Khulna University
Life Science School
Forestry and Wood Technology Discipline

Author(s): Md. Abdur Rahman Shaikh

Title: Homegarden plant diversity and their conservation status in Phultala Upazila, Khulna

Supervisor(s): S. M Rubaiot Abdullah, Assistant Professor, Forestry and Wood Technology Discipline, Khulna University

Programme: Bachelor of Science in Forestry

Homegarden plant diversity and their conservation status in Phultala Upazilla, Khulna

Md. Abdur Rahman Shaikh
STUDENT ID: 120540

FORESTRY AND WOOD TECHNOLOGY DISCIPLINE
LIFE SCIENCE SCHOOL, KHULNA UNIVERSITY
KHULNA-9208, BANGLADESH.

2017

Homegarden plant diversity and their conservation status in Phultala Upazilla, Khulna

Md. Abdur Rahman Shaikh

STUDENT ID: 120540

FORESTRY AND WOOD TECHNOLOGY DISCIPLINE

KHULNA UNIVERSITY

KHULNA- 9208

2017

Homegarden Plant Diversity and Their Conservation Status in Phultala Upazilla, Khulna

Course Title: Project Thesis

Course No.: FWT- 4114

[This dissertation has been prepared and submitted to the Forestry and Wood Technology Discipline, Khulna University, Khulna-9280, Bangladesh for the partial fulfillment of the four years professional B.Sc. (Hon's) degree in Forestry]

Supervisor

07.06.2017

S.M Rubaiot Abdullah
Assistant Professor
Forestry and Wood Technology Discipline
KhulnaUniversity
Khulna-9208
Bangladesh.

Submitted by

A. Rahman

Md. Abdur Rahman Shaikh
Student ID: 120540
Forestry and Wood Technology Discipline
KhulnaUniversity
Khulna-9208
Bangladesh.

DECLARATION

I, Md. Abdur Rahman Shaikh, declare that this thesis is the result of my own works and that it has not yet been submitted or accepted for a degree in any other university.

I, hereby, give consent for my thesis, if accepted, to be available for photocopying and for inter-library loans, and for the title and summary to be made available to outside organizations.

Md. Abdur Rahman Shaikh
Student ID: 120540
Forestry and Wood Technology Discipline
KhulnaUniversity
Khulna-9208.

DEDICATED

TO

MY BELOVED PARENTS

ACKNOWLEDGEMENT

First of all, I am very grateful to almighty Allah for successfully completion of this thesis work.

I would like to express my sincere gratitude and profound appreciation to my respectable supervisor S.M Rubaiot Abdullah, Assistant Professor, Forestry and Wood Technology Discipline, Khulna University, Khulna-9208 for his continuous supervision, guidance, inspiration, valuable advices and thoughtful suggestions during the research period. Moreover, without his kind supervision and encouragement I could not come up with this research. I am especially thankful to my honorable teachers Dr. Enamul Kabir (Professor, FWT Discipline) for his materialistic support.

I am grateful to my parents for their inspiration, profound suggestions, encouragement and continuous guidance that help me for conducting this study. I also thankful to my parents for their support, encouragement and continuous guidance that help me for conducting this study.

Special thanks to S.M Serazul Islam for helping me during data collection. I express my thanks to all of my friends and well-wishers.

Md. Abdur Rahman Shaikh

Abstract

The study described the diversity of plant species (trees, shrubs, herbs and climbers) in Phultala upazila, Khulna. A purposive sampling methods was employed in the study. A total of 179 (63% native) species were recorded of 71 homegardens of which 68 were tree species, 31 were shrubs species, 51 were herbs species and 29 were climber species. The homegardens were cover total area of 3.342 ha. and the average area was 0.045 ha. per homegarden. Among the findings species seven vulnerable, three near threatened and two are becoming rare. The most important uses of species were medicinal, fruit and timber. Among the tree species *Cocos nucifera* shows height IVI (49.75) and *Mangifera silvativa* shows lowest IVI (0.10), and according to the relative density most important shrubs, herbs and climber species were *Psidium guajava, Musa paradisiaca* and *Dioscorea alata* respectively. The leading tee family was found Leguminosae, shrubs family was Euphobiaceae, herb family was Araceae and climber family was Cucurbitaceae. But according to the individual Palme and Euphobiaceae was recorded as a leading tree and shrubs family respectively. For trees, the Shanon-winner index for diversity was 4.25, Diversity index 0.03, Species Richness index 19.16 and species Evenness index 0.70. For shrub, the Shanon-winner index for diversity was 2.78, Diversity index 0.02, Species Richness index 10.36 and species Evenness index 0.55. I hope that incising awareness and planting more trees can plays an important role to conserve the plant diversity in homegardens.

Table of Contents

List of Table

List of Figures

List of Acronyms

HG	Homegarden
CBD	Convention on Biological Diversity
EFFB	Encyclopedia of Flora and Fauna of Bangladesh
DBH	Diameter at Breast Height
FAO	Food and Agriculture Organization
GPS	Global Positioning System
NGO	Nongovernmental Organization
USDA	United States Department of Agriculture
APAN	Asia Pacific Agro forestry Network
NAWG	National Agro forestry Working Group
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
QGIS	Quantum Geographic Information System
IVI	Important Value Index
RD	Relative Density
RF	Relative Frequency
RDo	Relative Dominance
Ha	Hector

Chapter: 1

Introduction

1.1 Background and Justification of the study

Homegardens are fundamental to peasant`s lives, but they are not only units of production but are also part of the habitation units of the peasant family (Buylla Roces *et al.*, 1989). Although there are many variations of homegarden design and pattern, the basic features remain the same (Christanty, 1985). A homegarden usually contains a house, a bare space and a cultivated space. Usually the cultivated space (the garden) is located surrounding the house, in front of the house as front yard or behind the house as back yard. The bare space is used for various social and ceremonial activities. Intensive uses of cultivated space, the multiple functions of farm yard planting, predominance of root, tuber and tree crops and some of the characteristic train of traditional homegardens in many parts of the world (Ninez, 1987). The gardens often feature low capital input and simple technology and are intensively managed by family labour. Yields are generally low but stable and sustainable (Fernandes and Nair, 1986; Ninez, 1987; Soemarwoto, 1987). Personal preferences and attitudes, socio-economic status and culture often reflect the appearance, structure and function of the homegardens (Christanty, 1985).

Homegardens are often ignored by scientists and developments agents as an important part of traditional farming systems largely because of their small size and apparent insignificance (Bunderson *et al.*, 1990). They are often looked at as an example of primitive, undeveloped agriculture compared to modern high-yielding technological agrosystems (Michon *et al.*, 1983). Many studies have reported the existence of homegardens in various region of the world, but very few studies have adequately analyzed the structure, species composition, diversity and the management aspects of the homegardens (Millat-e-Mustafa *et al.*, 1996).

Homegardens are a highly efficient from of land use, incorporating a variety of crops with different growth habits. Almost every author who describes a Homegarden of a particular country gives a list of the important species found in the garden. There are a variety of methods in cataloguing plant species. Some authors take individual gardens. For example Mergen (1987) reported 191 species in one garden in java (the upper limit for number of species in one

garden found in the literature). Other author look at a village as a whole. For example in Java, 500 species were enumerated in a village by Michon (1983).

Species diversity in homegarden can range from less than five (Ahmed and Rahman, 2004; Come's and Ban, 2004; Withrow Robinson and Hibbs, 2005; Abdoellah *et al.*, 2006) to more than 100 (Mendez *et al.*, 2001; Vogel and Vogle-Lukasser, 2003; Hemp, 2006). In our county homegarden has a diversified species composition.

Biodiversity is very important issue now. Homegarden have a chance to conserve the biodiversity. Management of homegarden for biodiversity is very easy and less cost. The first step in assessing the conservation value of homegardens is to undertake a thorough botanical and structural survey (Kabir and Edward, 2008). Total plant diversity measures the direct conservation value of homegardens, while structural features may indirectly conserve other taxa, such as frugivorous birds, reptiles, amphibians, small mammals, or arthropods (Institute of ecology, 1979; Soemarwoto and Conway, 1992; Grifith, 2000; Montagnini, 2006).

1.2 Objectives

- To assess the plant diversity in homegarden of Phultala upazilla.
- To find out the threats and conservation status of plant species.

1.3 Scopes

- Now a day's biodiversity is an important Issus. From this research people may know the plant diversity in Phultala upazilla.
- In this research the species under threats are identified that can be conserve may be in situ or ex-situ conservation. So this report can be used for the management of homegardens.

Chapter: 2

Literature Review

2.1 Evolution of homegarden

History of evolution of homegarden is antiquated and not precise. Most probably, next to shifting cultivation, homegarden is the oldest land use activity. Homegarden may have evolved through initiation of cropping intensification to meet demand derived from increasing human pressure and corresponding shortage of cultivable lands (Kamrul and Nair, 2004). Their existence was observed to 3000 BC and perhaps 7000 BC (Soemarwoto, 1987). This is supported by Ramayana and Mahabharata (Based on events that have supposedly happened around 7000 BC and 4000 BC respectively) two great Indian epics contain an illustration of Ashok Vatika, an appearance of present homegardens (Puri and Nair, 2004). There have existence of village forest gardens, a type of homegarden since the tenth century AD (Michon, 1983). Origination of Javanese homegardens is reported as early as the seventh millennium BC (Hutterer, 1984) and homegardens in Kerala, India are considered at least 4000 years old (Kumar and Nair, 2004). Finally centuries of cultural and biological transformation and the accrued wisdom and insights of farmers interaction with environment, without access to outer inputs, capital or scientific skills was the essence of homegarden evolution.

2.2 Concepts of Homegarden

Homegardens are one of the most elaborate system of indigenous agroforestry, found most often in tropical and sub-tropical areas where subsistence land use system predominate (FAO, 1986). Homegarden can be defined as the land surrounding a house, on which a mixture of annual and perianal plants are grown together with/without animals largely managed by the household members for own use or commercial purpose. Brownrigg (1985) defined the term as "a supplementary food production system by and for members of a group of people with rights to the land, who eat meals together regularly". Fernandes and Nair (1986) state that the term home garden can mean anything from growing vegetables behind house to complex 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, with the compound of individual house, the whole crop-tree-animal unit being intensively managed by family labor".

2.3 Composition of homegarden

Although no quantitative information regarding species composition in the homegardens is available in the literature, the studies of Barrau (1961) in the pacific, McConnell and Dharmapala (1973) in Sri-lanka, Sommers (1978) in Philippines, Michon *et al.* (1983) in Java, Boonkind *et al.* (1984) in Thailand have acknowledged the predominance of fruit and food producing species in the homegardens of the respective countries. Similar observation were also made by Islam and Ahmad (1987), Khaleque (1987), Akhtar *et al.* (1989), Alam *et al.* (1990), Dasgupta *et al.* (1990), Islam *et al.* (1990), Kar *et al.* (1990), Khan *et al.* (1990), Miah *et al.* (1990) Mohin *et al.* (1990) at different agro-ecological zone of Bangladesh.

There is a general agreement among author on the complexity of homegardens displayed in diversity. But most articles seem to reach their conclusion by observation followed by inference based on current theories and only a few quantitative information are available in the literature. Kumar *et al.* (1994) reported diversity index of 1.129 to 3.016 in different part of Kerala, India. They concluded that the species diversity of the small gardens was significantly greater than the medium and large holdings. Christanty (1985) found a diversity index of 2.79 for Javanese homegardens and 3.71 for Sudanese homegardens. Kumar *et al.* (1994) noted equitability index of 0.542 for small, 0.368 for medium and 0.428 for large holdings of the Kerala homegardens.

Many authors from tropical regions describe homegarden on first sight as haphazard, random, even anarchic and rather poetically, "order in disorder". Within Kandy Homegardens of Sri-Lanka, Jacob and Alles, (1987) and Nanayakkara (1990) failed to find any spatial pattern of species distribution. Tuladhar (1990) also makes similar observation for the homegardens of Nepal.

In homegarden, the vertical stratification of vegetation has been long recognized as one of its characteristic features, though the variation of height within any one stratum has led to some arguments as to the distinctness of the various strata recognized by various authors. Barrau (1961), Michon (1983), Altieri and Farrell (1984), Fernandes *et al.* (1984), Okafor and Fernandes (1987), Odulo and Aluma (1990) from various geographical regions give schematic

presentation of vertical structure and observe that the canopies of most homegargens consist of 2-5 layers. Fernandes and Nair (1986) provide a useful general summary of layers:

<1 m	Vegetables, medicinals plants, tubers, roots
1-3 m	Foods plants e.g. cassava, banana, papaya, yams
3-5 m	Saplings of fruit/timber trees all growing taller
5-10 m	Fruit/timber trees, some growing taller
>10 m	Fruit/timber trees

They stress that layers are dynamic and there is constant recruitment from one layer to another. Soemarwoto (1987) first analyzed layers in Javaneses homegardens as above, then gave the percentage the number of the species and numbers of plants contained in each layer, showing that it was highest in the lowest layer and lowest in the upper layer, thus adding an elements to the picture of vegetation distribution over the garden as a whole.

2.4 Functions of Homegardens

- Cultivation of useful plants: annuals/perennials (mainly Herb) as well trees and shrubs
- Provision of products for household use and cash income
- Testing site for introduced crops such as introduced banana varieties, apple, grape vine etc to check their sustainability for large scale cultivation
- Resting area for livestock such as cows, goats, chickens, ducks, pigeons etc (supplementary activities)
- Provision of fuel wood and timbers tree
- Place for growing and cultivating vegetable crops such as beans, gourds, sweet potato, taro etc
- Provision of specific dietary considerations for different tribes.

2.5 Role of Homegardens in domestication of wild species

It is observed in Konyak Home Gardens that forest trees such as *Aquillaria agallocha* some varieties of bamboo, and fruit trees are successfully domesticated and cultivated. Multipurpose forest trees are cultivated in the home gardens of Kara (Nair and Krishnankutty, 1984).

2.6 Role of Homegardens in the economy

Homegardens are used widely to supplement outputs from other agro ecosystems, such as Jhum and terraced fields, by providing a variety of other subsistence and commercial crops. Certain products are specially cultivated in Konyak Homegardens as they are in great demand for the local market of Mon town. Recently local communities have started managing their Homegardens in response to the need of buyers. It is necessary to assess the changing pattern of Homegardens and its effect on the household economy.

2.7 Cultural significance of Homegardens

Rico-Gray *et al.* (1990) have pointed out that Mayan Homegardens, mainly those of the villages closer to Merida and other cities, tend to have more ornamental plants and commercial varieties of fruit trees at the expense of home traditional elements of Homegardens. This changing pattern of Home gardens and the effect of modern development are interesting aspect of present cultivation practices. Such an assessment will be helpful for understanding the cultural significance of Homegardens.

2.8 Management of Homegardens

The management of traditional homegarden management system has evolved as a response to many factors, cultural, economic and environmental as well as personal preferences (Southern 1940. Since farmers live in intimate contact with their homegarden production system, it is reasonable to assume that they have detailed knowledge of the components that they manage in their homegardens and the interaction between them and the local environment. Farmer's indigenous knowledge is often characterized as highly specific and context-bound, with knowledge emerging simply from localized, practical experience (Sconces and Thompson 1994). Local communities in many areas benefit from generation of experience of the management of complex land use system that take advantage of the benefit of stability and sustainability associated with complexity. They continuously conduct their own trials, particularly adopt and adapt technologies to their specific circumstances and spread innovation through their networks (Cornwall *et al.*, 1994). Their experimentation is quicker and more able to accommodate changing circumstances and diversity than those of research scientists.

Homegardens that they acquired empirically over generations. For example, Michon *et al.* (1983) claimed that Javanese farmers have such a thought 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. In fact, the diversified structure of homegarden provides knowledge of a broad range of plant species and system to the farmers. Farmers utilized this knowledge to manage plant species with different means of propagation, life form and origin with a variety of uses. However, literature provides a little basis for the management of many authors acknowledge the management skills of farmers in dealing with the complex homegardens across the world. Management activity of the homegarden plants, cultural operations such as weeding and pruning, watering and fertilizing, products and services of the homegardens, labour forces required for homegarden management and the constraints of the present management system.

Both seeds and vegetative methods are used to propagate plants in the homegardens. Indeed fruit trees may spring up wherever people eat fruits and leave the seeds behind. The farmers also scatter the seeds or nuts in suitable places. Sometimes bats, squirrels, birds also help in dispersal. Seedling of valuable species are also used to propagate the plants whenever available. Some authors (For example, Fernandes *et al.*, 1984 in chagga home garden) reported that the farmers also encourage naturally coming seedling of vegetable species to grow.

Pruning is important cultural operation practiced by the farmers for various regions. Buylla Roces *et al.* (1989) mention that in Mexico, the farmers prune tree to increase fruit production, to facilitate harvesting of fruits, to avoid conflicts to the neighbors due to excessive lateral growth of plants and to prolong to life spans of some shrubs and herbs. The farmers of Jessore district of Bangladesh prune their home garden plants mainly for four regions which in accordance of preference are: to get more frits, to get more quality fruits, to get fuel wood and to ensure more space for sunlight (Alam *et al.*, 1990).

Several authors (e.g. Bompard *et al.*, 1980 from Java; Fernandes *et al.*, 1984 from Chagga homegardens; Nair and Sreedharan, 1986 and Dadhwall *et al.*, 1989 from India; Hossain *et al.*, 1988; Alam *et al.*, 1990 and Miah *et al.*, 1990 from Bangladesh and Thaman, 1990 from the Pacific) report that the farmers generally use farm yard manure and organic manure/compost for the soil fertility management of their homegargens and application of chemical fertilizer is very rare and limited to valuable species only during the early stage of the development and/or during fruiting. Irrigation is done in a very limited scale for very high valued trees during dry season and/or early stage of establishment of seedling in different agro ecological zones of Bangladesh (Hossain *et al.*, 1988; Alam *et al.*, 1990 and Miah *et al.*, 1990).

The management of homegarden requires low labour input as have been reported by several authors from different countries, e.g. half hours to two hours daily in a 500 m sq. homegarden of Philippines (Sommers, 1978). Similar range is reported in Indonesia (Haryadi, 1975; Cited in Christanty, 1985); 50 minute per day in a 200 m sq. homegarden in Lima (Ninez, 1985); 35-45 days of family labour per year during the year of homegarden establishment and 17-22 days during subsequent years in Mexico (Buylla Roces *et al.*, 1989).

2.9 Prospects

One of the most striking features of homegardens, observed on all three continents (e.g. Anderson, 1950 in Guatemala; Kendaragama, 1983 in Sri-Lanka; Michon, 1983; Brierly, 1985 in Grenada; Christanty *et al.*, 1986 in Java; Okafor and Fernandes, 1987 in Nigeria; Buylla Roces *et al.*, 1989 in Mexico) is that, due to great diversity of species and their varied biological cycles, having the effect of staggering production of food crops, small daily harvests can be made year round for immediate home consumption. The multipurpose tree crops can provided shade, living fences, fodder and mulch, fuel wood, fruit, timber and poles. Other components provide food both for home consumption and for sale if a surplus remains, protection against pests, cash crops, medicines, spices, mushrooms, fibers for ropes and mats and even simply ornament.

Tropical homegardens have remained sustainable through the ability of farmers to adopt to new circumstances, species being altered without affecting the overall structure and productivity. Now a day with the increasing pressure to include cash crops in gardens there is doubt whether the system is sufficiently flexible to accommodate these changes (Forrester, 1992). One of the most useful account of change is Soemarwoto article (1987) where his stated objective is not only to describe the system but also to examine its potential for future development. He mentions current improvements but then lists a range of threats resulting to the gardens. These threats are nearly all connected with loss of species diversity. He warns against concentrating only on the tangible economic and nutritional aspects at the expanse of intangible ecological and social values. As a result, verity is limited, genetic erosion sets in, losses to pests and diseases increase and soil erosion becomes a problem, exacerbated by a decline in response to the availability of chemical fertilizers. Wiersum (1982) emphasizes the rapid changes occurring now a day, which the previously flexible systems are failing to assimilate. A major threat is from the pressure of population and modern agriculture. Increasing in population have led to diminishing crop diversity as farmers struggle to grow enough staple food crops, though they

know diversity confers more advantages. At the same time agricultural development works, often backed by the government and NGOs, are imposing their single component approach on many farmers and pressurizing them to change over to mono cropping.

Most authors, however, see a promising future of homegardens, with reservation. On the evidence from natural forest and homegardens through history, it does seem likely that diversity contributes to sustainability, therefore, while research is required to establish this more precisely, more argent research is necessary into increasing production while maintaining diversity and long term sustainability, perhaps in part by rehabilitating the traditional knowledge underlying the success of garden up to now (Michon *et al.,* 1983). Ninez (1987) holds that Homegardens represent one of the last frontiers for increasing food production, and urges "let the persistence of families all over the globe in growing their own food speak for itself.

Chapter: 3

Materials and Method

3.1 Study area

3.1.1 Location

The study was conducted in Phultala upazila of Khulna district of Bangladesh. It has 12867 households and total area 56.83 km^2. Phultala Upazila (Khulna) area 87.41 km^2, located in between 22°54' and 23°01' north latitudes and in between 89°23' and 89°29' east longitudes. It is bounded by Abhaynagar upazila on the north and west, Dumuria upazila and khan Jahan Ali Thana on the south, Dighalia and Abhaynagar upazilas on the east. Population Total 177570; male 92817, female 84753; Muslim 158772, Hindu 18212, Buddhist 489, Christian 14 and others 83 (BPC 2001).

In this figure, the green color indicate the district, navy blue indicate upazilla and the red mark indicate the studied homegardens.

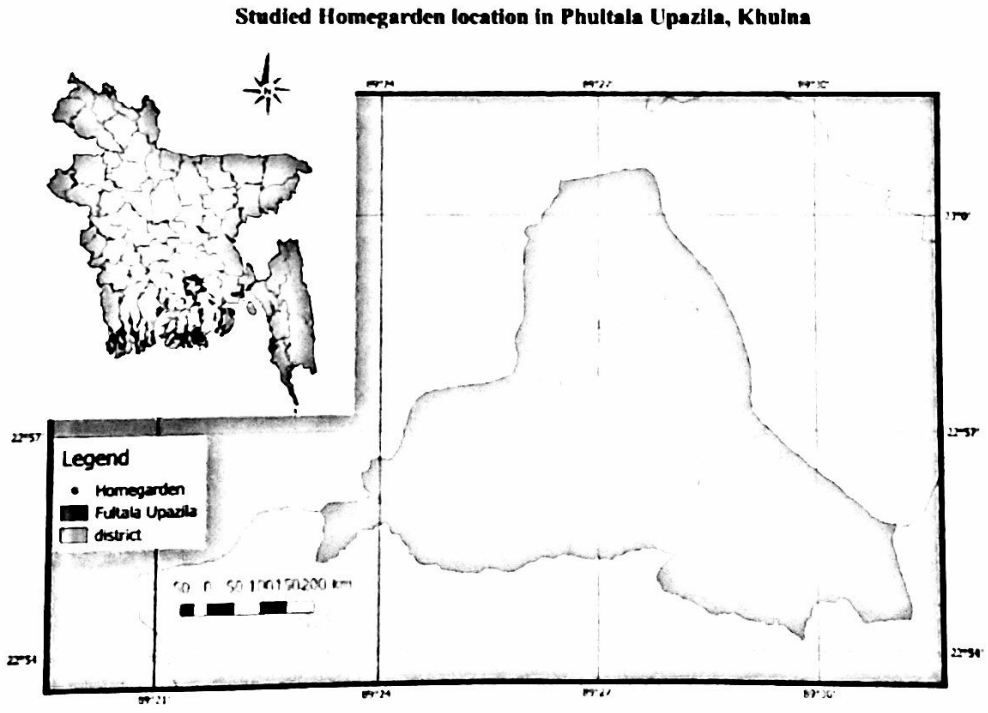

Figure 3.1: Map of study area produced in QGIS

3.1.2 Climatic condition

The climate of Phultala upazila is tropical to sub-tropical. Generally there are three but main three season are summer (March to May), winter (November to February) and rainy (June to October) season. These three seasons are characteristics of Khulna region. Winds are mostly blowing from north and northwest in the winter, blowing gently at 1 to 3 km/h in northern and central areas and 3 to 6 km/h near the coast. From March to May, violent thunderstorms produce winds up to 60 km/h. during the intensive storms of the early summer and late monsoon season, southerly winds of more than 160 km/h cause waves to crest as high as 3 meters in the Bay of Bengal, which brings disastrous flooding to coastal areas of this region (BBS, 2012).

3.1.2.1 Temperature

The annual average temperature of Phultala upazila is 26° C. January is the coldest and May is the hottest month in this region where monthly means varying between 12.4° C in January and 34.6° C in April. The climate of Phultala is quite pleasant with not usually much fluctuation in temperature in in winter and humid during summer. As the winter season progress into pre-monsoon summer season, temperatures start raising up. In some places temperature reach up to 40° C or more during the summer (BBS, 2012).

3.1.2.2 Rainfall

The annual average rainfall of Phultala is 1986 mm ranging from 1400 to 2600 mm. approximately 87% of annual average rainfall occurs in the rainy season means between May to October. The monsoon results from the contrast between low and high air pressure areas that result from differential heating of land and water. During the hot month of April and May hot air raise over the Indian subcontinent, creating low-pressure areas into which rush cooler, and moisture bearing winds from the Indian Ocean. This is the southwest monsoon, commencing in June and usually lasting through September (BBS, 2012).

3.1.2.3 Humidity

The annual average relative humidity of Phultala is 73%. March is the least humid month (62%). The relative humidity is 84% during rainy season (June to September) because of heavy rainfall but in summer season humidity become low.

3.1.2.4 Hydrology

The main river of Phultala upazila is Bairab and it has a huge bill that is bill Dakatia. Because of the bil, seasonal flooding is occurred near the bill. Fish cultivation is the common occupation is the some part of people near the bill in Damodor and Jamira union (BBS, 2012).

3.1.3 Geology and Soil

Geologically, the Bengal basin is one of the more active tectonic regions in the world. Sediments deposited by the Ganges-Brahmaputra-Meghna river system have formed Phultala upazila. These sediments are through to be as thick as 1000 feet. Soils in the delta have some localized variation, both aerially and stratighaphically but consist primarily of fine sands, silts, salty sands, sand silts and clayey silts. Remnants of swamp and forest appear in the form of peat layers in Khulna district. Excavation in this district show wood, trees or other or other vegetation at depths up to 100 feet below ground surface provides evidence of large scale subsidence, caused by compaction of recent sediments and possibly by structural down warping.

According to the report of Bureau of Bangladesh Statics 2012, Bangladesh has three broad types of soil; flood plain soils (79%), brown hill soils (12.7%) and terrace soils (8.3%). Flood plain soils are of fourteen sub-types like non-calcareous alluvium soil, calcareous alluvium, acid Sulphate soil, peat soil, non-calcareous grey floodplain soil, calcareous grey floodplain soil, grey piedmont soil, acid basin soil, non-calcareous dark grey floodplain soil, calcareous dark grey floodplain soil, calcareous brown floodplain soil, non-calcareous brown floodplain soil, brown piedmont soil and black terai soil extended over the floodplain area of the country. Calcareous floodplain is the basic soil types under this study area (BBS, 2012).

Table 3.1: Soil types different part of Khulna district

Region	Soil type
Coastal part of Khulna	Acid Sulphate
Coastal part of Khulna	Peat
Other parts of Khulna	Calcareous Alluvium
Other parts of Khulna	Calcareous gray floodplain soil
Other parts of Khulna	Non-calcareous dark grey floodplain soil
Other parts of Khulna	Calcareous dark grey floodplain soil
Other parts of Khulna	Calcareous brown floodplain soil

Source: BBS, 2012

3.2 Method

3.2.1 Sampling design

The study was conduct Phultala upazilla of Khulna district. Phultala upazila consist of four union named Phultala union, Damodor union, Atra Gilatola union and Jamira union. Each union again is composed of nine ward. Each ward is composed of many household. Every household planted with multistory species plants is called homegarden. From every ward, at least two homegardens were selected purposively for primary data collection. The plots were not fixed in size because total homegarden was considered as a plot and the size of each homegardens was not same.

3.2.2 Field data collection

All species present each sample home garden was recorded by local name and which species are not identify locally that was recorded by picture. The recorded species later confirm by the Encyclopedia of Flora and Fauna of Bangladesh, 2008. All individual of trees were counted and DBH was measured (measure above 1 cm at 1.3 m height) and shrubs were counted the numbers. The herbs and climbers were just recorded not counted the number due to the difficulties of differentiated the individuals. The location of each sample home garden was recorded by GPS.

3.2.3 Data analysis

To analyze the data gathering from 71 HG in Phultala Upazilla, the following parameters were considered. At first each species from 71 HG was classified into family, Life form (tree, shrub, herb and climber), origin (indigenous or exotic), local uses, conservation status and Threat to the Species (on the Bangladesh, Encyclopedia of Flora and Fauna of Bangladesh 2008).

Then Density, Relative Density, Frequency, and Relative Frequency of tree, shrub, herb and climber were calculated. Trees Dominance, Relative Dominance was also calculated by estimating tree diameter at breast height, then calculated trees basal area. Finally, tree's Importance Value Index (IVI) was calculated by the sum of Relative Density, Relative Frequency and Relative Dominance. The calculation procedures are as follows

1. Density $= \frac{Number\ of\ a\ Species}{Total\ Area\ Sampled}$

2. Frequency $= \frac{Area\ of\ HG\ in\ which\ a\ Species\ occurs}{Total\ Area\ Sampled}$

3. Dominance $= \frac{Total\ Basal\ Area\ of\ a\ Species}{Total\ Area\ Sampled}$

4. Relative Density $= \frac{Density\ of\ a\ Species}{Total\ Density\ of\ all\ Species} * 100$

5. Relative Frequency $= \frac{Frequency\ of\ a\ Species}{Total\ Frequency\ of\ all\ Species} * 100$

6. Relative Dominance $= \frac{\text{Dominance } of\ a\ Species}{Total\ \text{Dominance } of\ all\ Species} * 100$

7. Importance Value Index = Relative Density+ Relative Frequency+ Relative Dominance

The shanon-winner index for diversity (Michael, 1990), Diversity index (Odum, 1971). Species Richness Index and Species Evenness Index formula (Margalef, 1958) were also calculated with the help of formula are given below.

1. The Shanon-winner index for diversity, $H = -\sum_{k=0}^{n} \text{Pi} * \log 2\text{Pi}$

   Where, H = Index of Species Diversity

   Pi = No. of Individual of one Species/Total No. of Individuals in the Samples

2. Diversity Index, D = S/N

Where, D = Diversity Index,

S = Total Number of Species,

N = Total Number of Individuals.

3. Species Richness Index, R = (S-1)/ln N

Where, R = Species Richness Index,

S = Total Number of Species,

N = Total Number of Individuals of all the Species.

4. Species Evenness Index, E = H/log2 S

Where, E = Species Evenness Index,

H = Shanon-Winner Index of Diversity

S = Total No. of Species.

Chapter: 4

Result and Discussion

4.1 Results

4.1.1 Species Diversity and Structure

The sample area was 3.14 ha. from a total 71 homegardens in Phultala Upazilla. The average homegarden area was 0.04 ha. The range of homegarden area was from 0.01 to 0.25 ha. There was about 179 plant species that was includes 70 families. Among the total findings species 68 were three, 31 were shrubs, 51 were herb and 29 were climber species. Among 179 species, 112 were native and 67 were exotic species.

Table 4.1: Plant species composition and structure in Phultala Upazilla.

No of HG Surveyed	Total HG Area Surveyed (ha)	Average HG Area (ha)	Range of HG Area (ha)	No of Species
71	3.14	0.04	0.25-0.01	179

Components	No of Species	No of Species per HG	No of individuals	No of Individuals per HG	No of individuals per Ha
Tree	68	13	2473	34	740
Shrub	31	4	1532	21	451
Herb	51	4			
Climber	29	2			

4.1.2 Frequency Distribution of Plant Species

This figure shows the frequency of homegardens in different range of species. Among 71 homegardens the most common range of species is 16 to 20 species. No homegarden was found contain less than 6 species. Most of the homegardens contain the species around 11 to 30. Almost 18 homegardens falls within the range. Furthermore 16 homegardens and 17 homegardens have the species no 21-25 and 26-30 respectively.

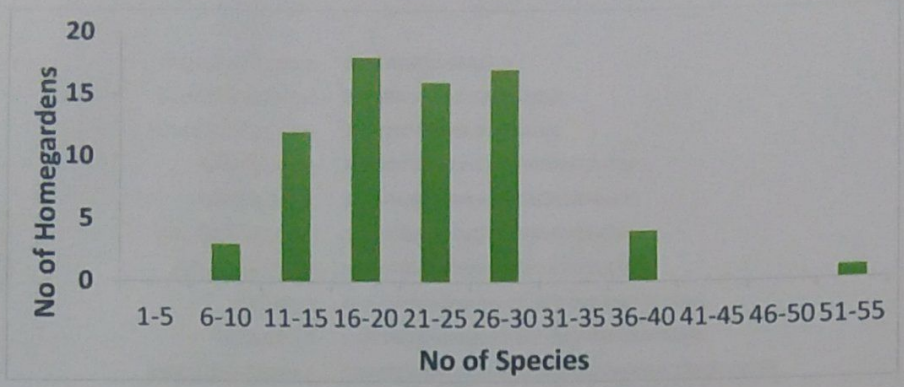

Figure 4.1: Frequency distribution of Plant Species

4.1.3 Family Composition

A total number of 70 families were encountered the study area. Tree species have leading families and it contains 37 families followed by herb, shrub and climber those are contain 19, 29 and 17 families respectively.

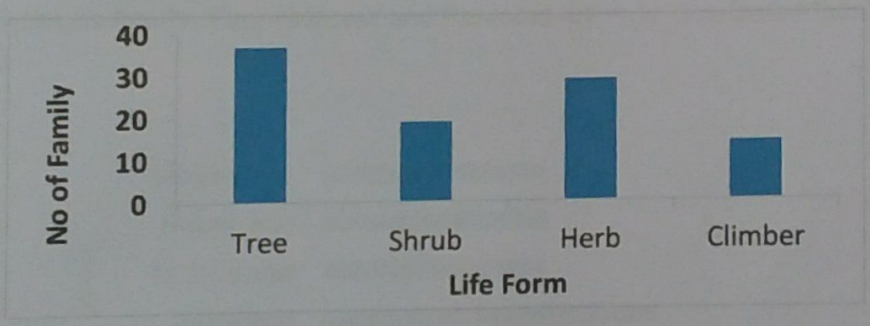

Figure 4.2: Family dominance in Phultala Upazilla, Khulna

4.1.3.1 Important Tree Family

There are 37 tree family found in this study. Among them, most dominant family is Leguminoceae containing 6 species. Rutaceae and palmae have five species. Almost four species was found for Euphorbiaceae and Moraceae family.

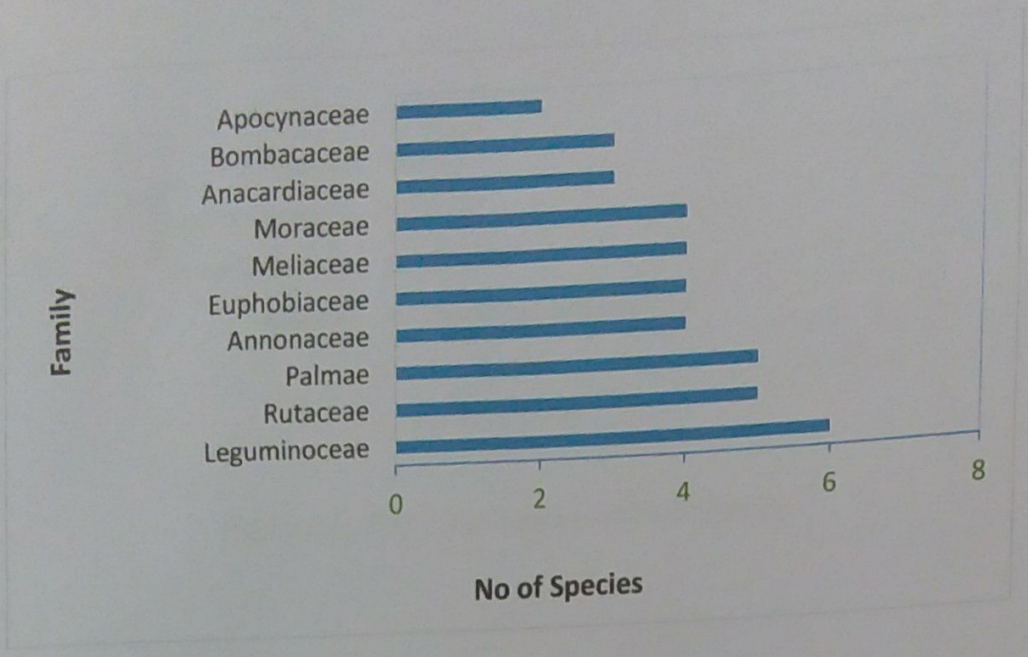

Figure 4.3: Top Ten Families of Tree Species

4.1.3.2 Important Shrub Family

A total of 19 shrubs family, Euphobiaceae and Rutaceae are most dominated family than others.

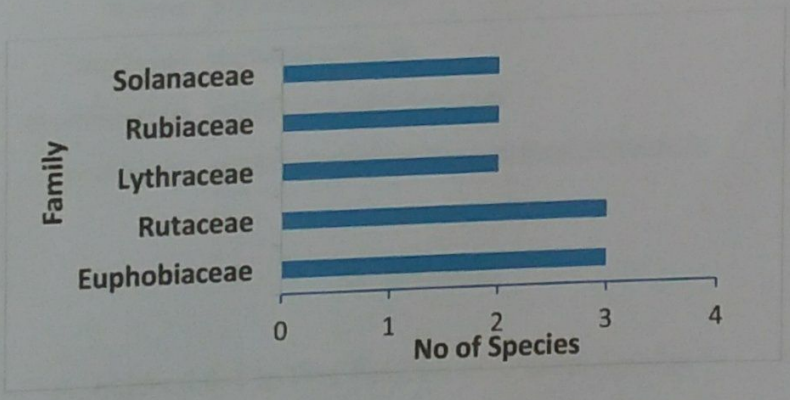

Figure 4.4: Top Five Families of Shrub Species

4.1.3.3 Important Herb Family

Among the herbs, families Araceae, Amaranthaceae and Zingiberaceae are the common family. Ten species of Araceae, four species of Amaranthaceae and three species of Zingiberaceae were found.

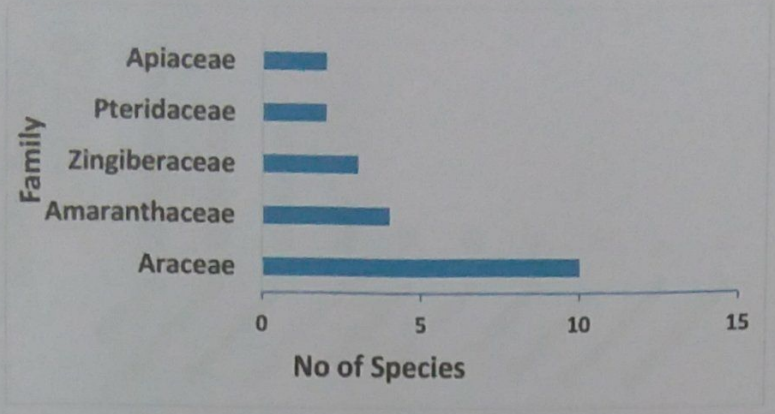

Figure 4.5: Top Five Families of Herb Species

4.1.3.4 Important Climber Family

The most common climber families were Cucurbitaceae, Menispermaceae and Cecuritaceae. Cecuritaceae includes five species. Moreover, Menispermaceae contains 3 species and Cecuritaceae and Fabaceae contain 2 species. Rest of the family contains only one species.

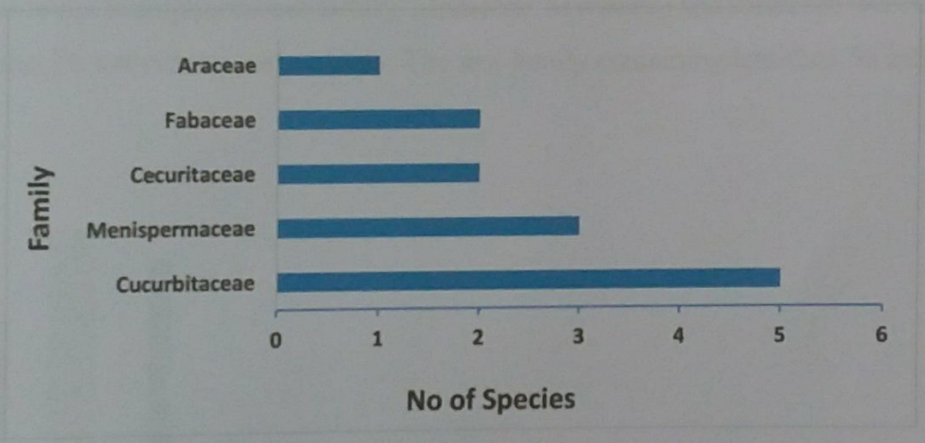

Figure 4.6: Top Five Families of Climber Species

4.1.4 Important Family with individuals

4.1.4.1 Important Tree Family with individuals

Among the finding families, 37 were recorded in tree family. The highest numbers of individuals were observed in Palmae family. A total of 700 individuals were found in Palmae family followed by Anacardiaceae that contain 500 and Annonaceae containing 450 individuals. All the other family has individuals less than 100.

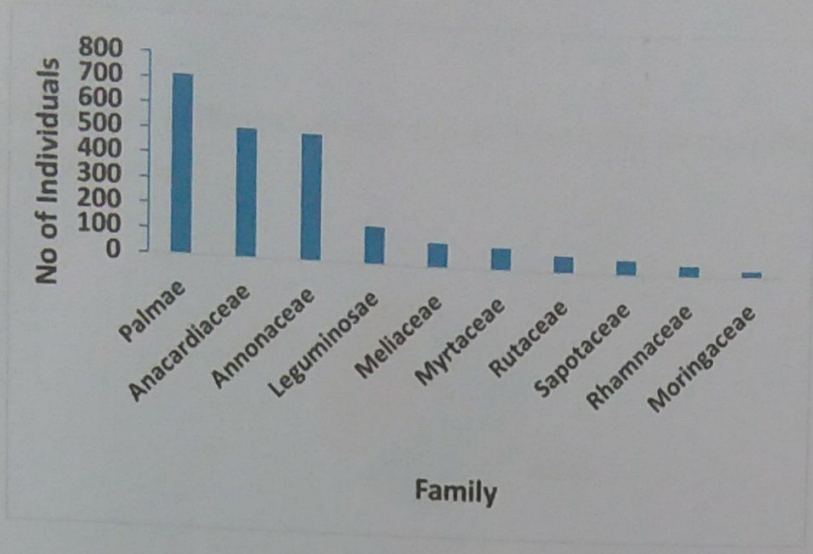

Figure 4.7: Top Ten Families of Tree Individuals

4.1.4.2 Important Shrubs Species with individuals

In 19 shrub, family Euphobiaceae is the leading family based on individuals. A total of 925 individuals found in Euphobiaceae family. Moraceae, Myrtaceae and Rutaceae were containing 230, 155 and 76 individuals respectively. The rest family containing less than 50 individuals.

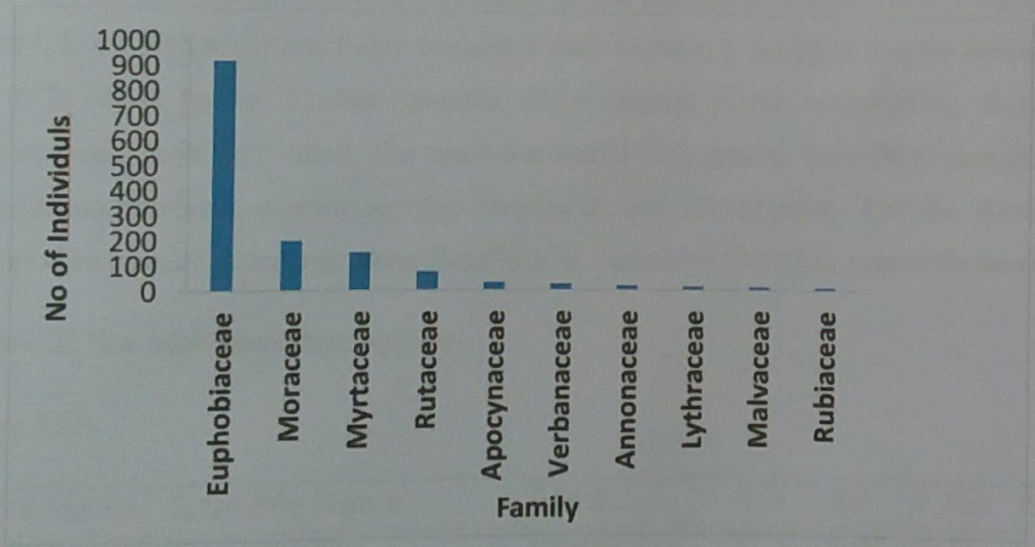

Figure 4.8: Top Ten Families of shrubs Individuals

4.1.5 Origin

In Phultala Upazilla, most of the species were native. Among this species 63% species were native and 37% were exotic.

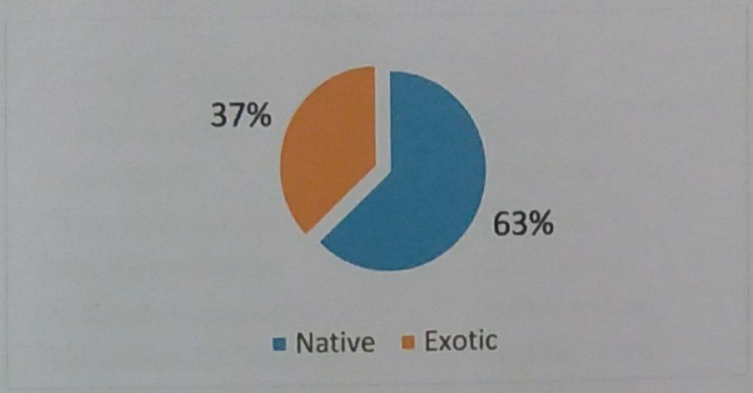

Figure 4.9: Origin of Species

4.1.6 Most important and least important species

In 68 tree species, the highest important value index (IVI) was recorded by *Cocos nucifera* L., *Swietenia mahagoni* (L.) Jacq. *Mangifera indica* L., *Arica catechu* L., *Albizia saman* (Jacq.) Merr.. Among this species *Swietenia mahagoni* (L.) is the higher relative density, *Mangifera indica* L is the higher relative frequency and. *Cocos nucifera* L is higher relative dominance. Out of 31 shrub species *Psidium guajava, Ficus hispida, Citrus aurantiifolia, Polyalthia suberosa* were most dominated. The most dominated herb species *were Musa paradisiaca, Alocasia macrorrhizos, Carica papaya, Dendrocalamus longispathus*. And the dominated climber species were *Dioscorea alata, Basella alba, Lagenaria siceraria, Cucurbita moschata*.

Table 4.2: Ten most important species

List of Tree

Local Name	Scientific Name	Family	R.D	R.F	R. Do	IVI
Narikel	*Cocos nucifera*	Palmae	11.61	6.08	32.06	49.75
Mahagoni	*Swietenia mahagoni*	Annonaceae	16.94	5.62	12.23	34.79
Aam	*Albizia saman*	Leguminosae	11.28	6.71	12.29	30.28
Supari	*Areca catechu*	Palmae	13.42	5.43	4.73	23.59
Rain tree	*Albizia saman*	Leguminosae	4.57	5.09	8.41	18.07
Kocha	*Lannea coromandelica*	Anacardiaceae	8.45	5.15	1.62	15.22

Kanthal	*Artocarpus heterophyllus*	Myrtaccae	3.56	4.21	2.33	10.10
Khejur	*Phoenix sylvestris*	Palmae	2.59	3.61	2.98	9.18
Sofeda	*Manikara zapota*	Sapotaceae	2.39	5.22	1.53	9.13
Tal	*Borassus flabellifer*	Palmae	1.21	2.29	3.40	6.91

List of Shrubs

Local Name	Scientific Name	Family	R.D	R.F
Payara	*Psidium guajava*	Myrtaceae	20.15	10.07
Dumur	*Ficus hispida*	Moraceae	16.56	13.19
Kagojilebu	*Citrus aurantiifolia*	Rutaceae	9.21	2.60
Hamjum	*Polyalthia suberosa*	Annonaceae	5.99	17.61
Patabahar	*Codiaeum variegatum*	Euphobiaceae	5.92	1.30
Berachita	*Pedilanthus tithymaloides*	Euphobiaceae	5.37	42.50
Vati	*Clerodendrum viscosum*	Verbanaceae	4.50	1.04
Daton	*Glycosmis pentaphylla*	Rutaceae	4.43	1.43
Mehedi	*Lawsonia inermis*	Lythraceae	3.44	1.69
Joba	*Hibiscus rosa-sinensis*	Malvaceae	3.41	0.91

List of Herbs

Local Name	Scientific Name	Family	R.F
Kola	*Musa paradisiaca*	Musaceae	13.62
Man Kachu	*Alocasia macrorrhizos*	Araceae	10.70
Papaya	*Carica papaya*	Caricaceae	9.97
Bas	*Dendrocalamuslongispathus*	Poaceae	5.60
Morich	*Capsicum frutescens*	Solanaceae	4.68
Jolpan Kachu	*Colocasia oresbia*	Araceae	4.37
Chotra	*Laportea cuneata*	Urticaceae	3.43
Ada	*Zingiber officinale*	Zingiberaceae	2.94
Ol Kachu	*Amorphophallus paeoniifolius*	Araceae	2.94
Gada ful	*Tagetes erecta*	Asteraceae	2.85

List of Climbers

Local Name	Scientific Name	Family	R.F
Mati alu	*Dioscorea alata*	Dioscoreaceae	20.88
Poi-shak	*Basella alba*	Basellaceae	11.40
Lau	*Lagenaria siceraria*	Cucurbitaceae	11.13
Misty kumra	*Cucurbita moschata*	Cecuritaceae	11.13
Jarmanilota	*Mikania cordata*	Asteraceae	8.50
Goroch	*Tinospora crispa*	Menispermaceae	5.46

Kakrol	*Momordica dioica*	Cucurbitaceae	5.36
Sheem	*Lablab purpureus*	Leguminosae	4.06
Bon angur			3.53
Chal kumra	*Benincasa hispida*	Cecuritaceae	2.86

Among 68 tree species the least important tree species are *Mangifera silvatica, Garcinia cowa, Nypa fruticans*. The total 31 shrub *Ricinus communis, Impatiens balsamina,* and *Carissa carandas* are least important species. Sesbania sasban, *Curcuma longa, Vitex negundo* are herbs species and *Stephania japonica, Ipomoea aquatic, Cuscuta reflexa* are the least important climber species. The least important tree is define based on important value index (IVI). The given species shows the lowest IVI.

Table 4.3: Ten least Important Species

List of tree

Local Name	Scientific Name	Family	R.D	R.F	R.Do	IVI
Uri Aam	*Mangifera silvatica*	Anacardiaceae	0.04	0.05	0.01	0.10
Tapol	*Garcinia cowa*	Ciusiaceae	0.04	0.06	0.02	0.12
Golpata	*Nypa fruticans*	Palmae	0.04	0.09	0.00	0.13
Dalim	*Punica granatum*	Lythraceae	0.04	0.09	0.00	0.13
Tejpata	*Cinnamomum tamala*	Lauraceae	0.04	0.09	0.03	0.16
Bokulful	*Mimusops elengi*	Sapotaceae	0.08	0.07	0.01	0.16
Sindur	*Mallotus philippensis*	Euphobiaceae	0.04	0.09	0.03	0.16
Chambul	*Albizia richardiana*	Mimosaceae	0.04	0.07	0.05	0.16
Jarul	*Lagerstroemia speciosa*	Lythraceae	0.04	0.11	0.02	0.17
Babla	*Vachellia nilotica*	Acanthaceae	0.04	0.11	0.03	0.18

List of shrubs

Local Name	Scientific Name	Family	R.D	R.F
Venna	*Ricinus communis*	Euphorbiaceae	0.17	0.06
Panchaba			0.22	0.06
Dopati	*Impatiens balsamina*	Balsaminaceae	0.28	0.19
Karmcha	*Carissa carandas*	Leguminoceae	0.28	0.19
Bashak	*Justicia adhatoda*	Acanthaceae	0.62	0.13
Hasna-hena	*Cestrum nocturnum*	Solanaceae	0.42	0.13
Nayantara	*Catharanthus roseus*	Apocynaceae	0.48	0.32
Apang	*Achyranthes aspera*	Amaranthaceae	0.49	0.13
Lomfol			0.57	0.13

List of Herbs

Local Name	Scientific Name	Family	R.F
Dhoncha	*Sesbania sesban*	Fabaceae	0.19
Dudraj			0.19
Holud	*Curcuma longa*	Zingiberaceae	0.19
Nisinda	*Vitex negundo*	Verbanaceae	0.19
Begun	*Solanum melongena*	Solanaceae	0.22
Dhona pata	*Eryngium foetidum*	Apiaceae	0.22
Soabin	*Glycine max*	Leguminasae	0.22
Kochori	*Colocasia mannii*	Araceae	0.25
Kolmi	*Ipomoea aquatica*	Convolvulaceae	0.27

List of Climbers

Local Name	Scientific Name	Family	R.F
Akhandi	*Stephania japonica*	Menispermaceae	0.25
Kolmisak	*Ipomoea aquatica*	Convolvulaceae	0.25
Shornolota	*Cuscuta reflexa*	Cuscutaceae	0.25
Harjora lota	*Cissus quadrangularis*	Vitaceae	0.30
Ballyful	*Jasminum sambac*	Oleaceae	0.40
Jinga	*Luffa acutangula*	Cucurbitaceae	0.40
Kolasim	*Canavalia virosa*	Fabaceae	0.40
Potol	*Piper sylvaticum*	Piperaceae	0.70
Aparijita	*Clitoria ternatea*	Fabaceae	0.75
Lajjabati	*Mimosa pudica*	Fabaceae	0.75

R.D= Relative Density, R.F= Relative Frequency and R.Do= Relative Dominance**4.1.6**

4.1.7 Species Diversity index

This study shows the result of diversity index only for tree and shrub. In Phultala Upazilla, every index for tree is higher than shrub. So most of the cases, tree species were dominated than shrub species.

Table 4.4: Index of tree and Shrub

Elements	Shanon-winner index	Diversity Index	Richness index	Evenness Index
Tree	4.25	0.03	19.16	0.70
Shrub	2.78	0.02	10.36	0.55

4.1.8 Local Uses of Plant Species

The uses of the plant were recorded based on the Encyclopedia of Flora and Fauna of Bangladesh 2008 and Kabir and webb (2008). According to this, most of the species were used as medicinal purpose and another leading uses were fruit, timber and timber beam. In homegarden, a large number of species were used as a vegetable and ornamental purpose. Among 179 species, 37 species were used as ornamental purpose and 28 species were used as vegetable.

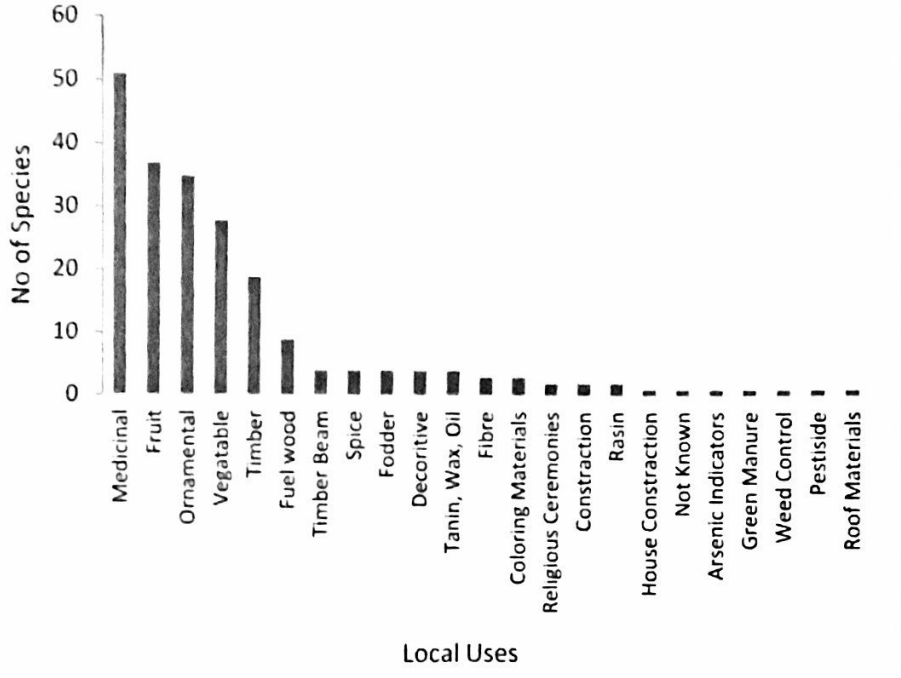

Figure 4.10: Local Uses of Species

4.1.9 Threats and Conservation Status of Plant Species

4.1.9.1 Threats of Plant Species

According to Encyclopedia of Flora and Fauna of Bangladesh (2008), most of the species were least concern but only few of the species lost their habitat and some of the species are threats for the medicinal uses. The highest numbers of species were found that was no threats. A total of 66 species were found in no threats followed by no major threats is known 50, no apparent

threats is known 22, deforestation and habitat loss10 species. All other causes are less than 10 species.

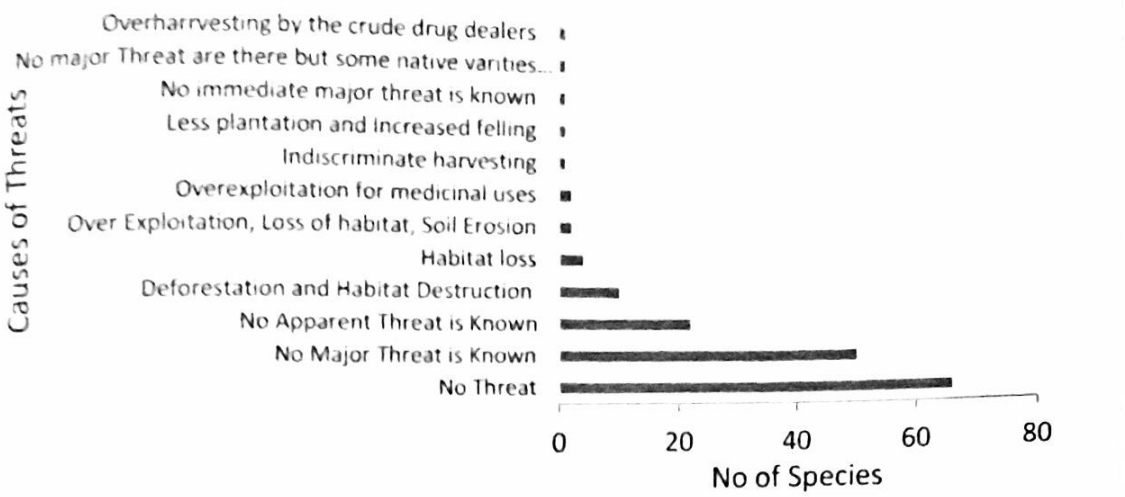

Figure 4.12: Threats of Plant Species

4.1.9.2 Conservation Status

A total 179 species most of the species were found in least concern (143 species). Among the rest species, 8 were vulnerable, 4 were not evaluated, 3 were near threatened and 2 species were conservation dependent and not evaluated but seem to be rare.

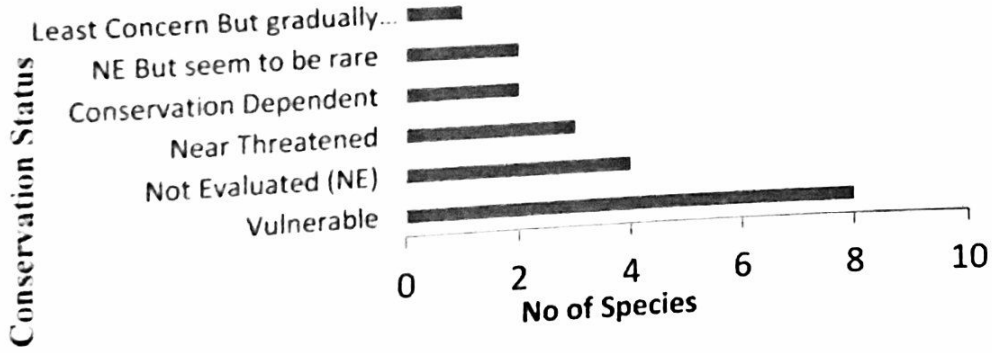

Figure 4.11: Conservation Status of Species

4.2 Discussion

4.2.1 Species diversity

In Bangladesh, the forest coverage is not sufficient in proportion to our demand. The homegardens are plays an important role to fulfil the demand of forest. The homegardens also conserve biodiversity. According to some published study agroforestry system, such as mixed shape coffee production (Perfecto *et al.*, 1996) or Indonesian agroforests (Thiollat, 1995), can contain significant level of both plant and animal biodiversity (Grifith, 2000; Montagnini, 2006). In Bangladesh and worldwide many article were published about homestead agroforestry. Compared to other published across the world and Tropical and subtropical Asia, Homegardens in southwestern Bangladesh exhibited high species richness (Kabir and Webb, 2008). Globally (Karyono, 1981; Padoch & De Jung, 1991; Soemarwoto & Conway, 1992; House & Ochoa, 1998; Jensen, 1993) shows higher homegarden plant species diversity.

The study of southwestern Bangladesh (Kabir and Webb, 2008) shows the most important trees, shrubs, herbs and climber species in homegarden based on RF. The study of homestead in offshore island in Bangladesh (Alam and Masum, 2005), they don't show the important species. In this study the important tree, shrubs, herbs and climbers are organized based on IVI.

The list of most important species is almost same compared with the study of southwestern Bangladesh (Kabir and Webb, 2008) and my study. However, the list of southwestern Bangladesh (Kabir and Webb, 2008) based on RF and my study based on IVI.

In Phultala Upazilla, *Mangifera silvatica, Garcinia cowa, Nypa fruticans* are some least important tree species, *Ricinus communis, Impatiens balsamina, Carissa carandas* are some least important shrubs species, *Sesbania sesban, Curcuma longa, Vitex negundo* are some important herbs species and *Stephania japonica, Ipomoea aquatic, Cuscuta reflexa* are some least important climber species. The other study about homegarden biodiversity I was not found the list of least important species.

In prospective of our country, Compared to that study (Kabir & Webb, 2008; Millat-e-Mustafa, *et al.*, 1997; Alam & Masum, 2005), my study shows more species richness in Phultala upazilla, Khulna. The number of plant species (excluding vegetable species) in this study area higher

than those found in homesteads of Tangail (52 spp), Ishurdi (34 spp), Jessore (28 spp), Patuakhali (20 spp) and Rangpur (21 spp) district respectively. Millat-e Mustafa, 1997 found 92 perennial plant species in one study conducted in different part of the country. Alam & Masum, 2005 found 142 species in Sandwip upazilla (the offshore island). Various Macro and Microenvironment factors of the homestead, need and choice of the family influenced the distribution of the plant species. That is why the species composition varied from one location to another location and from one farm category to another. In my study area, all the Homegardens contained many tree species than other plant species. The average plant species per Homegarden was 23 in which 13 were tree species. Therefore, tree species always dominated in Homegardens of Phultala upazilla as well as all over Bangladesh.

4.2.2 Diversity index

Data obtained from Shanon-Winner Species Diversity Index (4.25) show higher value than shrubs, which represents higher dominancy of tree species with more diversity. For shrub, herb and climber species, plant diversity was always less than tree species. The calculated value of Species Richness Index and Species Evenness Index was 19.16 and 0.70 respectively for tree that represent the more species richness of tree and more evenly the total number of individuals is distributed among all possible tree species. Species Richness Index and Species Evenness Index for shrub 10.36 and 0.55. Therefore, we can see that all the plant species in Phultala upazilla showed more species richness and more evenly, the total number of individuals is distributed among all possible plant species.

4.2.3 Local uses

Most of the species grown in homegarden are used as medicinal, fruit and ornamental purpose. According to Kabir and Webb (2008) the most common use of homegarden, species are food, medicinal, fuelwood ornamental and commercial purpose. That is almost same as my study. In Phultala upazilla the cultivations of fuel wood species in homegardens is almost negligible for the other sources of fuel. Some important uses of homegardens species that is not given the other study such as the uses as vegetables, coloring materials, fodder, spice etc. While larger farmers thought of fruits for long-term benefit, they did not take care the neighbor's inconvenience from shade (Aktar *et al.*, 1989).

4.2.4 Conservation status

This study showed the threats and conservation status of species. Most of the study about homegarden (Kabir and Webb, 2008 and Masum & Alam, 2005), listed the IUCN red list but in this study Encyclopedia of Flora and Fauna of Bangladesh (2008) was used to evaluate conservation status. Here we can see that most of the species of Araceae family are vulnerable and very few of the species are near threatened. On the other hand, most of the species are least concern and some of no concern.

The challenge of ex-situ conservation of plants in Homegardens can be tackled on three fronts. First, Homegardens need to be made aware of the status and rarity of the species they may have on their property; such awareness could result in localized efforts to conserve rare native species by promoting use that is more widespread. Awareness building campaigns, publications and educational programs are methods to increase public support for using native species in Homegardens (Trewhella *et al.*, 2005). To conserve those species as well as our biodiversity, encourage people to plant those species more and more. Second, Government and NGOs can do lot of thing to conserve those species. They supply indigenous species seedling to the farmers in regular basis and NGOs people motivate them to plant those species and say about its importance. Finally, the abundance and frequency of those species is very low because germination of those species is not viable. So artificial regeneration is necessary. Intervention methods such as hand pollination could be crucial in maintaining genetic diversity and regeneration potential of those species. To conserve our plant biodiversity as well as biodiversity; deforestation, habitat loss, over-exploitation, indiscriminate felling etc should be controlled. Therefore, to conserve our biodiversity, local people, Government and NGOs collaboration is very much important.

Chapter: 5

CONCLUSION AND RECOMMENDATIONS

Homegarden is an important parts of our forest area. Indirectly homegarden plays a role of natural forest. It also conserves biodiversity. Tropical homegardens can support the conservation the biodiversity. Sometimes homegarden plays a role for *ex-situ* conservation. Therefore, for any balance environment, homegarden is very important. The result of this study shown that the remarkable numbers of species is threatened due to the deforestation and habitat lost. For those species, homegarden may be a habitat. Majority of the species frequency is very low, for this, we can increase the frequency by homegardens. Among the finding species, some are vulnerable and some are near threated. We can conserve this vulnerable species by means of cultivation homegarden. Government and NGOs can introduce those important species to the local people. They can motivate the farmers about the positive aspects of biodiversity and plants.

This study was conduct only one Upazilla, in this Upazilla Atra Gilatola union is mainly residential area, and most of the area is covered by mills. Therefore, the sample of this union is very low. I used Encyclopedia of Flora and Fauna of Bangladesh 2008 for the identification of threats and conservation Status of species. IUCN red list should be used but I could not found the update version of the IUCN red list. I hope that further study in this area, those limitations will be minimized.

References

Akhtar, M.S., Abedin MZ. And Quddus, M.A. 1989. Why farmers grow in agricultural fields: some thoughts, some result. Research report 1988-89. Pp.161-78. On-farm Research Division, BARI, Jessore, Bangladesh.

Alam, M.S. and Masum K.M., 2005. Status of Homestead Biodiversity in the Offshore Island of Bangladesh, Research Journal of Agriculture and Biological Sciences 1(3): 246-253, 2005© 2005 INSInet Publication.

Alam, M.S., M.F. Haque, M.Z. Abedin and S. Akter, 1990. Homestead trees and household fuel uses in and around the farming systems research site, Jessore. In: Abedin, *et al* (Eds.). Homestead plantation and agroforestry in Bangladesh, pp106-119, BARI, RWEDP and WINROCK, Joydebpur, Bangladesh.

Altieri, M.A. and Farrell, J. 1984. Traditional farming system of South-central Chile with special emphasis on agroforestry. *Agroforestry systems* 2: 3-18.

Anderson, E., 1950. An Indian Garden at Santa Lucia, Guatemala. Cieba,

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

BBS, 2012. Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics (BBS), Statistic Division, Ministry of Planning, Bangladesh Secretariat, The Government of the People`s Republic of Bangladesh, Dhaka

Bompard, J., Ducatillion, C., Hecketsweiler, P. and Michon, G. 1980. *A traditional agricultural system: village forest girden in west Java.* Diploma thesis. Montpellier, France.

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. *Agroforestry systems* 2: 87-102

Brierly, J.S. 1985. West Indies Kitchen gardens: A historical prospective with current insights from Grenda. Food and Nutrition Bulletin 7(3): 52-60

Brownrigg, L. 1985. Homegardining in international development: what the literature shows. Washington, DC. The League for international food education. Washington, DC, USA.

Bunderson, T.W., Wakeel, A.E.L., Saad, Z.A. and Hashim, I.1990. Agroforestry practices and potentials in western Sudan. In: W.W. Budd, I.Duchhart, L.H. Hardesty and F. Steiner, (eds.), planning for agroforestry. Pp. 227-46. ELSEVIER, Oxford, UK.

Buylla Roces, M.E.A., Chavero, E.L. and Barrios, J.R.G.1989. homegardens in humid tropical region in southeast Maxico: an example of an agroforestry cropping system in a recentil established community. *Agroforestry systems* **8**: 133-56

Christanty, L., Abdoellah, O.S. Marten, G.G. and Iskandar, J. 1986. Traditional agroforestry in west Java: The Pekarangan (homegarden) and Kebun-Talun (Annual-perennial rotation) cropping systems. Traditional agriculture in southeast Asia. Pp. 132-58. Environment and policy Institute, East-West Centre, Honoluulu, Hawaii.

Christanty, 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.

Cornwall, A., Guijt, I. and Welbourn, A. 1994. Acknowledging process: challenges for agricultural reasesrch and extension methodology. In: I. Scoones and J. Thompson (eds.) Beyond farmer first. Pp 97-08. IT Publication, London, UK.

Dadhwall, K.S., Narain, P. and Dhyani, S.K. 1989. Agforestry system in the Garhwal Himalayas of India. Agroforestry System 7: 213-25.

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

Encyclopedia of Flora and Fauna of Bangladesh. In: Ahmed Z.U., Tahmida, Z.N., Hassan M.A. and K. Moniruzzaman. Asiatic Society of Bangladesh, 2008.

FAO. 1986. Tree growing by rural people. Forestry paper 64.

Fernandes E.C.M. and Nair, P.K.R. 1986. An evaluation the structure and function of the tropical homegardens. Agricultural systems **21**: 279-310.

Fernandes E.C.M., Oktingati, A. and Maghembe, J. 1984. The Chagga Homegardens: a multistoried agroforestry cropping system onMt. Kilimanjaro (Nortern Tanzamia). *Agroforestry system* **2**: 73-86

Forrester, K. 1992. Diversity and sustainability in homegardens. Term paper. School of agriculture and forest science, University of Wales, Bangor, UK.

Haryadi, M.M.S.S. 1975. Potential contribution of homegardining to nutrition intervention program in Indonesia. Paper presented at the seminar on food nutrition, Gadjah Mada University, Yogyakarta, Indonesia.

Hossain, M.S., Abedin, M.Z., Quddus, M.A., Hossain, S.M.M., Banu, T., Ara, S. and Ahmed, D. 1988. Women`s contributions to homestead agricultural production system in Bangladesh. Bangladesh Academy for Rural Development, Comilla.

Hutterer, K.L. 1984. Ecology and evaluation of agriculture in Southeast Asia. In: T.A. Rambo and P.E. Sajise, (eds.), *An introduction to human ecology research on agricultural system in Southeast Asia*. University of Philippines. Los Banos, Philippines.

Islam, M.B., Mannaf, M.A., Karim, M.R., Chawdhury, S.A., Abedin, M.Z. and Khair, A.B.M.A. 1990. Rural fuel supply, Homestead plantation and agroforestry System on the highland of Tista flood plain area. In : M.Z. Abedin, C.K. Lai and M.O. Ali. (eds.), Homestead plantation and agroforestry in Bangladesh. BARI, Joydebpur, Bangladesh

Jacob, V.J. and Alles, W.S. 1987. Kandyan garden of Sri-lanka. *Agroforestry systems* **5**: 123-37

Kabir, M E., Webb, E L., 2008. Can Homegardens conserve biodiversity in Bangladesh? Biotropica 40 (1), 95–103.

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

Kendaragama, K.M.A. 1983. Crop composition and income distribution of homegardens in Gampha district, Sri-lanka. Research report. Pomond College, Sri-lanka.

Khaleque, K. 1987. Homestead forestry practice in Bangladesh. *Agroforestry for rural needs.* Proceeding of the workshop of the IUFRO project group 1.15, pp. 1-12. India.

Khan, M.S., Hossain, M.A., Abedin, M.Z. and Islam, M.A 1990. Agroforestry and homestead plantation systems in non-saline tidal floodplain area in southern Bangladesh. In: M.Z.

Abedin, C.K.Lai and M.O. Ali, (eds.), *homestead plantation and agroforestry in Bangladesh*. BARI, Joydebpur, Bangladesh.

Kumar, B.M., George, S.J. and Chinnamanis, S. 1994. Diversity structure and standing stock of wood in homegardens of Kerala in Peninsular India. *Agroforestry systems* **25**: 243-62.

Mergen, F. 1987. Research opportunities to improve the production of Homegardens. *Agroforestry systems* **5**: 57-67

Miah, G., M.Z. Abedin, A.B.M.A. Khair, M. Shahidullah and A.J.M.A. Baki, 1990. Homestead Plantation and household fuel situation in Ganges floodplain of Bangladesh. In: Abedin MZ, Lai CK and Ali MO (eds) Homestead plantation and Agroforestry in Bangladesh, pp 120-135, BARI, Joydebpur, Bangladesh.

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

Millat-e-Mustafa, M., 1997. Tropical Homegardens: An overview. In: Alam MK, Ahmed FU and Amin SM (eds) Agroforestry: Bangladesh Perspective. Pp18-33, APAN/NAWG/BAEC, Dhaka, Bangladesh.

Momin, M.A., M.Z. Abedin, M.R. Amin, Q.M.S. Islam and M.M. Haque, 1990.Existing Homestead Plantation and Household Fuel Use Pattern in the Flood Prone Tangail Region of Bangladesh. In: Ninez, V.K., 1987. Household gardens: Theoretical.

Nair, M.A. and Sreedharan, C. 1986. Agroforestry farming system in the homesteads of Kerala, Southern India. *Agroforestry systems* 4: 339-63

Nair, C.T.S. and Krisnakutti, C.N. 1984. Socio-economis factors influencing farm forestry. A case study of tree cropping in homesteads in Kerala, India. In: Y.S. Rao, T.N. Vergara and G.W. Lovelace, (eds.0, community forestry: socio-economis aspects. Pp. 115-30. FAO regional office for Asia and Pacific. Bangkok, Thailand.

Nanayakkara, V.R. 1990. Agroforestry system in Sri-lanka. Expert consultation on agroforestry in the Asia and Pacific region. FAO regional office for Asia and the Pacific. Bangkok, Thailand.

Ninez, V.K. 1985. Working at half potential: constrictive analysis of homegarden programed in the Lima Slums with suggestions for an alternative approach. *Food and nutrition Bulletin* 7(3): 6-13

Ninez, V.K. 1987. Household gardens: Theoretical considerations on an old survival strategy. *Agricultural Systems* **23**: 167-86

Oduol, P.A. and Aluma, J.R.W. 1990. The banana (*Musa spp.*)-*Coffee robusta*: traditional agroforestry system of Uganda. *Agroforestry system* **11**: 213-216

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 trees with crops and small livestock. Agroforestry System 5: 153-68.

Scoones, I. and Thompson, J. 1994. Knowledge, Power and agriculture-towards a theoretical understanding. In: I. Scoones and J. Thompson (eds.), Beyond Farmer First. Pp. 16-31. IT publications, London, UK

Soemarwoto, O. 1987. Homegardens: A traditional agroforestry system with a promising future. In: H.A. Steepler and P.K.R. Nair, (eds.), Agroforestry : A Decade of Development. Pp. 157-70. International Center for Research in Agroforestry, Nairobi, Kenya.

Sommers, P. 1978. Traditional homegardens of selected Philippines households and their potential for improving human nutrition. MSc thesis. University of Philippines, Loss Banos, Philippines.

Thaman, R.R. 1990. Mixed homegardening in the Pacific Island: present status and fiture prospects. In: K. Landauer and M. Brazil, (eds), tropical Homegardens. Pp 41-65. United Nations University Press, Tokyo.

Trewhella, W. J., K. M. Rodriguez-Ceark, N. Corp, A. Entwistle, S. R. T. Garrett, E. Granek, K. L. Lengel, M. J. Raboudae, P. F. Reason, And B. J. Sewall. 2005. Environmental education as a component of multidisciplinary conservation programs: Lessons from conservation initiatives for critically endangered fruit bats in the western Indian Ocean. Conserve. Biology. 19: 75–85.

Tuladhar, A.R. 1990. Agroforestry in Nepal. Expert Consolation on Agroforestry in the Asia and the Pacific. Bangkok, Thiland.

Wiersum, K. 1982. Tree gardening and taungya on. *Agroforestry system* **1**: 53-70

Appendix 1

Homegardens Biodiversity Assessment

Upazilla		Latitude	
Union		Longitude	
Ward		HG No	
Village		HG Area	

Tree Information

Local name	DBH	P/N	N/E	Local Uses

Shrubs Information

Herbs Information

Local name	No of Individual	Local Uses	Local name	No of Individual	Local Uses

Climber Information

Local Name	No of Individual	Local Uses	Local Name	No of Individual	Local Uses

Appendix 2

List of Tree

Local Name	Scientific Name	Family	Origin	Native Country	Local Uses	Other Local Name	English Name	Threats to species	Conservation Status
Aam	*Mangifera indica L.*	Anacardicaea	E	Tropical Asia & Assam Myanmar Region	Fruit	No	Mango	No major Threat are there but some native varities are fast disappearing because of introducing of new varieties	LC
Akashmoni	*Acacia auriculiformis Benth.*	Leguminoceae	E	Australia	Timber	Sonajhuri	Ear-pod Wattle, Darwin Black Wattle	NT	LC
Amloki	*Phyllanthus emblica L.*	Euphobiaceae	N	Cambodia, Hong Kong, India,Loas	Medicine	Amla, Ambolati, Awla	Emblic Myrobalan, Indian Gooseberry	NT	LC
Amra	*Spondias pinnata (L. f.) Kurz*	Anacardiaceae	E	India & Myanmar	fruit	Deshi Amra, Pial, Thoura	Hog Plum	NAT	LC But gradually Disappearing
Arjun	*Terminalia arjuna (Roxb. ex DC.) Wight & Arn.*	Combretaceae	N	India, Sri Lanka, Malay Peninsula	Medicinal	Arjuna, Kahu	The Arjuna Myrobalan, White Murdah	Overexploitation for medicinal uses	VL
Ashphal	Dimocarpus longan Lour.	Sapindaceae	E	Southwestern India	Fruit and medicine	Kathlichu	Eyeball Tree, Dragon's Eye, Buldock	Deforestation and fire wood collection	NT
Ata	*Annona reticulata L.*	Annonaceae	E	Tropical America	Fruit	Nona, Nona ata	Bullock's Heart	NMT	LC
Babla	Vachellia nilotica L.	Acanthaceae	N	India, Pakistan,China	Timber, Fodder	no	Black Babool, Babul Tree, Gambia Pods	NT	LC
Barma Shimul	*Ceiba pentandra (L.) Gaertn.*	Bombacaceae	N	Tropical America, Africa & Asia	Fuel wood	No	Kapok Tree	NT	LC
Batabi lebu	*Citrus grandis Merr.*	Rutaceae	N	Southest Asia	Fruit	Jambura	Pummelo, Shaddock,Bitter Orange	NMT	LC
Bel	*Aegle marmelos (L.) Corrêa*	Rutaceae	N	India	Fruit	No	Bael Fruit,Bengal Quince	NAT	LC

Bokul Ful	*Minusops elengi L.*	Sapotaccae	N	Idia Myanmer, Sri Lanka.	Tanin,Wax, Starch From Bark, Oil.	Bokul	Bullet Wood, Indian Medlar	NT	LC
Bolla	Hibiscus tiliaceus L.	Malvaceae	E	Coastal tropical, sub-tropical area	Medicinal value and Resin	No	Sea hibiscus, Mahoe	NAT	LC
Bon Amra	Spondias purpurea L.	Anacardiaceae	E	Tropical america & Malaysia	Fruit & Timber	Beelati Amra,Amra	Hog Plum, Spanish Plum, Ambarella	NT	LC
Boroi	*Ziziphus mauritiana Lam.*	Rhamnaceae	E	Middle East & Subcontinant	Fruit	Kul	Indian Jujubi, Indian Plum	NT	LC
Bot	*Ficus benghalensis L.*	Moraceae	N	Bangladesh	Religious ceremonies	Bot Gachh	BanyanTree	NT	LC
Catiyan	*Alstonia scholaris (L.) R. Br.*	Apocynaceae	E	Borneo, Combodia, China	Wood	Chhatim	Devil's tree	NT	NE
Chalta	*Dillenia indica L.*	Dilleniaceae	N	Tropical Asia	Fruit	No	Elephant apple	NT	LC
Chumbol	*Albizia richardiana (Voigt) King & Prain*	Mimosaceae	E	Madagascar	Timber and fuel wood	Raj Koroi, Gagan Siris	No	NT	LC
Dalim	*Punica granatum L.*	Lythraceae	N	Balkans to Himalayas	Fruit	No	Pomegranate	NAT	LC
Debdaru	*Polyalthia longifolia (Sonn.) Thwaites*	Meliceae	N	India, Sri lanka	Timber	No	Mast Tree	NMT	LC
Dewa	*Artocarpus lacucha Buch.-Ham.*	Moraceae	N	India,Myanmar, Malaysia	Fruit and timber	Dewphal, Bon Khanthal	Monkey Jack	NT	LC
Gab	*Diospyros discolor Willd.*	Ebenaceae	E	Philippines	Fruit	Beelati Gab	Mabolo, Valvet Apple	NMT	LC
Ghora Nim	Melia azedarach L.	Araceae	N	India, Pakistan, Napal,Sri lanka	Medicinal value	Poa, Poma, Mahanim	Barbados Lilac, Pride of China	NMT	LC
Golpata	*Nypa fruticans Wurmb.*	Palmae	N	South and Southest Asia And Australia	Roof Material	No	Nipa Palm, Mangrove Palm	Over Exploitation, Loss of habitat, Soil Erosion	LC
Ipil Ipil	*Leucaena leucocephala (Lam.) de Wit*	Leguminoceae	E	Tropical America	Timber	No	Horse Tamarind, Wild Tamarind	NT	LC
Jalpai	*Elaeocarpus serratus L.*	Elaocarpaceae	N	India, Bhutan, Myanmar	Fruit and medicinal values	Belphoi	Indian Olive,Olive, Rugged Oil-fruit	NMT	LC
Jam	*Syzygium cumini L.*	Annonaceae	E	India and sri Lanka	Fruit	Kala Jam	Black Berry, Java Palm, Black Palm	NT	LC
Jamrul	*Syzygium samarangense (Blume) Merr. & L.M.Perry*	Myrtaceae	E	Andamans, Nicobars and Malacca	Fruit	No	Wax Jambu, Java apple	No immediate major threat is known	LC

Jarul	Lagerstroemia speciosa (L.) Pers.	Lythraceae	E	India, Indonesia, Myanmar	Ornamental	Kanta Jarul, Pannya Jarul	Pride of India, Queen Flower	NT	lC
Jiapoti	Putranjiva roxburaghii Wall.	Euphobiaceae	N	West Himalayan To Sri Lanka	Treatment of biliousness, Burning Sensation and Elephantiasis	Jiapura	No	NT	LC
Jiban	*Trema orientalis (L.) Blume*	Ulmaceae	N	Tropical America, Sri Lanka	Fodder and feul wood	Jinal, Chikan, Banjiga	Indian Nettle Tree, Charcoal Tree	NAT	LC
Jog Dumur	*Ficus racemosa L.*	Moraceae	E	*India, Myanmar.*	Fruit	Gulang Dumur	No	Habitat loss	NE
Kadam	*Anthocephalus chinensis (Lam.) Hassk.*	Annonaceae	N	Sri Lanka, Nepal, India	Ornamental	Bul-kadam	No	NAT	LC
Kamranga	*Averrhoa carambola L.*	Averrhoaceae	N	Indian Sub Continent	Fruit	Kamranga	Star Fruit, Carambola	NT	LC
Khanthal	*Artocarpus heterophyllus Lam.*	Myrtaceae	N	India	Fruit and Timber	Kathal	Jack fruit, jack	NT	LC
Khejur	*Phoenix sylvestris (L.) Roxb.*	Palmae	N	India and Pakistan	Fruit and Timber beam	Deshi Khejur	Wild Date Palm, Indian Oil Palm	NT	LC
Khoia Babla	*Acacia farnesiana (L.) Willd.*	Mimosacea	N	Tropical South America, Now Pantropical	Fruits and Timber	Belatibabla, Guiya Babla	Sweet Acacia, Stinking Acacia	NAT	LC
Kocha	Lannea coromandelica Merr.	Anacardiaceae	N	Hotter Part Of India, Andaman Islands & Sri Lanka	House Constraction	Jiga, Bhadi, Jial, Jialbhadi, Jigor	Wodier	no Apparent Threat in known	LC
koethbel	*Limonia acidissima Groff*	Rutaceae	E	South India And Sri Lanka	Fruit	NO	Wood Apple, Elephant apple and Monkey Fruit.	NMT	LC
Kolombag Labu	*Citrus limon L.*	Rutaceae	E	Southern Asia	Lemonade suashes & Medicinal Value	Karna Lebu, Gora Lebu	Lemon	NMT	LC
Koroi	*Albizia procera (Roxb.) Benth.*	Mimosaceae	N	India	Timber	Sil Koroi, Jat Koroi, Sada Koroi	White Siris	NT	LC
Lambu	Khaya anthotheca (Welw.) C.DC.	Meliaceae	E		Timber	No	No	NT	LC
Lichu	*Litchi chinensis Sonn.*	Sapindaceae	E	South Est China, Indo-Chinese Peninsula	Fruit	No	Litchi	NMT	LC

Mahagoni	*Swietenia mahagoni (L.) Jacq.*	Annonaceae	E	West indies, Coasts of central America	Timber	No	Spanish Mahagoni, West Indian and Small Leaved Mahagoni	NMT	LC
Mandar Kocha	Erythrina indica Lam.	Leguminoceae	N	India, Sri lanka	Ornamental	Mandar, Madar, Parijat	Indian Coral Tree	NT	LC
Matam									
Narikel	*Cocos nucifera L.*	Palme	E	Pacific Islands, Coast of Panama	Fruit and Timber beam	Daab	Coconut palm	No Apparent Threat in known	LC
Nim	*Azadirachta indica A.Juss.*	Meliaceae	E	Myanmar	Timber and medicine	Nimba	Margosa Tree, Indian Lalic	NT	LC
Papya	*Carica papaya L.*	Casicaceae	E	Maxico & Costa Rica	Fruit	Pepe	Papaya	NAT	LC
Pitapora/Pitali	Mallotus repandus (Willd.) Müll.Arg.	Euphobiaceae	N	China, Hong Kong, India, Malaysia	Fuel wood	Gunti, Jante	No	NT	LC
Puia/toon	Toona ciliata M.Roem.	Meliaceae	N	Pakistan	Timber, pesticide	Toon, Peo, Piyatoon, Kuma,Prias	Indian Mahagony, Toon,Australian Red Cedar, Cedar	NMT	LC
Radhachura	*Caesalpinia Pulcherrima L*	Caesalpiniaceae	E	South America	Ornamental, Indian medicine	Chotokrisnachura	Peacock Flower, Paradise Flower	NT	lC
Rain Tree	*Albizia saman (Jacq.) Merr.*	Leguminoceae	E	Central America	Timber	Belati siris, Randi-koroi	Cow Tamarind, Monkey Pod,	NT	LC
Redi/ venna	*Ricinus communis L.*	Euphorbiaceae	E	Northeast Tropical Africa	Castor oil	Bherenda, Gab-bherenda	Castor, Castor Bean,	NMT	LC
Royena/Pitraj	Aphanamixis polystachya Wall.	Meliaceae	N	India, Pakistan, Nepal, Bhutan	Mediacinal value, Timber	Royna,Pitti, Titra	Amoora	NMT	LC
Sajna	*Moringa oleifera Lam.*	Moringaceae	N	Indian Sub Continent	Fruit &fodder	Sojne	Ben oil Tree, DrumStick Tree	NT	LC
Shegun	Tectona grandis L.f.	Lamiaceae	E	India, Myanmar	Furniture, Construction	Shegoon, Teak	The Teak Tree	NT	LC
Shimul tula	*Bombax ceiba L.*	Bombacaceae	N	India, Myanmar, South China, Thailand	Cotton fuel wood	Simul, Tula Gachh	Red Silk Cotton Tree	NT	LC
Sindur	Bixa orellana L.	Bombacaceae	E	Tropical America	Coloring Material	Belati Haldi, Latkan	Annatto, Listict Plant	NMT	LC
Sissoo	*Dalbergia sissoo DC.*	Leguminoceae	N	India, Bhutan, Myanmar Pakistan Afganistan	Timber	No	Sissoo, South Indian Red Wood	NMT	LC

Sofeda	*Manikara zapota (L.) P.Royen*	Sapotaceae	E	West indies, Tropical America	Fruit	No	Sapodilla, Naseberry, Sapota	NT	LC
Sonalu	*Cassia fistula L.*	Caseslpinieae	N	Tropical Asia	Fuel wood	Sonali, Bandar Lathi	Golden Shower Tree, Purging cassia	NMT	LC
Sora	Streblus asper Lour.	Moraceae	N	Bhutan, Cambodia, China, India, Laos	Medicinal Value and Leaves for Wood & ivory polishing	Sheora, Harbi, Hekra, Harban	Siamese Rough Brush, Tooth Brush Tree	NT	LC
Supari	*Areca catechu L.*	Palme	E	Malaysia	Fruit and Timber beam	Gua	Betel nut palm, Areca nut palm	No Apparent Threat in known	LC
Tal	*Borassus flabellifer L.*	Palmae	N	Indiia, Pakistan, Bangladesh	Fruit and Timber beam		Palmyra Palm, Toddy Palm	Less plantation and Increased felling	LC
Tetul	*Tamarindus indica L.*	Leguminoceae	E	Tropical Africa	Wood ,fruit	Tentul, Amli,Ambli	Tamarind	NT	LC
Tok Komla	*Citrus reticulata Blanco*	Rutaceae	E	South East Asia	Fruit & Medicinal Value	Komla, Komla Lebu	Mandarin, Orange	NMT	LC
Ulotkambal	*Abroma augusta (L.) L.f*	Stercullaceae	N	India, Warmer Parts of china	Medicine	Tambol	Devil's Cotton	Over-exploitation	NT

List of Shrubs

Local Name	Scientific Name	Family	Origin	Native Country	Local Uses	Other Local Name	English Name	Threats to species	Conservation Status
Arhar	*Cajanus cajanifolius (Haines) Maesen*	Febaceae	N	Tropical Africa, India, Pakistan, New Guinea	Food crop	Arual	Pigeon Pea, Cajanus Pea, Red Gram	NAT	LC
Bashak	*Justicia adhatoda L.*	Acanthaceae	N	India, Laos, Vietnam.	Medicinal value	Vasak, Alok-bizak	White Draagon's Head	NMT	LC
Berachita	Pedilanthus tithymaloides Poit.	Euphobiaceae	N	India	Milky latex for warts and scorpion sting, Roots for emetic	Rangchita, Belatisiz	Jew's Slipper	NMT	LC

Buj									
Dumur	*Ficus hispida L.f.*	Moraceae	N	India, Pakistan, Myanmar, China, Malaysia, Australia	Fruit	Kakdumur	Opposite-leaved Fig, Rough-leaved Stem Fig	NT	LC
Golab/Rose	Rosa chinensis Jacq.	Rosaceae	E	China & India	Ornamental	Kanta Golab	Tea Rose	NMT	LC
Gondhoraj	*Gardenia jasminoides J.Ellis*	Rubiaceae	E	China, Japan	Ornamental	No	Gardenia, Cape jasmine	NMT	LC
Hamjum	Polyalthia suberosa (Roxb.)Bentn and hook		N	India,Sri lanka, Mtanmar	Fruits	Barachali, Murmuri, Kukuriam	No	NMT	LC
Hasna-hena	*Cestrum nocturnum L.*	Solanaceae	E	West Indies	Ornamental	No	Night Jesmine	NAT	LC
Joba	*Hibiscus rosa-sinensis L.*	Malyaceae	E	China	Ornamental	Rokta Joba	China Rose, Shoe Flower	NAT	LC
Kagoji Lebu	*Citrus aurantiifolia (Christm.) Swingle*	Rutaceae	E	East Indies	Fruit	Pati lebu	Lime, Sour Lime, Common Lme	NMT	LC
Kamini Ful	*Murraya paniculata (L.) Jack*	Rutaceae	N	South and Southest asia	Ornamental	Kamini	Cosmetic Bark, Orange Jasmine	NAT	LC
Karabi	Thevetia peruviana (Pers.) K.Schum.	Apocynaceae	E	Tropical America	Ornamental	Halde Karabi, Kalki Phul, Kanai Phul	Lucky Nut, Yellow Oleander	NT	LC
Karamcha	*Carissa carandas L.*	Leguminoceae	N	India, Malaysia	Medicinal value	No	Christ's Thorn	NMT	LC
Kathal Ful	*Artabotrys odoratissimus R.Br.*	Annonaceae	E	China	Ornamental	Kanthali Champa	Climbing Ylang-ylang	Less cultivated now a days, due to the scarcity of land	LC
Kaujinga									
Lalbherenda	Jatropha gossypifolia L	Euphobiaceae	N	South America	Ornamental and Medicinal value	Laljeol	Bellyache Nettle Spurge	NT	LC
Mehedi	*Lawsonia inermis L.*	Lythraceae	E	Africa, Arabia, Egypt, Srilanka, Pakistan< India	Leaves used as color	Mendi, Sudi	Henna, Indian Privet, Mignonette Tree	NT	LC
Momfol									
Nimbut									
Nishinda	Vitex negundo L.	Verbanaceae	N	India, Nepal, Bhutan, Indo-China, North Africa	Medicinal Value	Bara-nishinda	Indian Privet, Five-leaved Chaster Tree	NMT	LC

Patabahar	*Codiaeum variegatum (L.) Rumph. ex A.Juss.*	Euphobiaceae	E	Pantropical	Ornamental	No	Golden Ring Croton	NMT	LC
Pholsa	Grewia asiatica L.	Malvaceae	N	India And Sri Lanka	Vegetable and medicine	No	Phalsa	NMT	LC
Piyara	*Psidium guajava L.*	Myrtaceae	E	India, Myanmar.	Fruit	Sabri Aam	Guava	NT	LC
Potka	Microcos paniculata	Malvaceae	N	China, Myanmar & Indo-Malaysia	Medicinal value	Pichandi, Aar	No	NMT	LC
Potka	Microcos paniculata L.	Malvaceae	N	China, Myanmar & Indo-Malaysia	Medicinal value	Pichandi, Aar	No	NMT	LC
Rajanigondha	*Polianthes tuberosa L.*	Agavaceae	E	Mexico, Trinidad	Medicene for gonorrhoea, Ornamental	No	Tuberose	NMT	LC
Rangan Phul	Ixora coccinea L.	Rubiaceae	N	Sri Lanka, India, Pakistan	Ayurveda and folk Medicine	Jhumka phul, Rajana	Flame of the Woods	NT	LC
Roktokeuta									
Sheuli	*Nyctanthes arbor-tristis L.*	Nyctanthaceae	N	Sub Tropical Himalaya, India, Pakistan,Myanmar	Flower and ornamental	Shefali, Shefalica	Night-flowering Jasmine, Coral Jasmine,Sorrowful Tree	NMT	LC
Vati	Clerodendrum viscosum Vent.	Verbanaceae	N	India, Myaanmar,China,Thailand.	Medicinal value	Bhant, Ghetu, Ghetuphul	No	NT	LC

List of Herbs

Local Name	Scientific Name	Family	Origin	Native Country	Local Uses	Other Local Name	English Name	Threats to species	Conservation Status
Shatabdi Udvid	*Agave americana* L.	Agavaceae	E	Maxico	Fiber is used for making twine, ropes, cloth and sacks	Shatabarshi Udvid	Century Plant, American Aloe	NMT	Lc
Apang	Achyranthes aspera L.	Amaranthaceae	N	Tropic and wormer region of world	Medicinal value	Bilaikhamchi, Upatlengra	Prickly Chaff-flower	NMT	LC

Bas	*Dendrocalamuslongispathus Kurz.*	Poaceae	N	India, Northern Thailand & Myanmar	Construction work	Khang,Ora, Rupai, Taro	No	Indiscri minate harvestin g	NE
Begun	*Solanum melongena L.*	Solanaceae	E	South Asia	Vegetable	Baigun	Brinjal, Egg Plant, Aubergine	NT	LC
Cactus	Pachycereus pringlei (S.Watson) Britton & Rose	Cactaceae	E		Ornamental	No	No	NT	LC
Chutra	*Laportea cuneata (A. Rich.) Chew\ Laportea interrupta L.*	Urticaceae	N	Bangladesh	Medicinal value	Lal Bichuti	No	NMT	LC
Data Shak	*Amaranthus lividus Roxb.*	Amaranthaceae	N	Bangladesh	Vegetable,weeds, parasites,medicine	Gobura Notey	Livid Amaranth	NMT	LC
Dhaincha	Sesbania bispinosa (Jacq.) W.Wight	Fabaceae	E	Bangladesh	Green manure, rice straw, wood and fodder	No	No	NT	LC
Dhalia Ful	Dahlia pinnata Cav.	Asteraceae	E		Ornamental			NT	LC
Dheros	*Abelmoschus esculentus (L.) Moench*	Malvaceae	E	Southeast Asia	Vegetable	Bhendi	Lady's Finger, Okra	NT	LC
Dudmann Kachu	*Colocasia oresbia A.Hay.Sandakania*	Araceae	N	Indonesia	Vegetable and Ornamental	Sadakachu	NO	NAT	VL
Dupur ful	*Pentapetes phoenicea L.*	Nyctagineae	E	Sri Lanka, India, Australia, China, Japan, USA, Cuba	Ornamental	Bandhuli	Noon Flower, Copper Cup, Scarlet Mallow	NT	LC
Fern	*Pteris vittata L.*	Pteridaceae	N	India, Malaysia	Arsenic Indicators and Vegetable	Dhekia	Fern	Habitat Destracti on	LC
Gada Ful	*Tagetes erecta L.*	Asteraceae	E	Mexico	Medicinal value and decorative	Genda	African Marigold	NT	LC
Gatkol	Typhonium roxburghii schoot	Araceae	N	South India And Sri Lanka	Not Known	No	No	Deforest ation and Habitat Destructi on	VL
Ghritakumari, Aloe Vera	*Aloe vera (L.) Burm.f.*	Asphodelaceae	E	Tropics & Sub Tropics	Ornamental and Medicinal value	Ghritakanc han, Musabbar	Barbados Aloe, Medicinal Aloe	NMT	LC
Gotmann Kachu		Araceae	N		Vegetable				
Guri Kachu	Colocasia affinis Schott	Araceae	N	Tropical Himalayan & South West India	Vegetable	No	No	Deforest ation & Habitat	VL

								Destructi on	
Holud	*Curcuma longa L.*	Zingiberaceae	N	Tropics	Dyes and Medicine	Haldi	Turmeric	NT	LC
Jolpan/Dudh Kachu	*Xanthosoma violaceum schott*	Araceae	E	West Indies and South America	Vegetable and Ornamental	No	Blue Taro, Purple Stem Taro	NMT	LC
Kalo Kachu	*Colocasia esculenta (L.) Schott*	Araceae	N	Bangladesh	Vegetable and Ornamental	Kachu	Taro, Coco-Yam	NT	LC
Kola	*Musa paradisiaca L.*	Musaceae	N	Tropical asia	Fruit, Fiber	Kanch Kola	Banana	NAT	LC
Kolabati	*Canna indica L.*	Cannaceae	E	Tropic & sub Tropic Region	Ornamental	Sarbajoya	Indian Shot, Canna Lily	NT	LC
Man Kachu	*Alocasia macrorrhizos (L.) G.Don*	Araceae	N	India, Pacific island	Vegetable and Ornamental	Fankachu	Giant Taro	NAT	LC
Mikeful	*Amaryllis belladonna L.*	Amaryllidaceae	E		Ornamental	No	No	NT	LC
Modina									
Morich	Capsicum frutescens L.	Solanaceae	E	Tropical America	Vegetable	Kacha Morich, Lanka Morich	Spur piper, pepper, chilloes	NAT	LC
Morog ful	*Celosia argentea L*	*Amaranthaceae*	N	Throught India, Sri Lanka	Ornamental	Shet Morog Phul	Cock's Comb, Quail Grass	NMT	LC
Olkachu	*Amorphophallus paeoniifolius Dennst.*	Araceae	N	India, Sri Lanka, Java	Vegetable and Medicinal value	No	Elephant -Yam	NMT	LC
Palao Pata	*Pandanus amaryllifolius Roxb.*	Pandanaceae	N	Malaya	Cooking and medicene	No	Small Screw Pine	NT	NE
Pani Kochu	*Colocasia lihengiae C.L.Long*	Araceae	N	Yunnan (Southern China)	Vegetable and Ornamental	No	No	Deforest ation & Habitat Destructi on	VL
Patahorkuchi	*Bryophyllum pinnatum (Lam.) Oken*	Crassulaceae	E	Pantropical	Ornamental and Medicinal value	Kaphpata, Gatrapuri	Life Plant, Floppers	NT	LC
Pathabahar Kochu	Caladium bicolor Ait.	Araceae	N	South America, From Panama to Bolivia	Ornamental	No	Fancy-leaved Caladium	Defoores tation and Habitat Destructi on	VL
Peperomia	Peperomia pellucida L.	Piperaceae	E	Tropical America	Medicinal Value	Luchi pata	Shiny Bush, Pepper Elder	NT	LC

Piaj Ful	Zephyranthes grandiflora Lindl.	Liliaccae	E	Warmer Part Of America	Ornamental	Golapi Ghashphul	Pink Rain Lily, Fairy Lily, Zephar Lily	NT	LC
Pteris	*Pteris vittata L.*	Pteridaceae	N	India, Malaysia, The Tropics & Sub Tropics	Ornamental	Dhekia	Fern	Habitat Destruction	LC
Sadaful/Sadapakha togor	Tabernaemontana corymbosa Roxb.	Apocynaceae	E	China,India, Indonesia, Laos.	Ornamental, Not Known	No	Flower of love	Habitat Loss	NE But seem to be rare
Soya Bean	*Glycine max (L.) Merr.*	Leguminasae	E	India,Pakistan ,Nepal	Oil	Gari Kalai,	Soya Bean, Soybean	Nt	LC
Suti/shoti	Curcuma zedoaria (Christm.) Roscoe	Zingiberaceae	N	Bhutan, India, Indonesia, Malaysia	Spice	Failla	Zedoary	NMT	LC
Thankuni	*Centella asiatica (L.) Urb.*	Apiaceae	N	Tropics & Sub Tropics Of the New And Old World	Medicinal value	Thulkuri, Brahmabuti , Brahmokuti	Indian Pennywort Spadeleaf	NMT	LC
Time Ful	Gomphrena globosa L.	Amaranthaceae	E		Ornamental				
Tulshi	Ocimum sanctum L.	Lamiaceae	E	Old Tropics, China, Japan, Australia	Medicinal value	Kalo Tulshi	Sacred Basil	NMT	LC
Ada	Zingiber officinale Rosc.	Zingiberaceae	N	Tropical Asia	Medicinal Value & Spice	No	Ginger	NT	LC
Cycus									
Kochori	*Colocasia mannii Hook.*	Araceae	N	Assam of India	Vegetable & Medicinal Value	No	No	Deforestation & Habitat Destruction	VL

List of Climbers

Local Name	Scientific Name	Family	Origin	Native Country	Local Uses	Other Local Name	English Name	Threats to species	Conservation Status
Angur	Vitis vinifera *L.*	Vitaceae	E	Central Europe, and southwestern Asia, from Morocco and Portugal north to southern Germany and east to northern Iran	Fruit and Wine	No	Grape	NT	LC
Chal Kumra	Benincasa hispida (Thunb.) Cogn.	Cecuritaceae	N	Tropical & Subtropical Countries	Vegetable	No	Wax Gourd, White Gourd	NMT	LC
Akanadi	Stephania japonica Thunb.	Menispermaceae	N	India, Nepal, singapore	Medicinal Value	Nimukha, Raj Pathda	Snake Vine, Stephania	NMT	LC
Beli Ful	*Jasminum sambac L.*	Oleaceae	E	India, Malaysia, Indonesia	Flower, Medicinal Value and ornamental	Bely.Ban Mallika, Mogra	Arabian Jasmine	NAT	LC
Borbiti Sim									
Chui Jhal	*Piper retrofractum Vahl*	Piperaceae	N	Thailand,India & china	Culinary use/cooing	Choi,Chab	javanese Long Pepper	NT	LC
Dhundul	*Luffa acutangula (L.) Roxb.*	Cucurbitaceae	N			Tita Dhundul	Sponge Gourd	NMT	LC
Goros	Tinospora crispa L. Hook	Menispermaceae	N	India, Myanmar, Thailand, Cambodia, South China,Java	Medicinal Value	Gulancha	No	Habitat Loss	NT
Harjora lota	*Cissus quadrangularis L.*	Vitaceae	N	Bangladesh, India, Sri Lanka, Africa, Arabia, and Southeast Asia	treatment of bone fracture, menstrual disorder and scurvy, digestive problems.	Harbhanga Lota	Veld grape,Devil's backbone, Bone setter,Climbing cactus		
Jarmani Lota	Mikania cordata (Burm.f.) B.L.Rob.	Asteraceae	N	Tropical Asia, Philippines, Papua New Guinea	Remedy for snakebite, Medicinal	Assam-lata, Tarulata	Heartleaf Hempvine	NT	LC

Jhinga	*Luffa acutangula (L.) Roxb.*	Cucurbitaceae	N	China, India, Pakistan, Nepal, Malaysia, Russia	Vegetable	Ghosalata	Angled Loofah, Ridged Gourd	NMT	LC
Jolpan Alu									
Kakrol	*Momordica dioica Roxb. ex Willd.*	Cucurbitaceae	N	Australia, China, Indo-malaya, India	Vegetable	Golkak	Sweet Gourd, Giant Spine Gourd	NMT	LC
Kalmi shak	*Ipomoea aquatica Forssk.*	Convolvulaceae	N	Circumtropical	Shak	No	Swamp Cabbage, Water Spinach	NMT	LC
Kola Sheem	Canavalia virosa Roxb	Fabaceae	N	Tropical Africa	Vagitable and medicinal	Kath Shim	Wild Sword Bean	NT	LC
Lajjabati	Mimosa pudica L.	Febaceae	E	South America	Ornamental	Sarminda	Sensitive Plabt	NT	LC
Lau	*Lagenaria siceraria (Molina) Standl.*	Cucurbitaceae	N	Africa, China, India, Japan	Vegetable	Kodu, Pani Lau	Bottle Gourd, Club Gourd	NMT	LC
Madhabilata	*Hiptage benghalensis (L.) Kurz*	Malpighiaceae	N	India, Myanmar, China, Taiwan, Indonesia, Sri Lanka	Ornamental and Medicinal value	Madhubla ta, Basanti	Hiptage	NT	LC
Mati Alu	*Dioscorea alata L.*	Dioscoreaceae	N	Bangladesh	Madicinal value and vegetable	Chupri alu, Kham Alu	Greater Yam, Water Yam, White Yam	NAT	LC
Misti Kumra	*Cucurbita moschata Duchesne*	Cecuritaceae	E	Bolivia, Southern Peru & Northern Argentina	Vegetable	Mithakum ra	Pumpkin, Winter Squash	NMT	LC
Papoli	Piper sylvaticum Roxb.	Piperaceae	N	India, Myanmar,Nepal & Bhutan	Fruits are carminative & appetizer	Bon Pan, Pahari Pipal	No	Deforestation	CD

Patol	Trichosanthes dioica Roxb	Cucurbitaceae	N	Tropic	Vegetable	No	Pointed Gourd	NMT	LC
Poi-shak	*Basella alba L.*	Basellaceae	E	Tropic of old World	Vegetable	Poi, Putika	Sri Lankan Spinach, Indian Spinach	NT	LC
Sheem	*Lablab purpureus (L.) Sweet*	Leguminosae	N	Bangladesh	Vegetable	Urshi, Ushi	Lablab, Hyacinth Bean	NT	LC
Shornolota	Cuscuta reflexa Roxb.	Cuscutaceae	N	India, Sri Lanka, Malaysia	Ornamental	Swarnalata	Giant Dodder	NT	LC
Telakucha	*Coccinia grandis (L.) Voigt*	Cucurbitaceae	N	Africa, China, India, Japan	Medicinal value and weed control	No	Ivy Gourd, Scarlit Fruited Gourd	NMT	LC
Uchta	*Momordica charantia L.*	Cucurbitaceae	N	Tropical Country	Vegetable and medicine	Uchchhey	No	NMT	LC

Here, N = Native, E = Exotic, NMT = No Major Threat, NAT = N0 Apparent major Threat, NT = No Threat, LC = Least Concern, NE = Not Evaluated, VL= Vulnerable