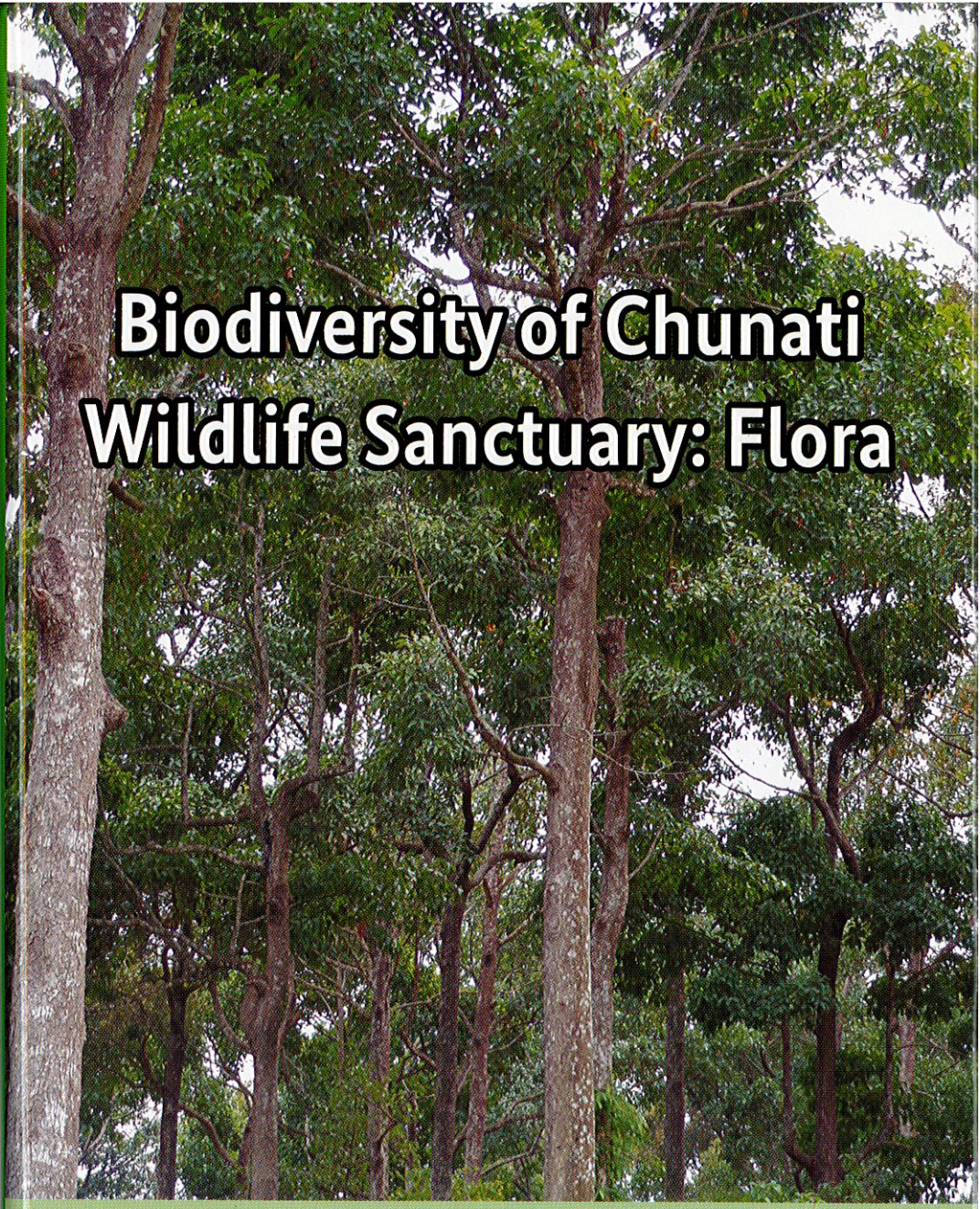

Biodiversity of Chunati Wildlife Sanctuary: Flora

Mohammed Kamal Hossain
Md. Akhter Hossain

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ARANNAYK FOUNDATION
Conserving forests for the future

Biodiversity of Chunati Wildlife Sanctuary: Flora

Mohammed Kamal Hossain
Md. Akhter Hossain

This book is made possible by the support of Management of Natural Resources and Community Forestry (MNRCF-Chunati) project implemented by Bangladesh Forest Department and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) and Arannayk Foundation.

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A natural forest patch of Puichari beat, Chunati Wildlife Sanctuary by Dr. Mohammed Kamal Hossain

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Authors

Preface

Biodiversity conservation for better future is one of the hot issues of present world, as global biodiversity is under severe threat because of population pressure, over extraction of natural resources along with other anthropogenic disturbances. Bangladesh is also facing the same fate as the country possesses limited natural resources with huge population. However, the Government of Bangladesh is trying to conserve biodiversity through both *in-situ* and *ex-situ* conservation initiatives. Meanwhile, Bangladesh Forest Department established 37 Protected Areas for protecting the country's diverse flora and fauna. Chunati Wildlife Sanctuary is one of the most familiar Protected Areas among them.

Chunati Wildlife Sanctuary harbours rich floral and faunal diversity with dense natural patches of Garjan (*Dipterocarpus* spp.), Boilam (*Anisoptera scaphula*) etc. But, severe deforestation, human settlement, agricultural expansion within the Wildlife Sanctuary caused significant degradation of it's rich floral and faunal resources. Bangladesh Forest Department in collaboration with different national and international NGOs has taken several research and development projects to improve the overall forest resources and livelihood conditions of the local peoples living in and around the forests of Chunati Wildlife Sanctuary.

Measuring and monitoring of changes in biodiversity and ecosystem status is important to evaluate the impacts of conservation activities. Presently, Bangladesh Forest Department and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is implementing a project titled "Management of Natural Resources and Community Forestry (MNRCF-Chunati)" funded by German Cooperation and Arannayk Foundation. In implementing the project, an initiative has been taken to assess the present floral diversity, forest tree structural composition and regeneration status of native tree species in Chunati Wildlife Sanctuary.

This publication is the outcome of the mentioned initiative. The study revealed that, the Wildlife Sanctuary harbours diverse floral resources (691 plant species including 240 trees, 102 shrubs, 211 herbs, 106 climbers, 19 ferns, 7 epiphytes and 6 parasites) with a significant occurrence of exotic tree species plantation. However, the natural regeneration potential of the sanctuary is promising. The book also noted significant anthropogenic disturbances (i.e. illegal felling, betel leaf cultivation, burning by incendiary fire etc.) and agricultural expansion within the areas of Chunati Wildlife Sanctuary.

This book will be an immense help in providing information about the floral diversity of Chunati Wildlife Sanctuary to the relevant stakeholders. The book will also help the Forest Department and researchers as baseline information for future planning, management and biodiversity conservation of Chunati Wildlife Sanctuary.

Authors

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Chapter 1

Introduction

The Chunati Wildlife Sanctuary (CWS), formerly a part of the reserved forests of Chittagong Forest Division, was designated as Protected Area on 8 March 1986 through a Gazette Notification No. 12/For.-1/84/174 (Green 1990). It is situated at a distance of about 70 km south of Chittagong city, lying approximately 21°48′ – 22°05′ North latitude and 91°57′ – 92°07′ East longitude. The Sanctuary is bounded on the east partly by Chittagong – Cox's Bazar highway **(Figure 1)**.

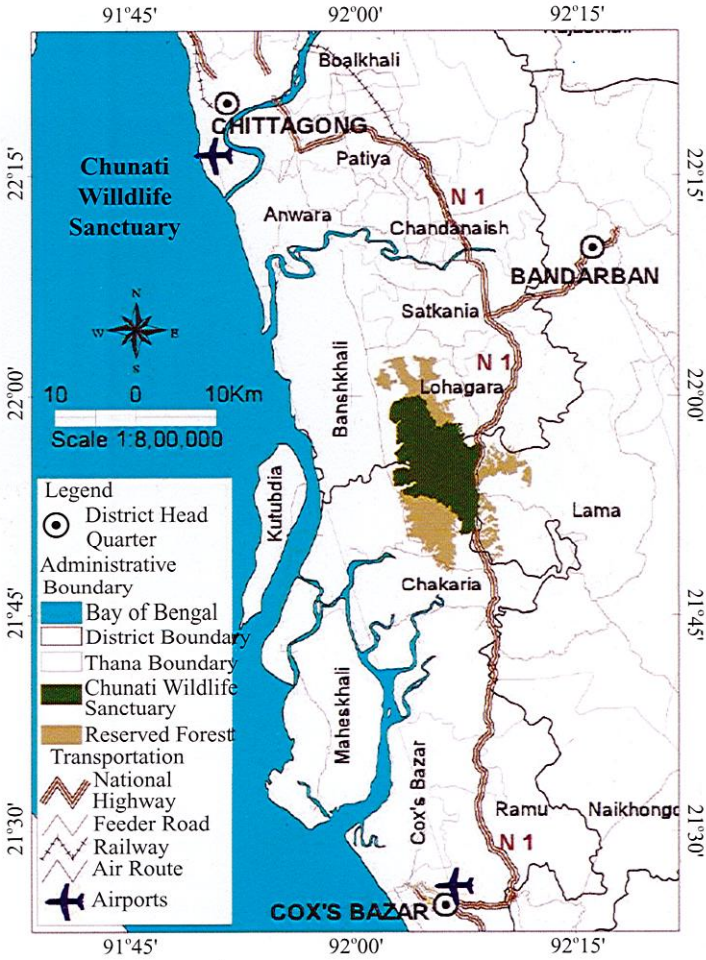
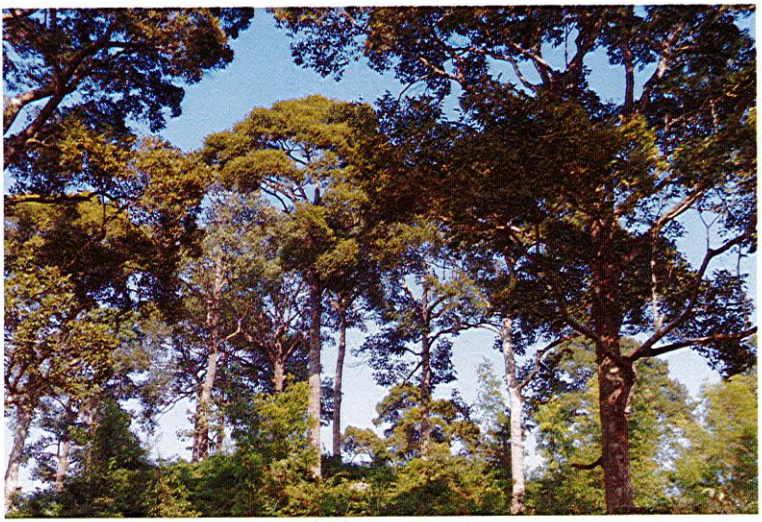


Figure 1. Location of Chunati Wildlife Sanctuary beside Chittagong - Cox's Bazar highway

The forest of Chunati Wildlife Sanctuary (CWS) is of tropical mixed evergreen type. It consists of undulated and fragile landscape. The forest of Chunati Wildlife Sanctuary is familiar as a natural patch of Garjan (*Dipterocarpus* spp.) and Boilam (*Anisoptera scaphula*). It is also recognized as a natural habitat of Asian elephant. The forest was once rich with dense flora and fauna, but it was almost degraded gradually in the eighties and nineties due to severe deforestation and biotic interferences. The forest was declared as wildlife sanctuary in 1986 with an aim to establish an undisturbed feeding, resting and breeding habitat for wildlife by stopping deforestation, biotic encroachment, and restoration of native vegetation coverage.



A remnant *Dipterocarp* (Garjan) patch in Chunati WS

Conservation of wildlife and their habitat by retaining floral population was another main purpose of establishing the wildlife sanctuary. Massive plantation activities with some exotic and native plant species were conducted for achieving rapid coverage in the sanctuary area after its establishment. But, many of the plantations and conservation initiatives were failed to achieve the desired targets due to local interference, weak implementation and improper management system. In the meantime, a substantial area of the forest was encroached by illegal human settlement and expansion of the agricultural crops.

Lack of awareness among local people regarding biodiversity conservation and livelihood dependency on forest was understood as

the main problem that lies behind the failure of conservation programs and initiatives. Nishorgo Support Program, Integrated Protected Area Co-management (IPAC), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Arannayk Foundation and recently United States Agency for International Development (USAID) came with their development projects for Chunati Wildlife Sanctuary. All of their development activities focused mainly on raising awareness among the local people for forest protection and biodiversity conservation, providing alternative income generation opportunity and achieving better forest coverage through biodiversity conservation and plantation activities. They also helped the local people by providing improved cooking stoves, small loan with easy conditions and incentives for farming. Co-management Committee (CMC), Community Patrol Group (CPG) and Village Conservation Forum (VCF) were formed involving local people in collaboration with Forest Department (FD) to strengthen the co-management programs of Chunati WS. Now-a-days, local people are conscious enough about importance of biodiversity conservation, and eagerly get them involved in conservation programs (Nath 2012).

The present Chunati WS comprising of Jaldi Range and Chunati Range covers an area of 7,764 ha. Administratively the sanctuary is managed under seven forest beats namely Chunati, Aziznagar, Harbang, Puichari, Napora, Chambol and Jaldi. A few secondary natural forest patches are available that have been regenerating largely through natural processes.

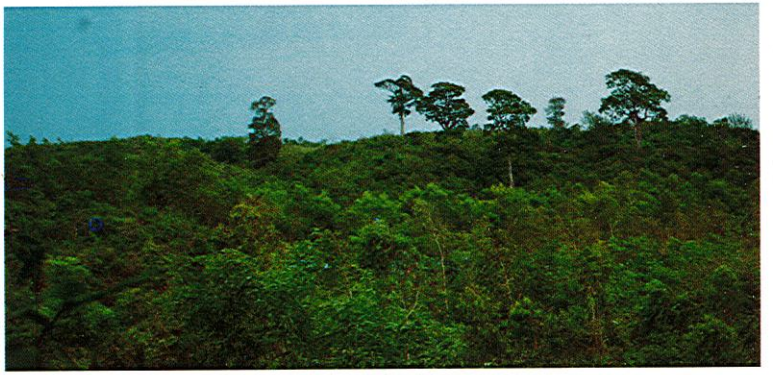
Continuous deforestation made the hills allmost barren in the core areas of Chunati WS

Because of significant disturbances to the original forest vegetation, major differences were found in forest structure and composition with the primary forests. During the recent periods of regrowth, the mixing of native and alien tree species has generated mix forests of both exotic and indigenous forest formations. Areas suffering from excessive fire are converted to grasslands. The fire adapted grass, *Imperata cylindrica*, is dominant in notable number of forest patches.

Chunati Wildlife Sanctuary includes 428.71 ha buffer zone plantation, 1,123 ha long rotation plantation, 243.3 ha fruits and fodder species plantation, 81 ha medicinal plantation, 76.66 ha enrichment plantation, and natural forests are scatteredly distributed in the rest of the areas (IPAC 2011).

Agricultural expansion and inhabitation in Chunati WS

Repeated fires in the dry season cause dying of regeneration and young plants



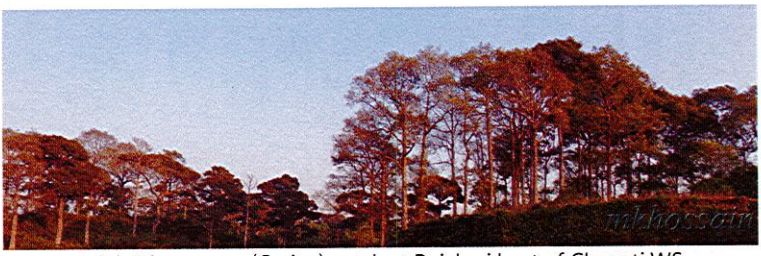
Scattered *Dipterocarp* trees surrounded by exotic Akasmoni trees

Several studies were conducted to assess the flora and population dynamics of vegetation resources of the Chunati WS (Khan 1990, Khan and Huq 2001, Rahman and Hossain 2002 and 2003, Nath 2012). All of these studies were reported from various aspects of flora of Chunati WS, where only Khan and Huq (2001) completely assessed all the flora of Chunati WS. But, in the meantime many native plant species were disappeared from Chunati WS along with the introduction of many exotic plant species, haphazard fire, continuous grazing etc. Considering the prevailing factors, it became necessary to assess the existing floral composition and the changes overtime in the Chunati WS. Hence, the study was conducted in Chunati WS with the following objectives.

Objectives

- Develop a biodiversity (Flora) database to provide information on the status of species and ecosystems of the Chunati WS
- Measuring the quantitative status of the tree species
- Documenting the qualitative assessment of the total flora
- Assess the threats of Alien Invasive Species (AIS) in terms of occurrence, distribution and abundance, and
- Identify the species of special conservation value including the natural regeneration status.

A rich Garjan patch at Puichori beat of Chunati WS



A rich *Dipterocarp* (Garjan) patch at Puichari beat of Chunati WS

Betel leaf cultivation in Chunati WS

Farm house (encroachment) in the core region of Chunati WS

Chapter 2

Methodology

2.1 Methods of the study

Information about the study area was collected from Chittagong Wildlife Management and Nature Conservation Division, Chittagong South Forest Division and concerned seven beat offices of Chunati and Jaldi Wildlife Ranges. The relevant literature was reviewed from different books, journals and published papers. The field methods followed for this survey were designed variously considering the topography, existing degraded landscape, climatic and edaphic conditions of Chunati WS. The field work was conducted in all the seven beats during December 2012 to June 2013.

2.2 Reconnaissance survey

Discussion with respective authority of Forest Department was conducted to have an idea of the topography, vegetation composition, accessibility of the whole study area prior to selection of sampling procedures. Maps of Chunati WS were collected beat-wise to facilitate sample plot design. Two transact walks across the study area were made with the help of field assistants. Both the beat area and vegetation type were considered during the quadrat sampling of the area (**Figure 2**).

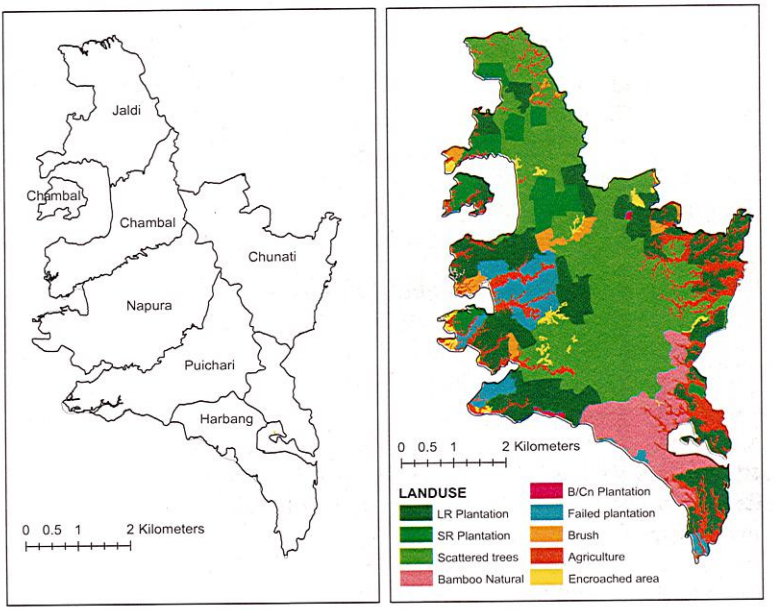


Figure 2. Beat boundaries and vegetation type of Chunati WS

2.3 Whole area survey

To assess floral composition of the Chunati WS, field work was done through whole area survey method that enabled field observations and plant specimen collections during the flowering and fruiting period of maximum number of species. More than 35 foot trails of substantial length in Chunati WS were surveyed for the assessment of floristic composition. Survey work was continued until the record and collection of new species were completed.

To assess the floristic composition, the observed plant species were identified, recorded and tagged in the field. Herbarium specimen of rare and unidentified plant samples with fertile material (flower, fruit and seed) were prepared for herbarium collection. Specimen with only vegetative part were also collected for herbarium preparation in case of unavailability of fertile materials. Photographs of the characteristic forest feature and plant species from suitable projection were taken in the wild to keep a digital record of morphological features of the plants. Herbarium with the collected specimen was prepared following standard scientific method and stored in the laboratory of the Institute of Forestry and Environmental Sciences, University of Chittagong.

2.4 Stratified random sampling

Stratified Random Sample method was used for the inventory of the tree species. The whole Chunati WS was divided into seven broad areas (block) considering the beat area, e.g. Chunati, Aziznagar, Harbang, Puichari, Napora, Chambol and Jaldi forest beat. Nine field trips including more than 45 days of field work was conducted during December, 2012 to June, 2013 to cover the whole study area.

20 m × 20 m sample plots (Quadrats) to assess floristic and structural composition: A total of 269 sample plots, each of 20 m × 20 m in size, were taken from all the seven blocks (Chunati 37, Aziznagar 19, Harbang 35, Puichari 42, Napora 54, Chambol 40 and Jaldi 42 plots) randomly to cover a sample area of 10.76 ha (**Figure 3**). Number of sample plots was determined based on the area of the respected forest block (beat). Sample plots were taken randomly in all the aspects and positions of hills. Plot locations were ensured in both the natural and plantation forest patches having few, medium and dense tree cover. Position of each sample plot was then recorded by a Ground Positioning System (GPS) device (**Appendix 1**). Then area of each plot was demarcated by measuring tape and rope. Plants having dbh >5 cm and at least

3 m height were considered as trees. In each plot all the tree species were identified by their local and/or scientific names. Their numbers were counted; total height and diameter at breast height (dbh) of the trees were measured using Suunto clinometer and diameter tape respectively. For multi-stemmed trees the bole dbh was measured below the forking. Each branch was considered as individual tree stem in difficult situation.

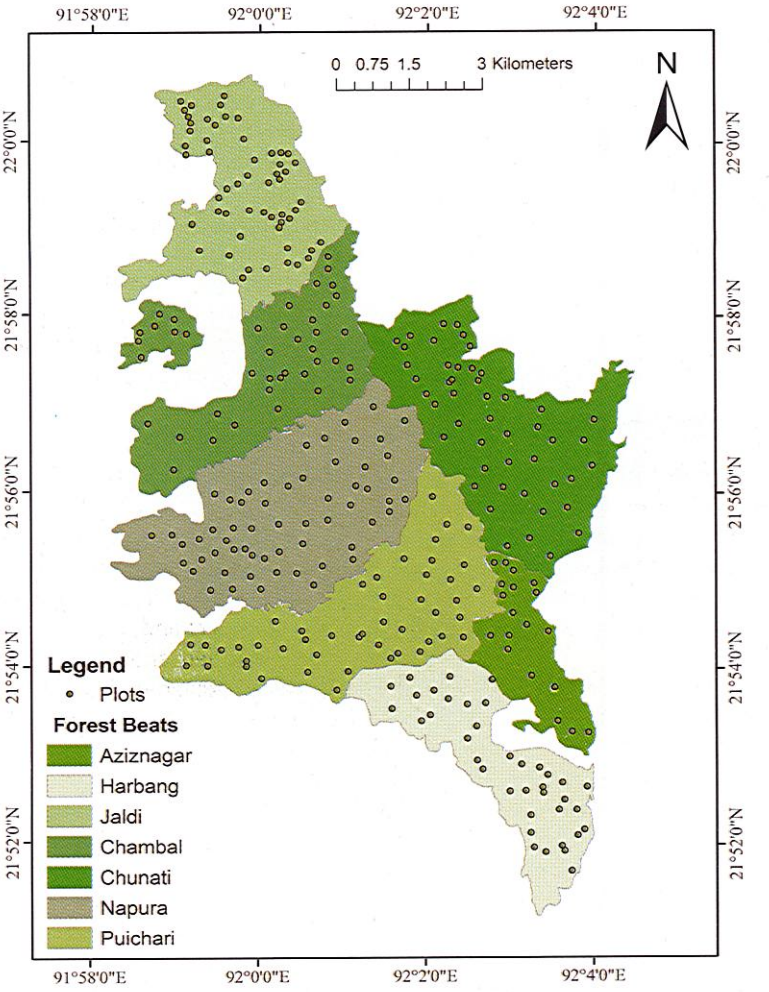


Figure 3. Position of sample plots taken in all seven Forest Beats of Chunati WS (Detail in Appendix 1)

Standard scientific methods of dbh measurement were followed in other critical situations, i.e. buttressed stem, leaned tree, slope, etc. Plant specimen were collected for the unidentified species and taken into polythene bag to ensure little damage and were then prepared for herbarium specimen following standard scientific methods. The fleshy specimen (for example fruits, seeds, etc.) were preserved within alcohol or other preservatives. Sampling with 20 m × 20 m sized plot was continued in each forest block until the species accumulation curve reaches to level off and plots cover all categories of land uses **(Table 1).**

Table 1. Range and beat areas (ha), number of quadrats taken and major vegetation types of Chunati WS

Serial No.	Range	Beat	Total Area (ha)	Quadrat No. (20 m × 20 m)	Available land use categories
1.	Chunati Range	Chunati	1159.10	37	• Natural patch • Plantations • Coppice forest • Barren areas • Agriculture farms • Homesteads, and • Wetlands/ swampy valleys
		Aziznagar	511.65	19	
		Harbang	939.65	35	
2.	Jaldi Range	Puichari	1354.65	42	
		Napura	1609.31	54	
		Chambol	1040.89	40	
		Jaldi	1148.58	42	
Total	02 Ranges	07 Beats	7763.83	269	

2.5 Sample plots to assess regeneration status

A total of 269 sample plots each of 5 m × 5 m in size from all the seven blocks (Chunati 37, Aziznagar 19, Harbang 35, Puichari 42, Napora 54, Chambol 40 and Jaldi 42 plots) were taken for the regeneration survey (**Figure 4**). Sample plots for regeneration were taken within the 20 m × 20 m main sample plot selected for tree species enumeration. Position of the sample plots were ensured in all the aspects and slopes of the hills in seven beats. The seedlings were identified and counted by species as well as their heights were measured. Regeneration process through seed originated seedling, coppice and root sucker was recorded from each of the regeneration plot.

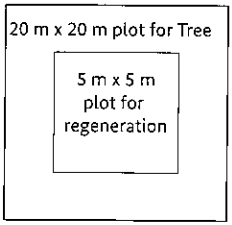


Figure 4. Quadrat design for tree species (20 m x 20 m) and regeneration (5 m x 5 m)

2.6 Homestead flora survey within Chunati Wildlife Sanctuary

Three homesteads from each beat situated within the boundary of reserve forest were surveyed for the floral estimation. The plants either planted or existed as parts of the natural forests within the homesteads were also recorded. Name of the plants of all habit form was recorded along with location of the homesteads by a GPS device.

***Equipments used in the field work*:** Measuring tape, GPS (Ground Positioning System), Diameter tape, Suunto clinometer, Scissor, Secateur, sharp knife, peg, rope, newspaper, art paper, camera, polybag, plant pressure, pencil, field notebook, data recording sheet, etc. were used during the field works to facilitate sampling and data collection.

Processing of the collected specimen: Collected plant specimen were dried in the sun following standard scientific method. For herbarium preparation the plant samples were mounted on sheets of standard size 29.21 cm × 41.91 cm (11.5"×16.5"). A tag with some important information like local name, scientific name, area of collection, habit, habitat, family, collector's name was attached with each sheet. The unknown samples were identified with the help of taxonomists of Bangladesh Forest Research Institute (BFRI) and Bangladesh National Herbarium (BNH). Consultation was done with published journals and reference books like Bengal Plants (Prain 1903), Encyclopedia of Flora and Fauna of Bangladesh (Ahmed *et al.* 2008) etc. to identify and verify the samples. The collected plant samples were preserved in the herbarium racks of the Seed Research Laboratory of Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU).

Analysis of field data: Identified plants were arranged taxonomically and categorized according to their habit form. The relative density, relative frequency, relative abundance and Importance Value Index (IVI) of tree species were calculated following the methods of Shukla and Chandal (2000). Height (m) and dbh (cm) were used to know structural composition based on height (m) and dbh (cm) classes. Four diversity indices, i.e. Shannon-Wiener's diversity index (H), Margalef's species richness index (R), Simpson's diversity index (D) and Species evenness index (E) were analyzed following Shannon and Wiener (1963), Margalef (1958), Simpson (1949) and Pielou (1966) respectively to get a picture of tree species diversity in Chunati WS. Sørensen's similarity index following Magurran (2004) was also calculated to show the similarity in tree species composition among the 7 different beats of Chunati WS.

$$\text{Relative density} = \frac{\text{Total no. of individuals of the species}}{\text{Total no. of individuals of all the species}} \times 100$$

$$\text{Frequency of a species} = \frac{\text{Total no. of quadrats in which the species occurred}}{\text{Total no. of quadrats studied}}$$

$$\text{Relative frequency} = \frac{\text{Frequency of one species}}{\text{Total frequency}} \times 100$$

$$\text{Abundance of a species} = \frac{\text{Total no. of individuals of a species in all the quadrats}}{\text{Total no. of quadrats in which the species occurred}}$$

$$\text{Relative abundance} = \frac{\text{Abdndance of one species}}{\text{Tatal abundance}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Basal area of one species}}{\text{Total basal area}} \times 100$$

IVI = Relative density + Relative frequency + Relative dominance

Margalef's index, R = (S-1)/Ln (N)

Shannon-Wiener's diversity index, $H = \sum_{i=1}^{n} P_i \ln P_i$

Simpson's diversity index, $D = \sum_{i=1}^{n} P_i^2$

Species evenness index, $E = \frac{H}{Ln\,(S)}$

Sørensen's Similarity index, $C_S = \frac{2AB}{A + B}$

Here, A = Number of species found in site/block A

AB = Number of species shared by both A and B sites

B = Number of tree species found in site/block B

H = Shannon-Wiener's diversity index

N = Total no. of individuals of all the species

P_i = Number of individuals of i^{th} species/Total number of individuals

S = Total number of species

Margalef's index (R) is high in communities that include a greater number of species and in which the number of individuals of each species decreases relatively slowly on passing from the more abundant to the less abundant ones (Margalef 1958). **Shannon-Wiener's diversity index** value is maximum when the number of individuals of all species is equal; value is zero if there is only one species (Shannon and Wiener, 1963). With **Simpson's diversity index (D),** 0 represents infinite diversity, and 1, no diversity. **Species evenness index (E)** also known as Shannon's equitable index, assumes a value between 0 to 1 with 1 being complete evenness (Pielou, 1966). **Sørensen's Similarity index** over species composition represent the variations in species diversity among different sites.

Natural portions of Chunati WS having bushy forest

Acacia plantation at Puichari beat

Agricultural practices within the boundary of Chunati WS

Chapter 3

Floristic Composition of Chunati WS and Categorization of Recorded Plants

Though the Chunati Wildlife Sanctuary is suffering from a number of biotic and abiotic interferences, the sanctuary contains considerably rich floral diversities with its irregular forest canopy. A total of 691 plant species belonging to 457 genera and 134 families were recorded from Chunati WS. Family Poaceae was represented by maximum 43 species under 31 genera followed by Euphorbiaceae (40 species under 22 genera), Fabaceae (38 species under 19 genera), Asteraceae (29 species under 25 genera) and Rubiaceae (29 species under 21 genera). Among the 134 families, 52 families were represented by only one species. On the other hand, top 20 families of the 134 families contain about 57% of all the 691 species. Among the 691 plant species, 687 are angiosperm and the remaining 4 species are gymnosperm.

Liliopsida: In the angiosperms, Liliopsida (monocot) were represented by 125 species belonging to 90 genera and 22 families. In Liliopsida (monocot), Poaceae appears to be the largest family containing 43 species under 31 genera followed by Cyperaceae (23 species and 12 genera) and Arecaceae (12 species and 9 genera). *Calamus guruba, Calamus tenuis, Calamus viminalis, Costus speciosus, Curculigo latifolia, Cynodon dactylon, Daemonorops jenkinsiana, Gigantochloa andamanica, Melocanna baccifera, Musa paradisiaca, Peliosanthes teta, Thysanolaena maxima* and *Zingiber zerumbet* are some of the commonly occurred native monocots of Chunati WS.

Magnoliopsida: Magnoliopsida (dicot) were represented by 543 species under 348 genera and 94 families. In Magnoliopsida (dicot), Euphorbiaceae family was represented by maximum 40 species under 22 genera followed by Fabaceae (38 species and 19 genera) and Asteraceae (29 speceis and 25 genera). *Ageratum conyzoides* (Ochunti), *Amaranthus spinosus* (Kantashakh), *Aporosa wallichii* (Castoma), *Anogeissus acuminata* (Sikori), *Argyreia capitiformis* (Vogalata), *Bridelia stipularis* (Pat khoi), *Calycopteris floribunda* (Guicha lata), *Chaetocarpus castanocarpus* (Atailla), *Chromolaena odorata* (Assamlata), *Clausena suffruticosa* (Kali moricha), *Combretum decandrum* (Kali guicha), *Combretum latifolium* (Sada guicha), *Connarus paniculatus* (Katgular), *Croton caudatus* (Horokjala), *Dalbergia stipulacea* (Dadbari), *Desmodium triquetrum* (Kala liya), *Dillenia scabrella* (Hargeza), *Dipterocarpus alatus* (Doillagarjan), *Dipterocarpus turbinatus* (Teliagarjan), *Eclipta alba* (Kalo kesor), *Ficus hispida* (Dumur), *Garcinia cowa* (Kao), *Glochidion multiloculare* (Pannyaturi), *Grewia nervosa* (Assargola), *Hedyotis scandens* (Latakami), *Holarrhena antidysenterica* (Kuruch), *Lantana camara* (Lantana), *Lithocarpus elegans* (Kali batna),

Lithocarpus polystachya (Shil batna), *Litsea glutinosa* (Karjuki menda), *Maesa ramentacea* (Lal moricha), *Melastoma malabathricum* (Bontezpata), *Mimosa pudica* (Lajjabati), *Morinda angustifolia* (Banamali), *Pseudoelephantopus spicatus* (Kukur gihba), *Syzygium fruticosum* (Putijam), *Syzygium claviflorum* (Nolijam), *Tabernamontana divaricata* (Tagor), *Urena lobata* (Ban-okra) and *Ziziphus oenoplia* (Bonboroi) are some of the native dicots that commonly occur in Chunati WS.

Pteridophyte: A total of 19 Pteridophytes belonging to 15 genera and 14 families were recorded from Chunati Wildlife Sanctuary. Athyriaceae, Lygodiaceae, Pteridaceae, Sinopteridaceae and Thelypteridaceae families contain maximum two species each.

Gymnosperm: *Araucaria cunninghamii, Gnetum montanum, Pinus oocarpa* and *Thuja orientalis* are the 4 gymnosperms belonging to 4 families were recorded from Chunati Wildlife Sanctuary.

Categorization of recorded plants based on habit form

All the 691 plant species recorded from Chunati Wildlife Sanctuary were categorized as tree, shrub, herb, climber, fern, epiphyte and parasite considering their habit form. Trees constitute the major category (240 species) of plant community followed by herbs (211 species), shrubs (102 species), climbers (106 species), ferns (19 species), epiphytes (7 species) and parasites (6 species) **(Figure 5)**. The number of family, genus and species of all categories of plants are shown in **Figure 6**.

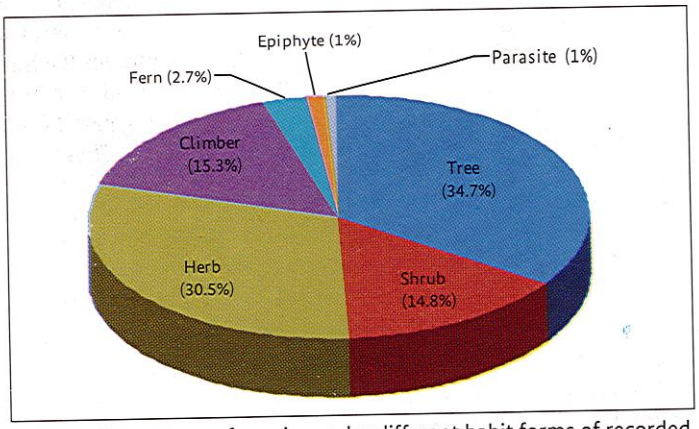


Figure 5. Percentage of species under different habit forms of recorded flora in Chunati WS

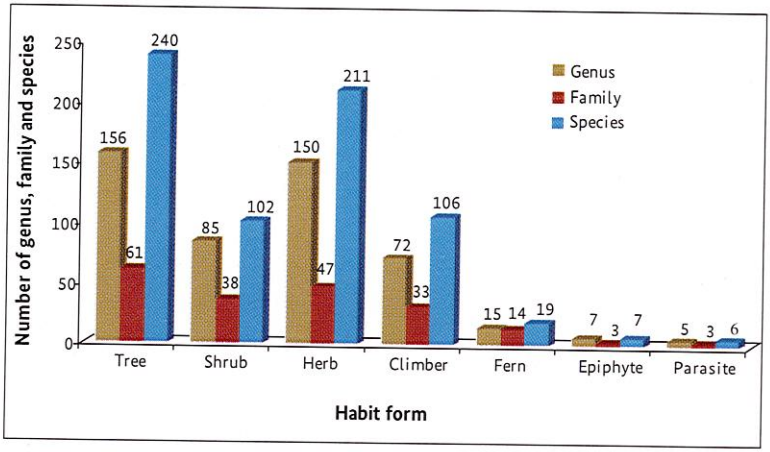


Figure 6. Number of genus, family ande species under different categories of plants recorded from Chunati WS

3.1 Trees

A total of 240 tree species belonging to 156 genera and 61 families were recorded from Chunati Wildife Sanctuary. Among them 169 species were recorded from the sample plots **(Figure 7)** and the remaining 71 species from the transects and homesteads. Euphorbiaceae family was represented by maximum 22 species under 13 genera, followed by Moraceae (19 species, 3 genera), Lauraceae (12 species, 7 genera) and Myrtaceae (12 species, 4 genera). The most common tree species of the wildlife sanctuary are *Acacia auriculiformis* (Akashmoni), *Aporosa wallichii* (Castoma), *Anogeissus acuminata* (Sikori), *Callicarpa arborea* (Bormala), *Chaetocarpus castanocarpus* (Atailla), *Dillenia scabrella* (Hargeza), *Dipterocarpus alatus* (Doilla garjan), *Dipterocarpus turbinatus* (Telia garjan), *Dipterocarpus costatus* (Baitta garjan), *Eucalyptus camaldulensis* (Eucalypts), *Ficus hispida* (Dumur), *Garcinia cowa* (Kao), *Glochidion multiloculare* (Pannyaturi), *Grewia nervosa* (Assar gola), *Holarrhena antidysenterica* (Kuruch), *Lithocarpus elegans* (Kali batna), *Lithocarpus polystachya* (Shil batna), *Litsea glutinosa* (Karjuki menda), *Macaranga denticulata* (Bura), *Maesa ramentacea* (Lal moricha), *Shorea robusta* (Sal), *Syzygium fruticosum* (Putijam), *Syzygium claviflorum* (Nolijam) and *Tectona grandis* (Shegun). The tree species along with their local and scientific name, family and common uses are provided in **Table 2.**

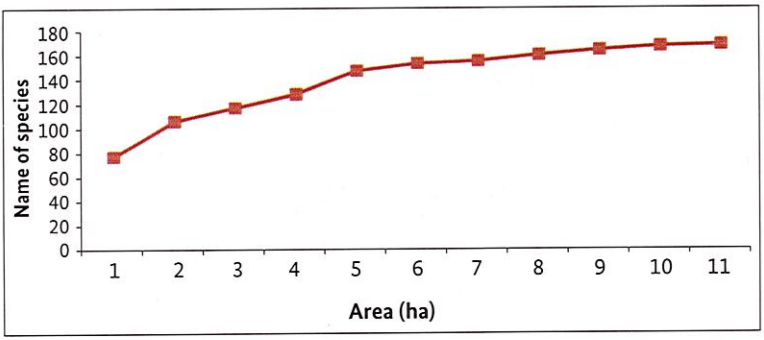


Figure 7. Species accumulation curve of tree species recorded from the quadrats in Chunati WS

According to the Forest Department official records, about 1952.67 ha plantation was raised in Chunati WS by the Forest Department (FD). Major plantation species are *Acacia auriculiformis* (Akashmoni), *Acacia mangium* (Mangium), *Syzygium firmum* (Dhakijam), *Dipterocarpus* sp. (Garjan), *Eucalyptus camaldulensis* (Eucalypts), *Shorea robusta* (Sal), *Tectona grandis* (Shegun), *Xylia xylocarpa* (Lohakath), *Anacardium occidentale* (Kajubadam), *Samanea saman* (Raintree) etc. Though the objective of the plantations was for better wildlife food provision, most of the species are non-palatable to wildlife. However, many fruit trees recorded from the homesteads situated within the wildlife sanctuary area are *Areca catechu* (Supari), *Averrhoa bilimbi* (Belombo), *Averrhoa carambola* (Kamranga), *Borassus flabellifer* (Tal), *Citrus reticulata* (Kamala), *Cocos nucifera* (Narikel), *Dillenia indica* (Chalta), *Diospyros blancoi* (Bilati gab), *Litchi chinensis* (Litchu), *Phoenix sylvestris* (Khejur). Some private horticultural orchards with *Mangifera indica* (Aam), *Psidium guajava* (Peyara), *Ziziphus mauritiana* (Boroi) were aslo noticed within the reserve forest areas of Chunati WS.

Acacia auriculiformis (Akasmoni)

Actinodaphne angustifolia (Modonmosta)

Among the 240 tree species, *Acacia auriculiformis* (Akashmoni), *Albizia procera* (Sada koroi), *Artocarpus chama* (Chapalish), *Dipterocarpus alatus* (Doilla garjan), *Dipterocarpus costatus* (Baitta garjan), *Dipterocarpus turbinatus* (Telia garjan), *Gmelina arborea* (Gamar), *Pinus oocarpa* (Pine), *Shorea robusta* (Sal), *Stereospermum colais* (Dharmara), *Tectona grandis* (Shegun), *Toona ciliata* (Chondon suruj), *Xylia xylocarpa* (Lohakath) etc. are important timber producing plants. In addition, *Acronychia pedunculata* (Bonjamir), *Albizia odoratissima* (Tetoya koroi), *Borassus flabellifer* (Tal), *Cassia fistula* (Sonalu), *Cordia dichotoma* (Bohal), *Diospyros malabarica* (Deshi gab), *Psidium guajava* (Peyara), *Samanea saman* (Raintree), *Syzygium cumini* (Kalojam), *Tamarindus indica* (Tentul) and *Tetrameles nudiflora* (Chandul) are economically important tree species as they provide multiple services, i.e. excellent fuel, medicinal and non-timber uses. Whereas, some tree species, e.g. *Aegle marmelos* (Bel), *Albizia odoratissima* (Tetoya koroi), *Albizia procera* (Sada koroi), *Alstonia scholaris* (Chatim), *Anogeissus acuminata* (Sikori), *Calophyllum inophyllum* (Punnayl), *Cassia fistula* (Sonalu), *Crateva magna* (Barun), *Diospyros malabarica* (Deshi gab), *Ficus benghalensis* (Bot), *Haldina cordifolia* (Haldu), *Glochidion multiloculare* (Pannyaturi), *Litsea glutinosa* (Karjuki menda), *Phyllanthus emblica* (Amloki), *Ricinus communis* (Varenda) and *Streblus asper* (Sheora) have substantial ethnobotanical importance. These plants are mainly used for medicinal, food and minor forest produce extraction purposes (Chopra *et al.* 1956, Raghavan 1993, Caius 1998, Pal and Jain 1998, Kumar and Srivastava 2002, Chakma *et al.* 2003, Uddin *et al.* 2004, Panday and Kumar 2006, Yusuf *et al.* 2006, Dey *et al.* 2007).

Table 2: Tree species recorded from Chunati WS along with their uses

[*F = Fuelwood, Fd = Food and Fodder, M = Medicinal, N = Miscellaneous non-timber uses (other than fuel, food, fodder and medicinal), T = Timber and Nk = Not known]

Scientific Name	Family	Local Name	Uses
Acacia auriculiformis A. Cunn. *ex* Benth.	Mimosaceae	Akashmoni	F, N, T*
Acacia hybrid	Mimosaceae	Hybrid acacia	F, T
Acacia mangium Willd.	Mimosaceae	Mangium	F, Fd, T
Acronychia pedunculata (L.) Miq.	Rutaceae	Bonjamir	Fd, M, N, T
Actinodaphne angustifolia Ness	Lauraceae	Modanmosta	T
Aegle marmelos (L.) Corr.	Rutaceae	Bel	Fd, M, T
Albizia chinensis (Osb.) Merr.	Mimosaceae	Chakua koroi	Fd, N, T
Albizia lebbeck (L.) Benth. & Hook.	Mimosaceae	Kalo koroi	F, N, T

Table 2 continued...

Scientific Name	Family	Local Name	Uses
Albizia odoratissima (L. f.) Benth.	Mimosaceae	Tetoya koroi	Fd, M, N, T
Albizia procera (Roxb.) Benth.	Mimosaceae	Sada koroi	F, M, T
Albizia richardiana (Voigt.) King & Prain	Mimosaceae	Raj koroi	N, T
Allophylus cobbe (L.) Raeuschel var. *serratus* (Roxb.) Prain	Sapindaceae	Chita	F, M
Alstonia scholaris (L.) R. Br.	Apocynaceae	Chatim	M, N
Anacardium occidentale L.	Anacardiaceae	Kaju badam	Fd, M, T
Annona reticulata L.	Annonaceae	Ata	Fd, M, N
Annona squamosa L.	Annonaceae	Sharifa	Fd, M
Anogeissus acuminata (Roxb. *ex* DC.) Guill. & Perr.	Combretaceae	Sikori, Itchri	N, T
Antidesma acidum Retz.	Euphorbiaceae	Elena	Fd, M
Antidesma bunius (L.) Spreng.	Euphorbiaceae	Bonshialbuka	Fd, M
Antidesma ghaesembilla Gaertn.	Euphorbiaceae	Khudijam	M
Antidesma velutinum Tulasne	Euphorbiaceae	Elena	F
Aphanamixis polystachya (Wall.) R.N. Parker	Meliaceae	Pitraj, Royna	M, T
Aporosa dioica (Roxb.) Muell.-Arg.	Euphorbiaceae	Pat kharolla	Fd, T
Aporosa wallichii Hook. F.	Euphorbi aceae	Castoma	Fd
Aquilaria agallocha Roxb.	Thymeliaceae	Agar	N
Araucaria cunninghamii Aiton *ex* D. Don	Araucariaceae	Christmas tree	N
Ardisia colorata Roxb.	Myrsinaceae	Siaberala	M
Ardisia paniculata Roxb.	Myrsinaceae	Barochallya	Nk
Areca catechu L.	Arecaceae	Supari	Fd, M, T
Artabotrys hexapetalus (L.f.) Bhandari	Annonaceae	Katali champa	M, N
Artocarpus chama Buch.-Ham. *ex* Wall.	Moraceae	Chapalish	Fd, T
Artocarpus heterophyllus Lamk.	Moraceae	Kanthal	Fd, N, T
Artocarpus lacucha Buch.-Ham.	Moraceae	Borta	Fd, M , T
Averrhoa bilimbi L.	Oxalidaceae	Belombo	Fd, N
Averrhoa carambola L.	Oxalidaceae	Kamranga	Fd, M, N
Azadirachta indica A. Juss.	Meliaceae	Neem	M, N
Baccaurea ramiflora Lour.	Euphorbiaceae	Lotkon	Fd, M, N
Barringtonia acutangula (L.) Gaertn.	Lecythidaceae	Hijol	M
Bauhinia purpurea L.	Caesalpiniaceae	Rakta kanchan	M, N, T
Bhesa robusta (Roxb.) Ding Hou	Celastraceae	Salkachra	T
Bischofia javanica Blume	Euphorbiaceae	Kanjal bhadi	M, T
Boehmeria glomerulifera Miq.	Urticaceae	Borthurthuri	N
Bombax ceiba L.	Bombacaceae	Shimultula	M, T
Bombax insigne Wall.	Bombacaceae	Bon tula	N
Borassus flabellifer L.	Arecaceae	Tal	Fd, M, N, T
Brownlowia elata Roxb.	Tiliaceae	Moos	T
Buchanania lancifolia Roxb.	Anacardiaceae	Chikonpial	Fd
Butea monosperma (Lamk.) Taub.	Fabaceae	Palash	M, N
Caesalpinia pulcherrima (L.) Sw.	Caesalpiniaceae	Radhachura	M, N
Callicarpa arborea Roxb.	Verbenaceae	Bormala	Fd, F, M
Callicarpa macrophylla Vahl	Verbenaceae	Baro bormala	M
Calophyllum inophyllum L.	Clusiaceae	Punnayl	M, N, T
Carallia brachiata (Lour.) Merr.	Rhizophoraceae	Keyabong	M, N, T

Table 2 continued...

Scientific Name	Family	Local Name	Uses
Cassia fistula L.	Caesalpiniaceae	Sonalu	Fd, M, N,T
Cassia nodosa Buch.-Hum. *ex* Roxb.	Caesalpiniaceae	Bon-sonalu	N, T
Castanopsis tribuloides (Smith) A. DC.	Fagaceae	Hingra	F, T
Casuarina equisetifolia Forst.	Casuarinaceae	Jhau	T
Ceiba pentandra (L.) Gaertn.	Bombacaceae	Burma simul	N, T
Chaetocarpus castanocarpus (Roxb.) Thw.	Euphorbiaceae	Atailla	F
Chukrasia tabularis A. Juss.	Meliaceae	Chickrassi	M, N, T
Cinnamomum glaucescens (Nees) Meiss	Lauraceae	Gonoroi	T
Cinnamomum iners Reinw. *ex* Blume	Lauraceae	Tez-bohu	M, T
Citrus maxima (Burm. f.) Merr.	Rutaceae	Jambura	Fd, M, N
Citrus reticulata Blanco	Rutaceae	Komla	Fd, M
Clausena heptaphylla (Roxb.) Wight & Arn. *ex* Steud.	Rutaceae	Pan mouri, Karanphul	Fd, N
Cleistocalyx nervosum (DC.) Kosterm. var. *paniala* (Roxb.) J. Parn. & P. Chantaranothai	Myrtaceae	jam	Fd, M, T
Cocos nucifera L.	Arecaceae	Narikel	Fd, N
Cordia dichotoma Forst. f.	Boraginaceae	Bohal	Fd, M, N, T
Cordia fragrantissima Kurz	Boraginaceae	Kaladuti	N, T
Cordia serrata Roxb.	Boraginaceae	Koratsora	Fd
Crateva magna (Lour.) DC.	Capparaceae	Barun	Fd
Crypteronia paniculata Blume	Crypteroniaceae	Champhata	M, T
Cryptocarya amygdalina Nees	Lauraceae	Bhuiya gachh	T
Dalbergia sissoo Roxb.	Fabaceae	Sissoo	Fd, T
Dehaasia kurzii King *ex* Hook. f.	Lauraceae	Modon-mosto	M
Delonix regia Rafin.	Caesalpiniaceae	Krisnachura	N
Derris robusta (Roxb. *ex* DC.) Benth.	Fabaceae	Jojja	F, T
Didymosperma gracilis Hook. F.	Arecaceae	Bon Supari	N, M
Dillenia indica L.	Dilleniaceae	Chalta	Fd, M, T
Dillenia scabrella Roxb. *ex* Wall.	Dilleniaceae	Hargeza	F, T
Diospyros blancoi A. DC.	Ebenaceae	Bilati gab	Fd, T
Diospyros malabarica (Desr.) Kostel.	Ebenaceae	Deshi gab	F, Fd, M, N, T
Diospyros montana Roxb.	Ebenaceae	Bongab	N, T
Diospyros pilosula (A. DC.) Hiern	Ebenaceae	Khalta gab	T
Diospyros sp.	Ebenaceae		T
Dipterocarpus alatus Roxb. *ex* G. Don	Dipterocarpaceae	Doilla garjon	M, T
Dipterocarpus costatus Gaertn.	Dipterocarpaceae	Baitta garjon	F, N, T
Dipterocarpus turbinatus Gaertn.	Dipterocarpaceae	Telia garjon	N, T
Drimycarpus racemosus Hook. F.	Anacardiaceae	Nala-amshi,	T, M
Duabanga grandiflora (Roxb. *ex* DC.) Walp.	Sonneratiace ae	Bandarhaula	T
Elaeis guineensis Jacq.	Arecaceae	Palm oil	Fd, N
Elaeocarpus floribundus Blume	Elaeocarpaceae	Titpai	Fd, N, T
Elaeocarpus tectorius (Lour.) Poir.	Elaeocarpaceae	Jalpai	Fd, T
Engelhardtia spicata Lesch. *ex* Blume.	Juglandaceae	Jhumka bhadi	M
Erythrina fusca Lour.	Fabaceae	Panya mandar	N
Erythrina variegata L.	Fabaceae	Mander	F, M, N
Eucalyptus camaldulensis Dehnh.	Myrtaceae	Eucalyptus	F, N, T

Table 2 continued...

Scientific Name	Family	Local Name	Uses
Eucalyptus citriodora Hook.	Myrtaceae	Eucalyptus	N, T
Eurya acuminata DC.	Theaceae	Ramjani	M, N, T
Fernandoa adenophylla (Wall. *ex* G. Don) van Steenis	Bignoniaceae	Barapata, Kaowatuti	N
Ficus auriculata Lour.	Moraceae	Lal dumur	Fd
Ficus benghalensis L.	Moraceae	Bot	Fd, M, N
Ficus benjamiana L.	Moraceae	Pakur	F, N
Ficus conglobata King	Morac eae	Bata-dumur	Fd
Ficus elastica Roxb. *ex* Hornem	Moraceae	Indian rubber	N
Ficus geniculata Kurz	Moraceae	Baragular	F
Ficus hispida L. f.	Moraceae	Dumur	Fd, M, N
Ficus lamponga Miq.	Moraceae	Jigbot	F
Ficus lanceolata Buch.-Ham. *ex* Roxb.	Moraceae	Buti-dumur	Fd
Ficus microcarpa L. f.	Moraceae	Jigbot	M, N
Ficus racemosa L.	Moraceae	Jogyadumur	Fd, M, N
Ficus semicordata Buch.-Ham. *ex* Smith	Moraceae	Chokorgola	Fd, M, N
Ficus tinctoria G. Forst. subsp. *Gibbosa* (Blume) Corner	Moraceae	Ranga-dumur	Fd, M
Ficus variegata Blume	Moraceae	Rangila dumur	F, Fd
Ficus virens Ait.	Moraceae	Pakur bot	Fd, M
Firmiana colorata (Roxb.) R. Br.	Sterculiaceae	Udal	Fd
Flacourtia jangomas (Lour.) Raeusch.	Flacourtiaceae	Painnagola	Fd, M, T
Garcinia cowa Roxb. *ex* DC.	Clusiaceae	Kao	Fd, N, T
Garcinia lanceaefolia Roxb.	Clusiaceae	Badujja gola	Fd, M
Garcinia speciosa Wall.	Clusiaceae	Moigga Kao	T
Gardenia coronaria Buch.-Ham.	Rubiaceae	Konnayari	F, T
Garuga pinnata Roxb.	Burseraceae	Bhadi	Fd, M, T
Glochidion arborescens Blume	Euphorbiaceae		Fd
Glochidion lanceolarium (Roxb.) Voigt	Euphorbiaceae	Lomba kechua	N
Glochidion multiloculare (Roxb. *ex* Willd.) Muell.- Arg.	Euphorbiaceae	Pannyaturi	T
Gluta elegans (Wall.) Hook. F.	Anacardiaceae	Kabita, Kattula	N, T
Gmelina arborea Roxb.	Verbenaceae	Gamar	M, T
Grewia nervosa (Lour.) Panigr.	Tiliaceae	Assargola	F, M
Grewia sapida Roxb. *ex* DC.	Tiliaceae	Naricha	Fd, N
Grweia serrulata DC.	Tiliaceae	Naricha	Fd
Haldina cordifolia (Roxb.) Ridsdale	Rubiaceae	Haldu	T
Helicia excelsa (Roxb.) Blume	Proteaceae	Baka pakan	T
Helicia robusta (Roxb.) R. Br. *ex* Wall.	Proteaceae	Baro pakan	N
Holarrhena antidysenterica (L.) Wall. *ex* Decne	Apocynaceae	Kuruch, Kuruj	M
Hopea odorata Roxb.	Dipterocarpaceae	Telsur	M, N, T
Illex godajam Colebr. *ex* Hook. F.	Aquifoliaceae	Jangli gewa	M, T
Lagerstroemia speciosa (L.) Pers.	Lythraceae	Painna jarul	M, T
Lagerstroemia thorelii Gagnep.	Lythraceae	Bilati jarul	N
Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	Jialbhadi	Fd, M, T
Lepisanthes rubiginosa (Roxb.) Leenh.	Sapindaceae	Rubiharina	Fd, M, T
Lepisanthes senegalensis (Poir.) Leenh.	Sapindaceae	Gotaharina	Fd, T

Table 2 continued...

Scientific Name	Family	Local Name	Uses
Lepisanthes tetraphylla (Vahl) Radlk.	Sapindaceae	Chariharina	T
Leucaena leucocephala (Lamk.) de Wit.	Mimosaceae	Ipil-ipil	Fd, T, N
Litchi chinensis Sonn.	Sapindaceae	Litchu, Lychee	Fd, M
Lithocarpus acuminata (Roxb.) Rehder	Fagaceae	Dholibatna	T
Lithocarpus elegans var. *elegans* (Blume) Hatus. *ex* Soepad.	Fagaceae	Kali batna, Jat batna	F, N, T
Lithocarpus polystachya (Wall. *ex* A. DC.) Rehder	Fagaceae	Batna	F, T
Litsea angustifolia Wall. *ex* Hook. F.	Lauraceae	Chotosial buka	Fd
Litsea glutinosa (Lour.) Robinson	Lauraceae	Karjuki menda	M, N
Litsea monopetala (Roxb.) Pers.	Lauraceae	Kat meda	M
Macaranga denticulata (Blume) Muell. - Arg.	Euphorbiaceae	Bura	M
Macaranga indica Wight	Euphorbiaceae	Nunia bura	M
Maesa indica (Roxb.) A. DC.	Myrsinaceae	Maesa, Moricha	Fd, M
Maesa paniculata A. DC.	Myrsinaceae	Kuljoni	Nk
Maesa ramentacea (Roxb.) A. DC.	Myrsinaceae	Lalmoricha	M
Mallotus philippensis (Lamk.) Mull. - Arg.	Euphorbiaceae	Sindur, Punag	F, Fd, M
Mallotus roxburghianus Muell.-Arg.	Euphorbiaceae	Chotobura	N
Mallotus tetracoccus (Roxb.) Kurz	Euphorbiaceae	Nunia kachi	F
Mangifera indica L.	Anacardiaceae	Aam	F, Fd, T
Mangifera sylvatica Roxb.	Anacardiaceae	Uriam	Fd, N, T
Melia sempervirens (L.) Sw.	Meliaceae	Goranim	M, N, T
Mesua ferrea L.	Clusiaceae	Nagesswar	M, N, T
Michelia champaca L.	Magnoliaceae	Champa	N, T
Mimusops elengi L.	Sapotaceae	Bokul	M, N, T
Mitragyna parvifolia (Roxb.) Korth var. *microphylla* (Kurz) Ridsdale	Rubiaceae	Dakrum	F, T
Murraya paniculata (L.) Jack	Rutaceae	Kamini	M, T
Myristica linifolia Roxb.	Myristacaceae	Lowbarela	F, T
Neolamarckia cadamba (Roxb.) Bosser	Rubiaceae	Kadam	M, T
Neolitsea cassia (L.) Rosterm.	Lauraceae	Saya nayachita	M, T
Neonauclea sessilifolia (Roxb.) Merr.	Rubiaceae	Kom	M, T
Nyctanthes arbor- tristis L.	Verbenaceae	Sheuli	M, N
Ochna squarrosa	Ochnaceae	Loamori	M, N
Olax acuminata Wall. *ex* Benth.	Olacaceae	Olamina	Nk
Olea dioica Roxb.	Oleaceae	Kau, Atajam	M, T
Olea salicifolia Wall. *ex* G. Don	Oleaceae	Olisal	F, T
Oreocnide integrifolia (Gaud.) Miq.	Urticaceae	Horhuta	N
Ormosia robusta (Roxb.) Baker	Fabaceae	Hokkanali	T
Oroxylum indicum (L.) Kurz	Bignoniaceae	Thona	M, T
Palaquium polyanthum Engl.	Sapotaceae	Tali	N, T
Peltophorum pterocarpum (DC.) K. Heyne	Caesalpiniaceae	Radhachura	Fd, N, T
Persea bombycina (King *ex* Hook. F.) Kosterm.	Lauraceae	Ishashak	N
Phoebe lanceolata (Nees) Nees	Lauraceae	Chaongri, Dulia	T
Phoebe pallida (Nees) Nees	Lauraceae	Fibli	Nk

Table 2 continued...

Scientific Name	Family	Local Name	Uses
Phoenix sylvestris Roxb.	Arecaceae	Khejur	Fd, M, N
Phyllanthus emblica L.	Euphorbiaceae	Amloki	Fd, M, N
Picrasma javanica Blume	Simaroubaceae	Nilghanta	M
Pinus oocarpa Schiede *ex* Schltdl.	Pinaceae	Pine	T
Pithecellobium angulatum Benth.	Mimosaceae	Kuramara	N
Plumeria rubra L.	Apocynaceae	Katgolap	M, N
Polyalthia longifolia (Sonn.) Thw.	Annonaceae	Debdaru	N, T
Prismatomeris tetrandra (Roxb.) subsp. *tetrandra* K. Schum.	Rubiaceae	Chinatita, Katmali	M
Protium serratum (Wall. *ex* Coelbr.) Engl.	Burseraceae	Gotgutia	Fd, T
Psidium guajava L.	Myrtaceae	Peyara	F, Fd, M, N
Pterospermum acerifolium (L) Willd.	Sterculiaceae	Moochigonda	M, T
Pterospermum semisagittatum Buch.-Ham. *ex* Roxb.	Sterculiaceae	Lana-assar	M, T
Pterygota alata (Roxb.) R. Br.	Sterculiaceae	Buddanarikel	N, T
Quercus gomeziana A. Camus	Fagaceae	Khossa batna	T
Ricinus cummunis L.	Euphorbiaceae	Varenda	M
Samanea saman (Jacq.) Merr.	Mimosaceae	Raint ree	F, Fd, N, T
Sapium baccatum Roxb.	Euphorbiaceae	Cham phata	F, Fd, T
Saraca asoca (Roxb.) de Wild.	Caesalpiniaceae	Ashok	M, N
Schima wallichii (DC.) Korth.	Theaceae	Kanak	M, N, T
Senna siamea (Lamk.) Irwin & Barneby	Caesalpiniaceae	Minjiri	Fd, N, T
Shorea robusta Roxb. *ex* Gaertn. f.	Dipterocarpaceae	Sal, Gazari	M, N, T
Sterculia villosa Roxb. *ex* Smith	Sterculiaceae	Baro Udal	M, N
Stereospermum colais (Buch.-*ex* Dillw.) Mabberley	Bignoniaceae	Dharmara	M, T
Stereospermum suaveolens (Roxb.) DC.	Bignoniaceae	Parul	M, T
Streblus asper Lour.	Moraceae	Sheora, Harba	Fd, M
Suregada multiflora (A. Juss.) Bail.	Euphorbiaceae	Moricha	F, T
Swietenia mahagoni Jacq.	Meliaceae	Mahagoni	T
Swintonia floribunda Griff.	Anacardiaceae	Civit	N, T
Symplocosr acemosa Roxb.	Symplocaceae	Lodh	M, N
Syzygium claviflorum (Roxb.) A. M. Cowan & J. M. Cowan	Myrtaceae	Nolijam	Fd
Syzygium cumini (L.) Skeels	Myrtaceae	Kalojam	F, Fd, M, T
Syzygium firmum Thw.	Myrtaceae	Dhaki jam	Fd, N
Syzygium fruticosum (Wall.) Masamune	Myrtaceae	Putijam	F, Fd, N
Syzygium jambos (L.) Alston	Myrtaceae	Gulapjam	Fd, M, T
Syzygium magacarpum (Craib) Rathakr. & N. C. Nair	Myrtaceae	Chaltajam	F, T
Syzygium praecox (Roxb.) Rathakr. & N. C. Nair	Myrtaceae	Poorajam	Fd, T
Syzygium ramosissimum (Blume) Balakrishnan	Myrtaceae	Ram jamrul	F, N
Syzygium syzygioides (Miq.) Merr. & L. M. Perry	Myrtaceae	Khudi jam	Fd, T
Tamarindus indica L.	Caesalpiniaceae	Tentul	F, Fd, M, N, T
Tamilnadia uliginosa (Retz.) Tirveng. & Sastre	Rubiaceae	Mankanta	M

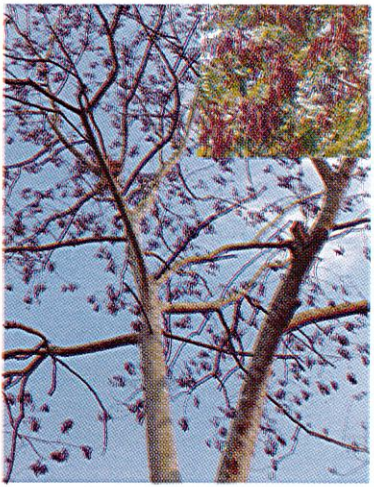
Table 2 continued...

Scientific Name	Family	Local Name	Uses
Tectona grandis L.f.	Verbenaceae	Shegun	M, T
Terminalia arjuna (Roxb. *ex* DC.) Wight & Arn.	Combretaceae	Arjun	M, T
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae	Bohera	Fd, M, T
Terminalia catappa L.	Combretaceae	Katbadam	Fd, M, T
Terminalia chebula Retz.	Combretaceae	Haritaki	M, N, T
Tetrameles nudiflora R. Br.	Datiscaceae	Chandul	Fd, M, N, T
Toona ciliata M. Roem.	Meliaceae	Chondon Suruj	T
Trema orientalis (L.) Blume	Ulmaceae	Jiban, Naricha	F, Fd, N
Trewia nudiflora L.	Euphorbiaceae	Pitali	M
Vitex glabrata R.Br.	Verbenaceae	Goda arsol	Fd, M, T
Vitex peduncularis Wall. *ex* Schauer	Verbenaceae	Goda	Fd, M, T
Vitex pinnata L.	Verbenaceae	Horina arsol	T
Xanthophyllum andamanicum King	Xanthophyllaceae	Hanshuk	T
Xanthophyllum flavescens Roxb.	Xanthophyllaceae	Bazna	F, T
Xylia xylocarpa (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) Neilsen	Mimosaceae	Lohakath	M, N, T
Zanthoxylum rhetsa (Roxb.) DC.	Rutaceae	Bajna, Bazinali	M, N, T
Ziziphus mauritiana Lamk.	Rhamnaceae	Boroi	F, Fd

Acronychia pedunculata (Bonjamir)

Albizia odoratissima (Tetoya koroi)

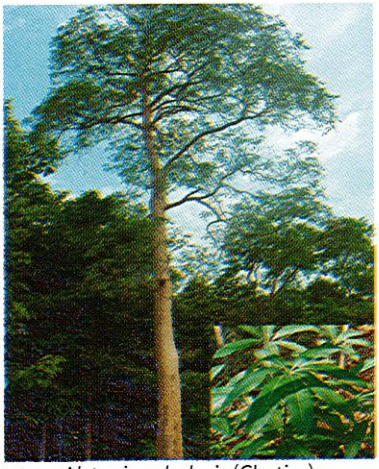
Anogeissus acuminata (Itchri)



Albizia procera (Sada koroi)

Albizia chinensis (Chakua koroi)

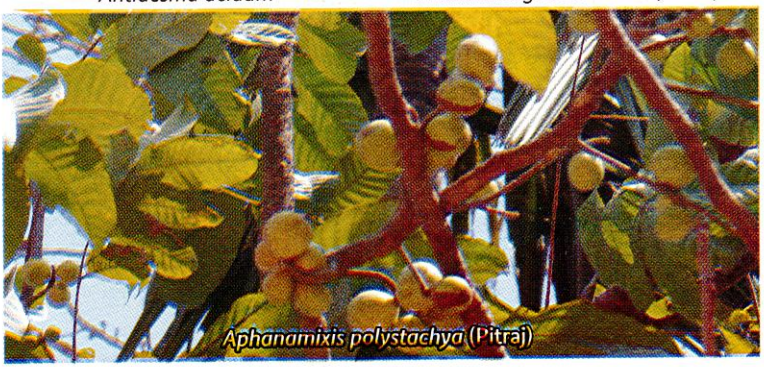
Albizia richardiana (Raj koroi)



Alstonia scholaris (Chatim)

Antidesma acidum

Antidesma ghaesembilla (Elena)



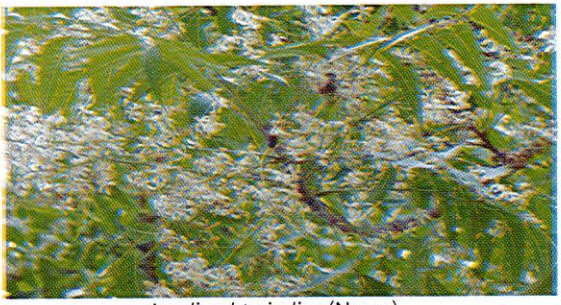
Aphanamixis polystachya (Pitraj)

Aquilaria agallocha (Agar)

Ardisia colorata (Sia barela)

Bhesa robusta (Salkachra)

Artocarpus lacucha (Borta)



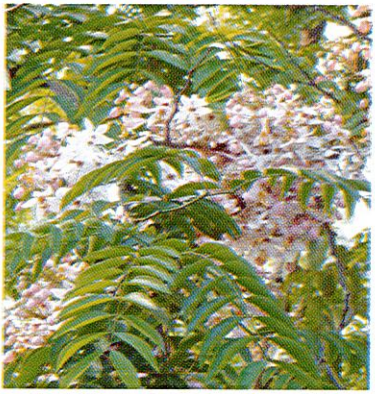
Azadirachta indica (Neem)

Aporosa wallichii (Castoma)

Bauhinia purpurea (Rakta kanchan)

Butea monosperma (Palash)

Cinnamomum iners (Tez-bohu)



Cassia nudosa (Bonsonalu)

Chaetocarpus castanocarpus (Atailla)

Cinnamomum glaucescens (Tez-bohu)

Carallia brachiata (Keyabong)

Crypteronia paniculata (Champata, Goru-mara)

Cassia fistula (Sonalu)

Caesalpinia pulcherrima (Radhachura)

Dalbergia sissoo (Sissoo)

Engelhardtia spicata (Jhumka badi)

Erythrina fusca (Mandar)

Dillenia scabrella (Hargeza)

Diospyros malabarica (Desi gab)

Elaeocarpus floribundus (Titpai)

Dipterocarpus turbinatus (Telia garjon)

Dipterocarpus alatus (Doilla garjon)

Ficus hispida (Dumur)

Ficus benghalensis (Bot)

Ficus elastica (Indian rubber)

Ficus auriculata (Lal Dumur)

Eurya acuminata (Ramjani)

Ficus lamponga (Jigbot)

Ficus semicordata (Chokorgola)

Garcinia lanceaefolia (Badujja gola)

Gardenia coronaria (Konnayari)

Garcinia cowa (Kao)

Glochidion multiloculare (Pannyaturi)

Grewia nervosa (Assargola)

Holarrhena antidysenterica (Kuruch)

Lannea coromandelica (Jialbhadi)

Helicia excelsa (Baka pakan)

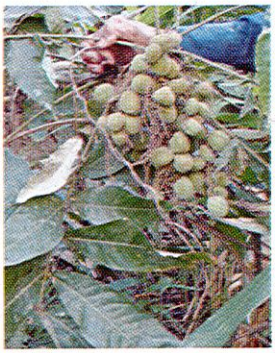
Lagerstroemia speciosa (Painna Jarul)

Grewia sapida (Naricha)

Hopea odorata (Telsur)

Leucaena leucocephala (Ipil ipil)

Lithocarpus acuminata (Dholi batna)



Lepisanthes tetraphylla (Chariharina)

Lithocarpus elegans (Jat batna, Kali batna)

Macaranga indica (Nunia Bura)

Maesa indica (Maesa, Moricha)

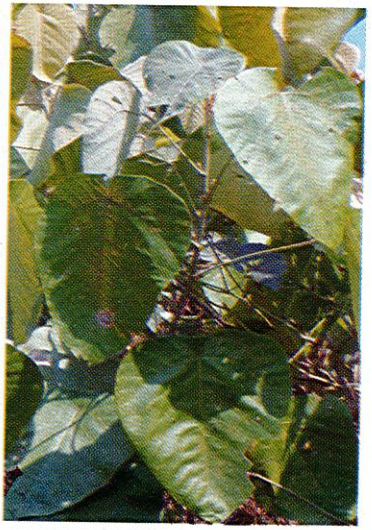
Litsea monopetala (Kat meda, Sukurja)

Lepisanthes rubiginosa (Rubiharina)

Maesa ramentacea (Lal moricha)

Litsea glutinosa (Karjuki Menda)

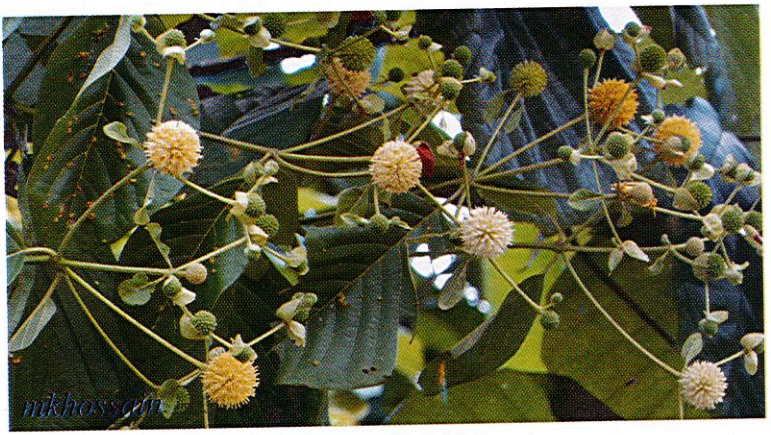
Mallotus philippensis (Sindur)



Macaranga denticulata (Bura)

Myristica linifolia (Lowbarela)

Ormosia robusta (Hokkanali)



Mitragyna parvifolia (Dakrum)

Michelia champaca (Champa)

Ochna squarrosa (Loamori)

Oroxylum indicum (Thona)

Protium serratum (Gotgutia)

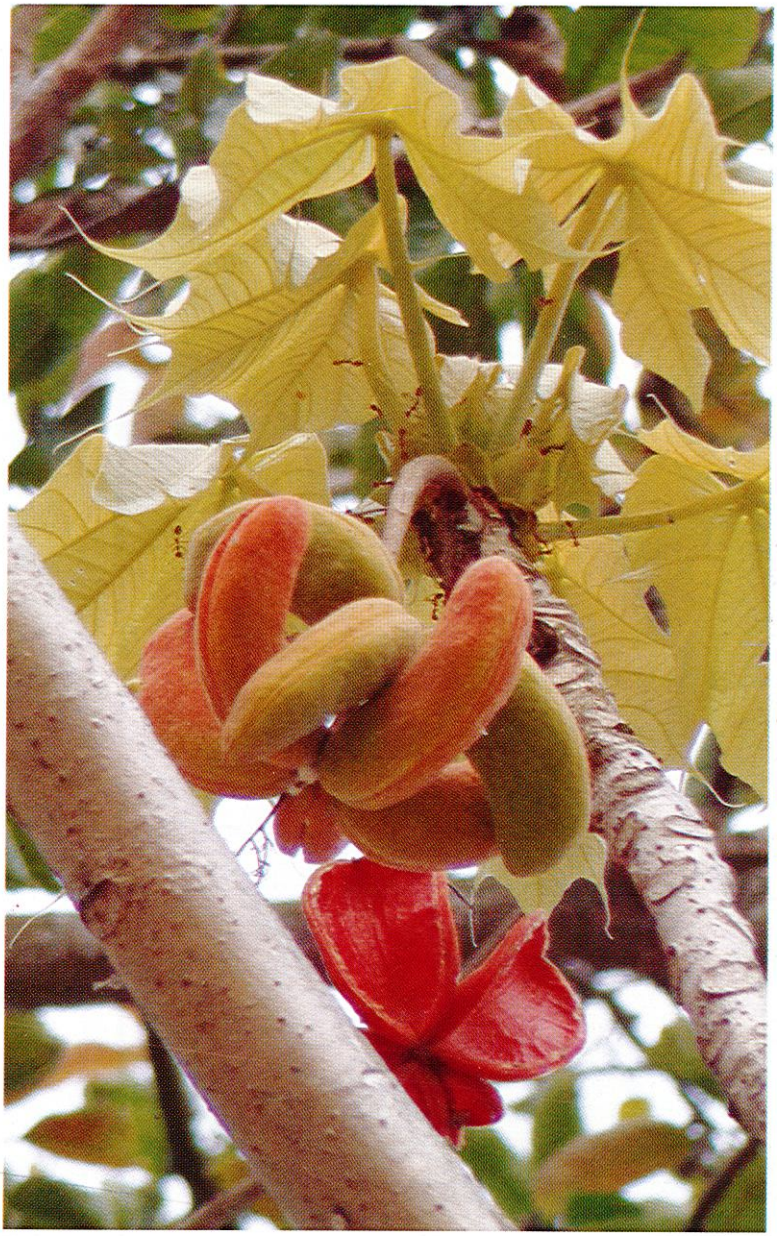
Pterospermum acerifolium (Mochigonda)

Duabanga grandiflora (Bandarhaula)

Phyllanthus emblica (Amloki)

Pterospermum semisegittatum (Lana-assar)

Samanea saman (Raintree)



Sterculia villosa (Baro udal)


Neonauclea sessilifolia (Kom)

Phoenix sylvestris (Khejur) fruit

Sapium baccatum (Champata, Kalagota)

Mangifera indica (Aam)

Syzygium claviflorum (Nolijam)

Suregada multiflora (Bon-naranga, Moricha)

Stereospermum suaveolens (Parul, Koida arsol)

Swintonia floribunda (Civit)

Syzygium firmum (Dhakijam)

Syzygium fruticosum (Putijam)

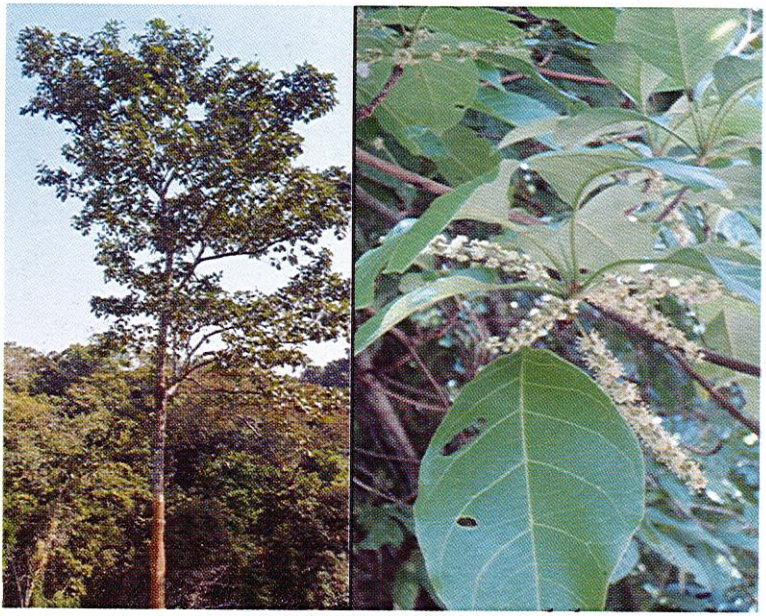
Tamilnadia uliginosa (Monkanta, Piralu)

Terminalia arjuna (Arjun)

Vitex peduncularis (Goda)

Trema orientalis (Jiban, Naricha)

Toona ciliata (Suruj)



Terminalia bellirica (Bohera)

Vitex pinnata (Horina Arsol)

3.1.1 Tree species diversity

There are around 37,000 tree species found in tropical forests (Odegaard 2000). Trees range in size from unbranched treelets less than a person's height to New Guinea's 89 meter *Araucaria hunsteinii* (Whitmore 1998). The diversity indices of the study were calculated from the data obtained through sample plots (20 m × 20 m) survey. Tree species composition assessed from the sample plots, stem density, basal area and various diversity indices of seven beats was calculated and compared **(Table 3)**. Aziznagar, Harbang and Jaldi beats showed almost equal number of tree species in the sample plots, whereas Puichori beat represented a maximum of 103 tree species. Stem density was found maximum (702 stem/ha) in Puichori beat followed by Chunati (671 stem/ha) and Napora (615 stem/ha). Basal area was maximum (18.96 m^2/ha) in Aziznagar beat followed by Chunati (12.47 m^2/ha) and Chambol (11.55 m^2/ha). The lowest stem density and basal area were found in Harbang (379 stem/ha) and Napora (7.23 m^2/ha) respectively. On the other hand, diversity indices, i.e. Shannon's diversity index, Margalef's diversity index, Simpson's diversity index, Species evenness index and Sørensen's similarity index were calculated separately for all the seven beats. Puichori beat was represented by maximum Shannon-Wiener's diversity index (3.58) and Margalef's diversity index (14.42). Simpson's diversity index (0.085) and Species evenness index (0.83) were found maximum for Aziznagar and Jaldi beat respectively. Whereas, Aziznagar, Chunati, Jaldi and Napora beats were represented by lowest Shannon-Wiener's diversity index (3.27), Margalef's richness index (10.56), Simpson's dominance index (0.05) and Species evenness index (0.73) respectively.

The value of Shannon-Wiener's diversity index (3.762) for whole Chunati WS is higher than that of 2.98 in Sitapahar reserve forest (Nath *et al.* 2000) and 3.25 in Tankawati natural forest of Chittagong (South) Forest Division (Motaleb and Hossain 2011). It is comparable to Shannon-Wiener's diversity index of 4.45 in Dudhpukuria-Dhopachori WS (Hossain *et al.* 2012). Margalef's index (19.21) for whole Chunati WS expresses the presence of greater number of plant species in Chunati WS. It is higher than the Margalef's index of Banskhali forest (13.03) reported by Alamgir and Al-Amin (2005) and Tankawati natural forest (14.83) reported by Motaleb and Hossain (2011). But, the index is lower than that of Dudhpukuria-Dhopachori Wildlife Sanctuary (23.46) reported by Hossain *et al.* (2012). Simpson's index of 0.056 indicates fewer probability of two individuals randomly selected from a sample will belong to the same species. The index value is higher than 0.0192

of Dudhpukuria-Dhopachori Wildlife Sanctuary (Hossain *et al.* 2012). But, this is lower in comparison to 0.11 in Tankawati natural forest (Motaleb and Hossain 2011) and 0.10 in Tripura, Northeast India (Majumdar *et al.* 2012). Species evenness index of 0.734 indicates higher evenness in the tree communities of Chunati WS. But, the figure is lower in comparison to species evenness index of 0.853 in Dudhpukuria-Dhopachori Wildlife sanctuary (Hossain *et al.* 2012). Whatsoever, all the diversity indices represent that Chunati WS is rich with her diverse floral resources.

Table 3. Diversity indices and associated details of tree species recorded from 269 quadrats of the seven beats in Chunati WS

Description	Aziznagar	Chambol	Chunati	Harbang	Jaldi	Napora	Puichori
No. of tree species	72	85	99	70	71	91	103
Density (stem/ha)	507	501	671	379	447	615	702
Basal area (m^2/ha)	18.96	11.55	12.47	9.95	7.77	7.23	10.51
Shannon-Wiener's diversity index	3.27	3.47	3.50	3.25	3.5	3.31	3.58
Margalef's richness index	11.93	12.56	10.57	11.0	10.6	12.52	14.42
Simpson's dominance index	0.085	0.062	0.051	0.077	0.05	0.082	0.057
Species evenness index	0.77	0.78	0.82	0.77	0.83	0.73	0.77

Assessing similarity between two plant communities is another measure of diversity among them. Sørensen's similarity index is a statistic used for comparing the similarity in species composition for two beats following Magurran (2004). Highest similarity (75%) was found between the tree communities of Harbang and Jaldi beats. On the other hand lowest similarity (38%) was found between the tree communities of Napora and Aziznagar beats **(Table 4)**. The overall similarity was calculated using all the pairwise similarity index values. It was 60.2% for all the seven beats of Chunati WS.

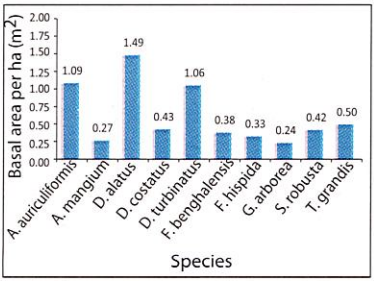
Table 4. Similarity indices (%) of tree species among the seven beats of Chunati WS

Name of the beats	Aziznagar	Chambol	Chunati	Harbang	Jaldi	Napora	Puichori
Aziznagar	----	68	69	70	69	38	63
Chambol		----	70	70	72	42	67
Chunati			----	67	65	41	66
Harbang				----	75	37	62
Jaldi					----	42	64
Napora						----	47
Puichori							----
Overall Similarity			**60.2**				

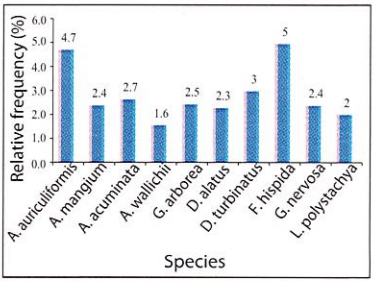
3.1.2 Importance Value Index (IVI) of tree species

A total of 269 sample plots of 20 m × 20 m in size were studied for assessing tree species diversity. The survey conducted within the forest of Chunati WS revealed a total of 5,968 stems having >5 cm dbh (diameter at breast height) of 169 tree species planted or growing naturally. The sampling procedure was conducted following stratified random sampling methods. All the seven forest beats and vegetation types of both the Chunati and Jaldi ranges were considered for sampling the whole area. There was substantial heterogeneity in forest vegetation among the seven beats.

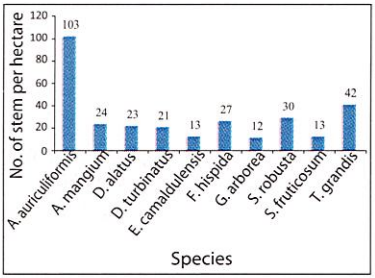
Importance Value Index (IVI) of the tree species was assessed along with Basal Area (BA), number of stem per hectare (stem/ha), Relative Density (RD), Relative Frequency (RF), Relative Abundance (RA) and Relative Dominance (RDo) of each species (Appendix 2). Dipterocarpus alatus was represented by maximum basal area (1.49 m^2/ha) followed by Acacia auriculiformis (1.09 m^2/ha), Dipterocarpus turbinatus (1.06 m^2/ha) and Tectona grandis (0.5 m^2/ha) (Figure 8a).



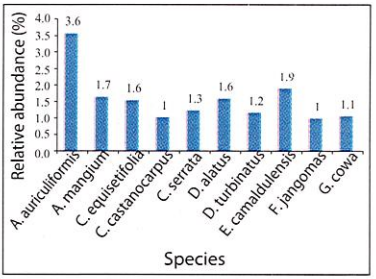
8a. Basal area per hectare (m^2)



8c. Relative frequency (%)



8b. Stem per hectare



8d. Relative abundance (%)

Figure 8. Ten tree species having maximum basal area (8a), stem per ha (8b), relative frequency (8c) and relative abundance (8d) in Chunati Wildlife Sanctuary

Maximum number of stems per ha was found for Acacia auriculiformis (103 stem/ha) followed by Tectona grandis (42 stem/ha), Shorea robusta (30 stem/ha) and Ficus hispida (27 stem/ha (Figure 8b). Among the 169 recorded tree species, Ficus hispida showed maximum (5%) relative frequency in Chunati WS (Figure 8c) followed by Acacia auriculiformis (4.7%) and Dipterocarpus turbinatus (3%). On the other hand, maxiumum (3.6%) relative abundance (RA) was calculated for Acacia auriculiformis followed by Eucalyptus camaldulensis (1.9%) and Acacia mangium (1.7%) (Figure 8d). Acacia auriculiformis having maximum IVI (33.7) appeared as the most dominant plant species in the sanctuary area (Figure 9). Massive plantation activities with invasive exotic species like Acacia auriculiformis caused its dominance in Chunati WS in comparison to all other native and introduced plant species. Excluding Acacia auriculiformis, other dominant plant species of Chunati Wildlife Sanctuary having higher IVI value are Dipterocarpus alatus (20.7), Dipterocarpus turbinatus (17), Tectona grandis (15.2), Ficus hispida (13), Shorea robusta (10.6), Acacia mangium (9.4), Syzygium fruticosum (6.5), Gmelina arborea (5.9), Anogeissus acuminata (5.6) etc. Whereas, Rahman and Hossain (2003) reported the maximum IVI (36.28) for Dipterocarpus turbinatus and only 19.85 for Acacia auriculiformis in Chunati WS, which is just reverse of the present findings (Figure 9). Ardisia colorata, Baccaurea ramiflora, Bhesa robusta, Citrus maxima, Citrus reticulata, Ficus geniculata, Glochidion lanceolarium, Gluta elegans, Lepisanthes tetraphylla, Maesa indica, Mangifera indica and Ochna squarrosa along with some other tree species were found to possess the lowest (0.07)

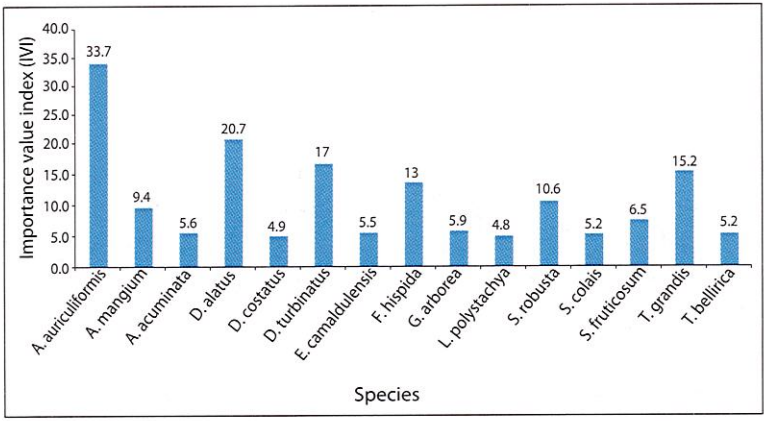


Figure 9. Fifteen tree species possessing maximum Importance Value Index (IVI) in Chunati WS

IVI value (Appendix 2). It was observed that most of the present dominant tree species are plantation species. Population of the native tree species reduced drastically because of the severe deforestation and forest degradation in the last decades. As a result, tree species having poor IVI seemed to be rare in the natural habitat of Chunati WS. Inadequate production of regenerating propagules, i.e. seeds, seedlings, root suckers etc. was another cause of their poor occurrence. Moreover, repeated fire and firewood collection in the forests of Chunati WS caused poor recruitment of the regenerated seedlings.

3.1.3 Vertical distribution of tree species

Vertical distribution of tree resources of Chunati WS was assumed by determining 6 height classes, viz. 3 -<8 m, 8 -<13 m, 13 -<18 m, 18 -<23 m, 23 -<28 m and 28 -<33 m. The total 5,968 tree stems recorded from the sample plots were considered for height class distribution. The lower height class 3 -<8 m is represented by maximum (4,284 stems) number of tree individuals (71.8% tree individuals) with maximum (156 species) number of tree species. Whereas, the percentage of individuals, number of individuals and number of species were found to reduce gradually in the higher height classes. Only 6 tree stems (0.1%) out of all 5,968 tree individuals belonging to 3 species were found in the uppermost height class of 28 m -<33 m. The trend line representing number of tree individuals at different height classes looks like a reverse-J shaped curve, and there is a sudden reduction of tree individuals in the height classes beyond 8 m and above (Figure 10). Reverse-J shaped curve indicates presence of more or less stable population structure or good regeneration status (Zegeye et al. 2011).

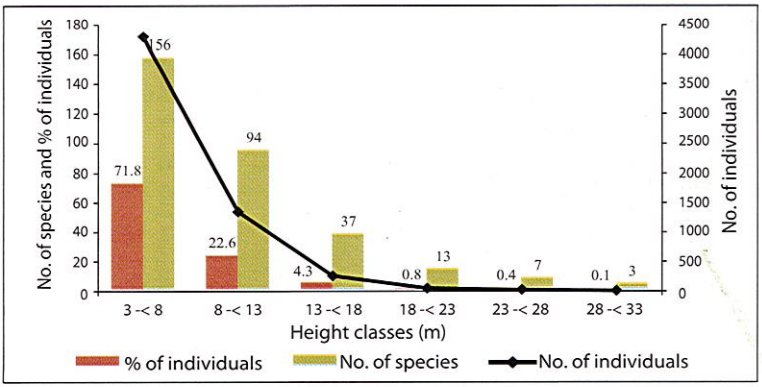


Figure 10. Tree species distribution, individual number and percentage in different height (m) classes in Chunati WS

The height class distribution shows poor vertical stratification in the forests of Chunati Wildlife Sanctuary. Most of the plantations were established in blocks with one or two species. As a result, there exist only single strata in plantation blocks. *Artocarpus chama, Dipterocarpus alatus, Dipterocarpus costatus, Dipterocarpus turbinatus, Shorea robusta, Stereospermum colais* etc. plants were found to dominate in the upper height classes. *Acacia auriculiformis, Acacia mangium, Albizia procera, Alstonia scholaris, Artocarpus lacucha, Derris robusta, Eucalyptus camaldulensis, Ficus benghalensis, Gmelina arborea, Senna siamea, Syzygium fruticosum* and *Tectona grandis* were dominant in the middle strata of Chunati WS forests. The plants naturally occur in the lower strata (height ranges) of Chunati WS forests are *Actinodaphne angustifolia, Albizia chinensis, Anogeissus acuminata, Aporosa wallichii, Chaetocarpus castanocarpus, Callicarpa arborea, Cinnamomum iners, Cryptocarya amygdalina, Dillenia scabrella, Ficus hispida, Garcinia cowa, Holarrhena antidysenterica, Lithocarpus polystachya, Suregada multiflora, Terminalia bellirica, Trema orientalis* etc. The plants of lower height classes are resistant to repeated fire that possess higher regeneration potential as they regenerate especially from root sucker or coppices. Only three tree species namely *Dipterocarpus costatus, Dipterocarpus turbinatus* and *Shorea robusta* were found in all the height classes. Distribution of individuals of dominant exotic and native tree species in different height ranges is shown in **Figure 11a** and **Figure 11b** respectively (**Details in Appendix 3**). Comparatively higher number of individuals of *Acacia auriculiformis, Acacia mangium, Eucalyptus camaldulensis* and *Tectona grandis* were distributed in the lower height ranges.

Height class distribution of the dominant native tree species, e.g. *Anogeissus acuminata, Dipterocarpus alatus, Dipterocarpus turbinatus, Ficus hispida, Garcinia cowa, Gmelina arborea, Shorea robusta, Stereospermum colais, Syzygium fruticosum* and *Lithocarpus polystachya* showed that only tree individuals of *Shorea robusta* and *Dipterocarpus turbinatus* occurred in all the five height classes. They are also the dominant tree species of the upper strata in Chunati WS. Whereas, *Ficus hispida* and *Lithocarpus polystachya* have maximum number of tree individuals in the lower height classes. These tree species are dominant in the lower strata perhaps due to their profuse regeneration and recruitment in the natural patches of Chunati WS (**Figure 11b**).

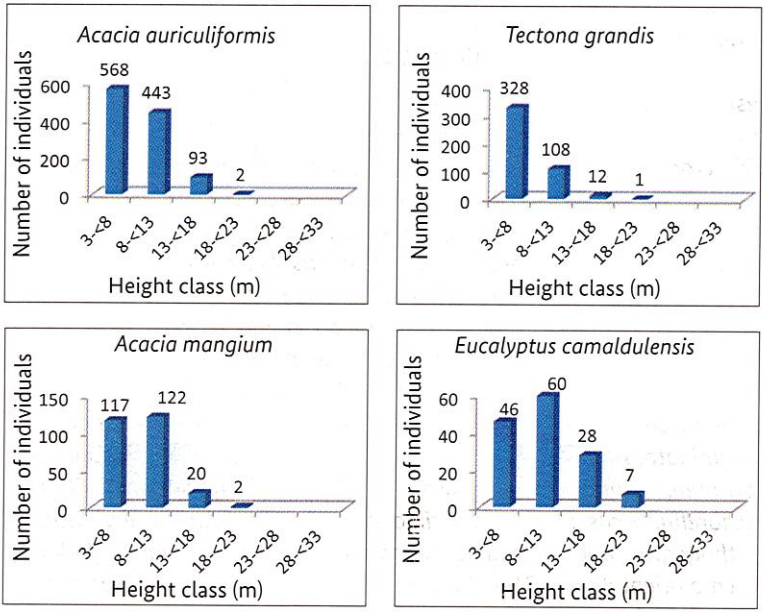
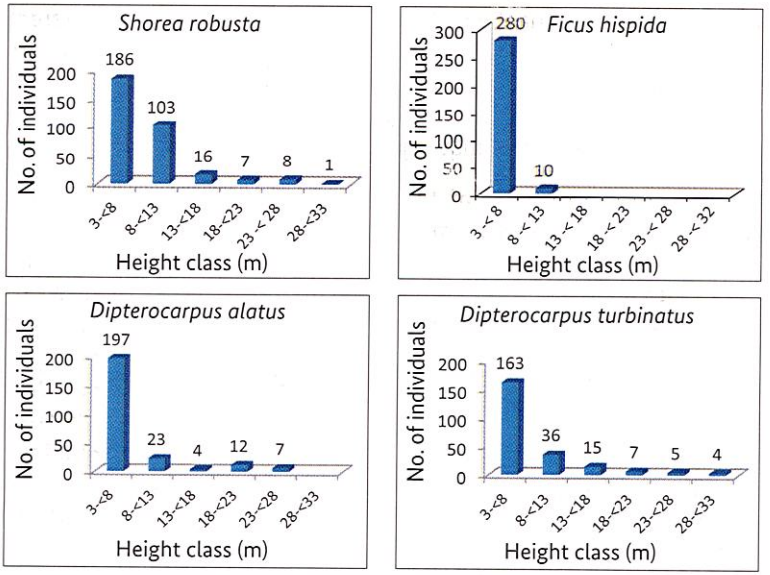


Figure 11a. Distribution of tree individuals in different height classes (m) of *Acacia auriculiformis, Tectona grandis, Acacia mangium*, and *Eucalyptus camaldulensis*.



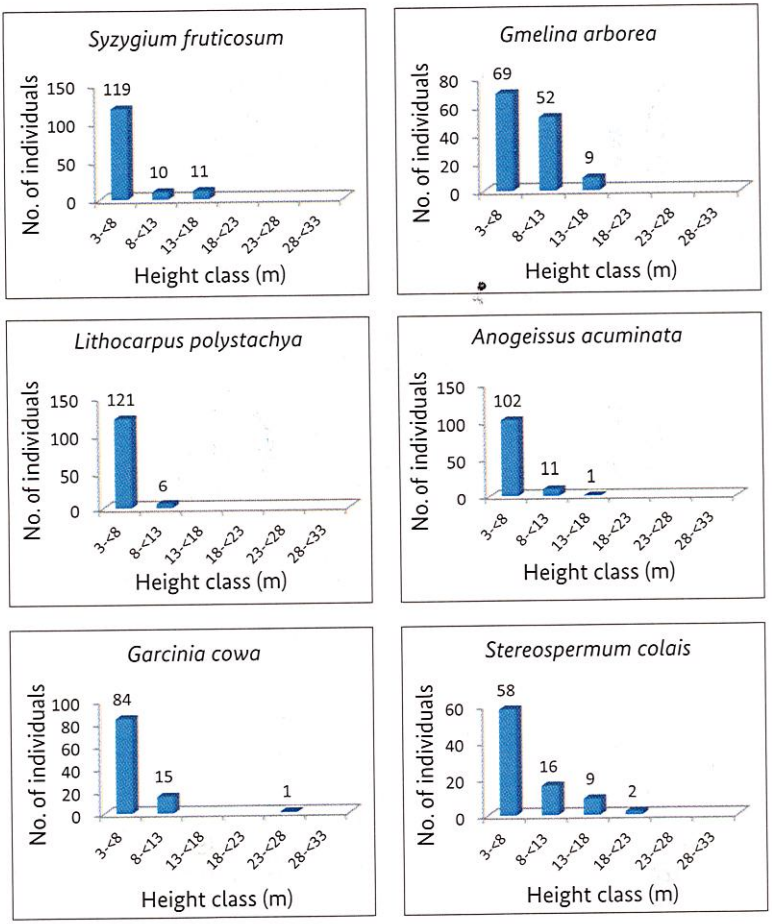


Figure 11b. Distribution of tree individuals in different height classes (m) of *Shorea robusta, Ficus hispida, Dipterocarpus alatus, D. turbinatus, Syzygium fruticosum, Gmelina arborea, Lithocarpus polystachya, Anogeissus acuminata, Garcinia cowa* and *Stereospermum colais*.

3.1.4 Structural composition of tree species based on diameter class distribution

All the recorded 5,968 tree stems having dbh of ≥5 cm were distributed into ten diameter classes (cm), e.g. 5 -<15, 15 -<25, 25 -<35, 35 -<45, 45 -<55, 55 -<65, 65 -<75, 75 -<85, 85 -<95 and ≥95 cm. Among them, 83.58% of all the tree individuals (4,988 tree stems of 5,968 stems)

belonging to 153 tree species were in the diameter range of 5 -<15 cm. The conservation status of the forest beats were strengthened significantly which resulted in higher recruitment percentage. The occurrence of higher number of trees in the lowest diameter class is the result of recent strengthening of the conservation programs. The number of representing tree species and percentage of tree individuals were found to be reduced gradually in the higher diameter classes (**Table 5**).

Table 5. Tree species distribution, individual stem number and percentage in different diameter classes (cm) in Chunati WS

Diameter Classes (cm)	No. of tree individuals	Tree individuals (%)	No. of representative species
5 -<15	4,988	83.58	153
15 -<25	754	12.63	95
25 -<35	103	1.73	41
35 -<45	34	0.57	21
45 -<55	28	0.47	14
55 -<65	21	0.35	12
65 -<75	6	0.10	4
75 -<85	2	0.03	1
85 -<95	7	0.12	5
≥95	25	0.42	8

Different diameter ranges were dominated by different tree species. Diameter (cm) ranges of 5 -<15 and 15 -<25 cm were dominanted by *Acacia auriculiformis* occupying 16.94% and 1.91% of all tree individuals respectively. Diameter class 25 –<35 cm, and 35 –<45 cm were dominant by *Shorea robusta* (0.22%) and *Samanea saman* (0.10%) respectively. On the other hand, *Dipterocarpus turbinatus* dominated in both diameter ranges of 45 –<55 cm and 55 –<65 cm, where *Dipterocarpus alatus* dominated the higher diameter classes (cm) of 65 -<75, 75 -<85, 85 -<95 and ≥95. None of the tree species was found to occur in all the diameter classes (cm). *Artocarpus chama*, *Dipterocarpus alatus*, *Dipterocarpus costatus* and *Samanea saman* occurred in most of the dbh classes (5 to 8 classes out of the 10 diamter classes). Percentage distribution of the tree individuals of dominant exotic and native tree species is shown in **Figure 12a** and **Figure 12b** respectively (Details in Appendix 4). All the dominant exotic tree species, e.g. *Acacia auriculiformis*, *Acacia mangium*, *Eucalyptus camaldulensis* and *Tectona grandis* were found maximum in the lower diameter classes. All of these were planted and yet to reach the maturity stage.

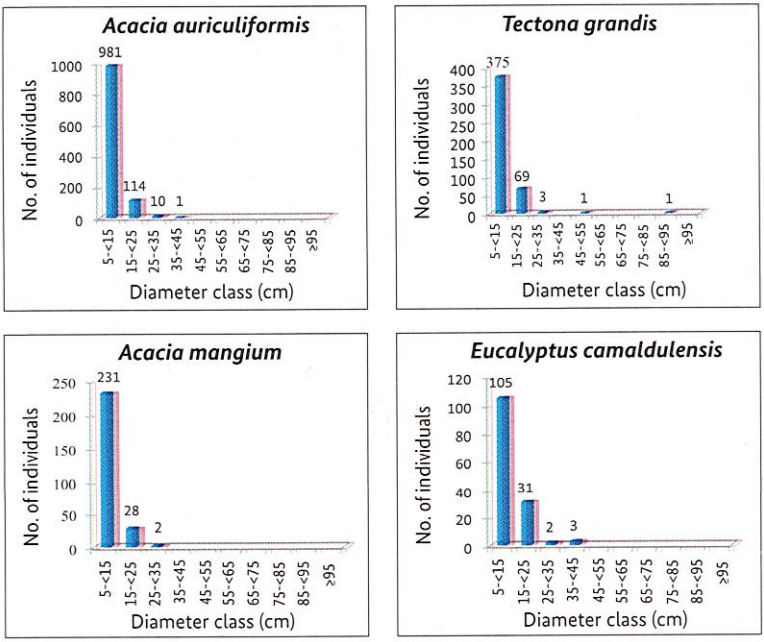
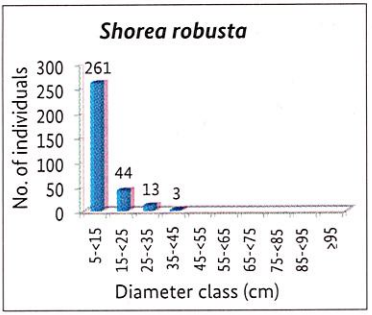
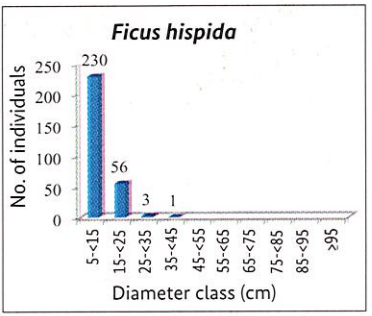
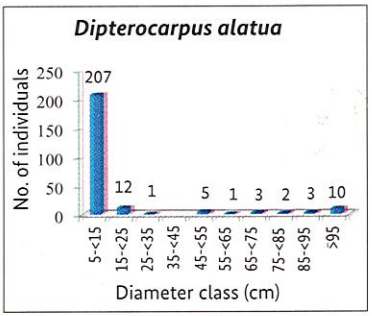


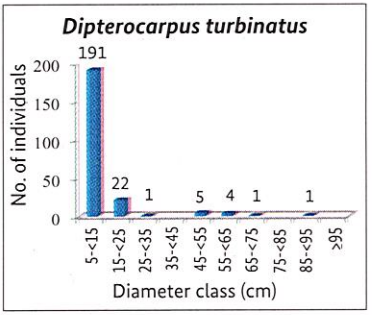
Figure 12a. Distribution of individual tree stems in different diameter classes (cm) of *Acacia auriculiformis, Tectona grandis, Acacia mangium* and *Eucalyptus camaldulensis*

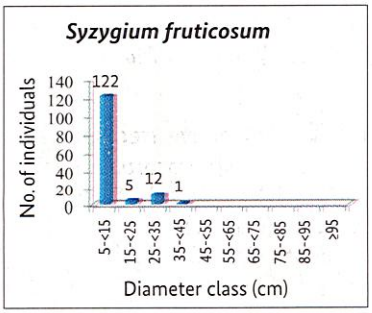
Diameter class (cm) distribution of the dominant native tree species, e.g. *Shorea robusta* (Sal), *Ficus hispida* (Dumur), *Dipterocarpus alatus* (Doilla garjan), *Dipterocarpus turbinatus* (Telia garjan), *Syzygium fruticosum* (Putijam), *Gmelina arborea* (Gamar), *Lithocarpus polystachya* (Shil batna), *Anogeissus acuminata* (Sikori), *Garcinia cowa* (Kao) and *Stereospermum colais* (Dharmara) showed that a few tree individuals of *Dipterocarpus turbinatus* and *D. alatus* were found in the upper diameter ranges. The remaining species were abundant in the lower diameter classes. So, it is obvious that the remnant forests of Chunati WS are in a preliminary stage of vegetation restoration process from the degraded forests. Natural recovery of the forest vegetation with native species is slow and uncertain as there exsists insufficient number of mother trees (**Figure 12b**).

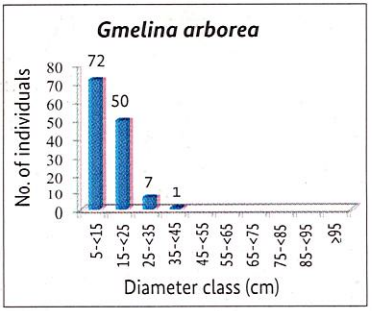

Shorea robusta
No. of individuals
300
250
200
150
100
50
0
261
44
13
3
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)

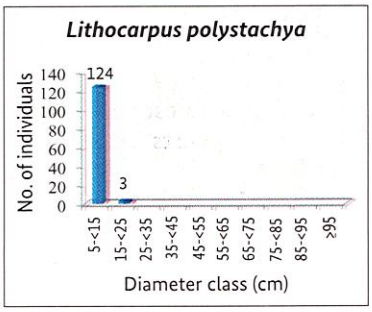

Ficus hispida
No. of individuals
250
200
150
100
50
0
230
56
3
1
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)

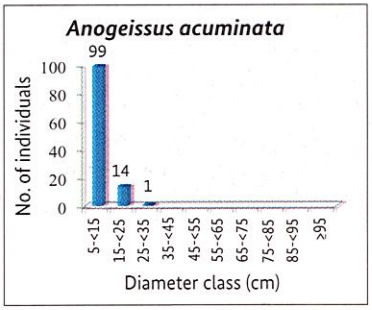

Dipterocarpus alatua
No. of individuals
250
200
150
100
50
0
207
12
1
5
1
3
2
3
10
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)


Dipterocarpus turbinatus
No. of individuals
200
150
100
50
0
191
22
1
5
4
1
1
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)


Syzygium fruticosum
No. of individuals
140
120
100
80
60
40
20
0
122
5
12
1
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)


Gmelina arborea
No. of individuals
80
70
60
50
40
30
20
10
0
72
50
7
1
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)


Lithocarpus polystachya
No. of individuals
140
120
100
80
60
40
20
0
124
3
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)


Anogeissus acuminata
No. of individuals
100
80
60
40
20
0
99
14
1
5-<15
15-<25
25-<35
35-<45
45-<55
55-<65
65-<75
75-<85
85-<95
≥95
Diameter class (cm)

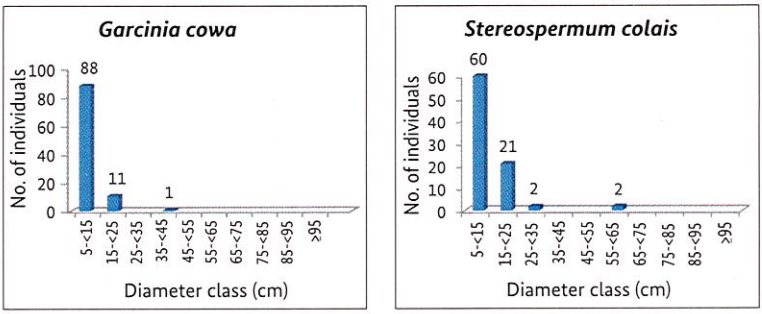


Figure 12b. Distribution of individual tree stems in different diameter classes (cm) of *Shorea robusta, Ficus hispida, Dipterocarpus alatus, D. turbinatus, Syzygium fruticosum, Gmelina arborea, Lithocarpus polystachya, Anogeissus acuminata, Garcinia cowa* and *Stereospermum colais*

Ramnant natural forests of Chunati WS

3.2 Shrubs

A total of 102 shrub species under 85 genera and 38 families were recorded from Chunati Wildlife Sanctuary. Rubiaceae family was represented by maximum number of species (14 species and 11 genera) followed by Euphorbiaceae (13 species and 11 genera), Fabaceae (7 species and 6 genera) and Verbenaceae (7 species and 5 genera). The shrub species that commonly occurred in Chunati Wildlife Sanctuary were *Breynia retusa, Bridelia stipularis, Bridelia tomentosa, Calycopteris floribunda, Clausena suffruticosa, Combretum latifolium, Croton caudatus, Gigantochloa andamanica, Glochidion zeylanicum, Lantana camara, Melastoma malabathricum, Melocanna baccifera, Morinda angustifolia, Tabernamontana divaricata, Urena lobata, Ziziphus oenoplia* etc. (**Table 6**).

Table 6: Shrub species recorded from Chunati WS

[*F = Fuelwood, Fd = Food and Fodder, M = Medicinal, N = Miscellaneous non-timber uses (other than fuel, food, fodder and medicinal), T = Timber and Nk = Not known]

Scientific Name	Family	Local Name	Use
Abelmoschus moschatus Medic.	Malvaceae	Mushak-dana	N, M*
Abutilon indicum (L.) Sweet.	Malvaceae	Petari	M, N
Acacia caesia (L.) Willd.	Mimosaceae	Sue	Nk
Acalypha hispida Burm. f.	Euphorbiaceae	Bara hatisur	M
Aganosma marginata (Roxb.) Go. Don	Apocynaceae	Chhoto kuruz	N
Allamanda cathartica L.	Apocynaceae	Mikeful	M, N
Ardisia elliptica Thunb.	Myrsinaceae	Sayatika	Fd
Ardisia humilis Thw.	Myrsinaceae	Chauldhoa	M, N
Bambusa tulda Roxb.	Poaceae	Mitinga	Fd, N
Bambusa vulgaris Scharad. *ex* Wendl.	Poaceae	Baijja, Baria	Fd, N
Bauhinia acuminata L.	Caesalpiniaceae	Sada kanchan	M, N
Breynia retusa (Dennst.) Alston	Euphorbiaceae	Silpati	M
Bridelia stipularis (L.) Blume	Euphorbiaceae	Pat khoi	Fd, N
Bridelia tomentosa Blume	Euphorbiaceae	Khoi	M
Buddleja asiatica Lour.	Loganiaceae	Neemda	M
Cajanus cajan (L.) Millsp.	Fabaceae	Arhor	Fd, M
Calotropis gigantea (L.) R. Br.	Asclepiadaceae	Akand	M
Calycopteris floribunda (Roxb.) Lamk.	Combretaceae	Guicha lata	M
Canthium angustifolium Roxb.	Rubiaceae	Kantanali	Nk
Canthium parvifolium Roxb.	Rubiaceae	Bish-main	M
Capparis zeylanica L.	Capparaceae	Kalookra	Fd, M
Citrus aurantifolia (Christm. & Panzer) Swingle	Rutaceae	Lebu	Fd, M
Clausena suffruticosa (Roxb.) Wight & Arn.	Rutaceae	Kali moricha	Fd, N
Clerodendrum indicum (L) O. Kuntze	Verbenaceae	Bamunhatti	M, N
Clerodendrum serratum (L) Moon	Verbenaceae	Borangi	Fd

Table 6 continued...

Scientific Name	Family	Local Name	Use
Clerodendrum viscosum Vent.	Verbenaceae	Bhant	M
Cnesmone javanica Blume	Euphorbiaceae	Paharibichuti	Nk
Codiaeum variegatum (L.) A. Juss.	Euphorbiaceae	Patabahar	N
Combretum acuminatum Roxb.	Combretaceae	Sada guicha	M
Combretum latifolium Blume	Combretaceae	Sada guicha	Nk
Crotalaria incana L.	Fabaceae	Choto jhunjhuni	N
Croton caudatus Geiseler	Euphorbiaceae	Horokjala	M
Croton roxburghii Balakr	Euphorbiaceae	Baragachh	M
Dendrocnide sinuata (Blume) Chew	Urticaceae	Bangaldandi	F, N
Desmodium heterocarpon (L.) DC.	Fabaceae	Karpo modi	Nk
Duranta repens L.	Verbenaceae	Kanta mehedi	M, N
Elaeagnus latifolia L.	Elaeagnaceae	Bon-jara	M
Elatostema rupestre (Buch.-Ham. *ex* D. Don) Wedd.	Urticaceae	Pathorjhara	Nk
Euonymus attenuatus Wall. *ex* Law.	Celastraceae	Atte-nima	Nk
Fagerlindia fasciculata (Roxb.) Tirveng.	Rubiaceae		Nk
Ficus heterophylla L. f.	Moraceae	Bhui-dumur	Fd, M
Ficus heteropleura Blume	Moraceae		F, Fd
Fissistigma wallichii (Hook. f. & Thom.) Merr.	Annonaceae	Litchi bheduli	Nk
Flemingia macrophylla (Willd.) O. Kuntze *ex* Merr.	Fabaceae	Bara-salphan	M
Flemingia strobilifera (L.) R. Br.	Fabaceae	Simbusak	Nk
Gardenia augusta (L.) Merr.	Rubiaceae	Gandhoraj	M, N
Gigantochloa andamanica (Kurz) Kurz	Poaceae	Kaliseri	N
Glochidion zeylanicum (Gaertn.) A. Juss.	Euphorbiaceae	Dephajam	M
Glycosmis pentaphylla (Retz.) A. DC.	Rutaceae	Ashsaora	M
Helicia erratica Hook. f.	Proteaceae	Khara pakan	Fd
Hibiscus rosa-sinensis L.	Malvaceae	Joba	M, N
Hibiscus surattensis L.	Malvaceae	Ram bhindi	Fd, M
Ipomoea fistulosa Mart. *ex* Choisy	Convolvulaceae	Dhol kolmi	F, N
Ixora acuminata Roxb.	Rubiaceae	Nata rangan	N
Ixora chinensis Lamk.	Rubiaceae	Rongon	N
Ixora cuneifolia Roxb.	Rubiaceae	Beophul	Nk
Jasminum sambac (L.) Aiton	Oleaceae	Bon mollika	M, N
Justicia adhatoda L.	Acanthaceae	Bashok pata	M
Justicia gendarussa Burm. f.	Acanthaceae	Kala bashak	M
Lantana camara L. var. *aculeata* Moldenke & Moldenke	Verbenaceae	Lantana	M, N
Leea aequata L.	Leeaceae	Kak jhongha	Nk
Licuala peltata Roxb.	Arecaceae	Kuruk pata	N
Mallotus repandus (Willd.) Muell.-Arg.	Euphorbiaceae	Gunti	M
Manihot esculenta Crantz	Euphorbiaceae	Shimul alu	M
Melastoma malabathricum L.	Melastomataceae	Bontezpata	M
Melocanna baccifera (Roxb.) Kurz	Poaceae	Muli, Paiyya	Fd, N
Meyna pubescens (Kurz) Robyns	Rubiaceae	Moina	Nk
Millettia cinerea Benth.	Fabaceae	Pokkharnoli	Nk
Morinda angustifolia Roxb.	Rubiaceae	Banamali	M, N

Table 6 continued...

Scientific Name	Family	Local Name	Use
Murraya koenigii (L.) Spreng.	Rutaceae	Choto kammini	Fd, M, N
Mussaenda erythrophylla Schum. & Thonn.	Rubiaceae	Muchonda	N
Mycetia longifolia (Wall.) O. Kuntze	Rubiaceae	-	Nk
Olax imbricata Roxb.	Olacaceae	Olakanta	Nk
Oxyceros kunstleri (King & Gamble) Tirveng.	Rubiaceae	Mohiskanta	M
Oxyspora cernua Hook. f. & Thoms. *ex* Triana.	Melastomataceae	Chokha	Nk
Pandanus minor Buch.-Ham *ex* Wall.	Pandanaceae	Choto keya	Nk
Pavetta indica L.	Rubiaceae	Kathchapa	M
Pedilanthus tithymaloides Poit.	Euphorbiaceae	-	M
Phyllanthus reticulatus Poir.	Euphorbiaceae	Chiki	M
Premna esculenta Roxb.	Verbenaceae	Lalana	Fd, M
Pycnarrhena pleniflora ('planiflora') Hook. f. & Thoms.	Menispermaceae	Henalora	Nk
Sarcochlamys pulcherrima Gaudich.	Urticaceae	Korobi	F, Fd, N
Schefflera elliptica (Blume) Horms.	Araliaceae	Jeng-jil	M
Schizostachyum dullooa (Gamble) R. Majumdar	Poaceae	Dolu	N
Sida rhombifolia L.	Malvaceae	Lalberela	M
Solanum melongena L.	Solanaceae	Begun	Fd, M
Solanum torvum Sw.	Solanaceae	Tit begun	Fd, M
Strobilanthes rufescens T. Anders.	Acanthaceae	Rafibila	Nk
Tabernamontana divaricata *ex* Roemer & Schult.	Apocynaceae	Tagor, Dudhphul	M, N
Tabernamontana recurva Roxb.	Apocynaceae	Tagor	N
Tecoma stans (L.) Juss. *ex* Kunth	Bignoniaceae	Holde	M, N
Tephrosia candida DC.	Fabaceae	Bogamedola	M
Tetracera sarmentosa (L.) Vahl subsp. *andamanica* (Hoogl.) Hoogl.	Dilleniaceae	Lata chalta	M
Thespesia lampas (Cav.) Dalz. & Gibs.	Malvaceae	Bonderi	M, N
Thuja orientalis L.	Cupressaceae	Thuja	M, N
Trevesia palmata (Roxb.) Vis.	Araliaceae	Vombal	Nk
Triumfetta rhomboidea Jacq.	Tiliaceae	Banokra	M, N
Urena lobata L.	Malvaceae	Ban-okra	M, N
Vitex trifolia L. f.	Verbenaceae	Nilnishinda	M, N
Wendlandia tinctoria DC. subsp. *orientalis* Cowan	Rubiaceae	Tulalodh	Nk
Wikstroemia indica (L.) C. A. Mey.	Thymeliaceae	Sotopata	M
Ziziphus oenoplia (L.) Mill.	Rhamnaceae	Bonboroi	Fd, M, N

Clausena suffruticosa (Kalo maricha)

Calotropis gigantea (Akand)

Croton caudatus (Horokjala)

Bauhinia acuminata (Sada kanchan)

Clerodendrum indicum (Bamunhatti)

Gigantochloa andamanica (Kali seri bans)

Combretum latifolium (Sada guicha)

Ixora cuneifolia (Beophul)

Combretum acuminatum (Sada guicha)

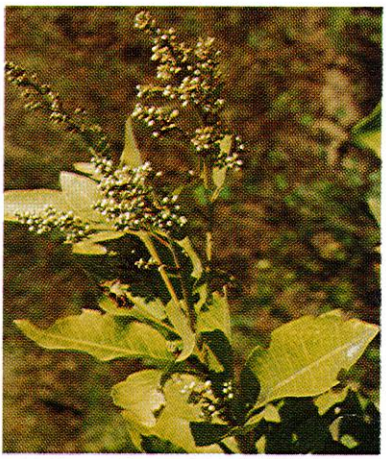
Clerodendrum viscosum (Bhant)

Lantana camara (Lantana)

Melastoma malabathricum (Bontezpata)

Justicia gendarussa (Kala bashak)

Ipomoea fistulosa (Dhol Kolmi)



Glycosmis pentaphylla (Matkila)

Phyllanthus reticulatus (Chiki)

Mussaenda erythrophylla (Muchonda)

Murraya koenigii (Choto kammini)

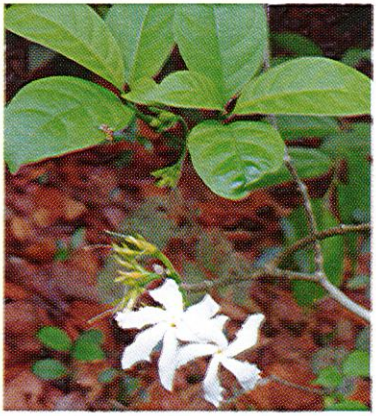
Morinda angustifolia (Banamali)

Sarcochlamys pulcherrima (Korobi)

Urena lobata (Bon-okra)

Trevesia palmata (Vombal)

Tephrosia candida (Bogamedola)



Tabernamontana divaricata (Tagor)

Wikstroemia indica (Sotopata)

Bamboos recorded from the wildlife sanctuary, were placed in the shrub categories. Among the five bamboo species, *Gigantochloa andamanica* (Kaliseri bansh) and *Melocanna baccifera* (Muli) were found to grow commonly in Chunati WS. *Bambusa vulgaris* (Baijja) was recorded from both the forests and the homesteads in and around the Chunati WS. Human inhabitation, cultivation and biotic interference resulted in occurrence of many domesticated shrubs, i.e. *Cajanus cajan, Citrus aurantifolia, Duranta repens, Gardenia augusta, Hibiscus rosa-sinensis, Ixora chinensis, Jasminum sambac, Mussaenda erythrophylla, Solanum melongena* etc. Some ornamental plants were also recorded from the homesteads and beat offices of Chunati WS. Among the shrub species, *Bauhinia acuminata* (Sada kanchan), *Murraya koenigii* (Choto kamini), *Premna esculenta* (Lalana), *Sarcochlamys pulcherrima* (Korobi), *Solanum torvum* (Titbegun) and *Ziziphus oenoplia* (Bonboroi) etc. are economically important as they concurrently provide medicinal, food and other services. Many researchers, e.g. Alam 1992, Banik 2000, Rahman *et al.* 2003 and Yusuf *et al.* 2006 reported that *Clerodendrum viscosum* (Bhant), *Melastoma malabathricum* (Bontezpata), *Melocanna baccifera* (Muli), and *Clausena suffruticosa* (Kali moricha) that occurred in Chunati WS have notable ethno-botanical importance.

3.3 Herbs

The survey revealed 211 herbs belonging to 150 genera and 47 families in Chunati Wildlife Sanctuary. Poaceae family appeared to be the largest as it contains 38 species under 28 genera followed by Asteraceae (28 species and 24 genera), Cyperaceae (23 species and 12 genera) and Fabaceae (10 species and 4 genera). The most commonly occurred herbs in the WS are *Ageratum conyzoides* (Ochunti), *Amaranthus spinosus* (Kanta shak), *Chromolaena odorata* (Assam gach), *Chrysopogon aciculatus* (Premkanta), *Costus speciosus* (Bonroi, Khustha), *Croton bonplandianus* (Bankhira), *Curculigo latifolia* (Biddiri pata), *Cynodon dactylon* (Durba grass), *Desmodium triquetrum* (Kalaliya), *Eclipta alba* (Kalokeshi), *Euphorbia hirta* (Ghaopata), *Mimosa pudica* (Lajjabati), *Musa paradisiaca* (Champa kola), *Peliosanthes teta* (Napata, Biddiripata), *Pseudoelephantopus spicatus* (Kukurgihba), *Synedrella nodiflora* (Relanodi), *Thysanolaena maxima* (Jahruful), *Vernonia cinerea* (Kuksim), *Zingiber zerumbet* (Pala) etc. (**Table 7**). Among the herbs, there were 116 species of dicotyledons and 95 speceis of monocotyledons. Many agri-crops were found to be cultivated in the sanctuary area, i.e. *Amaranthus tricolor, Ananus comosus, Carica papaya, Lycopersicon esculentum, Musa paradisiaca,*

Oryza sativa, Saccharum officinarum, Solanum tuberosum, Zea mays etc. A significant number of flowering plants were introduced in the yard of Nature Interpretaion Center (NIC) and office compounds of the beat offices of Chunati WS. Some of them are *Ageratum maxicana, Calendula officinalis, Catharanthus roseus, Cosmos bipinnatus, Dahlia variabilis, Helianthus annuus, Pitunia* hybrid, *Ravenala madagascariensis, Salvia splendens* and *Zinnia elegans*. There were many water bodies and streams that supports many herbs in the Chunati WS.

Table 7: Herbs recorded from Chunati WS

[*Fd = Food and Fodder, M = Medicinal, N = Miscellaneous non-timber uses (other than fuel, food, fodder and medicinal) and Nk = Not known]

Scientific Name	Family	Local Name	Use
Abelmoschus esculentus (L.) Moench	Malvaceae	Vendi	M, T*
Achyranthes aspera L.	Amaranthaceae	Apang	M
Acroceras tonkinense (Balansa) C. E. Hubb. *ex* Bor	Poaceae	Cerastonki	Fd
Adenosma indianum (Lour.) Merr.	Scrophulariaceae	Barakesuti	Nk
Ageratum conyzoides L.	Asteraceae	Ochunti	M
Ageratum maxicana L.	Asteraceae	Floss flower	N
Aglaonema hookerianum Schott	Araceae	Nimahook	N
Allium cepa L.	Liliaceae	Piyaj	Fd, M
Allium sativum L.	Liliaceae	Rashun	Fd, M
Alpinia conchigera Griff.	Zingiberaceae	Khetranga	M
Alpinia galanga (L.) Sw.	Zingiberaceae	Pala	M, N
Alpinia nigra (Gaertn.) Burtt.	Zingiberaceae	Jongli ada	M
Alternanthera philoxeroides (Mart.) Griseb.	Amaranthaceae	Helencha	Fd
Alternanthera sessilis (L.) R. Br. *ex* Roem. & Schult.	Amaranthaceae	Haicha	Fd, M
Amaranthus spinosus L.	Amaranthaceae	Kanta shak	Fd, M
Amaranthus tricolor L.	Amaranthaceae	Lalshakh	Fd
Amaranthus viridis L.	Amaranthaceae	Notay	M
Ampelygonum chinense (L.) Lindley	Polygonaceae	Mohicharan sak	M
Ananas comosus (L.) Merr.	Bromeliaceae	Anarosh	Fd, M, N
Anisomeles indica (L.) O. Kuntze	Lamiaceae	Mura tulsi	M
Arundo donax L.	Poaceae	Baronol	Fd, N
Asclepias curassavica L	Asclepiadaceae	Moricha	M
Axonopus compressus (Sw.) P. Beauv.	Poaceae	Carpet durba	Fd, N
Blumea lacera (Burm. f.) DC.	Asteraceae	Barokukshim	M, N
Brachiaria distachya (L.) Stapf	Poaceae	Cori ghas	Fd, N
Brachiaria reptans (L.) Gard. & Hubb.	Poaceae	Para ghas	Fd
Brassica oleracea L. var. *botrytis* L.	Brassicaceae	Phulkapi	Fd, M
Brassica oleracea L. var. *capitata* L.	Brassicaceae	Bandhakapi	Fd, M
Bryophyllum pinnatum (Lamk.) Oken	Crassulaceae	Pathor kuchi	Fd, M
Calendula officinalis L.	Asteraceae	Calendula	M, N
Capsicum frutescens L.	Solanaceae	Morich	Fd
Carex indica L.	Cyperaceae		N
Carica papaya L.	Caricaceae	Pepe	Fd, M

Table 7 continued...

Scientific Name	Family	Local Name	Use
Catharanthus roseus (L.) G. Don	Apocynaceae	Nayantara	N, M
Centella asiatica (L.) Urban	Apiaceae	Thankuni	Fd, M
Chenopodium album L.	Chenopodiaceae	Batua shak	Fd, M
Chromolaena odorata (L.) King & Robinson	Asteraceae	Assam gach	M
Chrysopogon aciculatus (Retz.) Trin	Poaceae	Premkanta	Fd, M, N
Colocasia esculenta (L.) Schott	Araceae	Kachu	Fd, M
Commelina diffusa Burm. f.	Commelinaceae	Monayna	Fd, M
Commelina erecta L.	Commelinaceae	Jata kanchira	Fd, M, N
Conyza semipinnatifida Wall. *ex* DC.	Asteraceae	-	Nk
Cosmos bipinnatus Cav.	Asteraceae	Cosmos flower	N
Costus speciosus (Koenig *ex* Retz.) Smith	Cymodoceaceae	Bonroi	M
Courtoisina cyperoides (Roxb.) Sojak	Cyperaceae		Nk
Crassocepholum crepidioides (Benth.) S. Moore	Asteraceae	Duubbecrepi	Nk
Crotalaria juncea L.	Fabaceae	Jhun-jhuni	M
Crotalaria pallida Ait.	Fabaceae	Jhun-jhuni	N
Crotalaria verrucosa L.	Fabaceae	Bara Jhun-jhuni	M
Croton bonplandianus Baill.	Euphorbiaceae	Bankhira	M
Croton lobatus L.	Euphorbiaceae		Nk
Cupheahy sopifolia Griseb	Lythraceae		Nk
Curculigo latifolia [Dryand.] Ait.	Liliaceae	Biddiri pata	N
Curcuma longa L.	Zingiberaceae	Halud	Fd, M
Cynodon dactylon (L.) Pers.	Poaceae	Durba grass	Fd, M, N
Cyperus cephalotes Vahl	Cyperaceae	Gothubi	Nk
Cyperus compactus Retz.	Cyperaceae	Bandorghasi	Nk
Cyperus exaltatus Retz.	Cyperaceae	Tata ghas	N
Cyperus haspan L.	Cyperaceae		N
Cyperus tuberosus Rottb.	Cyperaceae	Dimamutha	Fd
Cyrtococcum patens (L.) A. Camus	Poaceae		Fd
Cyrtococcum trigonum (Retz.) A. Camus	Poaceae		Nk
Dahlia variabilis Cav.	Asteraceae	Dahlia	N
Desmodium gangeticum (L.) DC.	Fabaceae	Salpani	Nk
Desmodium heterophyllum (Willd.) DC.	Fabaceae	Bon motorsuti	Nk
Desmodium oblongum Wall. *ex* Benth.	Fabaceae		Nk
Desmodium pulchellum (L.) Benth.	Fabaceae		M
Desmodium triquetrum (L.) DC.	Fabaceae	Kalaliya	Nk
Desmostachya bipinnata (L.) Stapf	Poaceae	Kusha	Fd, M
Digitaria sanguinalis (L.) Scop.	Poaceae	Anguli ghas	Fd
Dipteracanthus prostratus (Poir.) Nees	Acanthaceae		M
Dracaena spicata Roxb.	Agavaceae	Kadorateng gaas	Nk
Drosera burmannii Vahl	Droseraceae	Surja sishir	N
Echinochloa crusgalli (L.) P. Beauv.	Poaceae	Shama ghas	Fd, N
Eclipta alba (L.) Hassk.	Asteraceae	Kalokeshi	M
Eichhornia crassipes (Mart.) Solms	Pontederiaceae	Kochuripana	Fd
Eleocharis retroflexa (Poir.) Urban	Cyperaceae	Samudrapati ghasi	Nk
Elephantopus scaber L.	Asteraceae	Shamdalan	M
Eleusine indica (L.) Gaertn.	Poaceae	Malangakuri	Fd, N
Emilia sonchifolia (L.) DC.	Asteraceae	Bon-tulsi	Nk

Table 7 continued...

Scientific Name	Family	Local Name	Use
Enhydra fluctuans Lour.	Asteraceae	Helencha	Fd, M
Eragrostis ciliaris (L.) R. Br.	Poaceae	Lomkoni	Fd
Eragrostis coarctata Stapf	Poaceae	Chikna ghas	Nk
Eragrostis tenella (L.) P. Beauv. *ex* Roem. & Schult.	Poaceae		Fd
Eragrostis uniloides (Retz.) Nees *ex* Steud.	Poaceae	Chirakoni	Fd, N
Eriochloa procera (Retz.) C. E. Hubb.	Poaceae	Nolghass	Fd
Euphorbia hirta L.	Euphorbiaceae	Ghaopata	M
Evolvulus nummularius (L.) L.	Convolvulaceae	Bhuiokra	Nk
Fimbristylis aestivalis (Retz.) Vahl	Cyperaceae		Nk
Fimbristylis bisumbellata (Forssk.) Bubani	Cyperaceae		Nk
Fimbristylis dipsacea (Rottb.) C.B. Clarke	Cyperaceae		Nk
Fimbristylis falcata (Vahl) Kunth	Cyperaceae	Bindimathi	Nk
Fimbristylis miliacea (L.) Vahl	Cyperaceae	Bara javani	Nk
Fimbristylis rigidula Nees	Cyperaceae		Nk
Fimbristylis squarrosa Vahl	Cyperaceae	Zumka chech	Nk
Flagellaria indica L.	Flagellariaceae	Ban chanda	M
Floscopa scandens Lour.	Commelinaceae		M
Fuirena ciliaris (L.) Roxb.	Cyperaceae	Poshmi ghasi	Nk
Glinus oppositifolius (L.) A. DC.	Molluginaceae	Gimashakh	M
Gnaphalium luteo-album L.	Asteraceae	Bara kamra	M
Gnaphalium polycaulon Pers.	Asteraceae	Kulaklomi	Nk
Grangea maderaspatana (L.) Poir.	Asteraceae	Nemuti	M
Hedyotis auricularia L.	Rubiaceae		M
Hedyotis corymbosa (L.) Lamk.	Rubiaceae		M
Hedyotis verticillata (L.) Lamk.	Rubiaceae		Nk
Helianthus annuus L.	Asteraceae	Surjamukhi	Fd, M, N
Heliconia psittacorum L. f.	Heliconiaceae	Kolaphul	N
Heliotropium indicum L.	Boraginaceae	Hatisur	M
Hemarthria protensa Steud.	Poaceae	Chalia ghas	Nk
Hemistepta lyrata Bunge *ex* Fisher et Mey.	Asteraceae	Saussurea	Nk
Homalomena aromatica (Roxb. *ex* Sim) Schott	Araceae	Gandhobi kochu	N
Hydrolea zeylanica (L.) Vahl	Hydrophyllaceae	Kasschara	Fd, M
Hygrophila salicifolia (Vahl) Nees	Acanthaceae	Kakmasha	Fd
Hymenachne pseudointerrupta C. Muell.	Poaceae		Fd
Hypolytrum nemorum (Vahl) Spreng.	Cyperaceae		Nk
Hyptis suaveolens (L.) Poit.	Lamiaceae	Tokma	M, N
Imperata cylindrica (L.) P. Beauv	Poaceae	Chhan	Fd, M, N
Kyllinga nemoralis (J. R. Forst. & G. Forst.) Dandy *ex* Hutchins. & Dal ziel	Cyperaceae	Subasinirbisa	Fd
Lasia spinosa (L.) Thw.	Araceae	Kanta-kachu	Fd, M
Leucas aspera (Willd.) Link	Lamiaceae	Shetodrona	M
Leucas zeylanica (L.) R. Br.	Lamiaceae	Lankadhron	Nk
Limnocharis flava (L.) Buchen.	Limnocharitaceae	Letuce pana	N
Limnophila sessiliflora (Vahl) Blume	Scropholariaceae	Bamon keshori	M
Lindernia antipoda (L.) Alston.	Scropholariaceae	Zai ghas	Nk
Lindernia crustacea (L.) F. Muell.	Scropholariaceae	Chapra ghas	M
Lindernia procumbens (Krocker) Philcox	Scropholariaceae	Bokpuspo	M

Table 7 continued...

Scientific Name	Family	Local Name	Use
Lindernia pusilla (Willd.) Boldingh	Scrophulariaceae		Nk
Lobelia zeylanica L.	Campanulaceae	Cylon lobel	Fd
Ludwigia hyssopifolia (G. Don) Exell apud A. & R. Fernandes	Onagraceae	Zaikura	Nk
Lycopersicon esculentum Mill.	Solanaceae	Tomato	Fd
Maranta arundinacea L.	Marantaceae	Arraroot	N
Melochia corchorifolia L.	Sterculiaceae	Tikiokra	M
Mimosa diplotricha C. Wright *ex* Sauv.	Mimosaceae	Bara lajjabati	N
Mimosa pudica L.	Mimosaceae	Lajjabati	M
Mitracarpus hirtus (L.) DC.	Rubiaceae	Tupi kadam	Nk
Monochoria hastata (L.) Solms	Pontederiaceae	Bara nukha	Fd
Monochoria vaginalis (Burm. f.) Presl	Pontederiaceae	Nukha	Fd, M
Murdannia nudiflora (L.) Brenan	Commelinaceae	Kanduli	Nk
Musa ornata Roxb.	Musaceae	Ramkola	Fd
Musa paradisiaca L.	Musaceae	Champa kola	Fd
Narenga porphyrocoma (Hance) Bor	Poaceae	Maja ghas	N
Nelsonia canescens (Lamk.) Spreng.	Acanthaceae	Paramul	Nk
Oryza sativa L.	Poaceae	Dhan	Fd, M, N
Oxalis corniculata L.	Oxalidaceae	Amrul	M
Panicum brevifolium L.	Poaceae		Nk
Panicum maximum Jacq	Poaceae	Gini ghas	Fd, M
Panicum repens L.	Poaceae	Dhani ghas	Fd
Paspalum scrobiculatum L.	Poaceae	Bishmona ghas	Fd, M
Peliosonthes teta Andr.	Haemodoraceae	Napata	Nk
Persicaria flaccida (Meissn.) H. Gross. *ex* Loesen.	Polygonaceae	Lal bishkatali	M
Persicaria hydropiper (L.) Spach	Polygonaceae	Biskatali	M
Persicaria orientalis (L.) Spach	Polygonaceae	Bara panimorich	M
Persicaria tomentosa (Willd.) Sasaki	Polygonaceae		M
Phaulopsis imbricata (Forssk.) Sweet	Acanthaceae	Kantasi	N
Phragmites karka (Retz.) Trin. *ex* Steud.	Poaceae	Nalkhagra	Fd, M, N
Phyllanthus niruri L.	Euphorbiaceae	Vuiamla	M
Physalis minima L.	Solanaceae	Phutka	M
Pitunia hybrid	Solanaceae	Petunia flower	N
Pogonatherum crinitum (Thunb.) Kunth	Poaceae	Nitubansh	Nk
Pogostemon auricularius (L.) Hassk.	Lamiaceae	Aripachuli	Nk
Polygonum effusum Meissn.	Polygonaceae	Raniphul	M
Polygonum plebeium R. Br.	Polygonaceae	Chemti sag	M
Pseudoelephantopus spicatus (Juss. *ex* Aubl.) Gleason	Asteraceae	Kukurgihba	Nk
Pycreus unioloides (R. Br.) Urban	Cyperaceae	Paikol ghas	Nk
Raphanus sativus L.	Brassicaceae	Mula	Fd, M
Ravenala madagascariensis J. F. Gmel.	Strelitziaceae	Panthopadop	N
Rhynchospora corymbosa (L.) Britton	Cyperaceae	Shonathuti ghas	Fd, N
Rotala rotundifolia (Buch.-Ham. *ex* Roxb.) Koehne	Lythraceae	Dim ghurni	Nk
Rotala serpyllifolia (Roth.) Brem.	Lythraceae		Nk
Rumex vesicarius L.	Polygonaceae	Takpalong	M

Table 7 continued...

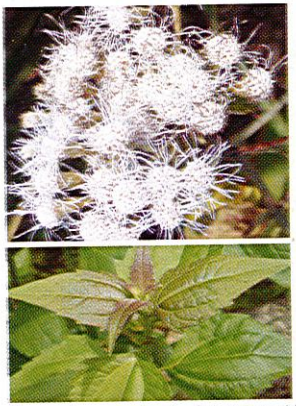
Scientific Name	Family	Local Name	Use
Rungia pectinata (L.) Nees	Acanthaceae	Pindi	M
Saccharum arundinaceum Retz.	Poaceae	Tenga ghas	M, N
Saccharum officinarum L.	Poaceae	Akh	Fd, M, N
Saccharum ravennae L.	Poaceae	Ekor	Fd, N
Saccharum spontaneum L.	Poaceae	Kash	Fd, N
Salvia splendens Sellow *ex* Roem. & Schult.	Lamiaceae	Silvia	N
Sansevieria trifasciata Prain	Agavaceae	Sutahara	M, N
Schoenolectus juncoides (Roxb.) Palla	Cyperaceae	Chechri	Nk
Schumannianthus dichotomus (Roxb.) Gagnep.	Marantaceae	Patipata	N
Scleria levis Retz.	Cyperaceae	Rialevi ghas	Nk
Scleria terrestris (L.) Fassett	Cyperaceae		Nk
Senna occidentalis Roxb.	Caesalpiniaceae	Bara-Chalkesunda	M
Senna tora (L.) Roxb.	Caesalpiniaceae	Chakunda	M, N
Sesbania bispinosa (Jacq.) Wight.	Fabaceae	Dhouncha	Fd, M, N
Setaria palmifolia (Koen.) Stapf	Poaceae	Urodhan	M
Setaria verticillata (L.) P. Beauv.	Poaceae	Dorabiari	Fd
Sida acuta Burm. f.	Malvaceae	Kureta	M, N
Sida cordifolia L.	Malvaceae	Shet-berela	M, N
Solanum americanum Mill.	Solanaceae	Tit-begun	Fd, M
Solanum nigrum L.	Solanaceae	Titbegun	M
Solanum tuberosum L.	Solanaceae	Golalu	Fd
Spermacoce articularis L.f.	Rubiaceae		Nk
Spermacoce stricta L.f.	Rubiaceae	Bismijil	M
Sphaeranthus indicus L.	Asteraceae	Murmuri	M, N
Spilanthes clava DC.	Asteraceae	Surja kannya	M
Sporobolus tremulus (Willd.) Kunth	Poaceae	Jholajoni ghas	Nk
Strobilanthes scaber Nees	Acanthaceae	Khaskhasabila	Nk
Synedrella nodiflora (L.) Gaertn.	Asteraceae	Relanodi	M
Tagetes erecta L.	Asteraceae	Gada	M, N
Tagetes petula L.	Asteraceae	Gada, Genda	M, N
Tephrosia purpurea (L.) Pers.	Fabaceae	Bon-nil	M, N
Thysanolaena maxima (Roxb.) Kuntze	Poaceae	Jahruful	Fd, N
Tournefortia roxburghii C. B. Clarke	Boraginaceae	Shamshog	Nk
Typhonium trilobatum (L.) Schott	Araceae	Ghetkul	Fd, M
Vernonia cinerea (L.) Less.	Asteraceae	Kuksim	Fd
Vernonia volkameriaefolia DC.	Asteraceae	-	Nk
Xanthium indicum Koen. *ex* Roxb.	Asteracea e	Ghagra	M
Zea mays L.	Poaceae	Bhutta	Fd, M
Zingiber officinale Rosc.	Zingiberaceae	Ada	Fd, M
Zingiber zerumbet (L.) Smith	Zingiberaceae	Pala	M
Zinnia elegans Jacq.	Asteraceae	Zinnia	N

Ageratum conyzoides (Ochunti)

Catharanthus roseus (Nayontara)

Amaranthus spinosus (Kanta shak)

Bryophyllum pinnatum (Pathorkutchi)



Chromolaena odorata (Assamgach)

Croton bonplandianus (Bara Jhun-jhani)

Centella asiatica (Thankuni)

Evolvulus nummularius (Bhuiokra)

Desmodium heterophyllum (Bon motorsuti)

Dracaena spicata (Kadorateng)

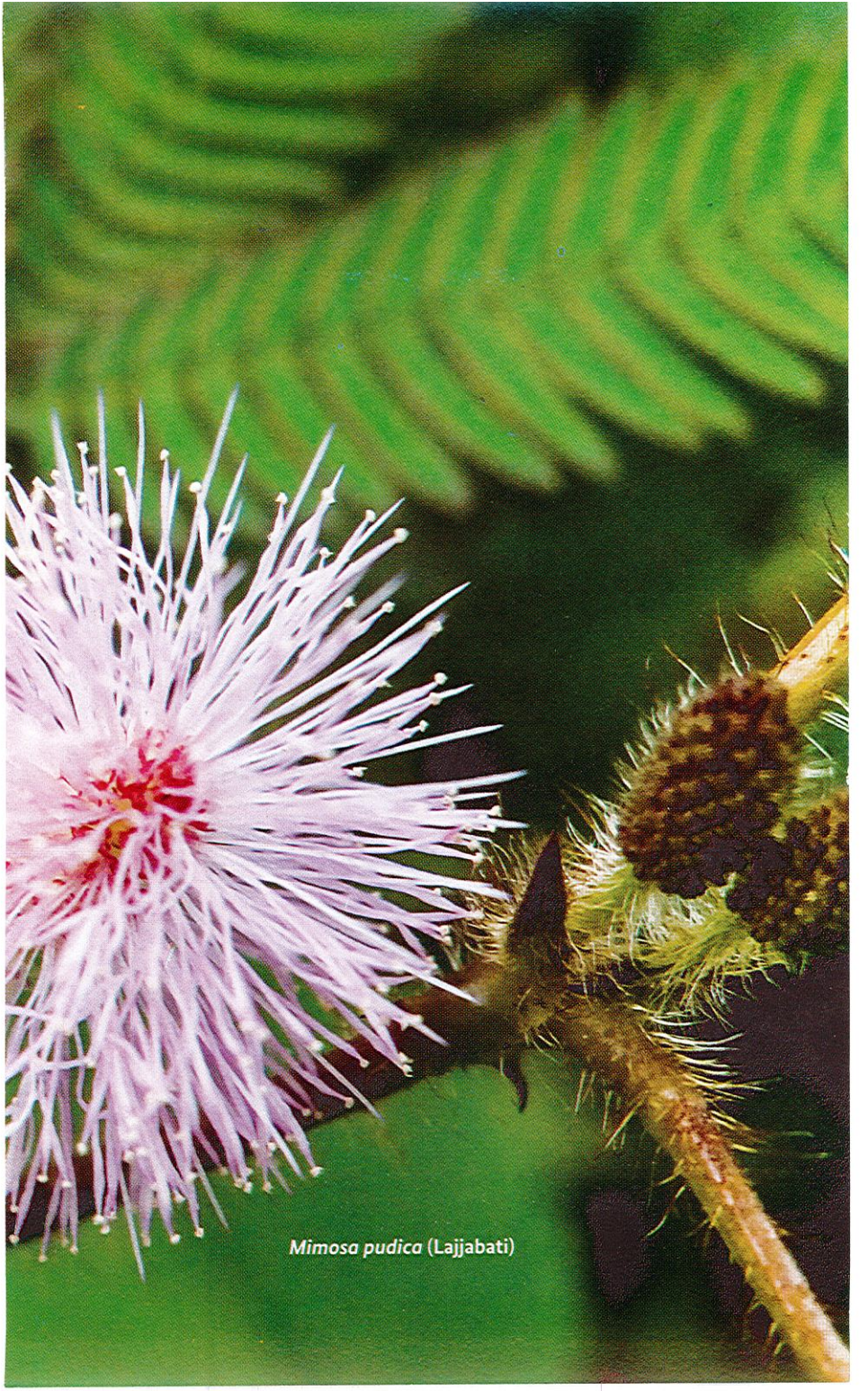
Hedyotis verticillata

Euphorbia hirta
(Ghaopata)

Drosera burmannii (Surja sishir)

Heliotropium indicum (Hatishur)

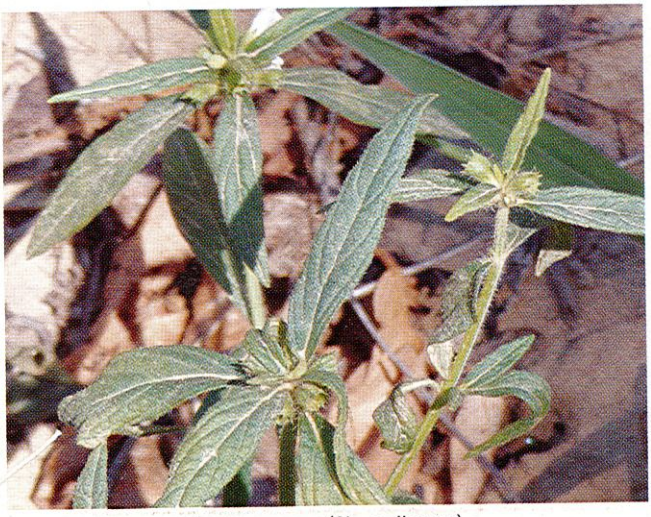
Imperata cylindrica (Chhan)



Mimosa pudica (Lajjabati)

Monochoria hastata (Bara nukha)

Musa ornata (Ram kola)



Leucas aspera (Shetodhrona)

Peliosanthes teta (Biddiri pata)

Saccharum spontaneum (Kash)

Pogostemon auricularius (Aripachuli)

Pseudoelephantopus spicatus (Kukurghiba)

Senna occidentalis (Bara kalkasunda)

Schumannianthus dichotomus (Patipata)

Thysanolaena maxima (Jahruful)

Tephrosia purpurea (bon nil)

Typhonium trilobatum (Ghetkul)

The waterlogged, marshy and swampy areas of Chunati WS support many grasses, i.e. *Alpinia conchigera* (Khetranga), *Alpinia galanga* (Pala), *Centella asiatica* (Thankuni), *Curculigo latifolia* (Biddiri pata), *Monochoria hastata* (Bara nukha, Kechor), *Phragmites karka* (Nalkhagra), *Schumannianthus dichotomus* (Patipata), *Zingiber zerumbet* (Pala) etc. The cultivation practices and human inhabitation within the reserve forests of Chunati WS along with gardening in the Beat Office yards caused occurrence of many farmland and ornamental herbs. Among the 211 herbaceous species, *Amaranthus spinosus* (Kanta shak), *Chrysopogon aciculatus* (Premkanta), *Cynodon dactylon* (Durba gash), *Hyptis suaveolens* (Tokma), *Imperata cylindrica* (Chhan), *Phragmites karka* (Nalkhagra), *Saccharum officinarum* (Akh), *Sesbania bispinosa* (Dhouncha), *Solanum americanum* (Titbegun), *Thysanolaena maxima* (Jharuful), *Zea mays* (Bhutta) etc. are economically most important as they can provide multiple services, i.e. medicinal, food, fodder and many others concurrently. Moreover, herbs namely *Ageratum conyzoides* (Ochunti), *Alpinia conchigera* (Khetranga), *Amaranthus viridis* (Notay), *Costus speciosus* (Bonroi), *Euphorbia hirta* (Ghaopata), *Helitropium indicum* (Hatishur), *Hyptis suaveolens* (Tokma), *Leucas aspera* (Shetodrone) etc. have ethno-botanical importance such as food, fodder and medicine (Ghani 2003, Srivastava and Kumar 2003, Uddin *et al.* 2004, Yusuf *et al.* 2006, Partha and Hossain 2007).

3.4 Climbers

A total of 106 climber species belonging to 72 genera and 33 families were recorded from Chunati Wildlife Sanctuary. Fabaceae family was represented by maximum number of species (15 species and 9 genera) followed by Cucurbitaceae (14 species and 10 genera), Convolvulaceae (11 species and 6 genera) and Menispermaceae (7 species and 6 genera). The common climbers that were found to occur in Chunati Wildlife Sanctuary are *Argyreia capitiformis* (Vogalata), *Byttneria pilosa* (Harjoralata), *Caesalpinia bonduc* (Lalkanta, Kuchai kanta), *Caesalpinia digyna* (Umulkuchi, Kuchai kanta), *Coccinia grandis* (Telakucha), *Combretum decandrum* (Kali guicha), *Connarus paniculatus* (Katgular), *Dalbergia stipulacea* (Dadbari), *Derris marginata* (Makrigilla), *Hedyotis scandens* (Bish lata), *Ichnocarpus frutescens* (Paralia lata, Dudhi lata), *Jasminum scandens* (Kalagona), *Merremia umbellata* (Sada kalmi), *Mucuna pruriens* (Al-Kushi), *Operculina turpethum* (Dudh kalmi), *Paederia foetida* (Gondobhaduli), *Passiflora foetida* (Jhumka lata), *Rourea minor* (Kawaturi), *Spatholobus purviflorus* (Sal lata), *Thunbergia grandiflora*

(Nillata, Banslota), *Tragia involucrata* (Chotra pata, Bichuti) etc. **(Table 8).** There were also some climbing agri-crops grown in the cultivation farms within the wildlife sanctuary. Common agri-crops are *Citrullus lanatus* (Tormuj), *Cucumis melo* (Bangi), *Ipomoea batatas* (Misti alu), *Lagenaria siceraria* (Lau) and *Momordica cochinchinensis* (Kakrol). On the other hand, *Calamus guruba* (Jali bet, Kejuni bet), *C. tenuis* (Sanchi bet, Chiring bet), *C. viminalis* (Korkhoijja bet) and *Daemonorops jenkinsiana* (Golla bet, Golak bet) are some of the canes that were found to grow in the forests of Chunati Wildlife Sanctuary. *Gnetum montanum* belonging to Gnetaceae family was recorded as the only climbing gymnosperm that grows naturally in the WS.

Table 8: Climbers recorded from Chunati WS

[*Fd = Food and Fodder, M = Medicinal, N = Miscellaneous non-timber uses (other than fuel, food, fodder and medicinal) and Nk = Not known]

Scientific Name	Family	Local Name	Use
Abrus precatorius L.	Fabaceae	Kuch	M*
Acacia concinna (Willd.) DC.	Mimosaceae	Banrita	M, N
Acacia pennata (L.) Willd.	Mimosaceae	Bon-Siris	M
Allamanda nerifolia Hook. f.	Apocynaceae	Harkakra	N
Argyreia argentea (Roxb.) Choisy	Convolvulaceae	Baro rupatola	Nk
Argyreia capitiformis (Poir.) van Cheek Oostr.	Convolvulaceae	Vogalata	M
Aristolochia saccata Wall.	Aristolochiaceae	Ishwarisaka	Nk
Aristolochia tagala Cham	Aristolochiaceae	Iswararmul	M
Atylosia scarabaeoides (L.) Baker	Fabaceae		M
Benincasa hispida (Thunb.) Cogn.	Cucurbitaceae	Chalkumra	Fd, M
Bonamia semidigyna (Roxb.) Hallier f.	Convolvulaceae	Chikon gandhobaduli	Nk
Bougainvillea glabra Choisy	Nyctaginaceae	Baganbilash	N
Byttneria aspera Colebr.	Sterculiaceae	Nilbhutta	N
Byttneria pilosa Roxb.	Sterculiaceae	Harjoralata	M
Caesalpinia bonduc (L.) Roxb.	Caesalpiniaceae	Lalkanta	M, N
Caesalpinia digyna Rottler	Caesalpiniaceae	Umulkuchi	N
Caesalpinia enneaphyllum Roxb.	Caesalpiniaceae	Bilai Kanta	N
Calamus guruba Buch.-Ham. *ex* Martius	Arecaceae	Jali bet, Kejuni bet	N
Calamus latifolius Roxb.	Arecaceae	Korak bet	Fd, N
Calamus tenuis Roxb.	Arecaceae	Sanchi bet	Fd, N
Calamus viminalis Willd.	Arecaceae	Korkhoijja bet	N
Cissampelos pareira L. var. *hirsuta* (Buch.-Ham. *ex* DC.) Forman	Menispermaceae	Akanadi	M
Citrullus lanatus (Thunb.) Matsumura & Nakai	Cucurbitaceae	Tormuj	Fd, M
Clitoria ternatea L.	Fabaceae	Nil aparajita	M, N
Coccinia grandis (L.) Voigt	Cucurbitaceae	Telakucha	Fd, M
Cocculus macrocarpus Wt. et. Arn	Menispermaceae	-	M

Table 8 continued...

Scientific Name	Family	Local Name	Use
Combretum decandrum Roxb.	Combretaceae	Kali guicha	N
Combretum flagrocarpum C. B. Clarke	Combretaceae	Flaggumuchi	Nk
Combretum griffithii Heurck & Muell.-Arg.	Combretaceae		Nk
Combretum ternatum (Wall. ex Clarke) O. Lecompte	Combretaceae	Guicha	Nk
Congea tomentosa Roxb.	Verbenaceae	Kongia	N
Connarus paniculatus Roxb.	Connaraceae	Katgular	N
Cucumis melo L.	Cucurbitaceae	Bangi	Fd, M
Cucumis sativus L.	Cucurbitaceae	Khira	Fd, M
Cucurbita maxima Duch. ex Lamk.	Cucurbitaceae	Mistikumra	Fd, M
Cyclea barbata Miers	Menispermaceae	Kalolata	M
Cynanchum calliolata F. Ham. ex Wight	Asclepiadaceae	Chagol bati	Nk
Daemonorops jenkinsiana (Griff.) Martius	Arecaceae	Golla bet	Fd, N
Dalbergia sp.	Fabaceae		Nk
Dalbergia stipulacea Roxb.	Fabaceae	Dadbari	M
Dalbergia tamarindifolia Roxb.	Fabaceae	Keti	M
Dalbergia volubilis Roxb.	Fabaceae	Sabanphul	N
Derris ferruginea (Roxb.) Benth.	Fabaceae	Ruphang	N
Derris marginata (Roxb.) Benth	Fabaceae	Makrigilla	Nk
Derris trifoliata Lour.	Fabaceae	Kalilata	Fd, M, N
Desmos chinensis Lour.	Annonaceae	Jokelata	M
Desmos longiflorus (Roxb.) Safford	Annonaceae	Kulla	Nk
Dioscorea bulbifera L. var. *bulbifera* L.	Dioscoreaceae	Pagla alu	Fd, M
Dioscorea oppositifolia L.	Dioscoreaceae	China maittya alu	Nk
Dioscorea pentaphylla L.	Dioscoreaceae	Alulata	Fd, M
Diploclisia glaucescens (Blume) Diels	Menispermaceae	Sonatola	M
Embelia ribes Burm. f.	Myrsinaceae	Bakul Lata	M
Entada rheedii Spreng.	Mimosaceae	Gilalata	M, N
Gloriosa superba L.	Liliaceae	Ulotchandal	M, N
Gnetum montanum Mgf.	Gnetaceae	Netum	Fd
Gouania tiliaefolia Lamk.	Rhamnaceae		M
Gymnema acuminatum (Roxb.) Wall.	Asclepiadaceae	Khara lata	Nk
Hedyotis scandens Roxb.	Rubiaceae	Bish lata	M
Hewittia sublobata (L. f.) O. Kuntze	Convolvulaceae	Jarad kalmi	Nk
Ichnocarpus frutescens (L.) R. Br.	Apocynaceae	Paralia lata	M, N
Ipomoea alba L.	Convolvulaceae	Dudhi kolmi	M
Ipomoea aquatica Forssk.	Convolvulaceae	Kalmi shak	Fd, M
Ipomoea batatas (L.) Lamk.	Convolvulaceae	Misti alu	Fd, M
Ipomoea obscura (L.) Ker.-Gawl.	Convolvulaceae	Kura kalmi	M
Jasminum anastomonzans Wall. ex DC.	Oleaceae	Kalagona	Nk
Jasminum laurifolium Roxb.	Oleaceae		Nk
Jasminum scandens Vahl	Oleaceae	Kalagona	Nk
Lablab purpureus (L.) Sweet	Fabaceae	Shim	Fd, M, N
Lagenaria siceraria (Molina) Standl.	Cucurbitaceae	Lau	Fd, M
Linostoma decandrum Wall.	Thymeliaceae	Mellata	Nk
Luffa acutangula (L.) Roxb.	Cucurbitaceae	Jhinga	Fd, M
Luffa cylindrica (L.) M. Roem.	Cucurbitaceae	Purul	Fd, N
Merremia umbellata (L.) Hallier f.	Convolvulaceae	Sada kalmi	Fd

Table 8 continued...

Scientific Name	Family	Local Name	Use
Merremia vitifolia (Burm. f.) Hallier f.	Convolvulaceae	Kormolata	M
Mikania cordata (Burm. f.) Robinson	Asteraceae	Assam lata	Fd, M
Momordica charantia L. var. *charantia* C. B. Clarke	Cucurbitaceae	Karolla	Fd, M
Momordica cochinchinensis (Lour.) Sprengel	Cucurbitaceae	Kakrol	Fd, M
Mucuna bracteata DC. *ex* Kurz	Fabaceae	Wakmi	M
Mucuna pruriens (L.) DC.	Fabaceae	Al-Kushi	M
Myriopteron extensum (Wight & Arn.) K. Schum.	Asclepiadaceae	Shukmoy	Nk
Myxopyrum smilacifolium (Wall.) Blume	Oleaceae	Chiknabizi	Nk
Operculina turpethum (L.) S. Manso	Convolvulaceae	Dudh kalmi	M, N
Oxystelma secamone (L.) Karst. var. *secamone*	Asclepiadaceae	Dudhia kata	Fd, M
Paederia foetida L.	Rubiaceae	Gondobhaduli	M
Passiflora foetida L.	Passifloraceae	Jhumka lata	M
Pericampylus glaucus (Lamk.) Merr.	Menispermaceae	Goria lota	M, N
Piper betle L.	Piperaceae	Pan	Fd, M
Piper hamiltonii C. DC.	Piperaceae	Jangali pan	Nk
Rourea minor (Gaertn.) Leenh.	Connaraceae	Kawaturi	M, N
Securidaca inappendiculata Hassk.	Polygalaceae		Nk
Smilax ocreata A. DC.	Smilacaceae	Kumarilata	Nk
Smilax ovalifolia Roxb.	Smilacaceae	Kumarilata	Fd, M
Solena amplexicaulis (Lamk.) Gandhi	Cucurbitaceae	Kundri	Fd, M
Spatholobus purviflorus (DC.) Kuntze	Fabaceae	Sal lata	M, N
Stemona tuberosa Lour.	Stemonaceae	Lalgurania alu	M
Stephania glabra (Roxb.) Miers	Menispermaceae	Thanda manik	M
Stephania japonica (Thunb.) Miers	Menispermaceae	Akanadi	M
Strophanthus wallichii Decne.	Apocynaceae	Trophan	M
Tapiria hirsuta Hook. f.	Anacardiaceae		Fd, M
Thunbergia grandiflora (Roxb. *ex* Rottler) Roxb.	Acanthaceae	Nillata	M, N
Tragia involucrata L.	Euphorbiaceae	Chotra pata	M
Trichosanthes anguina L.	Cucurbitaceae	Chichinga	Fd, M
Trichosanthes dioica Roxb.	Cucurbitaceae	Patal	Fd, M
Tylophora indica (Burm. f.) Merr.	Asclepiadaceae	Anantomul	M
Vigna unguiculata (L.) Walp.	Fabaceae	Borboti	Fd, M
Willoughbeia edulis Roxb.	Apocynaceae	Lata aam	Fd, M

Abrus precatorius (Kuch, Ratti)

Argyreia capitiformis (Vogalata)

Byttneria pilosa (Harjora lota)

Caesalpinia digyna (Kuchai kanta)

Calamus viminalis (Khorkhoirja bet)

Clitoria ternatea (Nil aparajita)

Combretum decandrum (Kali goicha)

Dalbergia stipulacea
(Dadbari, Ladarma)

Daemonorops jenkinsiana (Golla bet)

Dalbergia tamarindifolia (Keti)

Desmos chinensis (Jokelata)

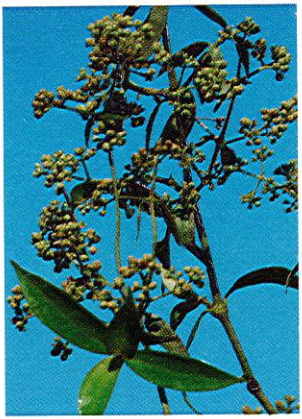
Dalbergia volubilis (Sabanphul)

Derris ferruginea (Ruphang)

Dioscorea bulbifera (Pagla alu)

Entada rheedii (Gilalata)

Ipomoea aquatica (Kolmi shakh)



Hedyotis scandens (Bish lata)

Gymnema acuminatum (Khara lota)

Ipomoea obscura (Kura kalmi)

Jasminum laurifolium

Jasminum scandens (Kalagona)

Linostoma decandrum (Mellata)

Merremia umbellata (Sada kalmi)

One climber (*Dalbergia* sp.) was identified up to genus only. There are some ornamental climbers, i.e. *Bougainvillea glabra* that were planted in the yards of beat offices and local households situated within the Wildlife Sanctuary area. Among the recorded climbers, *Calamus guruba* (Jali bet), *Calamus latifolius* (Korak bet), *Calamus tenuis* (Chiringbet), *Daemonorops jenkinsiana* (Golla bet), *Entada rheedii* (Gilalata), *Lablab purpureus* (Shim), *Lagenaria siceraria* (Lau), *Momordica charantia* (Karolla), *Operculina turpethum* (Dudh kalmi), *Piper betle* (Pan), *Thunbergia grandiflora* (Bans lota), *Vigna unguiculata* (Borboti) etc. are economically important since they can provide food, medicinal and other non-timber services. On the other hand, *Caesalpinia bonduc* (Kuchai kanta), *Caesalpinia digyna* (Kotchoi kanta), *Derris marginata* (Makrigilla), *Dioscorea bulbifera* (Pagla alu), *Dioscorea pentaphylla* (Alulata), *Mikania cordata* (Assamlata), *Merremia umbellata* (Sada kolmi), *Stephania glabra* (Thanda manik) etc. are ethnobotanically important considering food provision and medicine to ethnic people (Kanjilal *et al.* 1938, Alam 1992, Bhatak and Pandit 2003 and Yusuf *et al.* 2006).

Rourea minor (Kawaturi)

Mucuna pruriens (Al-kushi)

Pericampylus glaucus (Goria lota)

Passiflora foetida (Jumka-lata)

Tragia involucrata (Chotra pata)

Smilax ovalifolia (Kumarilata)

Thunbergia grandiflora (Nillata)

Willoughbeia edulis (Aamlota, Lata am)

Spatholobus purviflorus (Sal lata)

3.5 Ferns

A total of 19 fern species belonging to 15 genera and 14 families were recorded from Chunati Wildlife Sanctuary. Family Athyriaceae, Lygodiaceae, Pteridaceae, Sinopteridaceae and Thelypteridaceae contain maximum two species each (**Table 9**). The most common ferns that were found to grow in the sanctuary were *Adiatum incisum, Blechnum orientale, Dicranopteris linearis, Lindsaea ensifolia* and *Lygodium flexuosum*. *Drynaria quercifolia* is an epiphytic fern that was commonly found to grow on various host plants. The only aquatic pteridophyte recorded from Chunati Wildlife Sanctuary is *Marsilea quadrifolia*. Among the 19 fern species, *Angiopteris evecta* (Dheki shakh), *Blechnum orientale, Dicranopteris linearis* (Dhekia), *Lygodium microphyllum* (Patilata fern) etc. have notable economic importance as they can provide both food and ornamental services. Moreover, *Diplazium esculentum* (Dhekia) and *Lygodium flexuosum* (Lata dhekia) are some of the ethnobotanically important ferns of Chunati WS (Tarafdar and Chaudhuri 1991, Uddin *et al.* 1998 and Rahman *et al.* 2003).

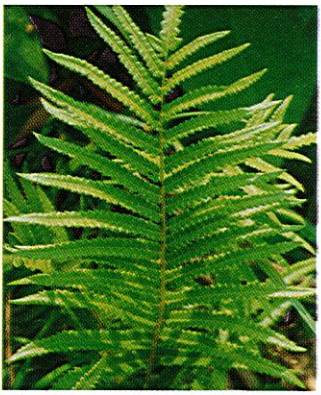
Table 9. Ferns recorded from Chunati WS

[*M = Medicinal, N = Miscellaneous non-timber uses (other than fuel, food, fodder and medicinal) and Nk = Not known]

Scientific Name	Family	Local Name	Use
Adiantum incisum Forssk.	Adiantaceae	Biddapata	N*
Angiopteris evecta (Forst) Hoffm.	Angiopteridaceae	Dhakia shak	Fd, M, N
Azolla pinnata R. Br.	Azollaceae	Lal khudipana	M, N
Blechnum orientale L.	Blechnaceae	-	Fd, M
Cheilanthes belangeri (Bory) C. Chr.	Sinopteridaceae	Shada dhekia	N
Cheilanthes farinosa (Forsk.). Kaulf.	Sinopteridaceae	Shada dhekia	N
Dicranopteris linearis (Burm. f.) Underw. var. *latiloba* Holtt.	Gleicheniaceae	Lomba dhekia	M, N
Diplazium esculentum (Retz.) Sw.	Athyriaceae	Dhekia shak	Fd
Diplazium polypodioides Bl.	Athyriaceae	Dhekia	Nk
Drynaria quercifolia (L.) J. Sm.	Polypodiaceae	Chotto pankhiraj	Nk
Lindsaea ensifolia Sw.	Lindsaeaceae	Bon dhekia	Nk
Lygodium flexuosum (L.) Sw.	Lygodiaceae	Lata dhekia	M, N
Lygodium microphyllum (Cav.) R. Br.	Lygodiaceae	Lata dhekia	Fd, M
Marsilea quadrifolia L.	Marsileaceae	Susni shak	Fd, M
Palhinhaea cernua (L.) Frnco et. Vasc.	Lycopodiaceae	-	N
Pronephrium nudatum (Roxb. *ex* Griff.) Holtt.	Thelypteridaceae	Dhekia	Nk
Pteris pellucida Presl	Pteridaceae	Dhekia	N
Pteris vittata L.	Pteridaceae	Dhekia	N
Trigonospora calcarata (Bl.) Holttum	Thelypteridaceae	Bish dhekia	Nk

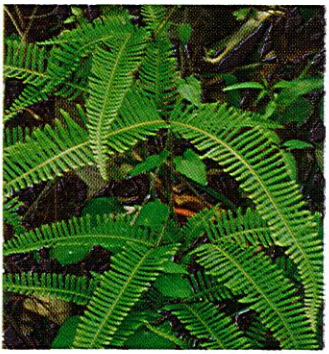
Adiantum incisum (Biddapata)

Blechnum orientale



Cheilanthes belangeri (Shada dhekia)

Cheilanthes farinosa (Shada dhekia)



Dicranopteris linearis (Lomba dhekia)

Diplazium polypodioides (Dhekia)

Drynaria quercifolia (Pankhiraj)

Lindsaea ensifolia (Bon dhekia)

Lygodium flexuosum (Lata dhekia)

Lygodium microphyllum (Lata dhekia)

3.6 Epiphytes

A total of 7 species of epiphytes belonging to 7 genera and 3 families were recorded from the Chunati WS. Orchidaceae family was reperesented by maximum 5 species belonging to 5 genera (**Table 10**). Asclepiadaceae and Araceae were two other families that contain 1 species each. *Acampe papillosa* and *Rhynchostylis retusa* were found very common in the sanctuary area. *Dipterocarpus* spp. (Garjan) and *Mangifera indica* (Aam) were seen as host plant of most of the epiphytes in Chunati WS. Most of the recorded epiphytes are orchids also. Among the epiphytes, *Cymbidium aloifolium*, *Bulbophyllum lilacinum* and *Rhynchostylis retusa* are used as ornamental plants in the homesteads and offices. Moreover, *Cymbidium aloifolium* (Churi) and *Pothos scandens* (Hatilata) have medicinal value.

Table 10. Epiphytes recorded from Chunati WS

[*M = Medicinal, N = Miscellaneous non-timber uses (other than fuel, food, fodder and medicinal) and Nk = Not known]

Scientific Name	Family	Local Name	Use
Acampe papillosa (Lindl.) Lindl.	Orchidaceae	Kandori phol	M
Aerides odorata Lour.	Orchidaceae	Sukhphul	M
Bulbophyllum lilacinum Ridl.	Orchidaceae	Gota parchallow	N
Cymbidium aloifolium (L.) Sw.	Orchidaceae	Churi	N, M
Dischidia major (Vahl) Merr.	Asclepiadaceae	Majarula	Nk
Pothos scandens L.	Araceae	Sunat, Hatilota	M
Rhynchostylis retusa (L.) Blume	Orchidaceae	Orchid	N, M

Aerides odorata (Sukhphul)

Dischidia major (Majarula)

Pothos scandens (Hatilota)

Bulbophyllum lilacinum (Gota parchallow)

Rhynchostylis retusa (Orchid)

3.7 Parasites

A total of 6 parasitic plant species belonging to 5 genera under 3 families were recorded from Chunati Wildlife Sanctuary. Loranthaceae family contains maximum 4 species belonging to 3 genera. Asclepiadaceae and Cuscutaceae were other two families that possess 1 species each. *Hoya parasitica, Macrosolen cochinchinensis* and *Scurrula gracilifolia* occurred commonly in the forests of Chunati Wildlife Sanctuary (**Table 11**). *Aporosa wallichii* and *Gmelina arborea* were found to be the most common host plants of *Scurrula gracilifolia*, whereas, *Cuscuta reflexa* was found to grow desperately on bushes. Among the parasites, *Cuscuta reflexa* (Swarnalata), *Macrosolen cochinchinensis* (Phorulla) and *Scurrula parasitica* (Phorulla) are economically important as they have substantial non-timber and medicinal value.

Table 11. Parasites recorded from Chunati WS

[*M = Medicinal, N = Miscellaneous non-timber uses (other than fuel, food, fodder and medicinal) and Nk = Not known]

Scientific Name	Family	Local Name	Use
Cuscuta reflexa Roxb.	Cuscutaceae	Swarnalata	M*
Dendrophthoe falcata (L. f.) Etting.	Loranthaceae	Phorolla	N
Hoya parasitica (Roxb.) Wall. *ex* Wight	Asclepiadaceae	Porgacha	Nk
Macrosolen cochinchinensis (Lour.) Van Tiegh.	Loranthaceae	Reuda, Phorolla	N
Scurrula gracilifolia (Roxb. *ex* Schult.) Danser	Loranthaceae	Porgacha, Phorolla	Nk
Scurrula parasitica L.	Loranthaceae	Phorolla	Nk

Hoya parasitica (Porgacha)

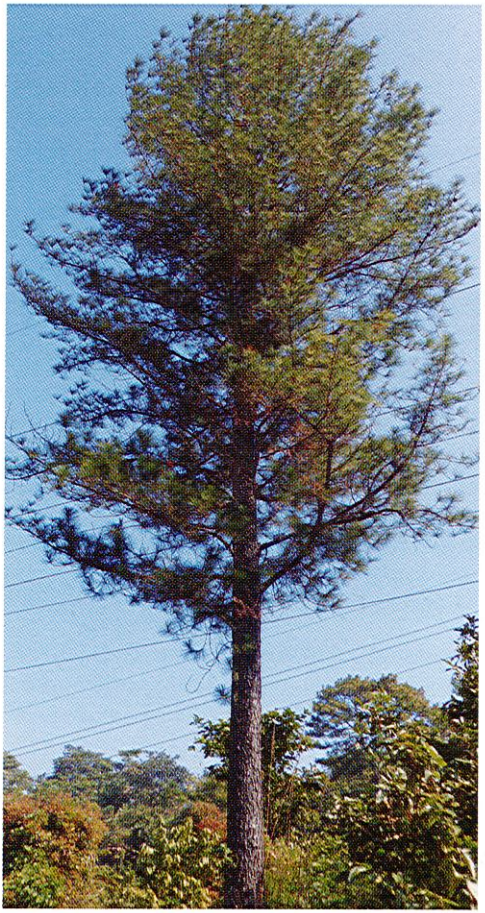
Macrosolen cochinchinensis (Phorolla)

Scurrula gracilifolia (Phorolla)

Cuscuta reflexa (Swarnalata)

3.8 Gymnosperm

Four gymnosperms were recorded from Chunati Wildlife Sanctuary. Among them, *Araucaria cunninghamii*, *Pinus oocarpa* and *Thuja orientalis* were recorded as exotic plantation tree species. The only naturally occurring gymnosperm recorded from Chunati WS is *Gnetum montanum* under Gnetaceae family. It is a climbing gymnosperm, hence discussed in the climber category. Similarly, other gymnosperms that fall under tree and shrub category according to their habit form were discussed accordingly.



A pine (*Pinus oocarpa*) tree planted in Chunati WS beside the Chittagong-Cox's Bazar highway

3.9 Traditional uses of the recorded plants

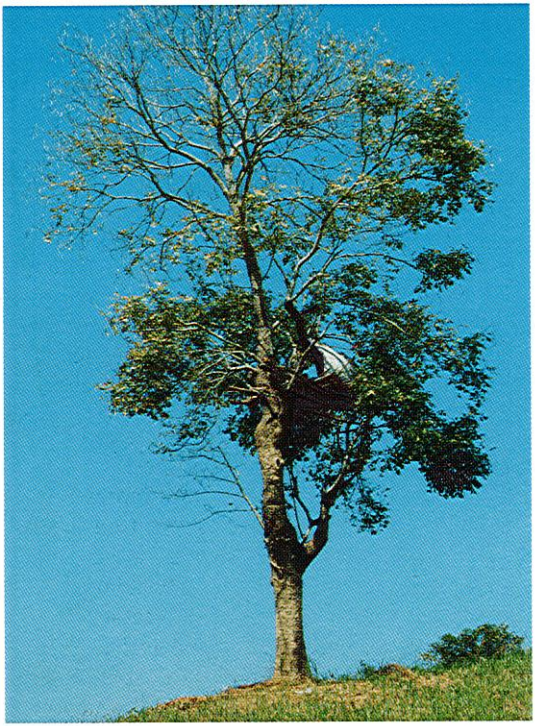
The diversified flora of Chunati Wildlife Sanctuary come to much use of the surrounding people of lower income groups. The forest is surrounded by more than 50,000 peoples (Nath 2012). A substantial number of people are also living inside the reserve forest. So, it is obvious that they are dependent on the forest at a greater extent and traditionally using the forest flora. Since large timber producing trees are very few in number, the surrounding people are found in cutting mainly the medium sized or young timber producing plants. There is a reduction of dependency on forest flora for medicine, thatching materials etc. But, till now people collect wood as house building materials, pole to sale in the market and grasses for fodder. Agricultural implements, some medicinally important plants, fuel-wood, bamboo, sun-grass along with other non-timber forest products are also collected by local people for meeting daily needs as well as to earn a little livelihood. Knowledge about the various uses of the available plants was gained through conversations made with the local peoples living within and surrounding areas of the forests. The traditional uses of the plants were then compared with the recognized and reported plant uses from different areas of Bangladesh. It is found that many medicinal plants, their medicinal values and uses are not known to local people though they are abundant in that area. Along with the timber plants, many fuel wood, medicinal, tannin, resin and fiber yielding, shade-providing and wild food producing plant species have been recorded from this Wildlife Sanctuary. Considering the uses of the plants, they are categorized as timber species, fuel wood species, wild food or fodder producing plant species, medicinal plant and miscellaneous uses. The number of species recorded from the Chunati Wildlife Sanctuary area under different general traditional use categories is shown in **Table 12** according to their habit form.

The study revealed 133 timber yielding trees in Chunati Wildlife Sanctuary. A total of 46 fuel wood yielding species were recorded from the sanctuary, where trees and shrubs were represented by 42 and 4 species respectively. 213 plant species (90 tree species, 20 shrub species, 65 herb species, 33 climber species and 5 fern species) were found to yield food or fodder. The medicine yielding plants constituted the major category among all kind of uses. A total of 353 plant species were recorded that can be used for medicinal purpose. Among the medicinal plants, the maximum species were represented by trees (116 species) followed by herbs (101 species), climbers (66 species) and shrubs (57 species). Plants used for pulp and paper, resin, shade, green

manure, fibre and ornamental purposes were grouped under miscellaneous category. A total of 243 plant species under miscellaneous category were recorded where trees were represented by 100 spceies. A total of 86 plant species were categorized under multiple uses (more than two uses). There is no information regarding the specific uses of 135 plant species recorded from the Chunati WS.

Table 12. Traditional use of plant species of different habit forms found in Chunati WS

Use categroy	Tree species (No.)	Shrub species (No.)	Herb species (No.)	Climber species (No.)	Fern species (No.)	Epiphytic species (No.)	Parasitic species (No.)	Total species (No.)
Timber	133	-	-	-	-	-	-	133
Fuelwood	42	4	-	-	-	-	-	46
Food or Fodder	90	20	65	33	5	-	-	213
Medicine	116	57	101	66	7	5	1	353
Miscellaneous	100	40	59	29	10	3	2	243
Multiple uses	72	3	7	3	1	-	-	86



People took shelter on Dharmara tree for watching the crops

Chapter 4

Regeneration and status of secondary succession in the forests of Chunati WS

Natural regeneration is essential for conservation and maintenance of biodiversity in natural forests (Hossain *et al.* 2004, Rahman *et al.* 2011). Wyatt-Smith (1987) mentioned that species composition of a forest is essential for its wise management in terms of economic value and natural regeneration potential. Plants maintain and expand their populations in time and space by the process of regeneration. Regeneration is a complex ecosystem process involving asexual and sexual reproduction, dispersal and establishment in relation to environmental factors (Barnes *et al.* 1998). The strategies by which plants regenerate are soil seed banks, seedling banks and vegetative parts (Grime 1979, Garwood 1989, Barnes *et al.* 1998). The pattern of population structure of woody plants can show the regeneration profile, which is used to determine their regeneration status (Teketay 1996). Assessment of soil seed banks and population structure has practical importance in forest conservation and management. Database of the regeneration status of the plant species is important for developing management strategies and setting priorities.

4.1 Natural regeneration status

A total of 3,256 seedlings of 105 regenerating tree species belonging to 35 families were recorded and identified from Chunati Wildlife Sanctuary. About 34% (12) families were represented by only one

Natural regeneration of native tree species through coppicing

species and 45% (16) by more than two species. Maximum 12 species were found under Euphorbiaceae family followed by Moraceae (11 species) and Myrtaceae (7 species) family (**Table 13**). Highest (26.50%) Family Relative Density (FRD) was represented by Euphorbiaceae family followed by Myrtaceae (11.43%) family. Family Relative Diversity Index (FRDI) was also found maximum (11.32%) for Euphorbiaceae family followed by Moraceae (10.38%) family. Maximum (37.83) Family Importance Value (FIV) index was found for Euphorbiaceae followed by Myrtaceae (18.03), Moraceae (16.21), Dipterocarpaceae (14.21) and Fagaceae (12.77) (**Table 13**).

Table 13. Family composition, number of regenerating tree species, number of seedlings under each family, Family Relative Density (FRD), Family Relative Diversity (FRDI) and Family Importance Value (FIV) index of the regenerating trees in Chunati WS

Sl. No.	Family	Species No.	No. of seedlings	FRD (%)	FRDI (%)	FIV
1	Anacardiaceae	3	16	0.49	2.83	3.32
2	Apocynaceae	2	51	1.57	1.89	3.45
3	Bignoniaceae	3	91	2.79	3.77	6.57
4	Boraginaceae	1	1	0.03	0.94	0.97
5	Burseraceae	1	50	1.54	0.94	2.48
6	Caesalpiniaceae	4	7	0.21	3.77	3.99
7	Celastraceae	1	2	0.06	0.94	1.00
8	Clusiaceae	2	64	1.97	1.89	3.85
9	Combretaceae	4	63	1.93	3.77	5.71
10	Dilleniaceae	1	18	0.55	0.94	1.50
11	Dipterocarpaceae	5	309	9.49	4.72	14.21
12	Elaeocarpaceae	2	4	0.12	1.89	2.01
13	Euphorbiaceae	12	863	26.50	11.32	37.83
14	Fabaceae	1	1	0.03	0.94	0.97
15	Fagaceae	4	293	9.00	3.77	12.77
16	Flacourtiaceae	1	21	0.64	0.94	1.59
17	Lauraceae	5	116	3.56	4.72	8.28
18	Lythraceae	1	1	0.03	0.94	0.97
19	Meliaceae	3	29	0.89	2.83	3.72
20	Mimosaceae	6	28	0.86	5.66	6.52
21	Moraceae	11	190	5.84	10.38	16.21
22	Myristicaceae	1	3	0.09	0.94	1.04
23	Myrsinaceae	2	64	1.97	1.89	3.85
24	Myrtaceae	7	372	11.43	6.60	18.03
25	Ochnaceae	1	1	0.03	0.94	0.97
26	Rhamnaceae	1	1	0.03	0.94	0.97
27	Rhizophoraceae	1	26	0.80	0.94	1.74

Sl. No.	Family	Species No.	No. of seedlings	FRD (%)	FRDI (%)	FIV
28	Rubiaceae	2	41	1.26	1.89	3.15
29	Rutaceae	2	20	0.61	1.89	2.50
30	Simaroubaceae	1	1	0.03	0.94	0.97
31	Sterculiaceae	4	74	2.27	3.77	6.05
32	Theaceae	1	2	0.06	0.94	1.00
33	Tiliaceae	2	269	8.26	1.89	10.15
34	Ulmaceae	1	46	1.41	0.94	2.36
35	Verbenaceae	6	118	3.62	5.66	9.28

Plantation is the major means of re-forestation in the barren lands of Chunati WS

Akasmoni plantation supports the naturally regenerated plant species

Lannea coromandelica (Bhadi) coppice

Lagerstroemia speciosa (Jarul) coppice

Pterospermum semisagittatum (Lana-assar)

Lithocarpus polystachya (Gurja Batna)

Dipterocarpus alatus (Doilla garjan) coppice

Cinnamomum iners (Tez-bohu) coppice

4.2 Quantitative characters of naturally regenerating tree species

The quantitative structure of naturally regenerating tree species in the Chunati Wildlife Sanctuary was studied on the basis of density, Relative Density (RD), Relative Frequency (RF), Relative Abundance (RA) and Importance Value Index (IVI). The highest number of seedlings per hectare was found for *Aporosa wallichii* (596) followed by *Grewia nervosa* (385), *Syzygium fruticosum* (274), *Lithocarpus polystachya* (242) and *Dipterocarpus alatus* (199) (**Table 14**). Lowest number of seedlings per hectare was recorded for *Cassia fistula* (1) and *Chukrasia tabularis* (1) followed by *Bhesa robusta* (3), *Eurya acuminata* (3) and *Albizia odoratissima* (4). Maximum (12.32%) relative density was recorded for *Aporosa wallichii* followed by *Grewia nervosa* (7.95%), *Syzygium fruticosum* (5.65%), *Lithocarpus polystachya* (5%) and *Dipterocarpus alatus* (4.12%). Maximum (7.28%) relative frequency was recorded for *Aporosa wallichii* followed by *Grewia nervosa* (7.12%), *Ficus hispida* (4.51%) and *Syzygium fruticosum* (4.35%). The highest (4.65%) relative abundance was calculated for *Aphanamixis polystachya* followed by *Gluta elegans* (2.79%), *Dipterocarpus costatus* (2.60%), *Shorea robusta* (2.38%) and *Dipterocarpus alatus* (2.31%). The maximum Importance Value Index (IVI) was found for *Aporosa wallichii* (21.62 out of 300) followed by *Grewia nervosa* (16.41), *Syzygium fruticosum* (11.56), *Lithocarpus polystachya* (9.94), *Ficus hispida* (9.45) and *Dipterocarpus alatus* (8.56).

Table 14. Seedlings per hectare, Relative Density (RD), Relative Frequency (RF), Relative Abundance (RA) and Importance Value Index (IVI) of the regenerating tree species of Chunati WS

Sl. No.	Scientific Name	Seedlings per ha	RD (%)	RF (%)	RA (%)	IVI
1	*Acacia auriculiformis*	13	0.28	0.55	0.60	1.43
2	*Actinodaphne angustifolia*	13	0.28	0.40	0.84	1.51
3	*Albizia chinensis*	10	0.21	0.47	0.54	1.23
4	*Albizia odoratissima*	4	0.09	0.08	1.39	1.57
5	*Albizia procera*	9	0.18	0.24	0.93	1.35
6	*Alstonia scholaris*	13	0.28	0.55	0.60	1.43
7	*Anogeissus acuminata*	42	0.86	1.42	0.72	3.01
8	*Antidesma bunius*	171	3.53	3.32	1.27	8.13
9	*Antidesma ghaesembilla*	4	0.09	0.16	0.70	0.95
10	*Antidesma velutinum*	37	0.77	0.79	1.16	2.72
11	*Aphanamixis polystachya*	30	0.61	0.16	4.65	5.42
12	*Aporosa dioica*	117	2.43	3.56	0.82	6.80
13	*Aporosa wallichii*	596	12.32	7.28	2.03	21.62
14	*Ardisia colorata*	4	0.09	0.16	0.70	0.95
15	*Artocarpus chama*	13	0.28	0.47	0.70	1.45
16	*Artocarpus heterophyllus*	4	0.09	0.24	0.46	0.79

Table 14 continued...

Sl. No.	Scientific Name	Seedlings/ha	RD (%)	RF (%)	RA (%)	IVI
17	*Artocarpus lacucha*	28	0.58	1.11	0.63	2.32
18	*Bauhinia purpurea*	6	0.12	0.08	1.86	2.06
19	*Bhesa robusta*	3	0.06	0.16	0.46	0.68
20	*Brownlowia elata*	15	0.31	0.63	0.58	1.52
21	*Callicarpa arborea*	64	1.32	1.74	0.91	3.97
22	*Carallia brachiata*	39	0.80	1.50	0.64	2.94
23	*Cassia fistula*	1	0.03	0.08	0.46	0.57
24	*Chaetocarpus castanocarpus*	6	0.12	0.16	0.93	1.21
25	*Chukrasia tabularis*	1	0.03	0.08	0.46	0.57
26	*Cinnamomum iners*	18	0.37	0.47	0.93	1.77
27	*Clausena heptaphylla*	6	0.12	0.16	0.93	1.21
28	*Clausena suffruticosa*	24	0.49	0.40	1.49	2.37
29	*Cordia fragrantissima*	1	0.03	0.08	0.46	0.57
30	*Cryptocarya amygdalina*	31	0.64	1.03	0.75	2.42
31	*Derris robusta*	1	0.03	0.08	0.46	0.57
32	*Dillenia scabrella*	27	0.55	0.71	0.93	2.19
33	*Dipterocarpus alatus*	199	4.12	2.14	2.31	8.56
34	*Dipterocarpus costatus*	42	0.86	0.40	2.60	3.86
35	*Dipterocarpus turbinatus*	80	1.66	1.34	1.48	4.48
36	*Elaeocarpus floribundus*	4	0.09	0.16	0.70	0.95
37	*Elaeocarpus tectorius*	1	0.03	0.08	0.46	0.57
38	*Eucalyptus camaldulensis*	18	0.37	0.40	1.12	1.88
39	*Eurya acuminata*	3	0.06	0.08	0.93	1.07
40	*Ficus auriculata*	9	0.18	0.24	0.93	1.35
41	*Ficus benjamiana*	1	0.03	0.08	0.46	0.57
42	*Ficus conglobata*	1	0.03	0.08	0.46	0.57
43	*Ficus geniculata*	3	0.06	0.08	0.93	1.07
44	*Ficus hispida*	189	3.90	4.51	1.04	9.45
45	*Ficus lanceolata*	1	0.03	0.08	0.46	0.57
46	*Ficus semicordata*	3	0.06	0.16	0.46	0.68
47	*Garcinia cowa*	92	1.90	2.14	1.07	5.11
48	*Garcinia speciosa*	3	0.06	0.16	0.46	0.68
49	*Gardenia coronaria*	31	0.64	0.63	1.22	2.50
50	*Glochidion multiloculare*	34	0.71	1.42	0.59	2.72
51	*Gluta elegans*	9	0.18	0.08	2.79	3.05
52	*Gmelina arborea*	6	0.12	0.32	0.46	0.90
53	*Grewia nervosa*	385	7.95	7.12	1.34	16.41
54	*Holarrhena antidysenterica*	62	1.29	1.66	0.93	3.88
55	*Hopea odorata*	1	0.03	0.08	0.46	0.57
56	*Lagerstroemia speciosa*	1	0.03	0.08	0.46	0.57
57	*Lannea coromandelica*	3	0.06	0.16	0.46	0.68
58	*Lithocarpus acuminata*	152	3.13	2.29	1.63	7.06
59	*Lithocarpus elegans*	24	0.49	0.47	1.24	2.21
60	*Lithocarpus polystachya*	242	5.01	2.77	2.16	9.94
61	*Litsea glutinosa*	109	2.24	3.32	0.81	6.37
62	*Macaranga denticulata*	58	1.20	1.42	1.01	3.63
63	*Maesa ramentacea*	91	1.87	1.82	1.23	4.93

Table 14 continued...

Sl. No.	Scientific Name	Seedlings/ha	RD (%)	RF (%)	RA (%)	IVI
64	*Mallotus roxburghianus*	195	4.02	2.22	2.17	8.41
65	*Mangifera indica*	12	0.25	0.47	0.62	1.34
66	*Mitragyna parvifolia*	55	1.14	1.82	0.75	3.70
67	*Myristica linifolia*	4	0.09	0.08	1.39	1.57
68	*Neolamarckia cadamba*	6	0.12	0.24	0.62	0.98
69	*Ochna squarrosa*	1	0.03	0.08	0.46	0.57
70	*Oroxylum indicum*	4	0.09	0.24	0.46	0.79
71	*Phoebe pallida*	1	0.03	0.08	0.46	0.57
72	*Phyllanthus emblica*	36	0.74	1.34	0.66	2.74
73	*Picrasma javanica*	1	0.03	0.08	0.46	0.57
74	*Pithecellobium angulatum*	1	0.03	0.08	0.46	0.57
75	*Protium serratum*	74	1.54	1.34	1.37	4.25
76	*Psidium guajaba*	4	0.09	0.24	0.46	0.79
77	*Pterygota alata*	1	0.03	0.08	0.46	0.57
78	*Pterospermum acerifolium*	4	0.09	0.16	0.70	0.95
79	*Pterospermum semisagittatum*	100	2.06	2.37	1.04	5.47
80	*Quercus gomeziana*	18	0.37	0.24	1.86	2.47
81	*Sapium baccatum*	13	0.28	0.40	0.84	1.51
82	*Senna siamea*	1	0.03	0.08	0.46	0.57
83	*Shorea robusta*	137	2.83	1.42	2.38	6.63
84	*Sterculia foetida*	4	0.09	0.16	0.70	0.95
85	*Stereospermum colais*	106	2.18	3.24	0.80	6.23
86	*Stereospermum suaveolens*	25	0.52	1.27	0.49	2.28
87	*Streblus asper*	28	0.58	1.11	0.63	2.32
88	*Suregada multiflora*	15	0.31	0.40	0.93	1.63
89	*Syzygium claviflorum*	86	1.78	2.14	1.00	4.92
90	*Syzygium cumini*	13	0.28	0.32	1.05	1.64
91	*Syzygium firmum*	155	3.19	3.01	1.27	7.47
92	*Syzygium fruticosum*	274	5.65	4.35	1.55	11.56
93	*Syzygium syzygioides*	3	0.06	0.08	0.93	1.07
94	*Tamarindus indica*	1	0.03	0.08	0.46	0.57
95	*Tectona grandis*	12	0.25	0.47	0.62	1.34
96	*Terminalia arjuna*	3	0.06	0.16	0.46	0.68
97	*Terminalia bellirica*	48	0.98	1.50	0.78	3.27
98	*Terminalia chebula*	1	0.03	0.08	0.46	0.57
99	*Toona ciliata*	12	0.25	0.40	0.74	1.38
100	*Trema orientalis*	68	1.41	1.58	1.07	4.06
101	*Vitex glabrata*	3	0.06	0.16	0.46	0.68
102	*Vitex peduncularis*	82	1.69	2.06	0.98	4.73
103	*Vitex pinnata*	9	0.18	0.16	1.39	1.74
104	*Xylia xylocarpa*	3	0.06	0.08	0.93	1.07
105	*Zizyphus mauritiana*	1	0.03	0.08	0.46	0.57

4.3 Biological diversity indices of regenerating species

Functional diversity represents the structural heterogeneity (Huston 1994). As per environmental heterogeneity hypothesis, increased heterogeneity would increase diversity. Different biological diversity indices, i.e. Species diversity index (S_{Di}), Species richness index (R), Shannon-Wiener index (H), Shannon's maximum diversity index (H_{max}), Species evenness index (E), Simpson's index (D) and Dominance of Simpson's index (D′) were studied for Chunati Wildlife Sanctuary to depict natural regeneration status of tree species (**Table 15**).

Table 15. Biological diversity indices for regenerating tree species in Chunati WS

Sl. No.	Diversity indices	Diversity index value
1	Species diversity index (S_{Di})	0.032
2	Species richness index (R)	12.86
3	Shannon-Wiener's diversity index (H)	3.67
4	Shannon's maximum diversity index (H_{max})	4.65
5	Species evenness index (E)	0.789
6	Simpson's diversity index (D)	0.042
7	Dominance of Simpson's index (D′)	0.96

4.4 Distribution of seedlings into different height classes

The percentage distribution of all the recorded seedlings of all species is shown in six height (cm) classes, viz. 0 -<50 cm, 50 -<100 cm, 100 -<150 cm, 150 -<200 cm, 200 -<250 cm and 250 -<300 cm. It was found that maximum (39.34%) seedlings were within a height range of 50 -<100 cm, whereas, only 0.74% seedlings were found in 250 -< 300 cm height range (**Figure 13**). It indicates recent disturbances to the regenerating materials in the early stages of the regeneration process. It may be due to environmental stress, e.g. exposure to open sun light, moisture deficient and/or anthropogenic factors, e.g. grazing, firewood collection or fire in dry seasons. On the other hand, collection of saplings and poles by local people for fencing purpose resulted in reduced percentage in the upper classes.

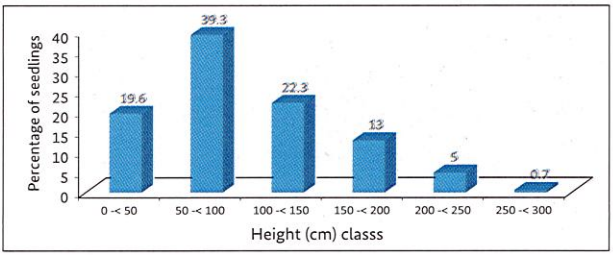


Figure 13. Percentage distribution of the seedlings into different height (cm) classes

Seedling recruitment percentage: A correlation between the number of seedlings of dominant tree species with their corresponding mother tree stems per hectare shows that *Dipterocarpus alatus* has maximum (11%) seedling recruitment percentage followed by *Lithocarpus polystachya* (5%) and *Syzygium fruticosum* (5%) (**Table 16**).

Table 16. Seedlings stock of 5 major dominant tree species with stem per hectare showing recruitment percentage at Chunati WS

Sl. No.	Scientific name	Stems/ha	Seedlings/ha	Recruitment success (%)
1	*Aporosa wallichii*	7	596	1
2	*Dipterocarpus alatus*	23	199	11
3	*Grewia nervosa*	8	385	2
4	*Lithocarpus polystachya*	12	242	5
5	*Syzygium fruticosum*	13	274	5

Regeneration and recruitment of native tree species from soil seed bank

Chapter 5

Alien Invasive Species in Chunati WS

Invasive plants and animals are a major threat to natural ecosystems and their species, second only to direct destruction of habitats by humans. The harmful impacts of alien invasive species are immense and usually irreversible. In many cases, exotic species have also proved problematic for high conservation value areas due to their detrimental effects that can potentially threaten the persistence of native flora and fauna (Barua *et al.* 2001, Biswas *et al.* 2007, Stinson *et al.* 2006). Virtually a number of invasive species have invaded and affected native biota in every ecosystem of the country. Unfortunately, very scarce information is available about the alien invasive species in Bangladesh and their impacts on the ecosystem and their native biotic resources (Hossain and Pasha 2001). However, in Bangladesh introduction of alien invasive species of flora and fauna were deliberate primarily in order to increase productivity to support the needs of a huge population (Mukul *et al.* 2006, Uddin *et al.* 2013).

The country has a long history of plant introduction from different countries or geographic regions of the world. Most of the plants have brought by settlers, invaders, seamen and traders (Islam 1991). In Bangladesh, a number of tree species have been introduced in the past, of which most do not naturalized, and that naturalized do not became important invasive (Hossain 1998 and 2008). However, a number of exotic plants were first introduced as garden or ornamental plants that later on aggressively established elsewhere.

Eucalyptus in Chunati WS- invasion or intentional introduction?

Some of the exotic plants are so well established that they are now the dominant plant and became noxious weeds of forests and wastelands, e.g. *Chromolaena odorata, Lantana camara, Mikania cordata* etc. (Hossain and Pasha 2004). Some troublesome weeds are also found in wetland also, e.g. *Eichhornia crassipes, Ipomoea fistulosa* etc. Factors that have also influenced the dissemination of exotics were their efficient dispersal capacities, large reproductive output, and greater tolerance to a broad range of environmental conditions than native species (Campbell 2005).

In Chunati WS, 96 species were categorized as exotic plants which are about 14% of the total recoreded plant species (**Figure 14**). Among the 96 exotic species, 39 species were herbs, 35 trees, 13 shrubs and 9 climbers. Many of the exotics were found to grow invasively in the natural ecosystems of Chunati WS. *Mikania cordata* is found to grow aggressively on shrubs and trees. Its luxuriant growth suppresses the tree seedlings and shrubs, even in most cases cause the severe mortality of the seedlings and saplings. *Chromolaena odorata, Ageratum conyzoides, Alternanthera philoxeroides, Croton bonplandianus, Mimosa pudica* and *Senna occidentalis* are the herbs that were found growing aggressively in the natural ecosystem of Chunati WS. *Lantana camara* and *Ipomoea fistulosa* are the two shrubby species that sporadically occupied in almost everywhere in Chunati WS. *Acacia auriculiformis, Acacia mangium* and *Eucalyptus camaldulensis* are the tree species that were used as main plantation species in Chunati WS. They were found well established in the natural ecosystem of Chunati WS. Growth rate of these tree species is faster than that of some native tree species. *Lantana camara* have potential allelopathic effects also (Hossain and Alam 2010).

Akashmoni plantation in Chunati WS suppress all other plant canopy

Deliberate plantings of exotics, e.g. *Acacia auriculiformis* are gradually replacing the native species from the WS. These trees are gradually replacing our native tree species because of their faster growth rate, easy propagation and wider adaptability. Profuse natural regeneration of *A. auriculiformis* was observed in the open forest areas that posed threat to the regeneration and recruitment of a number of native tree species.

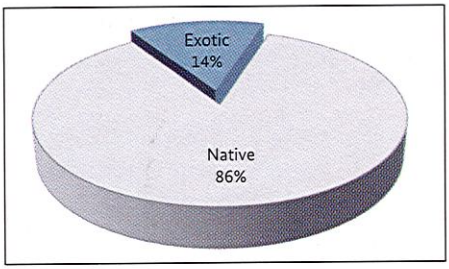


Figure 14. Percentage of both the exotic and native flora of Chunati WS

Luxuriant growth of *Chromolaena odorata* (Assamgach)

Mikania cordata (Assamlata) climbs over the important tree species

Lantana camara (Lantana) grows desperately in some portions of CWS

The present study revealed that a substantial area of Chunati WS is covered by *Acacia auriculiformis* and *A. mangium* plantations. Though the plantations of these pioneer colonizing species create vegetation cover, there is an increasing concern among foresters, ecologists, botanists, conservationists and policy makers about the threat of uncontrolled introduction of this aggressive tree species in the plantation programs. The issues are addressed in the National Biodiversity Strategy and Action Plan (MoEF 2006) and Biodiversity National Assessment and Programme of Action (MoEF 2010). To prevent the adverse impacts of invasive plant species to the natural ecosystem, especially in the Protected Areas (PAs), the possible recommendations are as follows:

- Enhancing awareness among planters, growers and the public about invasive species,
- Developing a database on existing invasive species,
- Developing environmentally sound eradication methods,
- Requiring extreme care in the selection of species to be introduced in order to minimize impacts on native species,
- Initiating attempts toward the restoration of indigenous flora and fauna to reduce native biodiversity loss,
- Studying the autecology (seed dispersal, reproductive ecology and factors limiting its distribution and abundances in the natural habitat) of the aliens,
- Developing general screening tools to reduce future invasive plant introductions, and
- Strengthening the necessary quarantines, legislation and regulations on introduction and spread of the invasive plants within the country (MoEF, 2006).

Extensive sungrass cultivation reduce site quality for native plant species in Chunati WS

Chapter 6

Forest Restoration Process in Chunati WS

The forest of Chunati WS is a secondary one. Its primary vegetation has passed under severe deforestation and degradation mainly because of biotic interferences. Few decades back it was densely covered with native vegetation including a number of commercially important timber species. But, now most of the valleys are occupied and converted into agricultural farms. Hills of the core area became almost barren except some woody bushes and many of the small hills were occupied by local people to build houses, betel leaf and vegetable farms. Forest Department and different NGOs are trying to recover the forest coverage in the wildlife sanctuary area after its establishment as a wildlife sanctuary in 1986. They are conducting plantations in the barren hills of Chunati WS along with motivating local people for conservation of forest resources through provision of training and changing livelihood pattern.

The present study was conducted by taking 269 stratified random sample plots (quadrats), where, naturally occupied vegetation was found in maximum (110 plot, 41%) number of plots. Whereas, the remaining plots were dominant with Plantation (P), Enrichment Plantation (EP), Mixed Plantation (MP), Natural and Plantation mixed vegetation (NP), Coppice (C), Coppice and Natural (CN), Coppice and Plantation (CP) and Horticultural Plantation (HP). Enrichment plantation (EP) and plantation with mixed species (MP) were represented by 20% (56 plots) and 19% (52 plots) sample plots respectively. Coppice origin young shoots with plantations and naturally occurring plants were also found in a number of plots (**Figure 15**). Maximum natural regeneration was observed in the sample plots of coppice origin and mixed plantations rather than the remnant natural patches. It may be concluded that the forests of Chunuti WS are restoring with vegetation coverage through artificial means than that of natural processes.

Restoration through artificial and natural regenation is essential in Chunati WS

A plantation patch of Sal (*Shorea robusta*) in Chunati WS

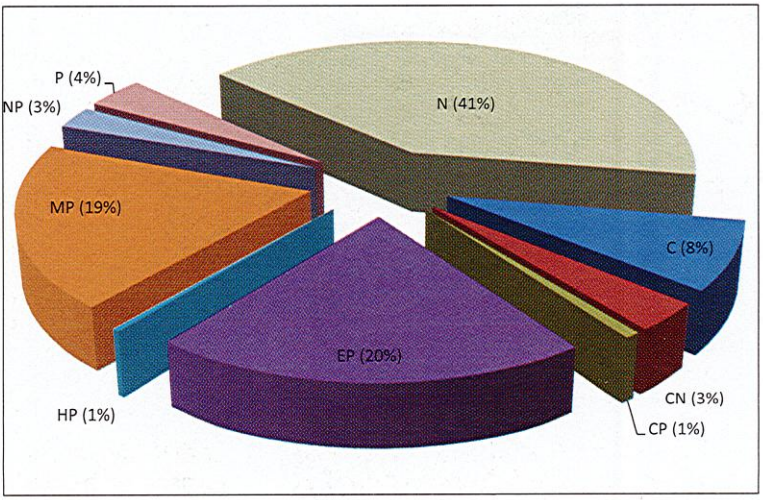


Figure 15: Forest restoration process (%) in Chunati WS through 269 stratified random plots represented by, C = coppice, CN = coppice and natural, CP = coppice and planted, EP = enrichment plantation, H = horticultural plantation, MP = mixed plantation, NP = natural and plantation, P = plantation and N = natural forests.

The origin of all the recorded 691 plant species in Chunati WS was analyzed. The plants were categorized as natural, cultivated and planted depending on their nature of origin. The tree species that were planted for afforestation and horticulture were considered as plantation species. Significant number of crops was cultivated in the farmlands and homesteads situated within the boundary of Chunati WS. These were considered as cultivated plants. About 83% plants were found to occur naturally in Chunati WS, whereas 10% and 7% species were categorized as planted (forest crops) and cultivated (agri-crops) species respectively (**Figure 16**). Most common cultivated plants are *Ananus comosus* (Anarosh), *Capsicum frutescens* (Morich), *Citrullus lanatus* (Tormuj), *Curcuma longa* (Halud), *Lablab purpureus* (Shim), *Lycopersicon esculentum* (Tomato), *Momordica charantia* (Karolla), *Momordica cochinchinensis* (Kakrol), *Oryza sativa* (Dhan), *Piper betle* (Pan), *Raphanus sativus* (Mula) etc. Besides, planted species include the woody plant species, i.e. *Acacia auriculiformis* (Akashmoni), *Acacia mangium* (Mangium), *Eucalyptus camaldulensis* (Eucalypts), *Gmelina arborea* (Gamar), *Senna siamea* (Minjiri), *Swietenia mahagoni* (Mahagoni) etc.

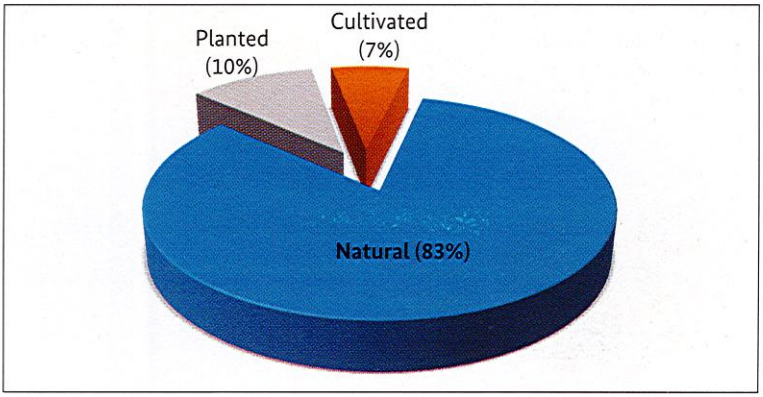


Figure 16. Mode of origin of the recorded flora of Chunati WS

From the above results and discussion it is obvious that Chunati WS mainly harbors naturally occurring plants in comparison to planted and cultivated plant species. But, the major areas of the WS are occupied by only few plantation forest species.

Tending operation in natural patch

Natural means of forest restoration

Traditional means of artificial forest restoration

Chapter 7

Conservation Issues, Threats and Recommendations for Floral Diversity of Chunati WS

7.1 Conservation Issues and Current Management Activities

Protected Areas (PAs) play a key role to reduce deforestation, habitat loss, wildlife habitat degradation and biodiversity loss. A quarter of the world's rain forests are at least nominally protected by some sort of conservation legislation (Ghazoul and Sheil 2010). The primary aim of establishing Chunati WS was to strengthen the conservation of the existing flora and fauna of the area. Conservation status of all the 691 plants of Chunati WS was assessed following the Encyclopedia of Flora and Fauna of Bangladesh (Ahmed *et al.* 2008). All the recorded plants were found to be represented by eight conservation categories, viz. Conservation Dependent (CD), Data Deficient (DD), Endangered (E), Least Concern (LC), Lower Risk (LR), Not Evaluated (NE), Near Threatened (NT) and Vulnerable (V). A total of 66% plant species (459 species out of 691) were found as Least Concerned (CD) which represents maximum plant species among all the categories. Whatsoever, vulnerable, endangered and near threatened plant species were represented by 4% (31 species), 1% (2 species) and 3% (18 species) respectively (**Figure 17**).

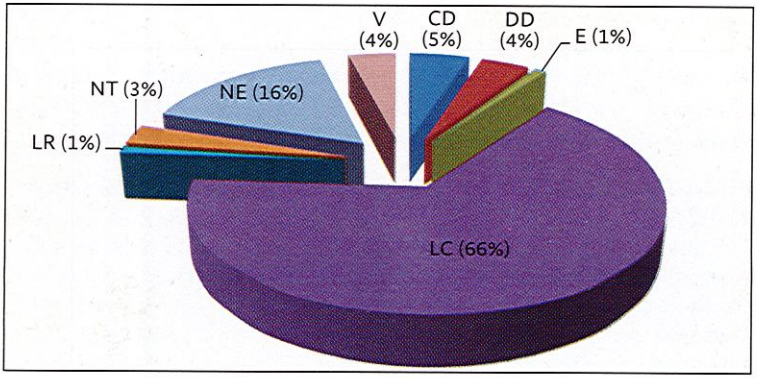


Figure 17: Percentage of the recorded plant species under different conservation categories [CD = Conservation dependent, DD = Data Deficient, E = Endangered, LC = Least Concern, LR = Lower Risk, NE = Not Evaluated, NT = Near Threatened, V = Vulnerable]

At present extraction of all kinds of forest products, trespass etc. that disturbs the natural habitat is strictly prohibited in Chunati WS. Community Patrolling Group (CPG) was formulated to patrol forest resources from illegal removal. This group works under a Co-Management Committee (CMC) which was formed involving the local leaders. As a result the surrounding people who are generally used to cut and collect the timber, fuel wood, bamboos, fence posts,

agricultural implements and house posts from the forests are not allowed to do the same. Local people became conscious and trying to protect their forests from deforestation. The Forest Department also extended their responsibilities to strengthen the conservation measures of the forest resources. USAID, Arannayk Foundation and GIZ are continuing the activities through CREL and MNRCF-CWS projects to aware people about the importance of sustaining the forest resources. They are involving local people in conservation activities of the forest area through co-management and trying to upgrade their livelihood through providing various incentives (providing agricultural crop seeds, fertilizer, revolving fund etc.) and initiating different alternative income generating activities (fisheries, agriculture etc.). But, till now there are some mishaps which threatens the forest ecosystem and ultimately conservation programs.

Cultivation of paddy in the privately owned land and forest valleys situated within the sanctuary area is one of the major threats to Chunati WS ecosystem. *Imperata cylindrica* (Sungrass) cultivation, its management and harvesting within the reserve forests of Chunati WS are allowed to local people. Seasonal revenue collection from the sungrass cultivators is one of the major income sources of Forest Department (FD). Broomstick production in the natural forests of Chunati WS is profuse. Local people earn a handsome amount of money by selling the collected broomsticks in nearby markets and cities.

The barren or almost barren hills of Chunati WS are generally selected by Forest Department for plantations. Plantations with both the short and long rotation tree species were established in the past. Weeding operation in the plantations is done more or less irregularly depending on the availability of funds. Traditional plantation establishment processes are generally followed by clearing off all sorts of natural regeneration and advanced growth with a serious erosion of the native plant genetic resources.

Forest restoration is enhanced by Akasmoni plantation in Chunati WS

7.2 Threats to the Conservation of Chunati WS Forest Ecosystem

Disturbance in natural forests can change habitat suitability for many species (Wilcox *et al.* 2006) and affect plant species composition and ecosystem function (Berhane *et al.* 2013). Human-induced disturbances and influences, such as logging, browsing and grazing can significantly modify species diversity and composition. As intensity and frequency of disturbance increases, the availability and abundance of many species could decline with increased risk of local extinction. More abundant and hardy species are less vulnerable to disturbance than rare and specialized species. Disturbance can also change the gap sizes in forest and alter species composition by encouraging pioneer plant species.

Destructive fire is a common scenario in Chunati WS

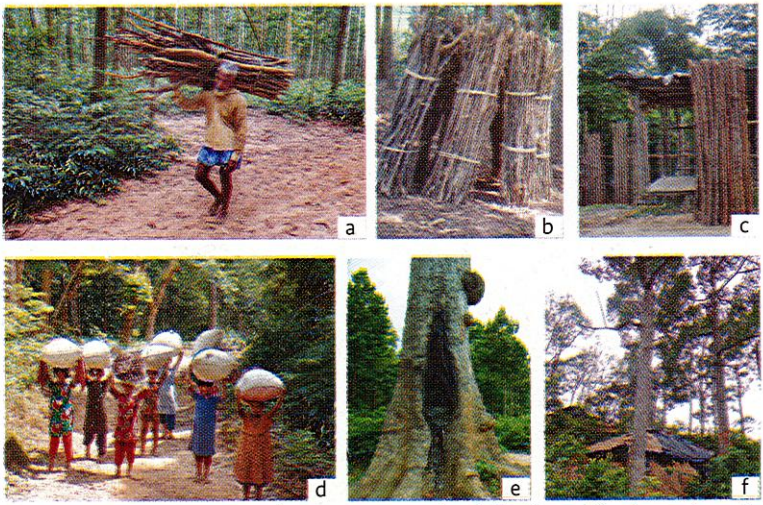
Fire caused complete dying of all young plants in Chunati WS

Fire completely burn the natural regeneration

Chunati WS is tremendously disturbed by the local people. But, adopted measures are very inadequate to address the issues. During the field visit, it was found that many areas of the WS were burnt by intentional fire that caused mortality of regenerated seedlings, saplings, micro-organisms, underbrush etc. Intensity and extensiveness of fire occurrence was so high that in many locations young trees were also burnt. Many birds lost their nests during fire. Soil dwelling animals had to run away from their own habitat. Food sources of wildlife are being reduced day by day. Thus, wildlife habitat in Chunati WS is being threatened severely.

Inhabitation and making of new houses within the forest area is another major threat to the ecosystem of Chunati WS. Currently, Rohinga intrusion and settlement (especially in the Aziznagar beat) in the Chunati WS area increased significantly. Human habitation and settlement are the major causes of deforestation and degradation of Chunati WS.

Cultivation of agri-crops, e.g. paddy, vegetables within the wildlife sanctuary areas and its further expansion in the forest area is another significant threat to the existing remnant natural forests of the wildlife sanctuary. There exists some privately owned agricultural fields within the WS. As a result local people trespass through the forest with the purpose of cultivation and it could not be stopped easily. This accelerates removal of forest resources continuously during trespass.



a) Fuel-wood extraction, b+c) native young poles felled for selling in market, d) extensive litter collection by local people, e) oil extraction from mother garjan trees and, f) human settlement in garjan forests of Chunati WS

Human trespass and settlement inside forests of Chunati WS

Agricultral expansion in the periphery of Chunati WS

Natural patches of Chunati WS are being fragmented

A substantial number of local people were involved in bamboo harvesting from the forests, which causes degradation of many bamboo grooves. As a result bamboo dependent wildlife, i.e. Asian Elephants are not getting enough food. Betel leaf cultivation is also responsible for the reduction of substantial quantities of bamboo in the WS.

The nearby and remote communities were also found to cut the saplings, poles and young trees for house building, fencing, and sometimes sale in the market. It ultimately reduces the regeneration and recruitment of the native valuable hardwood tree species. So, these sorts of extraction of forest resources should be stopped as soon as possible through strengthening protection measures and increasing awareness programs of the forest dependent people.

Betel leaf cultivation became common practice in the Chunati WS area. Extensive betel leaf cultivation in the forests of Chunati WS causes complete clearing of the respective area. The bamboo and other necessary implements are extracted from the forests. Farmers shift their betel leaf farm to the new forest areas in each cultivation season leaving the previous one abandoned. As a result the whole betel leaf cultivation process and its extensiveness cause severe deforestation and degradation of the WS.

Every year, extensive areas of tropical forests are intentionally burnt by anthropogenic fires, and are severely degraded or destroyed as a result. The spread of fire is strongly influenced by vegetation type, e.g. grassy environments are prone to fire frequently because of the rapid accumulation of fuel while rainforests burn occassionally because of micro-climates that keep fuels moist under all but drought conditions (Bowman and Murphy 2010). In Chunati WS, there are a number of sungrass fields in the core area of the sanctuary. Sungrass reduces the soil moisture and make the soil hard, thus hamper the regeneration. Cultivators ignite the debrises each year after harvesting to increase sungrass production and cultivation area. Sungrass selling is one of the cash income sources of many local people. It is also used as thatching materials by local people. There is no legal approach against maintaining and decreasing sungrass cultivation areas. Infestation by sungrass is a major threat in achieving a good forest coverage and early establishment of the plantations in the WS. Moreover, excessive collection of non-timber forest produces (NTFPs) from forests causes reduction of the resource.

Shooting and hunting of birds, wild boars and deer along with many other wildlives by the local hunters is another threat for wildlife conservation. Irritating elephants by human along with anthropogenic disturbances harms their free movement in Chunati WS.

7.3 Recommendation for floral Conservation Measures

The process of conserving endangered species can be divided into three phases: i) identification- determining which species are in danger of extinction; ii) protection- determining and implementing the short-term measures necessary to halt species' slide to extinction; and iii) recovery- determining and implementing the long-term measures necessary to rebuild the population of the species to the point at which it is no longer in danger of extinction (Wilcove 2010).

People living in and around a forest depend on forest resources for a substantial proportion of their subsistence, including food, fiber, medicines and other uses (Neumann and Hirsch 2000). Many others perceive forest exploitation as a means of escaping poverty (Belcher 2005, Sunderlin *et al.* 2005). Forest conservation is likely to be low on these peoples' priorities if it limits their possibilities for livelihood support (Ghazoul and Sheil 2010). So, development of living condition of the surrounding local people of Chunati WS through improving their livelihood and income, so as to meet their all basic needs should be of first priority; otherwise the conservation effort will go in vain.

It is important to extend and strengthen the protective measures of local administrative bodies of Forest Department (FD) against the threats like inhabitation, agricultural expansion, hunting, shooting, illegal cutting, fuel wood collection etc. Local administrative units (Beat Offices) of the Forest Department must be strengthened with necessary manpower, equipments, logistics and training, so that they become more capable to conduct the protection and conservation measures.

Steps should be taken to halt further expansion of any agricultural lands as well as betel leaf cultivation. If possible, privately owned agricultural land should be acquired by government and the owners may be relocated. Awareness raising and consciousness of local people regarding the importance of forestry, wildlife, environmental conservation, biodiversity and endangered ecosystems is mandatory. Government may provide some incentives through money, small loan, training etc. to help local people in managing alternative income generating programs. Relocation and permanent allocation of some barren lands to the forest dwelling people may reduce their dependency on the existing forest.

Betel leaf cultivation should be restricted to some marginal areas of Chunati WS. Sungrass cultivation should be discouraged and sungrass infested areas should bring under vegetation cover with pioneer

colonizing tree species. Grazing and browsing pressure from livestock in Chunati WS is substantial and prevention of grazing animals in reducing the direct effects of animal disturbance is essential.

Special conservation measures both *ex-situ* and *in-situ* methods may be initiated to conserve the threatened and rare native plant species. Enrichment plantation with some native, rare and wildlife food bearing plants, i.e. *Artocarpus* sp., *Ficus* sp., *Syzygium* sp., *Baccaurea ramiflora* (Latkon) etc. can be given priority in plantation programs.

Many other activities that were identified by IUCN and other conservation organizations which contribute to forest and species conservation, i. e. area-based protection, area-based management, species-centered management, education and awareness, improved law and policy, livelihoods and incentives as well as capacity building may be considered for the adjacent people of the Wildlife Sanctuary.

Permanent sample plots of adequate size (0.5 – 1.0 ha) may be established in representative vegetation types of the beats. Long-term ecological and biodiversity assessment along with monitoring may provide the success of restoration and re-colonization of the flora of Chunati WS area.

Community patrolling should be strengthened to reduce illicit felling as well as raising awareness among local people regarding nature conservation. However, political commitment, transparency and good governance are the pre-requisite for the conservation of both the flora and fauna of this species rich wildlife sanctuary.

References

Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (eds.). 2008. *Encyclopedia of Flora and Fauna of Bangladesh*, vol. 5-12. Asiatic Society of Bangladesh, Dhaka.

Alam, M.K. 1992. Medicinal ethno-botany of the Marma tribe of Bangladesh. *Economic Botany*, 46(3):330-335.

Alamgir, M. and Al-Amin, M. 2005. Plant diversity and their distribution pattern at strategically selected conserved forests of Banskhali, Chittagong. *Journal of Forestry and Environment*, 3:69-75.

Banik, R.L. 2000. *Silviculture and Field Guide to Priority Bamboos of Bangladesh and South Asia*. Bangladesh Forest Research Institute, Chittagong.

Barnes, B.V., Zak, D.R., Denton, S.R. and Spurr, S.H. 1998. *Forest Ecology*, 4th edition, New York: John Wiley and Sons.

Barua, S.P., Khan, M.M.H. and Reza, A.H.M.A. 2001. The status of alien invasive species in Bangladesh and their impact on the ecosystems. IUCN, Bangladesh.

Belcher, B.M. 2005. Forest product markets, forests and poverty reduction. *International Forestry Review*, 7:82-89.

Berhane, A., Totland, Ø. and Moe, S.R. 2013. Woody plant assemblage in isolated forest patches in a semi-arid agricultural matrix. *Biodiversity Conserv.*, 22:2519-2535.

Bhatak, R.K. and Pandit, P.K. 2003. Role of sacred grove in conservation of medicinal plants. *The Indian Forester*, 129 (2):224-232.

Biswas, S.R., Choudhury, J.K., Nishat, A. and Rahman, M.M. 2007. Do invasive plants threaten the Sundarbans mangrove forest of Bangladesh? *Forest Ecology and Management*, 245:1-9.

Bowman, D.M.J.S. and Murphy, B.P. 2010. Fire and biodiversity, ***In:*** Sodhi, N.S. and Ehrlich, P.R. (eds.), *Conservation Biology for All*, Oxford University Press, pp.163-180.

Caius, J.F. 1998. *The medicinal and poisonous plants of India*. Scientific Publisher, Jodhpur, India, 528 pp.

Campbell, S. 2005. A global perspective on forest invasive species: the problem, causes, and consequences. ***In:*** McKenzie, P., Brown, C., Jianghua, S. and Jian, W. (eds.), *The Unwelcome Guests*-Proceedings of the Asia-Pacific Forest Invasive Species Conference. FAO-RAP, Bangkok, pp.9-10.

Chakma, S., Hossain, M.K., Khan, B.M. and Kabir, M.A. 2003. Ethno-botanical knowledge of Chakma community in the use of medicinal plants in Chittagong Hill tracts, Bangladesh. *MFP News*, Dehra Dun, India, 13(3):3-7.

Chopra, R.N., Nayer, S.L. and Chopra, I.C. 1956. Glossary of Indian Medicinal Plants, CSIR, V ed. New Delhi. 12:157.

Dey, A.N., Datta, S. and Maitra, S. 2007. Traditional knowledge on medicinal plants for remedy of common ailments in northern part of West Bengal. *The Indian Forester*, 133(11):1535-1544.

Diserud, O. H. and Odegaard, F. 2006. A multiple-site similarity measure. *Biology Letters*, 3:20-22.

Garwood, N. 1989. Tropical soil seed banks. In: Leck, M.A., Parker, V.T., Simpson, R.L. (eds.), *Ecology of Soil Seed Banks*. Academic Press, San Diego, pp. 149-363.

Ghani, A. 2003. *Medicinal Plants of Bangladesh* (2nd edition). Asiatic Society of Bangladesh, Dhaka, Bangladesh, pp. 603.

Ghazoul, J. and Sheil, D. 2010. *Tropical rain forest ecology, diversity and conservation*. Oxford University Press, New York, pp. 371-372.

Green, M.J.B. 1990. *IUCN Directory of South Asian Protected Areas*. IUCN – The World Conservation Union, Gland, Switzerland, pp. 12.

Grime, J.P. 1979. *Plant strategies and vegetation processes*. John Wiley and Sons, Chichester, pp. 67.

Hossain, M.K. 1998. Role of plantation forestry in rehabilitation of degraded and secondary hill forests of Bangladesh. ***In:*** *Proceedings of the IUFRO Inter-Divisional Seoul Conference-Forest Ecosystem and Land Use in Mountain Areas*, 12-17 October, 1998, Seoul, Korea. pp. 243-250.

Hossain, M.K. 2008. Alien invasive plant species and their effects on hill forest ecosystems of Bangladesh. ***In:*** Kohli, R.K., Jose, S., Singh, H.P. and Batish, D.R. (eds.), *Invasive Plants and Forest Ecosystems*, CRC Press, USA, pp. 133-142.

Hossain, M.A., Hossain, M.K., Salam, M.A. and Rahman, S. 2012. Composition and diversity of tree species in Dudhpukuria-Dhopachori Wildlife Sanctuary of Chittagong (South) Forest Division, Bangladesh. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 4(2): 1447-1457.

Hossain, M.K. and Pasha, M.K. 2001. Alien Invasive Plants in Bangladesh and their Impacts on the Ecosystem. ***In:*** *Assessment and Management of Alien Species that Threatened Ecosystem, Habitats and Species.* Secretariat of the Convention on Biological Diversity, CBD Technical Paper No. 21, Montreal, Canada, pp. 73–75.

Hossain, M.K., and Pasha, M.K. 2004. An account of the exotic flora of Bangladesh. *Journal of Forestry and Environment*, 2:99-115.

Hossain, M.K. and Alam, M.N. 2010. Allelopathic effects of *Lantana camara* leaf extract on germination and growth behavior of some agricultural and forest crops in Bangladesh. *Pak. J. Weed Sci. Res.*, 16(2):217-226.

Hossain, M.K., Rahman, M.L., Hoque, A.T.M.R. and Alam, M.K. 2004. Comparative regeneration status in a natural forest and enrichment plantations of Chittagong (South) Forest Division, Bangladesh. *Journal of Forestry Research*, 15(4): 255-260.

Hubbell, S.P. 2001. *The Unified Neutral Theory of Biodiversity and Biogeography*. Princeton University Press, Princeton, NJ, USA. pp. 375.

Huston, M.A. 1994. *Biological Diversity. The Co-existence of Species on Changing landscape*. Cambridge University Press, Cambridge, pp. 681.

Integrated Protected Area Co-Management (IPAC). 2011. *Land use change trend analysis in seven Protected Areas in Bangladesh under IPAC through application of landsat imageries*, pp. 21-22.

Islam, A.K.M.N. 1991. *Two Centuries of Plant Studies in Bangladesh and Adjacent Regions*. Asiatic Society of Bangladesh, Dhaka.

Kanjilal, U.N., Kanjilal, P.C. and Das, A. (eds.). 1938. (Reprint 1982). *Flora of Assam*. Vol. 2, A Von Book Company, Delhi, India, pp. 409.

Khan, M.S. 1990. *The Flora of Chunati Wildlife Sanctuary. A Preliminary Survey Report.* Natural Resource Information Centre Project, Bangladesh, pp. 31.

Khan, M.S. and Huq, A.M. 2001. The vascular flora of Chunati Wildlife Sanctuary in South Chittagong, Bangladesh. *Bangladesh J. Plant Taxon.*, 8(1): 47-64.

Kumar, S. and Srivastava, N. 2002. Herbal research in Garhwal Himalayas: Retrospect and Prospects. *Ann. For.*, 10(1): 99-118.

Magurran, A. 2004. *Measuring Biological Diversity*. Blackwell Publishing, Oxford, UK.

Majumdar, K., Shankar, U. and Datta, B. K. 2012. Tree species diversity and stand structure along major community types in lowland primary and secondary moist deciduous forests in Tripura, Northeast India. *Journal of Forestry Research*, 23(4): 553-568.

Margalef, R. 1958. Information Theory in Ecology. *General Systematics*, 3:36-71.

MoEF (Ministry of Environment and Forests). 2006. *National Biodiversity Strategy and Action Plan for Bangladesh*. Ministry of Environment and Forests, Government of People's Republic of Bangladesh, Dhaka, pp. 1-84.

MoEF (Ministry of Environment and Forests). 2010. *Biodiversity National Assessment and Programme of Action 2020*. Ministry of Environment and Forests, Government of People's Republic of Bangladesh, Dhaka, pp. 1-112.

Motaleb, M.A. and Hossain, M.K. 2011. Assessment of tree species diversity of Tankawati natural forests, Chittagong (South) Forest Division, Bangladesh. *Eco-Friendly Agril. J.*, 4(02): 542-545.

Mukul, S.A., Uddin, M.B. and Tito, M.R. 2006. Study on the status and various uses of invasive alien plant species in and around Satchari National Park, Sylhet, Bangladesh. *Tiger paper*, 33: 28-32.

Nath, T.K. 2012. *Baseline Survey for Management of Natural Resources and Community Forestry*. Management of Natural Resource and Community Forestry in Chunati Wildlife Sanctuary (MNRCF-Chunati), Chittagong, Bangladesh. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), unpublished report, Bangladesh, pp. 1-49.

Nath, T.K., Hossain, M.K. and Alam, M.K. 2000. Assessment of tree species diversity of Sitapahar forest reserve, Chittagong Hill Tracts (South) Forest Division, Bangladesh. *Indian Forester*, 126:16-21

Neumann, R.P. and Hirsch, E. 2000. *Commercialisation of non-timber forest products: Review and analysis of research*. Bogor, Indonesia, Centre for International Forestry Research.

Odegaard, F. 2000. How many species of arthropods? Erwin's estimate revised. *Biological Journal of the Linnean Society*, 71: 583-597.

Pal, D.C. and Jain, S.K. 1998. Notes on Lodha medicines in Dinajpur district, West Bengal. *Econ. Bot.*, 43: 464-470.

Panday, R.S. and Kumar, A. 2006. An ethnobotanical study in the Vinddhyan region, Uttar Pradesh. *Indian Journal of Forestry*, 29(4): 389-394.

Partha, P. and Hossain, A.B.M.E. 2007. Ethnobotanical investigation into the Mandi ethnic community in Bangladesh. *Bangladesh J. Plant Taxon.*, 14(2): 129-145.

Pielou, E.C. 1966. Species diversity and pattern diversity in the study of ecological succession. *Journal of Theoretical Biology*, 10:370-383.

Prain, D. 1903. (Reprinted 1981). *Bengal Plants*, Vols. 1-2. Bishen Singh Mahendra Pal Singh, Dehra Dun, India. 1319 pp.

Raghavan, R.S. 1993. Capparaceae. ***In:*** Sharma, B.D. and Balakrishnan, N.P. (eds.). *Flora of India*, vol. 2 (Papaveraceae – Caryophyllaceae). Botanical Survey of India, Calcutta. pp. 248-335.

Rahman, M.A., Rashid, M.H. and Wilcock, C.C. 2000. Diversity, Ecology, Distribution and Ethnobotany of the Apocynaceae of Bangladesh. *Bangladesh J. Plant Taxon.*, 7(2): 57-76.

Rahman, M.A., Uddin, S.B. and Wilcock, C.C. 2003. Indigenous knowledge of herbal medicine in Bangladesh: Diarrhoea, dysentery, indigestion and stomach pains. *Journal of Medicinal and Aromatic Plant Sciences*, 25:1001-1009.

Rahman, M.H., Khan, M.A.S.A., Roy, B. and Fardusi, M.J. 2011. Assessment of natural regeneration status and diversity of tree species in the biodiversity conservation areas of Northeastern Bangladesh. *Journal of Forestry Research*, 22(4): 551-559.

Rahman, M.L. and Hossain, M.K. 2002. Distribution pattern of medicinal tree species in Chunati wildlife sanctuary of Chittagong. *Chittagong University Journal of Science*, 26(1): 55-69.

Rahman, M.L. and Hossain, M.K. 2003. Status of fodder and non-fodder tree species in Chunati wildlife sanctuary of Chittagong Forest Division, Bangladesh. *Int. J. For. Usuf. Mngt.*, 4(2): 9-14.

Shannon, C.E. and Wiener, W. 1963. *The Mathematical Theory of Communities*. University of Illinois Press, Urbana, pp. 111-117.

Shukla, R.S. and Chandal, P.S. 2000. *Plant Ecology and Soil Science* (9th edn.). Ramnagor: S. Chand and Company Limited, New Delhi, pp. 121-376.

Simpson, E.M. 1949. Measurement of diversity. *Nature*, 163:688.

Srivastava, N. and Kumar, S. 2003. Drug Plant Resources of Doon Valley. *Ann. For.*, 11(1): 68-84.

Stinson, K.A., Campbell, S.A., Powell, J.R., Wolfe, B.E., Callaway, R.M., Thelen, G.C., Hallett, S.G., Prati, D. and Klironomos, J.N. 2006. Invasive plant suppresses the growth of native tree seedlings by disrupting below ground mutualisms. *PloS Biology*, 4: 727-731.

Sunderlin, W.D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L. and Wunder, S. 2005. Livelihoods, forests, and conservation in developing countries: An overview. *World Development 33*, 1383-1402.

Tarafdar, C.R. and Chaudhuri, R.H.N. 1991. Less known medicinal uses of plants among the tribals of Hazaribagh district of Bihar. ***In***: Jain, S. K. (ed.), *Contribution to Indian Ethnobotany*. Scientific Publishers, India, pp. 91-100.

Teketay, D. 1996. *Seed Ecology and Regeneration in Dry Afromontane Forests of Ethiopia*. Swedish University of Agricultural Sciences, Sweden. 174 pp.

Uddin, M.B., Steinbauer, M.J., Jentsch, A., Mukul, S.A. and Beierkuhnlein, C. 2013. Do environmental attributes, disturbances and protection regimes determine the distribution of exotic plant species in Bangladesh forest ecosystem? *Forest Ecology and Management*, 303: 72-80.

Uddin, M.G., Mirza, M.M. and Pasha, M.K. 1998. The medicinal uses of pteridophytes of Bangladesh. Bangladesh *J. Plant Taxon.*, 5(2):29-41.

Uddin, S.N., Uddin, M.Z., Hassan, M.A. and Rahman, M.M. 2004. Preliminary ethnobotanical plant survey in Khagrachari district. *Bangladesh J. Plant Taxon.*, 11(2): 39-48.

Whitmore, T.C. 1998. *An Introduction to Tropical Rain Forests* (2nd edition), Oxford University Press, Oxford, U.K.

Wilcove, D.S. 2010. Endangered species management: the US experience, ***In***: Sodhi, N.S. and Ehrlich, P.R. (eds.), *Conservation Biology for all*, Oxford University Press, pp. 220-235.

Wilcox, C., Cairns, B.J. and Possingham, H.P. 2006. The role of habitat disturbance and recovery in metapopulation persistence. *Ecology*, 87: 855-863.

Wyatt-Smith, J. 1987. Problems and prospects for natural management of tropical moist forests. ***In***: Mergen, F. and Vincent, J.R. (eds.), *Natural Management of tropical Moist Forest*, New Haven, Connecticut, Yale University.

Yusuf, M., Wahab, M.A., Yousuf, M. and Chowdhury, J.U. 2006. Ethno-medico-botanical knowledge from Kaauhkali proper and Betbunia of Rangamati district. *Bangladesh J. Plant Taxon.*, 13(1):55-61.

Zegeye, H., Teketay, D. and Kelbessa, E. 2011. Diversity and regeneration status of woody species in Tara Gedam and Abebaye forests, North-Western Ethiopia. *Journal of Forestry Research*, 22(3): 315-328.

Appendices

Appendix 1. GPS locations of the sample plots (Quadrats) in all the 7 beats of Chunati WS

Plot No.	Beat & Plot	Co-ordinate	Elevation (m)	Forest Type
1	Chunati 1	21°58.870′- 92°03.334′	28	Enrichment plantation
2	Chunati 2	21°58.470′- 92°02.793′	31	Acacia p lantation
3	Chunati 3	21°58.334′- 92°02.517′	31	Mixed plantation
4	Chunati 4	21°58.348′- 92°02.527′	39	Mixed plantation
5	Chunati 5	21°58.304′- 92°02.190′	41	Natural
6	Chunati 6	21°58.104′- 92°02.240′	46	Natural
7	Chunati 7	21°58.144′- 92°02.056′	38	Natural
8	Chunati 8	21°58.102′- 92°02.156′	51	Mixed plantation
9	Chunati 9	21°58.056′- 92°02.267′	56	Mixed plantation
10	Chunati 10	21°57.925′- 92°02.204′	39	Coppice
11	Chunati 11	21°57.759′- 92°02.348′	41	Mixed plantation
12	Chunati 12	21°57.543′- 92°02.584′	39	Natural
13	Chunati 13	21°57.630′- 92°02.861′	34	Plantation
14	Chunati 14	21°57.457′- 92°02.285′	88	Coppice
15	Chunati 15	21°57.376′- 92°01.790′	58	Natural
16	Chunati 16	21°57.281′- 92°01.680′	51	Natural
17	Chunati 17	21°57.091′- 92°01.671′	60	Natural
18	Chunati 18	21°57.351′- 92°01.537′	49	Natural
19	Chunati 19	21°57.269′- 92°01.618′	55	Natural
20	Chunati 20	21°57.401′- 92°01.803′	48	Natural
21	Chunati 21	21°57.196′- 92°01.890′	68	Natural
22	Chunati 22	21°57.373′- 92°01.926′	56	Natural
23	Chunati 23	21°57.557′- 92°01.960′	40	Natural
24	Chunati 24	21°55.395′- 92°03.448′	49	Mixed (Coppice & Natural)
25	Chunati 25	21°55.385′- 92°03.361′	78	Mixed (Coppice & Natural)
26	Chunati 26	21°55.371′- 92°03.221′	74	Plantation
27	Chunati 27	21°55.462′- 92°03.182′	45	Natural
28	Chunati 28	21°55.501′- 92°03.144′	58	Natural
29	Chunati 29	21°55.595′- 92°03.992′	38	Natural
30	Chunati 30	21°55.905′- 92°03.844′	68	Natural
31	Chunati 31	21°56.045′- 92°03.121′	45	Mixed (Natural & Teak coppice)
32	Chunati 32	21°56.523′- 92°03.133′	32	Mixed (Natural & Teak coppice)
33	Chunati 33	21°56.798′- 92°03.172′	42	Mixed (Natural and Plantation)
34	Chunati 34	21°57.095′- 92°03.671′	42	Mixed (Natural and Plantation)
35	Chunati 35	21°57.210′- 92°03.732′	46	Plantation
36	Chunati 36	21°57.342′- 92°03.972′	47	Plantation
37	Chunati 37	21°55.491′- 92°03.498′	45	Mixed (Na tural and Plantation)
38	Aziznagar 1	21°55.101′- 92°03.489′	46	Natural
39	Aziznagar 2	21°55.160′- 92°03.381′	46	Coppice
40	Aziznagar 3	21°55.354′- 92°03.304′	52	Natural
41	Aziznagar 4	21°55.280′- 92°03.200′	52	Mixed plantation
42	Aziznagar 5	21°55.219′- 92°03.073′	44	Mixed plantation
43	Aziznagar 6	21°55.014′- 92°03.107′	44	Mixed plantation

Appendix 1 continued...

Plot No.	Beat & Plot	Co-ordinate	Elevation (m)	Forest Type
44	Aziznagar 7	21°55.184′- 92°03.954′	41	Natural
45	Aziznagar 8	21°55.099′- 92°02.639′	42	Natural
46	Aziznagar 9	21°55.020′- 92°02.855′	61	Mixed plantation
47	Aziznagar 10	21°54.862′- 92°02.894′	62	Coppice
48	Aziznagar 11	21°54.620′- 92°03.222′	49	Coppice
49	Aziznagar 12	21°54.427′- 92°03.146′	31	Mixed plantation
50	Aziznagar 13	21°54.515′- 92°02.885′	29	Plantation (Horticulture)
51	Aziznagar 14	21°54.429′- 92°02.622′	52	Natural
52	Aziznagar 15	21°54.001′- 92°03.182′	20	Natural
53	Aziznagar 16	21°54.142′- 92°03.469′	42	Plantation
54	Aziznagar 17	21°54.127′- 92°03.619′	44	Plantation
55	Aziznagar 18	21°54.106′- 92°03.638′	32	Mixed plantation
56	Aziznagar 19	21°54.409′- 92°03.611′	49	Mixed plantation
57	Harbang 1	21°53.400′- 92°03.569′	20	Enrichment plantation
58	Harbang 2	21°53.529′- 92°03.300′	25	Mixed plantation
59	Harbang 3	21°53.380′- 92°03.330′	33	Natural
60	Harbang 4	21°53.322′- 92°03.203′	36	Sal coppice
61	Harbang 5	21°53.416′- 92°03.134′	40	Akasmoni plantation
62	Harbang 6	21°53.361′- 92°02.952′	25	Mixed plantation
63	Harbang 7	21°53.372′- 92°02.864′	28	Teak coppice
64	Harbang 8	21°53.460′- 92°02.820′	35	Sal coppice
65	Harbang 9	21°53.481′- 92°02.602′	39	Natural
66	Harbang 10	21°53.441′- 92°02.427′	59	Natural
67	Harbang 11	21°53.326′- 92°02.634′	24	Plantation
68	Harbang 12	21°53.137′- 92°02.722′	21	Teak coppice
69	Harbang 13	21°53.029′- 92°02.887′	34	Natural
70	Harbang 14	21°52.808′- 92°03.014′	26	Akasmoni plantation
71	Harbang 15	21°52.778′- 92°03.095′	24	Mixed plantation
72	Harbang 16	21°52.748′- 92°03.172′	21	Mixed plantation
73	Harbang 17	21°52.709′- 92°03.343′	28	Enrichment plantation
74	Harbang 18	21°52.847′- 92°03.823′	18	Mixed plantation
75	Harbang 19	21°51.861′- 92°03.325′	26	Mixed plantation
76	Harbang 20	21°51.876′- 92°03.175′	23	Acacia plantation
77	Harbang 21	21°51.058′- 92°02.998′	29	Mixed plantation
78	Harbang 22	21°51.169′- 92°02.921′	22	Natural
79	Harbang 23	21°52.246′- 92°02.868′	24	Akasmoni plantation
80	Harbang 24	21°52.279′- 92°02.748′	35	Mixed plantation
81	Harbang 25	21°52.517′- 92°02.719′	24	Mixed plantation
82	Harbang 26	21°52.631′- 92°02.651′	22	Mixed plantation
83	Harbang 27	21°52.758′- 92°02.481′	36	Enrichment plantation
84	Harbang 28	21°52.886′- 92°02.540′	35	Mixed plantation
85	Harbang 29	21°52.907′- 92°02.657′	28	Akasmoni plantation
86	Harbang 30	21°52.792′- 92°02.892′	32	Mixed plantation
87	Harbang 31	21°52.646′- 92°03.240′	16	Teak coppice
88	Harbang 32	21°52.364′- 92°03.319′	12	Mixed (plantation and natural)

Appendix 1 continued...

Plot No.	Beat & Plot	Co-ordinate	Elevation (m)	Forest Type
89	Harbang 33	21°52.435′- 92°03.346′	23	Mixed plantation
90	Harbang 34	21°52.293′- 92°03.454′	30	Mixed (plantation and natural)
91	Harbang 35	21°52.155′- 92°03.528′	26	Natural
92	Puichori 1	21°54.286′- 91°58.805′	22	Enrichment plantation
93	Puichori 2	21°54.226′- 91°58.900′	28	Enrichment plantation
94	Puichori 3	21°54.148′- 91°58.985′	34	Natural
95	Puichori 4	21°54.217′- 91°59.174′	30	Plantation
96	Puichori 5	21°54.286′- 91°59.443′	27	Plantation
97	Puichori 6	21°54.406′- 92°59.701′	28	Enrichment plantation
98	Puichori 7	21°54.435′- 92°59.838′	42	Coppice & plantation
99	Puichori 8	21°54.442′- 92°00.016′	43	Coppice & plantation
100	Puichori 9	21°54.404′- 92°00.142′	62	Sal coppice
101	Puichori 10	21°54.413′- 92°00.379′	69	Natural
102	Puichori 11	21°54.400′- 92°00.4.17′	65	Natural
103	Puichori 12	21°54.367′- 92°00.509′	50	Natural
104	Puichori 13	21°54.324′- 92°00.498′	72	Naturalized shegun coppice
105	Puichori 14	21°54.178′- 92°00.470′	56	Naturalized sal coppice
106	Puichori 15	21°53.961′- 92°00.460′	54	Naturalized shegun coppice
107	Puichori 16	21°54.065′- 92°00.492′	69	Natural
108	Puichori 17	21°54.090′- 92°00.626′	61	Shegun and natural
109	Puichori 18	21°54.024′- 92°00.677′	28	Failed plantation
110	Puichori 19	21°54.992′- 92°00.573′	38	Mixed plantation
111	Puichori 20	21°53.918′- 92°00.224′	28	Mixed plantation
112	Puichori 21	21°53.870′- 91°59.863′	25	Akashmoni plantation
113	Puichori 22	21°53.823′- 91°59.689′	29	Akashmoni Plantation
114	Puichori 23	21°53.851′- 91°59.587′	24	Akashmoni Plantation
115	Puichori 24	21°53.977′- 91°59.505′	34	Akashmoni Plantation
116	Puichori 25	21°53.952′- 91°59.674′	47	Mixed plantation
117	Puichori 26	21°53.908′- 91°59.628′	38	Natural
118	Puichori 27	21°53.863′- 91°59.600′	34	Natural
119	Puichori 28	21°54.013′- 91°59.656′	45	Natural
120	Puichori 29	21°54.048′- 91°59.781′	19	Enrichment plantation
121	Puichori 30	21°54.102′- 91°59.738′	30	Akashmoni plantation
122	Puichori 31	21°54.121′- 91°59.885′	23	Natural
123	Puichori 32	21°54.191′- 91°59.892′	22	Enrichment plantation
124	Puichori 33	21°54.257′- 91°59.894′	33	Natural
125	Puichori 34	21°54.386′- 91°59.870′	45	Natural
126	Puichori 35	21°54.434′- 91°59.847′	49	Mixed plantation
127	Puichori 36	21°54.513′- 91°59.837′	42	Enrichment plantation
128	Puichori 37	21°54.593′- 91°59.786′	17	Natural
129	Puichori 38	21°54.593′- 91°59.677′	20	Natural
130	Puichori 39	21°54.577′- 91°59.527′	24	Natural
131	Puichori 40	21°54.507′- 91°59.127′	35	Enrichment plantation
132	Puichori 41	21°54.420′- 91°58.974′	18	Very few tree except bush
133	Puichori 42	21°54.356′- 91°58.842′	14	Very few tree except bush

Appendix 1 continued...

Plot No.	Beat & Plot	Co-ordinate	Elevation (m)	Forest Type
134	Napura 1	21°55.708′-91°58.628′	36	Akashmoni plantation
135	Napura 2	21°55.724′-91°58.767′	44	Mixed plantation
136	Napura 3	21°55.524′-91°58.589′	39	Mixed plantation
137	Napura 4	21°55.308′-91°58.471′	23	Natural
138	Napura 5	21°55.315′-91°58.600′	42	Akashmoni plantation
139	Napura 6	21°55.353′-91°58.882′	9	Mixed plantation
140	Napura 7	21°55.272′-91°59.125′	40	Akashmoni plantation
141	Napura 8	21°55.356′-91°59.589′	36	Natural
142	Napura 9	21°55.563′-91°59.923′	60	Natural
143	Napura 10	21°55.573′-91°59.994′	49	Natural
144	Napura 11	21°55.582′-91°00.111′	39	Natural
145	Napura 12	21°55.615′-91°00.263′	39	Natural
146	Napura 13	21°55.730′-91°00.354′	45	Shegun coppice
147	Napura 14	21°55.872′-91°00.355′	47	Natural
148	Napura 15	21°55.839′-91°00.268′	46	Shegun coppice and natural
149	Napura 16	21°55.921′-91°00.171′	55	Natural
150	Napura 17	21°55.980′-91°59.971′	39	Natural
151	Napura 18	21°55.856′-91°59.882′	40	Sal coppice
152	Napura 19	21°55.762′-91°58.548′	27	Natural
153	Napura 20	21°55.649′-91°58.528′	18	Akashmoni plantation
154	Napura 21	21°55.142′-91°58.576′	19	Akashmoni plantation and natural
155	Napura 22	21°55.165′-91°58.848′	26	Enrichment plantation
156	Napura 23	21°55.014′-91°58.935′	45	Natural
157	Napura 24	21°54.924′-91°59.155′	34	Natural
158	Napura 25	21°54.811′-91°59.279′	25	Natural
159	Napura 26	21°55.017′-91°59.465′	20	Natural
160	Napura 27	21°55.100′-91°59.544′	21	Natural
161	Napura 28	21°55.192′-91°59.629′	45	Mixed plantation
162	Napura 29	21°55.227′-91°59.824′	58	Natural
163	Napura 30	21°55.310′-91°59.921′	59	Natural
164	Napura 31	21°55.353′-91°00.068′	58	Natural
165	Napura 32	21°55.489′-91°00.058′	53	Enrichment plantation
166	Napura 33	21°55.434′-91°00.171′	61	Natural
167	Napura 34	21°55.489′-91°00.231′	70	Natural
168	Napura 35	21°55.543′-91°00.357′	64	Shegun coppice and natural
169	Napura 36	21°55.539′-91°00.454′	75	Shegun coppice
170	Napura 37	21°55.632′-91°00.071′	43	Natural
171	Napura 38	21°55.762′-91°00.257′	15	Enrichment plantation
172	Napura 39	21°56.177′-91°59.279′	25	Akashmoni plantation
173	Napura 40	21°56.182′-91°59.451′	20	Akashmoni plantation
174	Napura 41	21°56.345′-91°59.726′	21	Gamar plantation
175	Napura 42	21°56.665′-91°00.137′	33	Shegun coppice
176	Napura 43	21°56.760′-91°00.271′	68	Natural
177	Napura 44	21°56.718′-91°00.403′	50	Natural
178	Napura 45	21°56.486′-91°00.233′	20	Natural

Appendix 1 continued...

Plot No.	Beat & Plot	Co-ordinate	Elevation (m)	Forest Type
179	Napura 46	21°56.663′- 91°00.372′	53	Natural
180	Napura 47	21°56.396′- 91°00.056′	19	Natural
181	Napura 48	21°56.223′- 91°00.109′	43	Eucalyptus plantation
182	Napura 49	21°56.094′- 91°00.030′	74	Natural
183	Napura 50	21°56.014′- 91°59.973′	58	Natural
184	Napura 51	21°55.948′- 91°59.736′	27	Natural
185	Napura 52	21°55.981′- 91°59.554′	23	Akashmoni plantation
186	Napura 53	21°55.903′- 91°59.328′	22	Mixed plantation
187	Napura 54	21°55.790′- 91°58.935′	42	Mixed plantation
188	Chambol 1	21°57.457′- 91°58.427′	20	Natural
189	Chambol 2	21°57.239′- 91°59.178′	18	Mixed plantation
190	Chambol 3	21°57.168′- 91°59.462′	28	Mixed plantation & natural
191	Chambol 4	21°57.112′- 91°59.610′	28	Mixed plantation
192	Chambol 5	21°57.055′- 91°59.882′	71	Enrichment plantation
193	Chambol 6	21°57.090′- 91°59.981′	71	Shegun coppice and natural
194	Chambol 7	21°56.997′- 91°00.107′	69	Natural
195	Chambol 8	21°56.920′- 91°00.234′	43	Natural
196	Chambol 9	21°56.887′- 91°00.420′	43	Natural
197	Chambol 10	21°56.917′- 91°00.504′	28	Enrichment plantation
198	Chambol 11	21°56.957′- 91°00.820′	44	Natural
199	Chambol 12	21°56.988′- 91°00.877′	43	Natural
200	Chambol 13	21°56.797′- 91°00.173′	38	Natural
201	Chambol 14	21°56.506′- 91°59.699′	26	Natural
202	Chambol 15	21°56.395′- 91°59.441′	29	Akashmoni plantation
203	Chambol 16	21°56.370′- 91°59.237′	33	Enrichment plantation
204	Chambol 17	21°56.489′- 91°59.093′	32	Akahsmoni plantation
205	Chambol 18	21°56.564′- 91°59.995′	56	Mixed plantation
206	Chambol 19	21°56.718′- 91°59.061′	59	Mixed plantation
207	Chambol 20	21°56.960′- 91°58.883′	20	Mixed plantation
208	Chambol 21	21°56.987′- 91°58.583′	21	Natural
209	Chambol 22	21°57.494′- 91°58.548′	27	Enrichment plantation
210	Chambol 23	21°57.574′- 91°58.961′	21	Mixed plantation
211	Chambol 24	21°57.727′- 91°58.996′	34	Natural
212	Chambol 25	21°57.802′- 91°59.944′	38	Natural
213	Chambol 26	21°57.930′- 91°00.096′	37	Natural
214	Chambol 27	21°58.074′- 91°00.267′	71	Natural
215	Chambol 28	21°58.092′- 91°00.325′	61	Natural
216	Chambol 29	21°58.332′- 91°00.381′	43	Natural
217	Chambol 30	21°58.315′- 91°00.100′	32	Natural
218	Chambol 31	21°58.229′- 91°00.099′	38	Natural
219	Chambol 32	21°58.127′- 91°59.962′	35	Natural
220	Chambol 33	21°58.077′- 91°59.864′	39	Natural
221	Chambol 34	21°58.084′- 91°59.196′	58	Shegun coppice
222	Chambol 35	21°58.072′- 91°59.071′	53	Akashmoni plantation
223	Chambol 36	21°58.089′- 91°58.955′	57	Enrichment plantation

Appendix 1 continued...

Plot No.	Beat & Plot	Co-ordinate	Elevation (m)	Forest Type
224	Chambol 37	21°57.999´- 91°58.875´	61	Enrichment plantation
225	Chambol 38	21°57.907´- 91°58.746´	40	Akashmoni plantation
226	Chambol 39	21°57.763´- 91°58.688´	51	Enrichment plantation
227	Chambol 40	21°57.634´- 91°58.656´	28	Mixed plantation
228	Jaldi 1	21°59.252´- 91°58.854´	16	Enrichment plantation
229	Jaldi 2	21°59.154´- 91°59.043´	42	Natural
230	Jaldi 3	21°59.167´- 91°59.179´	43	Natural
231	Jaldi 4	21°59.185´- 91°59.224´	56	Natural
232	Jaldi 5	21°59.221´- 91°59.392´	66	Natural
233	Jaldi 6	21°59.125´- 91°59.515´	76	Enrichment plantation
234	Jaldi 7	21°59.194´- 91°59.611´	67	Natural
235	Jaldi 8	21°59.228´- 91°59.786´	26	Enrichment plantation
236	Jaldi 9	21°59.225´- 91°59.987´	42	Natural
237	Jaldi 10	21°59.191´- 92°00.145´	55	Natural
238	Jaldi 11	21°59.258´- 92°00.229´	79	Natural
239	Jaldi 12	21°59.279´- 92°00.234´	87	Enrichment plantation
240	Jaldi 13	21°59.424´- 92°00.198´	40	Enrichment plantation
241	Jaldi 14	21°59.492´- 92°00.020´	36	Enrichment plantation
242	Jaldi 15	21°59.582´- 91°59.843´	29	Natural
243	Jaldi 16	21°59.637´- 91°59.695´	28	Natural
244	Jaldi 17	21°59.627´- 91°59.493´	70	Natural
245	Jaldi 18	21°59.669´- 91°59.401´	71	Enrichment plantation
246	Jaldi 19	21°59.576´- 91°59.319´	63	Natural
247	Jaldi 20	21°59.444´- 91°59.094´	42	Mixed plantation
248	Jaldi 21	21°59.583´- 91°58.986´	42	Mixed plantation
249	Jaldi 22	21°59.674´- 91°59.240´	34	Mixed plantation
250	Jaldi 23	21°59.699´- 91°59.372´	34	Natural
251	Jaldi 24	21°59.499´- 91°59.839´	35	Shegun coppice and natural
252	Jaldi 25	21°59.947´- 91°59.729´	30	Shegun coppice and natural
253	Jaldi 26	22°00.115´- 91°59.671´	43	Natural
254	Jaldi 27	22°00.293´- 91°59.640´	58	Shegun coppice
255	Jaldi 28	22°00.357´- 91°59.572´	34	Natural
256	Jaldi 29	22°00.491´- 91°59.365´	15	Shegun coppice
257	Jaldi 30	22°00.591´- 91°59.263´	24	Shegun coppice
258	Jaldi 31	22°00.589´- 91°59.063´	17	Mixed plantation
259	Jaldi 32	22°00.785´- 91°59.060´	28	Natural
260	Jaldi 33	22°00.629´- 91°58.898´	27	Mixed plantation
261	Jaldi 34	22°00.690´- 91°58.883´	16	Mixed plantation
262	Jaldi 35	22°00.504´- 91°58.770´	20	Raintree
263	Jaldi 36	22°00.436´- 91°58.639´	23	Mixed plantation
264	jaldi 37	22°00.324´- 91°58.535´	32	Mixed plantation
265	Jaldi 38	22°00.238´- 91°58.238´	37	Mixed plantation
266	Jaldi 39	22°00.161´- 91°58.189´	25	Garjan plantation
267	Jaldi 40	22°59.515´- 91°58.058´	20	Enrichment plantation
268	Jaldi 41	22°59.245´- 91°58.303´	20	Akashmoni plantation
269	Jaldi 42	22°59.252´- 91°58.457´	32	Almost barren/bush

Appendix 2. Importance Value Index (IVI) of the tree species recorded from the sample plots of Chunati WS

Scientific Name	BA ha^{-1} (m^2)	Stem ha^{-1}	RD (%)	RF (%)	RA (%)	RDo (%)	IVI
Acacia auriculiformis	1.0911	102.8	18.53	4.72	3.59	10.48	33.73
Acacia hybrid	0.0296	4.09	0.74	0.79	0.86	0.285	1.81
Acacia mangium	0.2715	24.26	4.37	2.41	1.66	2.607	9.39
Acronychia pedunculata	0.0014	0.19	0.03	0.1	0.31	0.013	0.15
Actinodaphne angustifolia	0.0114	1.12	0.2	0.49	0.37	0.11	0.8
Aegle marmelos	0.0020	0.09	0.02	0.05	0.31	0.019	0.08
Albizia chinensis	0.1032	3.44	0.62	0.98	0.58	0.991	2.59
Albizia odoratissima	0.0112	0.37	0.07	0.15	0.42	0.108	0.32
Albizia procera	0.0995	2.79	0.5	0.84	0.55	0.955	2.29
Alstonia scholaris	0.0484	2.79	0.5	0.79	0.58	0.465	1.75
Anacardium occidentale	0.0039	0.84	0.15	0.25	0.56	0.037	0.43
Anogeissus acuminata	0.1072	10.6	1.91	2.66	0.66	1.03	5.6
Antidesma acidum	0.0047	0.84	0.15	0.25	0.56	0.045	0.44
Antidesma bunius	0.0062	1.3	0.23	0.44	0.48	0.06	0.74
Antidesma ghaesembilla	0.0006	0.19	0.03	0.1	0.31	0.005	0.14
Antidesma velutinum	0.0011	0.46	0.08	0.2	0.39	0.011	0.29
Aphanamixis polystachya	0.0151	0.84	0.15	0.25	0.56	0.146	0.54
Aporosa dioica	0.0178	3.81	0.69	1.33	0.47	0.17	2.19
Aporosa wallichii	0.0868	7.06	1.27	1.57	0.74	0.834	3.68
Aquilaria agallocha	0.0030	0.37	0.07	0.15	0.42	0.028	0.24
Ardisia colorata	0.0002	0.09	0.02	0.05	0.31	0.002	0.07
Ardisia paniculata	0.0032	0.65	0.12	0.2	0.55	0.03	0.34
Artocarpus chama	0.2042	3.9	0.7	1.18	0.55	1.961	3.84
Artocarpus heterophyllus	0.1780	4.28	0.77	0.89	0.8	1.709	3.37
Artocarpus lacucha	0.0704	2.42	0.44	1.13	0.35	0.676	2.24
Averrhoa carambola	0.0159	0.19	0.03	0.05	0.62	0.153	0.24
Azadirachta indica	0.0060	0.65	0.12	0.15	0.73	0.058	0.32
Baccaurea ramiflora	0.0003	0.09	0.02	0.05	0.31	0.002	0.07
Bauhinia purpurea	0.0025	0.09	0.02	0.05	0.31	0.024	0.09
Bhesa robusta	0.0006	0.09	0.02	0.05	0.31	0.005	0.07
Bischofia javanica	0.0029	0.37	0.07	0.2	0.31	0.028	0.29
Boehmeria glomerulifera	0.0029	0.28	0.05	0.15	0.31	0.028	0.23
Bombax ceiba	0.0046	0.09	0.02	0.05	0.31	0.044	0.11
Bombax insigne	0.0204	1.02	0.18	0.49	0.34	0.196	0.87
Brownlowia elata	0.0030	0.28	0.03	0.09	0.07	0.029	0.15
Caesalpinia pulcherrima	0.0005	0.19	0.03	0.05	0.62	0.004	0.09
Callicarpa arborea	0.0884	7.43	1.34	2.46	0.5	0.849	4.65

Appendix 2 continued...

Scientific Name	BA ha^{-1} (m^2)	Stem ha^{-1}	RD (%)	RF (%)	RA (%)	RDo (%)	IVI
Carallia brachiata	0.0032	0.46	0.08	0.25	0.31	0.03	0.36
Cassia fistula	0.0036	0.46	0.08	0.2	0.39	0.035	0.32
Cassia nodosa	0.0043	0.37	0.07	0.15	0.42	0.041	0.26
Castanopsis tribuloides	0.0042	0.56	0.1	0.25	0.37	0.04	0.39
Casuarina equisetifolia	0.0069	0.46	0.08	0.05	1.56	0.066	0.2
Chaetocarpus castanocarpus	0.0248	4.65	0.84	0.74	1.04	0.238	1.81
Chukrasia tabularis	0.0215	2.79	0.5	0.54	0.85	0.206	1.25
Cinnamomum glaucescens	0.0088	0.84	0.15	0.2	0.7	0.085	0.43
Cinnamomum iners	0.0118	1.67	0.3	0.74	0.37	0.113	1.15
Citrus maxima	0.0003	0.09	0.02	0.05	0.31	0.002	0.07
Citrus reticulata	0.0002	0.09	0.02	0.05	0.31	0.002	0.07
Clausena heptaphylla	0.0098	1.12	0.2	0.3	0.62	0.094	0.59
Cordia dichotoma	0.0010	0.28	0.05	0.05	0.94	0.009	0.11
Cordia fragrantissima	0.0014	0.28	0.05	0.15	0.31	0.013	0.21
Cordia serrata	0.0010	0.37	0.07	0.05	1.25	0.01	0.13
Crataeva magna	0.0002	0.09	0.02	0.05	0.31	0.002	0.07
Crypteronia paniculata	0.0039	0.09	0.02	0.05	0.31	0.037	0.1
Cryptocarya amygdalina	0.0424	2.51	0.45	0.93	0.44	0.407	1.79
Dalbergia sissoo	0.0037	0.09	0.02	0.05	0.31	0.036	0.1
Derris robusta	0.0374	1.67	0.3	0.49	0.56	0.359	1.15
Didymosperma gracilis	0.0020	0.09	0.02	0.05	0.31	0.018	0.08
Dillenia scabrella	0.0388	4.09	0.74	1.08	0.62	0.373	2.19
Dipterocarpus alatus	1.4888	22.6	4.07	2.31	1.61	14.3	20.68
Dipterocarpus costatus	0.4315	1.77	0.32	0.39	0.74	4.144	4.86
Dipterocarpus turbinatus	1.0586	21.4	3.85	3	1.18	10.16	17.02
Drimycarpus racemosus	0.0010	0.19	0.03	0.1	0.31	0.01	0.14
Elaeocarpus floribundus	0.0191	1.58	0.28	0.44	0.59	0.183	0.91
Elaeocarpus tectorius	0.0301	2.51	0.45	0.69	0.6	0.289	1.43
Engelhardtia spicata	0.0064	0.65	0.12	0.3	0.36	0.062	0.47
Erythrina fusca	0.0283	0.65	0.12	0.2	0.55	0.272	0.59
Eucalyptus camaldulensis	0.2100	13.1	2.36	1.13	1.91	2.017	5.51
Eurya acuminata	0.0038	0.74	0.13	0.2	0.62	0.036	0.37
Ficus auriculata	0.0247	1.58	0.28	0.44	0.59	0.237	0.96
Ficus benghalensis	0.3845	0.56	0.1	0.3	0.31	3.692	4.09
Ficus benjamiana	0.0014	0.09	0.02	0.05	0.31	0.013	0.08
Ficus conglobata	0.0017	0.09	0.02	0.05	0.31	0.016	0.08
Ficus geniculata	0.0005	0.09	0.02	0.05	0.31	0.005	0.07
Ficus hispida	0.3305	26.95	4.86	4.97	0.9	3.173	13

Appendix 2 continued...

Scientific Name	BA ha^{-1} (m^2)	Stem ha^{-1}	RD (%)	RF (%)	RA (%)	RDo (%)	IVI
Ficus lamponga	0.1131	0.37	0.07	0.2	0.31	1.086	1.35
Ficus lanceolata	0.0030	0.28	0.05	0.15	0.31	0.029	0.23
Ficus racemosa	0.0076	0.28	0.05	0.15	0.31	0.073	0.27
Ficus semicordata	0.0118	0.93	0.17	0.39	0.39	0.113	0.67
Ficus tinctoria	0.0013	0.09	0.02	0.05	0.31	0.012	0.08
Ficus variegata	0.0011	0.37	0.07	0.15	0.42	0.011	0.23
Ficus virens	0.1340	0.09	0.02	0.05	0.31	1.287	1.35
Flacourtia jangomas	0.0120	1.21	0.22	0.2	1.01	0.115	0.53
Garcinia cowa	0.0886	9.29	1.68	1.43	1.08	0.85	3.95
Garcinia morella	0.0038	0.37	0.07	0.15	0.42	0.037	0.25
Garcinia speciosa	0.0021	0.56	0.1	0.3	0.31	0.021	0.42
Gardenia coronaria	0.0184	1.39	0.25	0.59	0.39	0.177	1.02
Glochidion lanceolarium	0.0008	0.09	0.02	0.05	0.31	0.008	0.07
Glochidion multiloculare	0.0027	0.65	0.12	0.34	0.31	0.026	0.49
Gluta elegans	0.0002	0.09	0.02	0.05	0.31	0.002	0.07
Gmelina arborea	0.2369	12.1	2.18	1.43	1.4	2.275	5.88
Grewia nervosa	0.0588	8.46	1.52	2.41	0.58	0.565	4.5
Grewia sapida	0.0072	0.74	0.13	0.2	0.62	0.07	0.4
Holarrhena antidysenterica	0.0600	5.67	1.02	1.48	0.63	0.576	3.07
Hopea odorata	0.0757	3.07	0.55	0.64	0.79	0.727	1.92
Lagerstroemia speciosa	0.0151	1.3	0.23	0.34	0.62	0.145	0.72
Lannea coromandelica	0.0716	4	0.72	1.57	0.42	0.687	2.98
Lepisanthes rubiginosa	0.0073	0.56	0.1	0.3	0.31	0.071	0.47
Lepisanthes tetraphylla	0.0003	0.09	0.02	0.05	0.31	0.003	0.07
Litchi chinensis	0.0342	1.02	0.18	0.34	0.49	0.329	0.86
Lithocarpus acuminata	0.0010	0.28	0.05	0.05	0.94	0.01	0.11
Lithocarpus elegans	0.0177	0.46	0.08	0.25	0.31	0.169	0.5
Lithocarpus polystachya	0.0664	11.8	2.13	2.02	0.97	0.637	4.78
Litsea glutinosa	0.0111	2.14	0.39	0.89	0.4	0.106	1.38
Macaranga denticulata	0.0464	3.72	0.67	1.13	0.54	0.446	2.25
Macaranga indica	0.0020	0.28	0.05	0.15	0.31	0.019	0.22
Maesa indica	0.0006	0.09	0.02	0.05	0.31	0.005	0.07
Maesa ramentacea	0.0071	2.04	0.37	0.84	0.4	0.068	1.27
Mallotus philippensis	0.0046	0.56	0.1	0.25	0.37	0.045	0.39
Mallotus roxburghianus	0.0018	0.37	0.07	0.2	0.31	0.017	0.28
Mangifera indica	0.1171	2.97	0.54	1.23	0.4	1.124	2.89
Mangifera sylvatica	0.0002	0.09	0.02	0.05	0.31	0.002	0.07
Mitragyna parvifolia	0.0271	4.46	0.8	1.38	0.53	0.261	2.44

Appendix 2 continued...

Scientific Name	BA ha^{-1} (m^2)	Stem ha^{-1}	RD (%)	RF (%)	RA (%)	RDo (%)	IVI
Myristica linifolia	0.0043	0.65	0.12	0.25	0.44	0.041	0.4
Neolamarckia cadamba	0.0181	1.3	0.23	0.59	0.36	0.174	1
Ochna squarrosa	0.0002	0.09	0.02	0.05	0.31	0.002	0.07
Oreocnide integrifolia	0.0002	0.09	0.02	0.05	0.31	0.002	0.07
Oroxylum indicum	0.0089	1.3	0.23	0.54	0.4	0.085	0.86
Persea bombycina	0.0012	0.28	0.05	0.15	0.31	0.011	0.21
Phoebe lanceolata	0.0014	0.28	0.05	0.05	0.94	0.013	0.11
Phoebe pallida	0.0019	0.19	0.03	0.1	0.31	0.017	0.15
Phoenix sylvestris	0.0267	0.19	0.03	0.05	0.62	0.256	0.34
Phyllanthus emblica	0.0145	2.42	0.44	0.98	0.41	0.139	1.56
Picrasma javanica	0.0007	0.19	0.03	0.1	0.31	0.007	0.14
Pinus oocarpa	0.0252	0.19	0.03	0.05	0.62	0.242	0.32
Pithecellobium angulatum	0.0047	0.28	0.05	0.1	0.47	0.046	0.19
Prismatomeris tetrandra	0.0004	0.09	0.02	0.05	0.31	0.004	0.07
Protium serratum	0.0125	2.14	0.39	0.79	0.45	0.119	1.29
Psidium guajaba	0.0273	4.18	0.75	0.93	0.74	0.262	1.95
Pterygota alata	0.0242	0.09	0.02	0.05	0.31	0.232	0.3
Pterospermum acerifolium	0.0069	0.46	0.10	0.30	0.24	0.066	0.47
Pterospermum semisagittatum	0.0091	0.84	0.15	0.44	0.31	0.087	0.68
Quercus gomeziana	0.0043	0.84	0.15	0.39	0.35	0.041	0.59
Samanea saman	0.2309	2.32	0.42	0.44	0.87	2.217	3.08
Sapium baccatum	0.0032	0.37	0.07	0.1	0.62	0.031	0.2
Senna siamea	0.0582	3.62	0.65	0.54	1.11	0.559	1.75
Shorea robusta	0.4234	29.8	5.38	1.13	4.35	4.066	10.58
Sterculia villosa	0.0270	1.58	0.28	0.74	0.35	0.26	1.28
Stereospermum colais	0.1600	7.9	1.42	2.21	0.59	1.536	5.17
Stereospermum suaveolens	0.0089	1.3	0.23	0.64	0.34	0.086	0.96
Streblus asper	0.0230	1.49	0.27	0.54	0.45	0.221	1.03
Suregada multiflora	0.0101	2.14	0.39	0.89	0.4	0.097	1.37
Swietenia mahagoni	0.0329	2.42	0.44	0.44	0.9	0.316	1.19
Swintonia floribunda	0.0003	0.09	0.02	0.05	0.31	0.003	0.07
Symplocos racemosa	0.0009	0.09	0.02	0.05	0.31	0.009	0.08
Syzygium claviflorum	0.0181	3.81	0.69	1.23	0.51	0.174	2.09
Syzygium cumini	0.0072	1.3	0.23	0.34	0.62	0.069	0.65
Syzygium firmum	0.0712	7.53	1.36	2.07	0.6	0.683	4.11
Syzygium fruticosum	0.1678	13	2.35	2.56	0.84	1.612	6.52
Syzygium ramosissimum	0.0062	1.3	0.23	0.39	0.55	0.06	0.69
Syzygium syzygioides	0.0003	0.09	0.02	0.05	0.31	0.003	0.07

Appendix 2 continued...

Scientific Name	BA ha^{-1} (m^2)	Stem ha^{-1}	RD (%)	RF (%)	RA (%)	RDo (%)	IVI
Syzygium wallichii	0.0009	0.09	0.02	0.05	0.31	0.009	0.08
Tamarindus indica	0.0358	0.09	0.02	0.05	0.31	0.343	0.41
Tectona grandis	0.5015	41.7	7.52	2.9	2.37	4.816	15.24
Terminalia arjuna	0.0146	2.6	0.47	0.79	0.55	0.14	1.4
Terminalia bellirica	0.1531	7.53	1.36	2.36	0.53	1.469	5.19
Terminalia chebula	0.0082	0.84	0.15	0.34	0.4	0.078	0.57
Tetrameles nudiflora	0.0035	0.09	0.02	0.05	0.31	0.034	0.1
Toona ciliata	0.0293	2.51	0.45	1.18	0.35	0.282	1.91
Trema orientalis	0.0531	5.11	0.92	1.38	0.61	0.51	2.81
Trewia nudiflora	0.0337	0.28	0.05	0.15	0.31	0.324	0.52
Vitex glabrata	0.0168	1.02	0.18	0.44	0.38	0.161	0.79
Vitex peduncularis	0.0282	3.25	0.59	0.84	0.64	0.27	1.69
Vitex pinnata	0.0020	0.28	0.05	0.15	0.31	0.018	0.22
Xanthophyllum andamanicum	0.0032	0.28	0.05	0.15	0.31	0.031	0.23
Xanthophyllum flavescens	0.0006	0.09	0.02	0.05	0.31	0.005	0.07
Xylia xylocarpa	0.0179	1.3	0.23	0.05	4.36	0.172	0.46
Zanthoxylum rhetsa	0.0029	0.19	0.03	0.1	0.31	0.028	0.16
Ziziphus mauritiana	0.0247	0.74	0.13	0.3	0.42	0.238	0.67
Total	10.4145	554.65	100	100	100	100	300

Appendix 3. Height class distribution of the tree species recorded from the sample plots of Chunati WS

Scientific Name	Percentage distribution of the tree species in different height (m) classes						Total
	3-< 8	8-< 13	13-< 18	18-< 23	23-< 28	28-< 33	
Acacia auriculiformis	9.52	7.42	1.56	0.03	0	0	18.53
Acacia hybrid	0.49	0.25					0.74
Acacia mangium	1.96	2.04	0.34	0.03			4.37
Acronychia pedunculata	0.03						0.03
Actinodaphne angustifolia	0.15	0.05					0.2
Aegle marmelos	0.02						0.02
Albizia chinensis	0.5	0.08	0.03				0.61
Albizia odoratissima	0.03	0.03					0.06
Albizia procera	0.3	0.12	0.05	0.03			0.5
Alstonia scholaris	0.34	0.15	0.02				0.51
Anacardium occidentale	0.15						0.15
Anogeissus acuminata	1.71	0.18	0.02				1.91
Antidesma acidum	0.15						0.15

Appendix 3 continued...

Scientific Name	Percentage distribution of the tree species in different height (m) classes						Total
	3 -< 8	8 -< 13	13 -< 18	18 -< 23	23 -< 28	28 -< 33	
Antidesma bunius	0.23						0.23
Antidesma ghaesembilla	0.03						0.03
Antidesma velutinum	0.08						0.08
Aphanamixis polystachya	0.1	0.05					0.15
Aporosa dioica	0.69						0.69
Aporosa wallichii	1.21	0.07					1.28
Aquilaria agallocha	0.07						0.07
Ardisia colorata	0.02						0.02
Ardisia paniculata	0.12						0.12
Artocarpus chama	0.37	0.25	0.05	0.02	0.02		0.71
Artocarpus heterophyllus	0.49	0.27	0.02				0.78
Artocarpus lacucha	0.27	0.12	0.05				0.44
Averrhoa carambola	0	0.03					0.03
Azadirachta indica	0.12						0.12
Baccaurea ramiflora	0.02						0.02
Bauhinia purpurea	0.02						0.02
Bhesa robusta	0.02						0.02
Bischofia javanica	0.07						0.07
Boehmeria glomerulifera	0.02	0.03					0.05
Bombax ceiba	0	0.02					0.02
Bombax insigne	0.15	0.02	0.02				0.19
Brownlowia elata	0.03	0.02					0.05
Caesalpinia pulcherrima	0.03						0.03
Callicarpa arborea	1.22	0.12					1.34
Carallia brachiata	0.08						0.08
Cassia fistula	0.08						0.08
Cassia nodosa	0.05	0.02					0.07
Castanopsis tribuloides	0.08	0.02					0.1
Casuarina equisetifolia	0.02	0.05	0.02				0.09
Chaetocarpus castanocarpus	0.75	0.08					0.83
Chukrasia tabularis	0.37	0.13					0.5
Cinnamomum glaucescens	0.13	0.02					0.15
Cinnamomum iners	0.27	0.03					0.3
Citrus maxima	0.02						0.02
Citrus reticulata	0.02						0.02
Clausena heptaphylla	0.2						0.2
Cordia dichotoma	0.05						0.05
Cordia fragrantissima	0.03	0.02					0.05
Cordia serrata	0.07						0.07

Appendix 3 continued...

Scientific Name	Percentage distribution of the tree species in different height (m) classes						Total
	3-< 8	8-< 13	13-< 18	18-< 23	23-< 28	28-< 33	
Crataeva magna	0.02						0.02
Crypteronia paniculata	0	0.02					0.02
Cryptocarya amygdalina	0.34	0.08	0.03				0.45
Dalbergia sissoo	0		0.02				0.02
Derris robusta	0.22	0.07	0.02				0.31
Didymosperma gracilis	0	0.02					0.02
Dillenia scabrella	0.64	0.1					0.74
Dipterocarpus alatus	3.3	0.39	0.07	0.2	0.12		4.08
Dipterocarpus costatus	0.17	0.05	0.02	0.05	0.02	0.02	0.33
Dipterocarpus turbinatus	2.73	0.6	0.25	0.12	0.08	0.07	3.85
Drimycarpus racemosus	0.03						0.03
Elaeocarpus floribundus	0.23	0.03	0.02				0.28
Elaeocarpus tectorius	0.34	0.12					0.46
Engelhardtia spicata	0.08	0.03					0.11
Erythrina fusca	0.08	0.03					0.11
Eucalyptus camaldulensis	0.77	1.01	0.47	0.12			2.37
Eurya acuminata	0.13						0.13
Ficus auriculata	0.23	0.05					0.28
Ficus bengholensis	0.03	0.02	0.05				0.1
Ficus benjamiana	0	0.02					0.02
Ficus conglobata	0.02						0.02
Ficus geniculata	0.02						0.02
Ficus hispida	4.67	0.17			0.02		4.86
Ficus lamponga	0.02	0.02	0.03				0.07
Ficus lanceolata	0.05						0.05
Ficus racemosa	0.02	0.03					0.05
Ficus semicordata	0.17						0.17
Ficus tinctoria	0.02						0.02
Ficus variegata	0.07						0.07
Ficus virens	0	0.02					0.02
Flacourtia jangomas	0.22						0.22
Garcinia cowa	1.41	0.25			0.02		1.68
Garcinia morella	0.02	0.05					0.07
Garcinia speciosa	0.1						0.1
Gardenia coronaria	0.17	0.08					0.25
Glochidion lanceolarium	0.02						0.02
Glochidion multiloculare	0.12						0.12
Gluta elegans	0.02						0.02
Gmelina arborea	1.16	0.87	0.15				2.18

Appendix 3 continued...

Scientific Name	Percentage distribution of the tree species in different height (m) classes						Total
	3-< 8	8-< 13	13-< 18	18-< 23	23-< 28	28-< 33	
Grewia nervosa	1.39	0.13					1.52
Grewia sapida	0.13						0.13
Holarrhena antidysenterica	0.99	0.03					1.02
Hopea odorata	0.44	0.1		0.02			0.56
Lagerstroemia speciosa	0.1	0.13					0.23
Lannea coromandelica	0.65	0.07					0.72
Lepisanthes rubiginosa	0.08		0.02				0.1
Lepisanthes tetraphylla	0.02						0.02
Litchi chinensis	0.15	0.03					0.18
Lithocarpus acuminata	0.05						0.05
Lithocarpus elegans	0.07		0.02				0.09
Lithocarpus polystachya	2.03	0.1					2.13
Litsea glutinosa	0.37	0.02					0.39
Macaranga denticulata	0.62	0.05					0.67
Macaranga indica	0.05						0.05
Maesa indica	0.02		0.02				0.04
Maesa ramentacea	0.37						0.37
Mallotus philippensis	0.1						0.1
Mallotus roxburghianus	0.07						0.07
Mangifera indica	0.4	0.12					0.52
Mangifera sylvatica	0.02						0.02
Mitragyna parvifolia	0.77	0.03					0.8
Myristica linifolia	0.1	0.02					0.12
Neolamarckia cadamba	0.2	0.02	0.02				0.24
Ochna squarrosa	0.02						0.02
Oreocnide integrifolia	0.02						0.02
Oroxylum indicum	0.2	0.03					0.23
Persea bombycina	0.05						0.05
Phoebe lanceolata	0.05						0.05
Phoebe pallida	0.03						0.03
Phoenix sylvestris	0	0.03					0.03
Phyllanthus emblica	0.39	0.05					0.44
Picrasma javanica	0.03						0.03
Pinus oocarpa	0		0.03				0.03
Pithecellobium angulatum	0.02	0.03					0.05
Prismatomeris tetrandra	0.02						0.02
Protium serratum	0.35	0.03					0.38
Psidium guajaba	0.74	0.02					0.76
Pterygota alata	0	0.02					0.02

Appendix 3 continued...

Scientific Name	Percentage distribution of the tree species in different height (m) classes						Total
	3-< 8	8-< 13	13-< 18	18-< 23	23-< 28	28-< 33	
Pterospermum acerifolium	0.07	0.02					0.09
Pterospermum semisagittatum	0.12	0.02	0.02				0.16
Quercus gomeziana	0.15						0.15
Samanea saman	0.08	0.3	0.03				0.41
Sapium baccatum	0.07						0.07
Senna siamea	0.37	0.25	0.03			0.02	0.65
Shorea robusta	3.12	1.73	0.27	0.12	0.13		5.39
Sterculia villosa	0.2	0.07	0.02				0.29
Stereospermum colais	0.97	0.27	0.15	0.03			1.42
Stereospermum suaveolens	0.23						0.23
Streblus asper	0.27						0.27
Suregada multiflora	0.39						0.39
Swietenia mahagoni	0.34	0.1					0.44
Swintonia floribunda	0.02						0.02
Symplocos racemosa	0.02						0.02
Syzygium claviflorum	0.69						0.69
Syzygium cumini	0.23						0.23
Syzygium firmum	1.12	0.24					1.36
Syzygium fruticosum	1.99	0.17	0.18				2.34
Syzygium ramosissimum	0.23						0.23
Syzygium syzygioides	0.02						0.02
Syzygium wallichii	0.02						0.02
Tamarindus indica	0		0.02				0.02
Tectona grandis	5.5	1.81	0.2	0.02			7.53
Terminalia arjuna	0.47						0.47
Terminalia bellirica	1.14	0.22					1.36
Terminalia chebula	0.15						0.15
Tetrameles nudiflora	0	0.02					0.02
Toona ciliata	0.32	0.07	0.02				0.41
Trema orientalis	0.8	0.08					0.88
Trewia nudiflora	0.02	0.02		0.02			0.06
Vitex glabrata	0.13	0.05					0.18
Vitex peduncularis	0.52	0.07					0.59
Vitex pinnata	0.03	0.02					0.05
Xanthophyllum andamanicum	0.03	0.02					0.05
Xanthophyllum flavescens	0.02						0.02
Xylia xylocarpa	0.07	0.17					0.24
Zanthoxylum rhetsa	0.03						0.03
Zizyphus mauritiana	0.12	0.02					0.14
Total	**71.77**	**22.6**	**4.32**	**0.8**	**0.4**	**0.1**	**100**

Appendix 4. Diameter class distribution of the tree species recorded from the sample plots of Chunati WS

Scientific name	% distribution of the tree species in different dbh classes (cm)										Total
	5 - <14.9	15 - <24.9	25 - <34.9	35 - <44.9	45 - <54.9	55 - <64.9	65 - <74.9	75 - <84.9	85 - <94.9	≥95	
Acacia auriculiformis	16.44	1.91	0.17	0.02							18.53
Acacia hybrida	0.70	0.03									0.74
Acacia mangium	3.87	0.47	0.03								4.37
Acronychia pedunculata	0.03										0.03
Actinodaphne angustifolia	0.17	0.03									0.20
Aegle marmelos		0.02									0.02
Albizia chinensis	0.35	0.18	0.03	0.02	0.03						0.62
Albizia odoratissima	0.02	0.05									0.07
Albizia procera	0.30	0.13	0.02	0.02		0.03					0.50
Alstonia scholaris	0.30	0.18	0.02								0.50
Anacardium occidentale	0.15										0.15
Anogeissus acuminata	1.66	0.23	0.02								1.91
Antidesma acidum	0.15										0.15
Antidesma bunius	0.23										0.23
Antidesma ghaesembilla	0.03										0.03
Antidesma velutinum	0.08										0.08
Aphanamixis polystachya	0.10	0.03	0.02								0.15
Aporosa dioica	0.15	0.02									0.17
Aporosa wallichii	1.22	0.05									1.27
Aquilaria agallocha	0.07										0.07
Ardisia colorata	0.02										0.02
Ardisia paniculata	0.12										0.12
Artocarpus chama	0.42	0.20	0.02		0.02	0.03				0.02	0.70
Artocarpus heterophyllus	0.40	0.18	0.10		0.05	0.03					0.77
Artocarpus lacucha	0.25	0.10	0.03	0.05							0.44
Averrhoa carambola			0.02	0.02							0.03
Azadirachta indica	0.12										0.12
Baccaurea ramiflora	0.02										0.02
Bauhinia purpurea		0.02									0.02
Bhesa robusta	0.02										0.02
Bischofia javanica	0.05	0.02									0.07
Boehmeria glomerulifera	0.05										0.05
Bombax ceiba			0.02								0.02
Bombax insigne	0.13	0.03	0.02								0.18
Brownlowia elata	0.03	0.02									0.05
Caesalpinia pulcherima	0.03										0.03
Callicarpa arborea	1.06	0.27	0.02								1.34
Carallia brachiata	0.08										0.08
Cassia fistula	0.07	0.02									0.08
Cassia nodosa	0.05	0.02									0.07
Castanopsis tribuloides	0.08	0.02									0.10
Casuarina equisetifolia	0.05	0.03									0.08

Appendix 4 continued...

Scientific name	% distribution of the tree species in different dbh classes (cm)										Total
	5 - <14.9	15 - <24.9	25 - <34.9	35 - <44.9	45 - <54.9	55 - <64.9	65 - <74.9	75 - <84.9	85 - <94.9	≥95	
Chaetocarpus costanocarpus	0.82	0.02									0.84
Chukrasia tabularis	0.50										0.50
Cinnamomum glaucescens	0.13	0.02									0.15
Cinnamomum iners	0.28	0.02									0.30
Citrus maxima	0.02										0.02
Citrus reticulata	0.02										0.02
Clausena heptaphylla	0.18	0.02									0.20
Cordia dichotoma	0.05										0.05
Cordia fragrantissima	0.05										0.05
Cordia serrata	0.07										0.07
Crataeva magna	0.02										0.02
Crypteronia paniculata		0.02									0.02
Cryptocarya amygdalina	0.32	0.08	0.05								0.45
Dalbergia sissoo		0.02									0.02
Derris robusta	0.17	0.12		0.02							0.30
Didymosperma gracilis		0.02									0.02
Dillenia scabrella	0.65	0.07	0.02								0.74
Dipterocarpus alatus	3.47	0.20			0.08	0.02	0.05	0.03	0.05	0.17	4.07
Dipterocarpus costatus	0.18	0.03			0.03	0.02				0.05	0.32
Dipterocarpus turbinatus	3.20	0.37	0.02		0.08	0.07	0.02		0.02		3.77
Drimycarpus racemosus	0.03										0.03
Elaeocarpus floribundus	0.27		0.02								0.28
Elaeocarpus tectorius	0.37	0.08								0.08	0.54
Engelhardtia spicata	0.08	0.03									0.12
Erythrina fusca	0.05	0.03	0.02		0.02						0.12
Eucalyptus camaldulensis	1.76	0.52	0.03	0.05							2.36
Eurya acuminata	0.13										0.13
Ficus auriculata	0.18	0.10									0.28
Ficus benghalensis	0.02				0.02				0.02	0.05	0.10
Ficus benjamiana	0.02										0.02
Ficus conglobata		0.02									0.02
Ficus geniculata	0.02										0.02
Ficus hispida	3.85	0.94	0.05	0.02							4.86
Ficus lamponga	0.02		0.02			0.02				0.02	0.07
Ficus lanceolata	0.03	0.02									0.05
Ficus racemosa		0.05									0.05
Ficus semicordata	0.13	0.03									0.17
Ficus tinctoria	0.02										0.02
Ficus variegata	0.07										0.07
Ficus virens										0.02	0.02
Flacourtia jangomas	0.20	0.02									0.22
Garcinia cowa	1.47	0.18		0.02							1.68
Garcinia morella	0.07										0.07
Garcinia speciosa	0.10										0.10

Appendix 4 continued...

Scientific name	% distribution of the tree species in different dbh classes (cm)										Total
	5 - <14.9	15 - <24.9	25 - <34.9	35 - <44.9	45 - <54.9	55 - <64.9	65 - <74.9	75 - <84.9	85 - <94.9	≥95	
Gardenia coronaria	0.15	0.08	0.02								0.25
Glochidion lanceolarium	0.02										0.02
Glochidion multiloculare	0.12										0.12
Gluta elegans	0.02										0.02
Gmelina arborea	1.21	0.84	0.12	0.02							2.18
Grewia nervosa	1.42	0.10									1.52
Grewia sapida	0.12	0.02									0.13
Holarrhena antidysenterica	0.97	0.03				0.02					1.02
Hopea odorata	0.50	0.03							0.02		0.55
Lagerstroemia speciosa	0.18	0.05									0.23
Lannea coromandelica	0.50	0.17	0.03	0.02							0.72
Lepisanthes rubiginosa	0.08	0.02									0.10
Lepisanthes tetraphylla	0.02										0.02
Litchi chinensis	0.13	0.02		0.02	0.02						0.18
Lithocarpus acuminata	0.05										0.05
Lithocarpus elegans	0.07				0.02						0.08
Lithocarpus polystachya	2.08	0.05									2.13
Litsea glutinosa	0.39										0.39
Macaranga denticulata	0.55	0.10		0.02							0.67
Macaranga indica	0.05										0.05
Maesa indica	0.02		0.07		0.02						0.10
Maesa ramentacea	0.37										0.37
Mallotus philippensis	0.10										0.10
Mallotus roxburghianus	0.07										0.07
Mangifera indica	0.37	0.03		0.03			0.02				0.45
Mangifera sylvatica	0.02										0.02
Mitragyna parvifolia	0.80										0.80
Myristica linifolia	0.10	0.02									0.12
Neolamarckia cadamba	0.20	0.02	0.02								0.23
Ochna squarrosa	0.02										0.02
Oreocnide integrifolia	0.02										0.02
Oroxylum indicum	0.23										0.23
Persea bombycina	0.05										0.05
Phoebe lanceolata	0.05										0.05
Phoebe pallida	0.03										0.03
Phoenix sylvestris				0.03							0.03
Phyllanthus emblica	0.40	0.03									0.44
Picrasma javanica	0.03										0.03
Pinus oocarpa			0.02		0.02						0.03
Pithecellobium angulatum	0.03	0.02									0.05
Prismatomeris tetrandra	0.02										0.02
Protium serrotum	0.37	0.02									0.39
Psidium guajaba	0.70	0.05									0.75
Pterygota alata						0.02					0.02

Appendix 4 continued...

Scientific name	% distribution of the tree species in different dbh classes (cm)										Total
	5 - <14.9	15 - <24.9	25 - <34.9	35 - <44.9	45 - <54.9	55 - <64.9	65 - <74.9	75 - <84.9	85 - <94.9	≥95	
Pterospermum acerifolium	0.07										0.07
Pterospermum semisagittatum	0.13		0.02								0.15
Quercus gomeziana	0.15										0.15
Samanea saman	0.05	0.13	0.03	0.10	0.05	0.05					0.42
Sapium baccatum	0.07										0.07
Senna siamea	0.49	0.13	0.03								0.65
Shorea robusta	4.37	0.74	0.22	0.05							5.38
Sterculia villosa	0.20	0.05	0.03								0.28
Stereospermum colais	1.01	0.35	0.03			0.03					1.42
Steteospermum suaveolens	0.22	0.02									0.23
Streblus asper	0.20	0.05		0.02							0.27
Suregada multiflora	0.37	0.02									0.39
Swietenia mahagoni	0.34	0.07	0.03								0.44
Swintonia floribunda	0.02										0.02
Symplocos racemosa	0.02										0.02
Syzygium claviflorum	0.67	0.02									0.69
Syzygium cumini	0.22	0.02									0.23
Syzygium firmum	1.19	0.15	0.02								1.36
Syzygium fruticosum	2.04	0.08	0.20	0.02							2.35
Syzygium ramosissimum	0.23										0.23
Syzygium syzygioides	0.02										0.02
Syzygium wallichii	0.02										0.02
Tamarindus indica	0.52						0.02				0.54
Tectona grandis	6.28	1.16	0.05		0.02				0.02		7.52
Terminalia arjuna	0.45	0.02									0.47
Terminalia bellirica	1.19	0.15								0.02	1.36
Terminalia chebula	0.12	0.03									0.15
Tetrameles nudiflora		0.02									0.02
Toona ciliata	0.40	0.02	0.02	0.02							0.45
Trema orientalis	0.80	0.12									0.92
Trewia nudiflora	0.02		0.02			0.02					0.05
Vitex glabrata	0.15	0.02		0.02							0.18
Vitex peduncularis	0.50	0.08									0.59
Vitex pinnata	0.05										0.05
Xanthophyllum andamanicum	0.03	0.02									0.05
Xanthophyllum flovescens	0.02										0.02
Xylia xylocarpa	0.17	0.07									0.23
Zanthoxylum rhetsa	0.02	0.02									0.03
Zizyphus mauritiana	0.02	0.10	0.02								0.13
Total	**83.59**	**12.63**	**1.73**	**0.57**	**0.47**	**0.35**	**0.10**	**0.03**	**0.12**	**0.42**	**100**

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Dr. Hossain holds the life membership of Bangladesh Botanical Society; Bangladesh Association for the Advancement of Science (BAAS); Asiatic Society of Bangladesh; General Secretary, Biodiversity Research Group of Bangladesh (BRGB); Vice-President, Institution of Environmental Professionals, Bangladesh; Member, Editorial Board, Journal of Forestry and Environment, Chittagong University; Editorial Board Member of the Journal of Forestry Research, China. Dr. Hossain visited the UK, USA, Australia, Canada, China, Denmark, Finland, Sri Lanka, Japan, India, Korea, Nepal, Malaysia, Indonesia, Netherland, Thailand, Taiwan, Turkey, Vietnam, Sweden, Switzerland for academic and research purposes.

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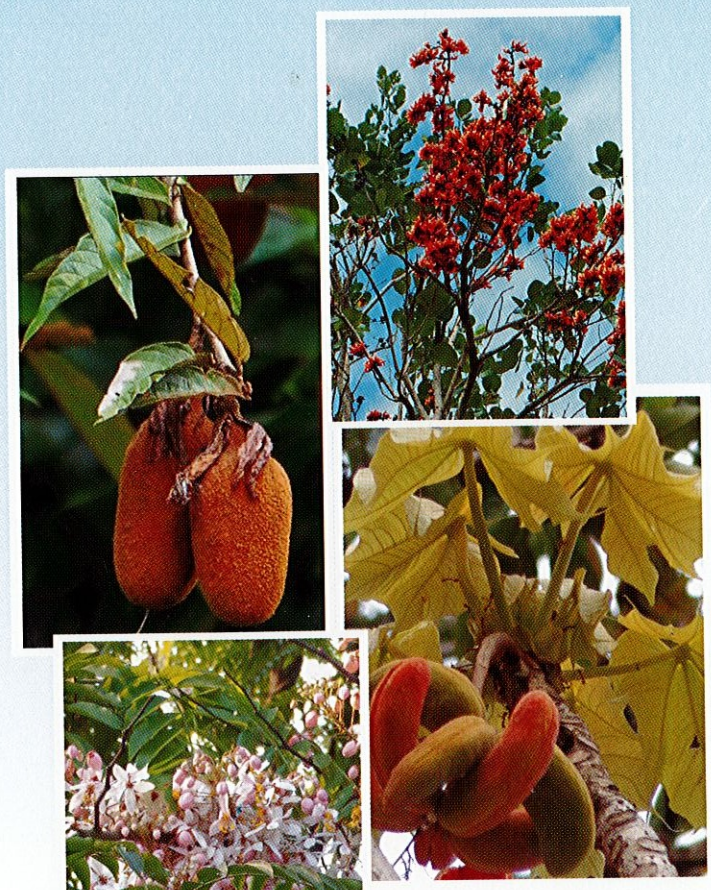

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