	1.04	--	--
Pineapple	*Ananus comosus*	--	--	1.10	--	--
Bel	*Aegle marmelos*	--	--	0.77	--	--
Dalim	*Punica granatum*	2.15	1.04	--	--	--
Jujube	*Zizyphus jujuba*	1.36	0.70	--	0.70	0.12
Lebu	*Citrus spp*	--	--	1.44	--	--
Jambura	*Cirtus grandis*	--	1.30	0.80	--	--
Litchi	*Lichi chinensis*	--	1.25	1.48	--	1.06
Papaya	*Carica papaya*	3.06	1.10	--	1.60	--
Guava	*Psidum guajava*	2.20	0.50	--	1.20	--
Sajna	*Moringa oleifera*	--	1.20	--	--	0.20
Betelnut	*Areca catechu*	1.24	4.26	3.52	2.60	2.77
Sofeda	*Achras sapota*	--	--	--	--	--
Tetul	*Tamarindus indica*	--	--	0.80	--	--
Timber species						
Mahogony	*Swietenia Mahogoni*	1.26	0.31	5.10	1.85	4.36
Koroi	*Albizzia lebbeck*	0.32	0.25	--	1.54	0.42
Sisso	*Dalbergia sisso*	0.40	3.32	0.70	0.60	2.10
Rain tree	*Samanea Saman*	--	--	2.10	--	3.12
Babla	*Acuacia nilolica*	--	--	0.76	--	--
Akashmoni	*Acasia sp.*	--	--	2.06	1.52	1.40
Gamar	*Gmelina arborea*	--	1.50	--	--	--
Segun		--	0.64	1.62	--	1.26
Kadam	*Anthocephalus sinensis*	0.63	1.70	0.82	--	--
Ipil-lpil	*Leucaena leucocephala*	0.84	--	--	2.55	1.48
Simul	*Bobbax ciba*	--	--	0.12	--	0.36

Common name	Scientific name	**Relative prevalence (RP)**				
		Homeyard	Frontyard	Backyard	Approach road	Boundary
Medicinal species						
Arjun	*Terminalia arjuna*	0.74	0.60	0.40	0.64	0.22
Neem	*Azadirechta indica*	0.92	0.70	0.77	0.18	0.50
Tulsi	*Ocimum sanctum*	0.72	0.30	--	--	--
Ulot kombol		--	--	0.30	--	--
Aloevera		--	0.22	--	--	0.18

4.4 Diversity index and equitability

The simplest measure of any character of a community that makes into account both the abundance pattern (evenness/equitability =E) and the species richness in Simpson's diversity index (D). Diversity index and equitability of plant species in the different microsites were worked out by Simpson's diversity index (Table 13). The result showed that tree diversity index varied among the different microsites. Among the microsites, the highest diversity was found in homeyard (2.285) followed by backyard (2.078), boundary (2.042), approach road (1.987) and frontyard (1.886). Equitability was also followed the similar trend (Table 13).

Table 13. Diversity index and equitability of different types of trees at different microsites

Microsites	Pi^2 for different plant type			D*	E
	Fruit	Timber	Medicinal		
Homeyard	0.276	0.142	0.0082	2.285	0.78
Frontyard	0.384	0.110	0.0028	1.886	0.62
Backyard	0.148	0.128	0.0031	2.078	0.72
Approach road	0.352	0.116	0.0008	1.987	0.66
Boundary	0.372	0.118	0.0021	2.042	0.70

*D = Simpson's diversity index, E = Simpson equitability index

4.5 Vegetables and spices grown at different microsites

The study revealed that the number of vegetables and spices grown at different microsites of homestead increased with the increase of farm size and the maximum number of vegetables and spices were recorded in large farm category (Table 14). Among the microsites of the homestead, the highest number of vegetables were recorded in frontyard (9.4) followed by homeyard (7.5), backyard (5.8), boundary (3.4) and approach road (2.8), respectively. In boundary and approach road, no spices were found to grow in the study area, while the maximum number of spices was recorded at frontyard (2.9) of the homestead.

Table 14. Profusion of vegetables and spices grown in different microsites of homestead according to farm size

Microsites	Land categories								Average	
	Landless		Small		Medium		Large			
	Veg.	Spi.	Veg.	Spi.	Veg.	Spi.	Veg.	Spi.	Veg.	Spi.
Homeyard	5.5	1.0	7.5	2.0	8.6	2.0	8.5	2.0	7.5	1.8
Frontyard	7.0	2.5	8.0	3.0	11.2	2.0	11.5	4.0	9.4	2.9
Backyard	4.0	1.5	6.0	1.5	7.0	3.0	6.0	3.0	5.8	2.3
Approach road	2.0	--	2.0	--	3.0	--	4.0	--	2.8	--
Boundary	2.5	--	3.0	--	3.5	--	4.5	--	3.4	--

4.6 Problem faced by the farmers

The need for growing trees was felt by almost all farmers. But their desires were limited due to various problems (Table 15). Among the problems reported by the respondent, damage of seedlings by animal/natural calamity (67.50%) was the major problem (Table 15). Lack of sources of good seedlings, fruits stolen and lack of technical knowledge and miss management were also major constraints (45, 42 and 40% respectively).

Lack of knowledge on optimum doses and proper use of fertilizers, lack of

technical knowledge and miss management and lack of place for new plantation were also found to be other common problems that caused difficulties in post-harvest operations of crops. About 22.50 percent of the respondents opined that lack of technical knowledge regarding management practices for trees was a barrier also. Other problems identified by the respondents were lack of place for new plantation (22.50%), and lack of knowledge on optimum doses and proper use of fertilizers (27.50%).

Basak (2002) identified the cattle damage was the major problem faced by the farmers in tree plantation in homestead. More or less similar problems were identified by Chowdhury and Satter (1992). Although Alam *et al.* (1990) and Miah *et al.* (1990) identified lack of good seedlings as the major constraint of tree growing in homesteads. Such a problem was not much evident in the present study. Because, in the recent years, a number of private nursery have been established in the nearby places.

Table 15. Problem faced by the farmers in homestead during homestead gardening practices

Problem	Respondent	
	Number	Percent
Lack of place for new plantation	9	22.50
Lack of sources of good seedlings	18	45.00
Lack of knowledge on optimum doses and proper use of fertilizers	11	27.50
Damage by animals/natural calamity	27	67.50
Damage due to insect and pest infestation	6	15.00
Lack of technical knowledge and miss management	16	40.00
Barrier for sunlight and air	10	25.00
Fruits stolen	17	42.50
Disagreement with neighbors	24	60.00

CHAPTER V

SUMMARY CONCLUSION AND RECOMMENDATION

5.1 Summary

The study was carried out in Gazipur district. Two opazillas were selected identically and one union was selected from each upazilla and two villages were selected randomly from each union. Data were collected from 4 villages; Ashapur and Benupur villages are under Kaliakoir upazila and Maona and Lakshumpur villages are under Sreepur upazila. For this purpose, analysis and documentation of existing plant resources in the different microsites of a homestead are essential. Keeping this in view, a survey was carried out at Gazipur district from February to July 2016.

A total of 40 homesteads (10 from each farm category) were interviewed by using a pre-tested questionnaire to collect the necessary information. Respondents were selected from 4 different farm categories i.e, landless, small, medium and large. Homesteads were selected randomly within the each farm category. Data on different aspects of homestead tree resources, their distribution, management level and constraints across the production units i.e., microsites were collected and analyzed.

Family heads of different ages were found in the study area to manage their homestead where 52.50% respondents were middle aged (35-50 years), 35.00% respondents were old aged and only 12.50% respondents were young aged (up to 35 years). Most of the respondents (40%) were primary educated of which 27.5, 25 and 7.50% respondents were illiterate, secondary and above secondary education level, respectively. Agriculture was the main occupation for near about 50% of the respondents. Service (30) and business (17.5%) were the other two occupations.

It has been found that the area of different microsites of homestead varied within same farm category and among the different farm categories as well. Large farmer had the maximum land area of all the microsites followed by medium, small and landless farmer. The average area coverage of boundary side was the maximum and the approach road was the minimum as well.

Among the micrositcs, an average of 15.48, 26.73, 30.95, 12.14 and 33.60 trees per farm was recorded at homeyard, frontyard, backyard, approach road and boundary, respectively. In the homeyard 56.70, 34.89 and 8.40% trees were fruit, timber and medicinal; in the frontyard 65.00, 29.84 and 5.14% trees were fruit, timber and medicinal; in the backyard 36.91, 57.92, and 5.17% trees were fruit, timber and medicinal; in the approach road 63.03, 33.98 and 2.99% trees were fruit, timber and medicinal plants; and in the boundary 62.50, 34.38 and 3.13% trees were fruit, timber and medicinal, respectively.

The number of trees per farm increased with the increase of farm size and the maximum and the minimum number of trees per farm were recorded in large and landless farm category, respectively.

Boundary was identified as the most developed segment of the microsites. In homeyard, papaya was the most prevalent species (3.06). In frontyard and approach road; betelnut (4.26) coconut (3.20) respectively were the most prevalent species. In backyard and boundary; mango (3.90 and 5.30, respectively) was the most prevalent species.

Diversity index and equitability of different types of trees according to different microsites were worked out by Simpon's diversity index. The tree diversity index varied among different microsites. The result showed that the diversity was found the highest in the homeyard (2.285) and the lowest was in the frontyard (1.886). Equitability was the highest in homeyard (0.78), followed by backyard (0.72), boundary (0.70), approach road (0.66) and frontyard (0.62).

Vegetables and spices were found to grow at different microsites of homestead and increased with the increase of farm size. The maximum number of vegetables per microsite was recorded at frontyard (9.4) and the minimum number of vegetables per microsite was recorded at homeyard (2.0). Frontyard (2.9) was also identified the richest microsite in respect to spices production. No spices were found in boundary and approach road.

A number of problems have been reported by the growers. Among them, the major problem faced by the farmer was damage of seedlings by animals/natural calamity (67.50%). Disagreement with neighbors about plantation was another major problem faced by the respondents. Fruit stolen, Lack of place for new plantation, lack of technical knowledge and good quality seedlings were the other major problems.

5.2 Conclusion

- Area of the different microsites of the homestead, increased as the farm size increase, and large farmers had the maximum land area irrespective of microsites, while the landless farmers had the least land areas in all the microsites. Among the microsites, boundary was the largest microsite and approach road was the smallest microsite in the study area.
- Among the farm categories, an average of 74.90, 97.45, 137.80 and 165.40 trees per farm were found in landless, small, medium and large farm categories, respectively. Among the microsites, an average of 15.48, 26.73, 30.95, 12.14 and 33.60 trees per farm was recorded at homeyard, frontyard, backyard, approach road and boundary, respectively. The average tree composition consisting of fruit, timber and medicinal plants was 55.70, 39.51 and 4.78, respectively.
- A number of tree species has been identified in the different microsites of homestead. Boundary was identified as the most developed segment of the microsites. In backyard and boundary, mango (3.90 and 5.30 respectively) was the most prevalent species. In homeyard, papaya was the most prevalent species (3.06).
- In case of timber trees, mehogony was the most prevalent species in the homeyard, backward and boundary. In the frontyard and approach road; sisso and ipil-ipil respectively were the most prevalent species.
- In case of medicinal plants, neem was the most prevalent medicinal plant in the homeyard, frontyard, backward and boundary while arjun was the most prevalent species in approach road.
- Diversity index of homeyard (2.285) and frontyard (1.886) was the maximum and the minimum, respectively. Equitability of the species was also followed the similar trend.

5.3 Recommendations

On the basis of the findings of the present study, the following recommendations are drawn:

1. Attempts should be undertaken to create awareness among the respondents of the studied region to enrich the all available microsites of the homestead with economic point of view.

2. The study was restrained in a specific bio-ecological zone with 40 farmers only, so, there is a need to take a comprehensive study faceing most of the ecological zones of Bangladesh with a considerable number of sample farmers.

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APPENDICES

Appendix I. Questionnaire of the study

Questionnaire on plant species diversity of homestead microsites of Gazipur district of Bangladesh

Sample No. ……..

Type of the respondent: Landless/Small/Medium/Large (Put √)

1. Identification of the respondent:

Name: ..…….. Father‘s name: ……..
Village: …….. Post Office: ……...
Upazilla: …… District: …….
Age: …….. EducationLevel: ……

2. Occupation:
Main: ……..
Other: …….

3. Education status
Mention your education level (Put √)
a) No education b) Primary c) Secondary d) Above secondary

4. Description of land ownership:
A. Total homestead area (Deci): ……...
B. Total own cultivated land (Deci): ……..…

5. How old is the homestead? …….……

6. Characteristics of the Homestead: (Put √)
A. Type of land (High, medium high, low)
b. Soil type-Sandy/Loamy/Sandy-loamy/Clay

7. Mention AF System of the homestead: (Put √)
a) Tree + Crop + Fish + Livestock
b) Tree + Crop + Fish
c) Tree + Crop
d) Others (Specify): …….

8. Production component (Microsite): Mention different plant species at different microsites of homestead with land type, area, age and vegetation layer

A. Boundary - Tree/herb plantation

Species	Land type	Area (length×width)	Number according to age (year)		No. of vegetation layer
			No.	Age	
Fruit species					
Timber species					
Medicinal species					

B. Back yard - Tree/herb plantation

Species	Land type	Area (length×width)	Number according to age (year)		No. of vegetation layer
			No.	Age	
Fruit species					
Timber species					
Medicinal species					

C. Front yard - Tree/herb plantation

Species	Land type	Area (length×width)	Number according to age (year)		No. of vegetation layer
			No.	Age	
Fruit species					
Timber species					
Medicinal species					

D. Homeyard - Tree/herb plantation

Species	Land type	Area (length×width)	Number according to age (year)		No. of vegetation layer
			No.	Age	
Fruit species					
Timber species					
Medicinal species					

E. Approach road - Tree/herb plantation

Species	Land type	Area (length×width)	Number according to age (year)		No. of vegetation layer
			No.	Age	
Fruit species					
Timber species					
Medicinal species					

9. Specify the vegetables and other crops (varieties) grown at your homestead microsites

Crops	Varieties	Associated trees/open	Duration (age of trees)	Reasons for choosing this combination
Boundary				
Back yard				
Front yard				
Pond sites				
Approach road				

10. Are your production of fruits and vegetables, fuel wood and cowdung sufficient? Please mention the status according to your need

Products	Sufficient (Put √)		Is production increasing? (Put √)		Percent (%) increase or decrease production as compared to last 5 years
	Yes	No	Yes	No	
Fruits					
Vegetables					
Fuel wood					
Cowdung					

11. Mention your annual income from homestead microsites

Items	Gross income (Tk in thousands)	Net income (Tk in thousands)
Fruits		
Timbers		
Vegetables		
Fuel wood		
Cowdung and manure		

12. What are the problems that you faced at the time of planting trees in your homestead Garden?

Problems (Please mention with ranking score from 1 to 10)

a) Lack of space for new plantation
b) Lack of good seedlings
c) Lack of knowledge about amount and type of fertilizers to be used
d) Damage by animals/children/storm
e) Insect pest and diseases infestation
f) Lack of technical knowledge
g) Obstructs sunlight and air
h) Conflict with neighbors
i) Fruits are stolen
j) Others

13. How do you think these problems can be overcome?

a) ……..…….

b) ……

c) ……

d) …….

Thank You

Signature of the Researcher

Date: …….