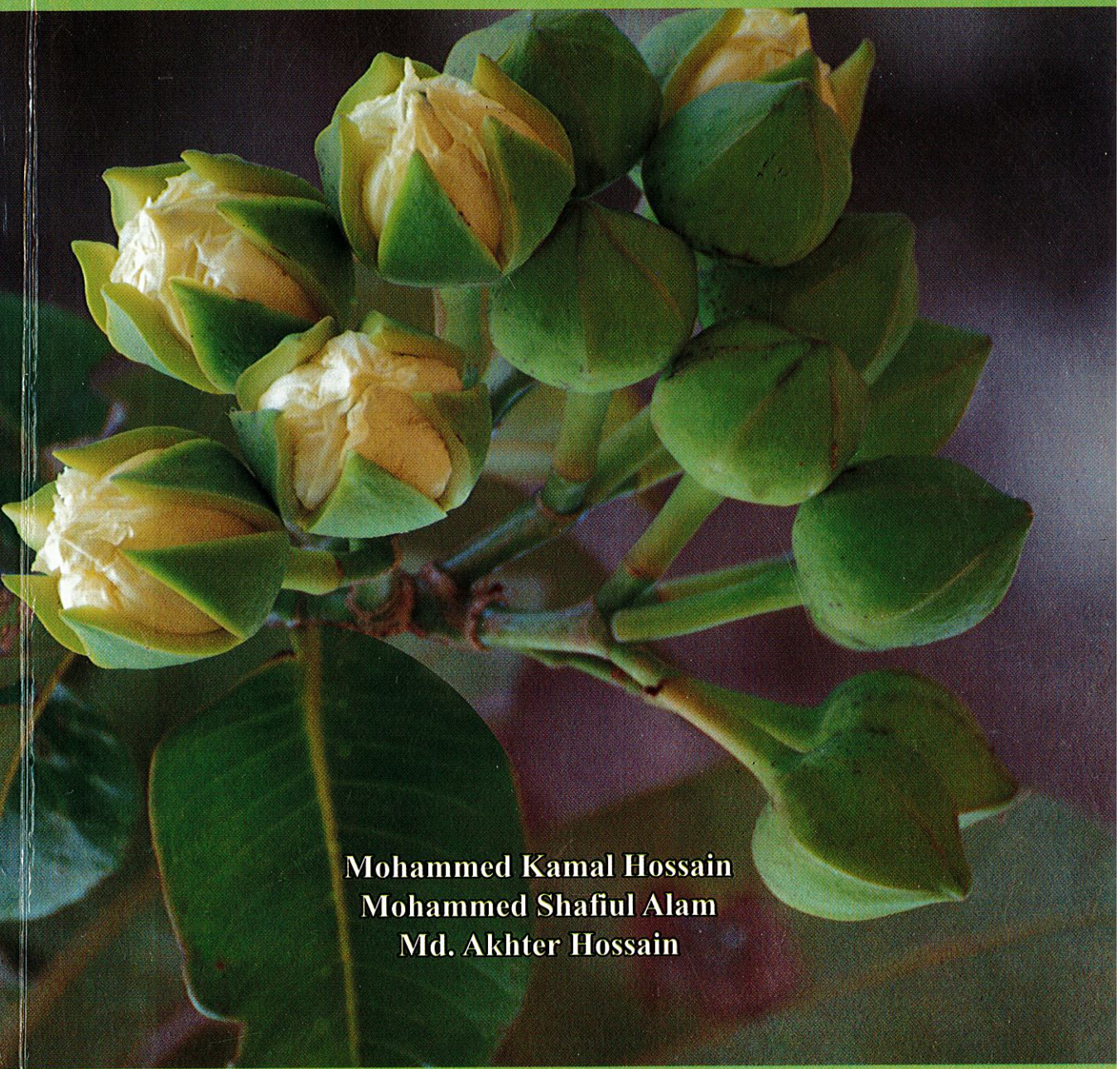
CONSERVATION OF THREATENED TREE SPECIES IN CHITTAGONG UNIVERSITY CAMPUS



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ARANNAYK FOUNDATION
Conserving forests for the future

CONSERVATION OF THREATENED TREE SPECIES IN CHITTAGONG UNIVERSITY CAMPUS

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Published by
Arannayk Foundation
June 2017

ARANNAYK FOUNDATION
Conserving forests for the future

Arannayk Foundation, 21 Western Road, Banani DOHS, Dhaka 1206, Bangladesh
Website: www.arannayk.org

Front cover photograph
Six year's old Bandarhula (*Duabunga grandiflora*) flowering in CU campus

Citation
Hossain, M.K., Alam, M.S. and Hossain, M.A. 2017. Conservation of Threatened Tree Species in Chittagong University Campus, Arannayk Foundation, Dhaka, Bangladesh. pp. 183

ISBN: 978-984-34-2763-2

Design and layout
Dr. Mohammed Kamal Hossain

Printed by
Al-Madina Computer & Printers
182, Anderkilla, Chittagong

Price
Tk. 300
US$ 10

List of Abbreviations

AF: Arannayk Foundation
ANR: Assisted Natural Regeneration
BFD: Bangladesh Forest Department
BFRI: Bangladesh Forest Research Institute
BGCI: Botanic Gardens Conservation International
BNH: Bangladesh National Herbarium
CBD: Convention on Biological Diversity
CHT: Chittagong Hill Tracts
CI: Conservation International
CITES - The Convention on International Trade in Endangered Species of Wild Fauna and Flora
COP: Conference of Parties
DBH: Diameter at Breast Height
DoE: Department of Environment
FAO: Food and Agriculture Organization of the United Nations
FGR: Forest Genetic Resources
GDP: Gross Domestic Products
GTA: Global Tree Assessment
GTS: Global Tree Search
GTSG: Global Tree Specialist Group
GSPC: Global Strategy for Plant Conservation
IFESCU: Institute of Forestry and Environmental Sciences, Chittagong University
IUCN: The International Union for Conservation of Nature
NTFPs: Non-Timber Forest Products
PAs: Protected Areas
REDD+: Reducing Emissions from Deforestation and Forest Degradation
SBSTTA: Subsidiary Body on Scientific, Technical and Technological Advice (of CBD)
SDG: Sustainable Development Goals
SSC: Species Survival Commission
UNFCCC: United Nations Framework Convention on Climate Change
VCF: Village Common Forest
WCSP: World Checklist of Selected Plant Families
WSSD: World Summit on Sustainable Development

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Preface

Forests are the single most important repositories of terrestrial plants and have a widely realized contribution to human well-being. Besides providing timber and other NTFPs for human consumption, forests also provide cultural, educational, aesthetic and spiritual values. Forest trees and other woody plants support many other plants and animals, and have developed complex mechanisms to maintain high levels of genetic diversity. Bangladesh is situated between the Indo-Himalayas and Indo-Chinese sub-regions with distinct physiographic characteristics, and diverse forms of ecosystems with rich flora and fauna. Bangladesh has more than 5,000 species of angiosperms. But, due to high population pressure, environmental pollution, monoculture, habitat destruction through land use change, introduction and rapid spread of invasive alien species along with the recent climate change is becoming a serious threat to rich flora and fauna of Bangladesh. According to the *Encyclopedia of Flora and Fauna of Bangladesh*, 486 vascular plants are considered as threatened in Bangladesh.

Arannayk Foundation (AF) also known as Bangladesh Tropical Forest Conservation Foundation was established by the joint initiative of the Government of Bangladesh and United States of America in response to the depletion of tropical forest resources. AF's mission is to facilitate the conservation, protection, restoration and sustainable use and management of tropical forests in Bangladesh. With the financial support of AF, Institute of Forestry and Environmental Sciences of Chittagong University (IFESCU) has made an exploratory survey of flora of forests of Bangladesh to find out the status of different tree species and restore critically endangered species under *ex-situ* condition so that seeds and other planting materials are available for future plantation. The title of the project was ***"Restoration and Recolonization of Threatened Tree Species in Bangladesh"***. Through systematic survey, status of native tree species in natural forests of Chittagong, Chittagong Hill Tracts, Sylhet, Cox's Bazar and sal forests of Dhaka, Tangail and Mymensingh were identified, fruits and seeds were collected, developed seedling raising protocols in the nursery and established 10.0 ha of seed stands in the campus for *ex-situ* conservation to protect the threatened species from disappearance and as a future source of planting materials.

The book describes botanical description, distribution (global and in Bangladesh), phenology, status and conservation status of 60 threatened tree species of hills and sal forests areas of Bangladesh. Photographs of each species are provided to help the readers in identification of the species. Botanical names are in accordance with the ***"Encyclopedia of Flora and Fauna of Bangladesh"*** published by the Asiatic Society of Bangladesh. This book will help the planters, Forest Department and the students of Forestry, Botany, Agriculture and other disciplines of Biological Sciences to have a ready reference of the threatened tree species of Bangladesh.

The Authors

Foreword

Bangladesh is a biodiversity rich country. The people of the country have traditionally been using and conserving biodiversity generation after generations. Maintaining the sustainable use of these rich biodiversity is very important for a huge population of the country. However, the current status of biodiversity in Bangladesh is under stress. Population pressure, reckless pollution, monoculture, habitat destruction through land use change, introduction and rapid spread of invasive alien species along with the recent climate change is becoming a serious threat on our biodiversity. Considering the importance of protection and improvement of the country's environment and biodiversity, the Government of Bangladesh in 2011 inserted the section 18A in the constitution as "***the state shall endeavour to protect and improve the environment and to preserve and safe-guard the natural resources, biodiversity, wetlands, forests and wildlife for the present and future citizens***". Biodiversity is essential for achieving sustainable development and global priorities including poverty reduction and other targets and goals of SDG.

Chittagong University is contributing to the country with providing skilled manpower from her 42 departments and 7 Institutes regularly. The University also possesses 1,755.54 acres of lands ranging from hills, hillocks, flat land, lakes and wetlands. A part of the tropical forest lands of Chittagong and CHT, the campus possess more than 835 plant species and continuous incorporation of plant species increasing the flora of the campus. The population of wild fauna is increasing in the campus along with the increasing vegetation coverage in the campus. Recent development of boundary wall in eastern side also protects the flora and fauna of the campus and shall create a safe habitat for the biodiversity of the campus. The Department of Botany and Institute of Forestry and Environmental Sciences (IFES) is regularly planting in the available lands in Botanical gardens, roadsides and hilly lands. The campus is one of the most greenery campuses in the country and received five times the "**Prime Minister National Award**" for significant contribution in the afforestation and reforestation programs.

It is my pleasure to see the book titled "CONSERVATION OF THREATENED TREE SPECIES IN CHITTAGONG UNIVERSITY CAMPUS" authored by Dr. Mohammed Kamal Hossain, Dr. Mohammed Shafiul Alam and Md. Akhter Hossain of Institute of Forestry and Environmental Sciences, Chittagong University that has taken a praise-worthy step to introduce the native threatened tree species in the campus. This book will help the Forest Department and the students of Forestry, Botany, Agriculture and other disciplines of Biological Sciences to have a ready reference of the native tree species of Bangladesh. I take the pleasure to extend my sincere thanks to the authors for writing this book and Arannayk Foundation (Tropical Forest Conservation Program) for their splendid support for publishing the book. Extend of similar support from Arranayk Foundation would be cordially appreciated in future.

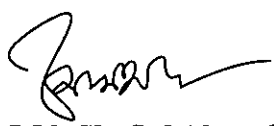
(Professor Dr. Iftekhar Uddin Chowdhury)
Vice-Chancellor
University of Chittagong

Foreword

The forests of Bangladesh have been under planned management for more than hundred years. But the pressures from population growth have far exceeded the planned conservation efforts. There is enough evidence that both the flora and fauna is threatened in the country as the forests have shrunk, degraded and fragmented. Bangladesh has signed and ratified the Convention on Biological Diversity (CBD) and accordingly committed to conserve the biodiversity of the country. Bangladesh currently has 38 Protected Areas (PAs) covering an area of 10.72% of total forest area and is about 1.8% of the total land area of the country. The challenge for the forestry sector is to sustain environmental services of forests while meeting the demand of timber, fuel wood, and other forest produces. This calls for vertical expansion of forestry sector in Bangladesh. Successful Social Forestry activities of Bangladesh Forest Department do strongly suggest the involvement of people for conservation and management of forest resources in all available marginal, waste, and degraded forest lands. Plantation programs are getting priority in both public and private sectors of the country. But, the choice of species is still under debate regarding the plantations of some exotics!

Though Bangladesh is a small country but rich in biodiversity. The people of the country have traditionally been using and conserving biodiversity generation after generations. Maintaining the sustainable use of these rich biodiversity is very important for a huge population of the country. Priority of few species in plantation forestry has already threatened hundreds of native flora, particularly tree species from her native habitats. Recently Forest Department has given emphasis to Assisted Natural Regeneration (ANR) techniques for encouraging the regeneration, recruitment, growth and development of native tree species in the degraded natural forests. *Ex-situ* conservation programs in PAs, Botanical Gardens, and Parks are also encouraged for the conservation of Native Forest Genetic Resources (FGR).

The initiative of the Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU) and Arranayk Foundation in *ex situ* conservation of native tree species in the University campus is praiseworthy. The book titled **"CONSERVATION OF THREATENED TREE SPECIES IN CHITTAGONG UNIVERSITY CAMPUS"** will help the Forest Department and the students of Forestry, Botany, Agriculture and other disciplines of Biological Sciences to have a ready reference of the native tree species of Bangladesh. I take the pleasure to extend my sincere thanks to the authors for writing this book.

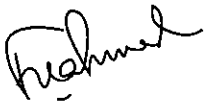


(Md. Shafiul Alam Chowdhury)
Chief Conservator of Forests
Bangladesh Forest Department

Foreword

Arannayk Foundation (AF) promotes conservation of forests and forest biodiversity in Bangladesh. It works in partnership with NGOs, academia and other relevant organizations. Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU) as a partner of Arannayk Foundation implemented a project on development of nursery practices for endangered species where 26 nurseries were engaged in identification of endangered species, collecting seeds and developing nursery protocols for the species. In addition, IFESCU was involved in conservation and restoration of two critically endangered species namely Civit (*Swintonia floribunda*) and Banspata (*Podocarpus nerifolius*). During the process of project implementation, it was found that many other forest species were also critically endangered and the Board of Arannayk Foundation suggested conserving all such species in Chittagong University Campus involving IFESCU. It may be mentioned that some of the forest lands are highly degraded and those needed immediate afforestation and reforestation for restoration. The forest assessment report by FAO and Forest Department in 2007 also found that there are at least 6% of the total land areas in the country which are poorly stocked. Restoration and recolonization of native tree species in the areas is another option as the country committed to conserve the native flora and fauna in the CBD agreements.

Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU), with financial and technical support from the Arannayk Foundation was involved in identification of the endangered species of different forest areas, collecting seeds or scions and developing nursery protocols using seeds or vegetative propagules for restoration and recolonization of threatened tree species in the IFESCU campus and in its native sites. So far, 60 threatened tree species have been successfully restored in the University campus. The outcome of the research project titled "CONSERVATION OF THREATENED TREE SPECIES IN CHITTAGONG UNIVERSITY CAMPUS" authored by Professor Dr. Mohammed Kamal Hossain, Professor Dr. Mohammed Shafiul Alam and Md. Akhter Hossain of Institute of Forestry and Environmental Sciences, Chittagong University is a praise-worthy step to conserve the native threatened tree species in the IFESCU campus. Arannayk Foundation is pleased to publish the book and we thank the authors for their untiring efforts in writing this book. It will be definitely helpful for tree planters and Bangladesh Forest Department including students of forestry in Bangladesh.



Farid Uddin Ahmed
Executive Director
Arannayk Foundation

Foreword

Biodiversity in Bangladesh is depleting from all natural habitats relentlessly. Current national policies and economic systems do not incorporate the values of biodiversity effectively in either the political or the market systems, and many current policies are not fully implemented in the country. The depletion of biodiversity in Bangladesh is the result of over-extraction and exploitation. However, considering the importance of protection and improvement of the country's environment and biodiversity, the Government of Bangladesh in 2011 inserted the section 18A in the Constitution as *"the state shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetlands, forests and wildlife for the present and future citizens"*. Biodiversity is essential for achieving sustainable development and global priorities including poverty reduction and other targets and goals of Sustainable Development Goals.

Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU) is contributing to the sector of Forestry and Environmental Sciences of the country since its inception in 1976. Chittagong University possesses 1,755.54 acres of lands ranging from hills, hillocks, flat land, lakes and wetlands. A part of the tropical forest lands of Chittagong and Chittagong Hill Tracts (CHT), the campus possesses rich flora and continuous incorporation of plant species increasing the plant species in the campus. The population of wild fauna is increasing in the campus along with the increasing vegetation coverage. Institute of Forestry and Environmental Sciences (IFES) is regularly planting the trees in the available vacant lands of the University. The campus is one of the most greenery campuses in the country and received five times the **"Prime Minister National Award"** for significant contribution in the afforestation and reforestation programs. The Institute is working hard to bringing back the native tree species in the campus with an aim to conserve the Forest Genetic Resources (FGR) of the country.

It is my pleasure to see the book titled **"CONSERVATION OF THREATENED TREE SPECIES IN CHITTAGONG UNIVERSITY CAMPUS"** authored by the faculty members Dr. Mohammed Kamal Hossain, Dr. Mohammed Shafiul Alam and Md. Akhter Hossain of this Institute of Forestry and Environmental Sciences, Chittagong University that has taken a praiseworthy step to introduce the native threatened tree species in the campus. This book will help the Forest Department and the students of Forestry, Botany, Zoology, Agriculture and other disciplines of Biological Sciences as a ready reference of the native tree species of Bangladesh. I take the pleasure to extend my sincere thanks to the authors for writing this book and Arannayk Foundation (Tropical Forest Conservation Program) for their splendid support of establishing the plantations in the campus and publishing the book. Extent of similar support from Arannayk Foundation would be cordially appreciated in future.

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Director
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University of Chittagong

Acknowledgments

All praises goes to the Almighty Allah, the most benevolent and merciful, **Who** created all creatures for the well-being of human kind.

We are cordially grateful to Professor Dr. Iftekhar Uddin Chowdhury, honorable Vice-Chancellor of Chittagong University; Mr. Shafiul Alam Chowdhury, Chief Conservator of Forests, Bangladesh Forest Department, Mr. Farid Uddin Ahmed, Executive Director, Arannayk Foundation and Professor Dr. M. Danesh Miah, Director, IFESCU for giving forewarding for this book.

The authors are highly grateful to Arannayk Foundation, especially the Board Members and the Executive Director for financial supports and kind approval of publishing this book. Sincere thanks to Dr. Abdul Quddus, Mr. Abedul Hoque, Mr. Abdul Mannan, Mrs. Farhana Khan Pushpa of Arannayk Foundation. The authors are highly thankful to all faculty members of the Institute of Forestry and Environmental Sciences of Chittagong University for their support in writing the book. Special thanks are extended to the officers and field staff of plantation unit of the Institute.

We are also expressing appreciation to all concerned officers of Bangladesh Forest Department, Forest Botany Division of Bangladesh Forest Research Institute (BFRI) for helping in field work and identification of native tree species of natural forests of Bangladesh.

Cordial thanks to Professor M. Kalimuddin Bhuiyan (Retired Professor of IFESCU), Dr. Mohammed Yusuf (Retired Director) of Bangladesh Council of Scientific and Industrial Research Laboratories Chittagong (BCSIR); Dr. M. Khairul Alam (Retired Chief Research Officer, BFRI); Dr. Mohammad Mohiuddin, Chief Research Officer, Forest Management Branch; Dr. Rafiqul Haider, Divisional Officer, Minor Forest Products Division of Bangladesh Forest Research Institute (BFRI) for suggestions and rigorous reviewing the manuscript.

We are grateful to the authors from whose writing we have chosen the excerpts. We are also grateful to many stakeholders for lending their experiences, knowledge and information in preparing the book. Sincere thanks to the project/thesis students of Institute of Forestry and Environmental Sciences of Chittagong University (IFESCU) for their contribution in Seed Laboratory, Nursery and in the *ex situ* conservation programs of threatened tree species in the campus.

Finally request to the readers for improving this book in future providing your suggestions, comments, critics if you have any in the following address: mkhossain2009@gmail.com

Dr. Mohammed Kamal Hossain
Dr. Mohammed Shafiul Alam
Md. Akhter Hossain

Chapter 1

Flora of Bangladesh

1.1 Overview of flora of Bangladesh

A flora is a comprehensive, systematic account of the plant species of a given area. In other word 'flora' refers to the plants occurring within a given region as well as to the publication of scientific descriptions of those plants. A flora may contain anything from a simple list of the plants occurring in an area to a very detailed account of those plants. Floras are different from popular manuals in that they attempt to cover all of the plants, rather than only the most common or conspicuous ones.

A flora almost always contains scientific names, and it may also include common names, literature references, descriptions, habitats, geographical distribution, illustrations, flowering times, phenology and notes. Less often, floras include such specialized information as data on plant chemistry, reproduction, chromosome numbers, and population occurrences. Sometimes the plants are listed alphabetically, and sometimes they are represented within a classification system that indicates which plants are most similar or are to be related. Floras often also include devices called "keys" that enable the user to identify an unknown plant.

Humans and most other animals are almost dependent on plants, directly or indirectly, as a source of energy. About 25% of the estimated 270,000 vascular plant species are edible but only about 3,000 species are regularly used for food. Plants contribute more than animals due to their extraordinary array of diverse classes of bio-chemicals with a variety of biological activities. Worldwide tens of thousands of species of higher plants, and several hundred lower plants, are currently used by humans for diversified purposes, such as food, fuel, fibre, oil, herbs, spices, industrial crops and as forage and fodder for domesticated animals. In the tropics alone it has been estimated that 25,000-30,000 species are in use (Heywood 1982) and up to 25,000 species have been used in traditional medicines. Traditional Chienese medicine alone uses over 5,000 plant species, while traditional medicine in India is based on 7,000 different plant taxa. In the United States, a quarter of all prescriptions dispensed by pharmacies are substances extracted from plants. International trade in medicinal plants and their products was over US$ 60 billion in 2000, and is expected to reach US$ 5 trillion by 2050. In addition, thousands of species are grown as ornamentals, i.e. trees in parks, public and private gardens, and avenue trees for beautification. Areas with vegetation attract large numbers of tourists for their scenic beauty. Careful and controlled tourism contribute in the national economy. Flora provide valuable environmental services, such as the prevention of soil erosion and flooding of down slope agricultural and settled areas, as well as safeguarding watersheds and contributing to climate stability.

The landmass of present Bangladesh has been historically was an inaccessible area due to its extensive network of rivers and canals and dense vegetation. Travels by Ibn Batuta (980-1037) and his records appear to be the first systematic listing of plants in this area (Pasha 2011). Later on the Europeans notably the Dutch, Portuguese, Frence and the British carried out systematic

explorations of the plant resources of India (Hassan and Ahmed 2008). Botanical studies in Eastern India including present Bangladesh were initiated by William Roxburgh who was appointed as the Superintendent of the Royal Botanic Garden in Calcutta in 1793. The flora study thus starts in this sub-continent by Roxburgh (1814, 1820-24, 1832), and followed by Hooker (1872), Kurz (1877), Clarke (1889), Prain (1903), Brandis (1906), Heinig (1925), Cowan (1926), Kanjilal et al. (1934-1940), Raizda (1941), Datta and Mitra (1953) and Sinclair (1955). After that the noteworthy works are done by Khan (2001), Khan and Banu (1972), Khan and Halim (1987, Khan et al. (2001), and finally Siddiqi et al. (2007), Ahmed et al. (2008, 2009) compiled almost all the taxa recorded so far in Bangladesh. In this compilation 3,562 species belonging to 1,379 genera and 199 families were recorded, of which about 25% taxa seem to be either very rare, scarce or have never been seen or collected after the first record (Hassan and Ahmed 2008).

Biogeographically, Bangladesh is located at the cross roads of the Indo-Himalayan and Indo-Chinese sub-regions under the Oriental region, and the country acts as an important merging and sharing habitat, land bridge and biological corridors of the flora and fauna between these sub-regions (DoE 2015). The geographical location and the climate of the country support a rich biodiversity but, unfortunately the total flora of the country is not yet fully investigated.

Prain (1903) in his "Bengal Plants" recorded 2,734 species of flowering plants under 1,120 genera and 148 families from the then Bengal. Distribution of the plants make it evident that 2,082 species under 983 genera and 144 families occur in Bangladesh. However, to this number (2,082 species), 400 new records (already reported) and new entry from greater Sylhet area should be added to get a reliable number of flowering plant species occurring in Bangladesh. Khan (1991) estimated the number as high as 5,000 under 186 families. Islam (2003) reported more than 6,000 plant species occur in Bangladesh, of which 300 are exotic and 8 are endemic. The Encyclopedia of Flora and Fauna of Bangladesh (2007-2009) contains a comprehensive list of plant species of Bangladesh. It recorded 3,611 taxa of angiosperms from the Bangladesh territory. Irfanullah (2013) reported 64 new angiosperm species from Bangladesh between 2009 and 2013 and 8 were described as new to science. In addition to that, very recently, Bangladesh National Herbarium has reported 50 angiosperm species as new records for the country (Ara and Khan 2015). Considering the available information, the total number of plants recorded and estimated in Bangladesh in comparison to world is shown in Table 1.

Table 1. Recorded and estimated number of flora of Bangladesh and worldwide

Categories	Recorded in Bangladesh	Estimated in Bangladesh	World described	World estimated
Algae	3,600	6,000	40,000	200-350,000
Fungi	275	--	90,000	1500,000
Lichens	51	--	13,500	20,000
Bryophytes	290	400	14,000	23,000
Pteridophytes	200	250	12,000	13,500
Gymnosperms	7	7	650	650
Angiosperms	3,723	>5,700	250,000	300,000

1.2 Trees in the World and in Bangladesh

Whether a Tree stands among many in a forest or field, or is a central tree that provides shade for a village meeting place, the answer to "What is a Tree?" is not simple (FAO 1995). Global Tree Specialist Group (GTSG) of IUCN defines tree as "a woody plant with usually a single stem growing to a height of at least two metres, or if multi-stemmed, then at least one vertical stem five centimetres in diameter at breast height". We also accept the definition of a phanerophyte used in the World Checklist of Selected Plant Families, where stems are described as woody and persisting for several years, buds normally above 3 metres (WCSP), with the exceptions of tree ferns, cycads, "woody" grasses, bromeliads and Musaceae. The tree-size range has generally been estimated by visual observation or noted from literatures. Basak and Alam (2015) categorized trees to small (up to 10m), medium (10-15m) and large (more than 15m) based on height. Howevre, the values of trees (Rivers et al. 2015) are as follows (Box 1).

Box 1: Values of Trees	
Tree value(s)	**Description**
Cultural	Trees and their products have sacred or symbolic status for certain communities and cultures, and play a central role in stories, myths and histories.
Ecological	Many trees support additional species in the ecosystem, by providing food, shelter, water provision and nitrogen fixation, e.g. legumes.
Flagship species	Flagship species act as ambassadors for their environment, capturing the heart of the public and being the basis for conservation programs that support the wider ecosystem where they are found.
Food	Tree products have been a food source for thousands of years and today form the basis of multi-million dollar industries. 66 wild fruits are reported from the hill forests of Bangladesh.
Medicine	Many trees provide medicinal remedies extracted from the wood, bark, roots, leaves, flowers, fruits and seeds. There is international trade in medicinal tree products, and many products are fundamental to the well-being of local communities.
Ornamental	Many trees are grown ornamentally around the world, selected for their beautiful flowers, bark, berries, leaves or form.
Resin	Resins are thick liquids exuded by many trees. Due to the varying chemical structures of resins they have a variety of uses such as varnish, adhesives and incense, e.g. agar, dhup.
Timber	Many trees provide timber with varying strength, durability, resonance, colour and scent. From tropical forests alone, international timber exports exceed US$20 billion per year, but this figure excludes the vast amount traded and used locally throughout the world.

Trees have been around for more than 370 million years, and today there are about 80 thousand species of them, occupying 3.5 billion hectares worldwide, including 250 million ha of commercial plantations. Botanical exploration and discovery has hugely expanded, but the precise number of plant species still remains uncertain, with current estimates suggesting there are 370,495 seed plants (Lughadha et al. 2016). Estimates of the number of tree species have ranged from 45,000 to 100,000 (Fine and Ree 2006, Oldfield et al. 1998, Savolainen 2000, Tudge 2006), with reports suggesting there are 21,000 species in temperate regions (Hunt 1996) and 40,000–53,000 in the tropics (Slik et al. 2015). Most of these figures are based on broad estimates or modeled numbers of trees; none of them have been derived from an authoritative global list of trees.

Knowledge about the tree flora of a country or an area is very important for its sustainable use and future management. The importance of trees as key structural components of forest ecosystems, sources of timber and non-timber products, and providers of vital ecosystem services is very important to know the number of species in each ecosystem. Various initiatives (SBSTTA 1996, Lammerts van Bueren and Duivenvoorden 1996) have suggested that tree species diversity can be used as a surrogate for overall species diversity in forest ecosystems. Tree populations harbor naturally high genetic diversity compared with short-lived plants and usually have enough plasticity to guarantee ecological and economic functions under multiple stress factors. Trees also support a number of algae, lichens, mosses, ferns, orchids, parasites, climbers, insects, birds and other wildlife. It is estimated that the tropical forests contain at least 50 percent and probably a considerably higher proportion of all the living species on the earth including a great proportion of higher plants and mammals. There are 50 indigenous tree species in Europe north of Alaps, whereas, in Malaysia an area of forest covering just 50 ha was found to contain 830 tree species, and in Peru nearly 300 tree species of trees have been recorded on a single hectare (Whitmore 1984). By definition, most of the planet's remaining biodiversity is in developing nations (Ellison 2016). The recent compilation is that there are 60,065 tree species recorded worldwide (Beech et al. 2017). Over 45% (27,203) of tree species are found in just 10 families only. The family with the most tree species is the Leguminosae with 5,405 tree species, followed by Rubiaceae (4,827), and Myrtaceae (4,330). The most diverse tree genera are *Syzygium* (1,069 species), *Eugenia* (884 species), and *Eucalyptus* (747 species), all in the family Myrtaceae. *Ficus* (Moraceae), *Diospyros* (Ebenaceae), and *Psychotria* (Rubiaceae) are the fourth, fifth, and sixth largest genera respectively. The country with the most diverse tree flora is Brazil, with 8,715 tree species, followed by Colombia (5,776 spp.) and Indonesia (5,142 spp.). Nearly 58% of all tree species (34,575) are single country endemics (Beech et al. 2017).

In Bangladesh, there is no exclusive account of the tree flora, though list of important tree species are found in forest management plans of some Forest Divisions. Some sporadic information from Bangladesh Forest Research Institute, Universities, and Bangladesh National Herbarium published the number of tree species from different forest and homesteads. Khan (1986) briefly described 224 timber species available in the country. Estimation is that the country has about 500 usable tree species, but only a few widely known species (A, B and C class) are mostly exploited and used (Sattar 1997). Afrin (2009) reported a total of 815 tree species from Bangladesh. Basak and Alam (2015) compiling the name of 1,048 tree species including exotics, gymnosperm, dicot and monocots. The overexploitation has resulted in decreased population size of these species in the forests. As a consequence, the national timber markets have been suffering from timber supply shortage for the last few decades. Enumeration of flora including tree species from some Protected Areas (PAs) and biodiversity rich areas showed the richness of tree species in Bangladesh (Table 2).

Table 2. Number of total flora and tree species recorded from some PAs and biodiversity rich areas of Bangladesh

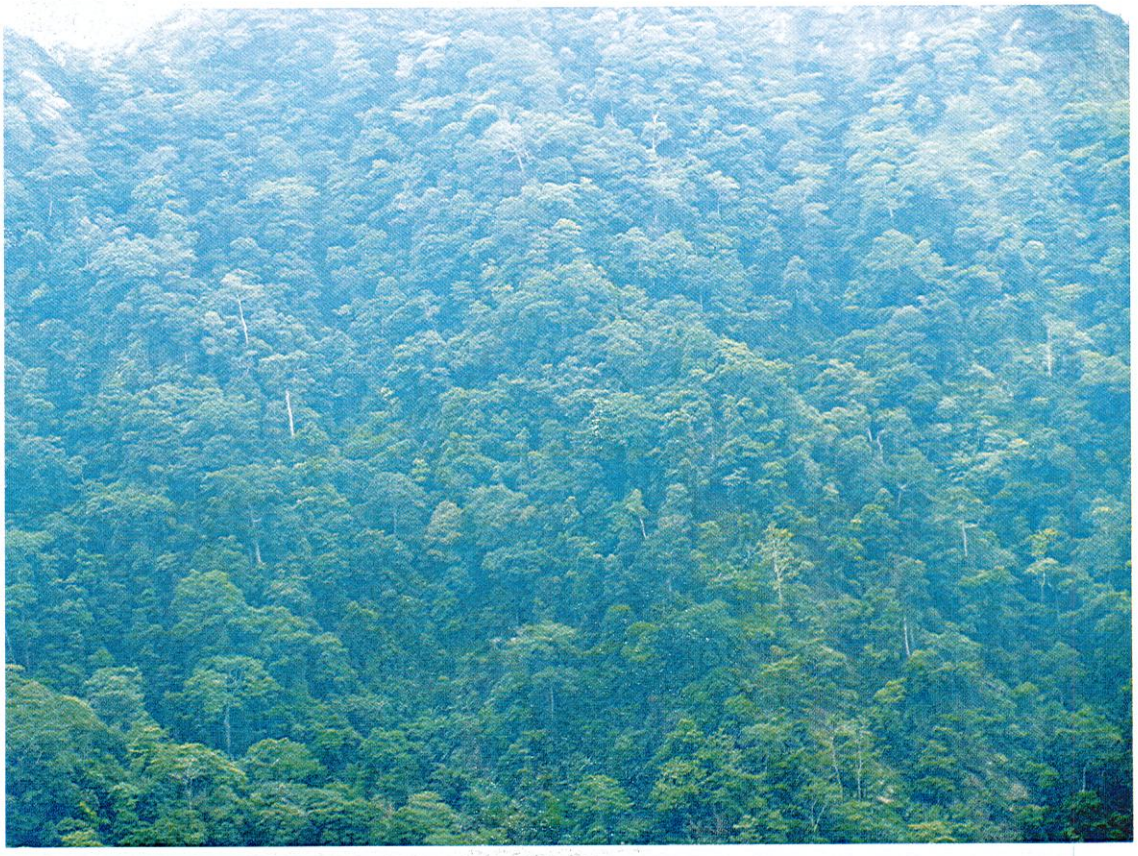
Protected Areas (PAs)/ Plant Rich Areas	Total plant species	Tree species	References
Bangladesh Forest Research Institute Campus	605	238	Alam et al. 2015
Chittagong University Campus	832	184	Momen et al. 2006
Chunati Wildlife Sanctuary	691	240	Hossain & Hossain 2014
Dudhpukuria-Dopachari Wildlife Sanctuary	608	182	Feeroz et al. 2012
Fasiakhali Wildlife Sanctuary	285	82	Uddin et al. 2011
Inani Protected Forest	443	151	Feeroz 2016
Lawachara National Park	374	90	Uddin and Hassan 2010
Madhupur National Park	385	140	Rahman et al. 2017
National Botanical Garden Mirpur	1010	306	Dey 2014
Nijhum Dweep National Park	152	66	Uddin et al. 2015
Rema-Kalenga Wildlife Sanctuary	620	142	Feeroz et al. 2011
Satchari National Park	245	73	Arefin et al. 2011
Sitakunda Botanical Garden & Eco-park	312	140	Dutta et al. 2014
Sonadia Island, Moheshkhali	138	56	Arefin et al. 2017
Teknaf Wildlife Sanctuary	536	142	Feeroz 2013
Tilagarh Eco-Park, Sylhet	41	12	Choudhury et al. 2004

In addition, list of important forest tree species are found in the Working Plans or Management Plans of respective Forest Divisions or Protected Areas. Information on forest flora of Bangladesh are available in Heinig (1925), Sinclair (1955), Prain (1903), Brandis (1906), Cowan (1926), Mia and Huq (1986), Khan and Alam (1996), Rahman and Uddin (1997), Uddin et al. (1998), Uddin and Rahman (1999), Alam (1988, 1999). Dey et al. (1998) provide an annotated list of trees of Chittagong. A systematic annotation of 342 tree species occurring in the forests, villages and homesteads comprising indigenous, naturalized and exotics introduced in the recent past are briefly described by Das and Alam (2001). However, most of the tree flora of Bangladesh is found in natural forests of the country (Alam 2008).

The Tropical Wet Evergreen Forests: The tropical wet evergreen forests of Bangladesh are an important forest type in terms of biodiversity, forest assets and environmental concerns. Originally the trees in the top canopy reach a height of 45-60 m. A few semi-evergreen or deciduous tree species may occur but they do not really change the evergreen nature of the forests. These forests occur usually in hills and moist shady areas in Chittagong Hill Tracts (Khagrachari, Rangamati and Bandarban), Sylhet, Habigonj, Moulavibazar, Cox's Bazar and

Chittagong (Das 1990). Dominant tree species of these forests are boilam (*Anisoptera scaphula*), chapalish (*Artocarpus chama*), garjan (*Dipterocarpus turbinatus, D. alatus* and *D. costatus*), telsur (*Hopea odorata*), champa (*Michelia champaca*), narikeli (*Pterygota alata*), civit (*Swintonia floribunda*) etc.

The Tropical Semi-Evergreen Forests: This type of forests occur in more exposed dry locations of Cox's Bazar, Chittagong, and Chittagong Hill Tracts and in Sylhet. The top canopy species of the tropical semi-evergreen forests reach a height of 25-57 m. In this forest, the evergreen species predominate, but many deciduous species are also found there. As a result, during winter the forest gives a semi-evergreen (green cover with some distinct brown leafless tree crowns) view to distinguish it from the pure evergreen forests. Many of the species of evergreen forests also occur in this type of forests.



Natural forests of Jiban nagar, Bandarban

Natural forests of Kaptai National Park

Natural forests of Baishari beat, Cox's Bazar

Garjan dominated natural forest patch of Bangabandhu Safari Park, Cox's Bazar

Natural forests of Satchari National Park

Sal Forest: The popularly known Sal forests of Bangladesh are of tropical moist deciduous type. These forests occur in Dhaka, Gazipur, Tangail, Mymensingh, Sherpur, Jamalpur, Netrokona, Dinajpur, Panchagar, Rangpur, Noagaon, and a small patch in Comilla. In these forests, the predominant species is Sal (*Shorea robusta*). Associate species are palas (*Butea monosperma*), haldu (*Haldina cordifolia*), sidha jarul (*Lagerstroemia parviflora*), kumbi or gadila (*Careya arborea*), hargaza or ajuli (*Dillenia pentagyna*), bhela or beola (*Semecarpus anacardium*), koroi (*Albizia* spp.), gandhi gazari (*Miliusa velutina*), menda (*Litsea monopetala*), kusum (*Schleichera oleosa*), chapalish (*Artocarpus chama*), udal (*Sterculia villosa*), bahera (*Terminalia bellirica*), kurchi (*Holarrhena antidysenterica*), horitaki (*Terminalia chebula*), Sil bhadi (*Garuga pinnata*), royna or pitraj (*Aphanamixis polystachya*), sheora (*Streblus asper*), sonalu (*Cassia fistula*), assar/datoi (*Grewia nervosa*), amloki (*Phyllanthus emblica*) etc.

Natural sal forests of Madhupur National Park, Tangail

Mangrove Forests: Mangrove forests are mainly evergreen forests of varying density and height, always associated with wet soils. The mangrove forests are well developed in the Sundarbans on the Ganges- Brahmaputra Delta (Siddiqi 2001). Sundri (*Heritiera fomes*) is the dominant tree species with associates of gewa (*Excoecaria agallocha*), baen (*Avicennia officinalis*), garjan/bara-goran (*Rhizophora mucronata*), kankra (*Bruguiera sexangula*) and goran (*Ceriops decandra*). Many other species also constitute the tidal or mangrove vegetations of Bangladesh.

Sundarbans mangrove forests

Coastal plantations at Moheshkhali, Cox's Bazar

Sundarbans forests at Kotka

Homestead Forests: Planting trees near homesteads is a traditional land use system in Bangladesh. Homestead forests develop as small groves scattered around homesteads through ecological and anthropogenic selections. Multi-layered vertical stratification, species diversity, and diversity of economic plants rather than number of individual species are characteristic features of homestead forests in Bangladesh. The homestead flora of Bangladesh ranges from seasonal annual herbs to woody perennials including indigenous and exotic species of multiple uses and supports. A total of 184 tree species along with several hundreds of vegetables and spices were reported from homesteads of Bangladesh by Khan and Alam 1996. People of Bangladesh are often more likely to plant or manage trees for the production of higher-value products, e.g. timber, poles, fruit or fodder, or even for a service, such as boundary demarcation, shade or ornament with fuel regarded as a by-product.

Swamp Forests: Besides the major forest types, there are small patches of degraded swamp forests in Kishoregonj, Sylhet, Sunamgonj, Hobigonj and Netrokona. Major tree species of these forests are hijal (*Barringtonia acutangula*), borun (*Crataeva magna*), bias (*Salix tetrasperma*) and koroch (*Pongamia pinnata*).

Ratargul swamp forest, Sylhet

IFESCU students exploring the Ratargul wetland ecosystem

1.3 Endemic plants in Bangladesh

The taxa restricted in occurrence to a particular or definite small or large area are referred to as endemics, which may be continental, country, province, regional, or local. Islands are known for high levels of endemism and, thus endemic taxa (New Caledonia and Hawaii have about 95%) than main lands. Sri Lanka has about 25% endemic species and Nepal has 5% endemic species. About 33% higher plants in India are endemic. Once it was thought that Bangladesh land is of recent geological origin, so there will be no endemic species. Only the endemic species of India are being shared due to connectivity and continuous surrounding land mass. Khan (2001) first pointed out that Bangladesh has at least 8 endemic angiosperms. Later on, Khan et al. (2001) mentioned 16 endemic plants of Bangladesh in their Red Data Book of Vascular Plants of Bangladesh. Finally, Pasha (2011) reported 25 endemic plants of Bangladesh. The endemic species possess 8 small to large trees including one palm (Table 3).

Table 3. Endemic taxa of Bangladesh

No	Scientific name	Local name	Habit	Family	Conservation status
1	*Carex caespitita*	Daraglick	Herb	Cyperaceae	DD*
2	*Cissus sicyoides*	Shiklata	Climber	Vitaceae	CR
3	*Cleistanthus oblongifolius*	Cleistangi	Tree	Euphorbiaceae	DD
4	*Croton chittagongensis*	Chittagong marichcha	Small tree	Euphorbiaceae	EN
5	*Croton chlorocalyx*	Lorok marichcha	Small tree	Euphorbiaceae	CR
6	*Corypha taliera*	Tali	Palm tree	Arecaceae	EW
7	*Cyperus pilosus*	Shokto khagra	Herb	Cyperaceae	DD
8	*Dalbergia confertiflora*	Jangli talwari shim	Woody climber	Papilionaceae	NE
9	*Gymnostachyum listeri*	Gymnotori	Under-shrub	Acanthaceae	EN
10	*Gomphostemma salarkhaniana*	Khani-bormala	Herb	Lamiaceae	NE
11	*Hedyotis thomsoni*	Soni papra	herb	Rubiaceae	VU
12	*Knema bengalensis*	Khudi barela	Tree	Myristicaceae	VU
13	*Lagenandra gomezii*	Lagendragi	Herb	Araceae	CR
14	*Limnophila cana*	Canakutra	Herb	Scrophuliriaceae	NE
15	*Lithocarpus acuminatus*	Dholi batna, kala batna	Tree	Fagaceae	EN
16	*Litsea clarkei*	Charki haria	Tree	Lauraceae	CR
17	*Myrioneuron clarkei*	Myronuron	Shrub	Rubiaceae	EN
18	*Nothopegia acuminata*	Nishorti	Shrub	Anacardiaceae	CR
19	*Ophiorrhiza villosa*	Pislagandhali	Herb	Rubiaceae	CR
20	*Phrynum imbricatum*	Pituli pata	Herb	Marantaceae	NE
21	*Rotala simpliciuscula*	Shimghurni	Herb	Lythraceae	CR
22	*Tarenna scandens*	Gujer-kata	Shrub	Rubiaceae	EN
23	*Taxillus thelocarpa*	Taxiladi	Parasitic shrub	Loranthaceae	NE
24	*Trigonostemon praetervisus*	Gonovis	Shrub/small tree	Euphorbiaceae	CR
25	*Vernonia thomsoni*	Tomsivernon	Under-shrub	Asteraceae	CR

[*DD-Data Deficient, CR-Critically Endangered, EN-Endangered, EW-Extinct in wild, NE-Not Evaluated, VU-Vulnerable]

1.4 Exotic plants in Bangladesh

Plant migration or introduction from one place to other, may be either natural or planted, is a continuous and even unending process. Bangladesh, like many other countries have a long history of plant introduction from the distant places and even the remote corners of the world. Through the different routes of land, maritime and inland water, many plants have brought by settlers, invaders and traders. In this way of introduction many plants became a part and parcel of Bangladesh flora. A portion of the exotic plants, those have been migrated through the natural process, are hard to recognize. However, the first extensive account of 299 exotic plants of Bangladesh was reported by Hossain and Pasha (2004). Among the exotics, herbaceous and lianas were highest in number (47%) followed by tree (31%) and shrubs (22%). Many of the exotic plants are considered as extremely economic crops.

1.5 Exotic trees in Bangladesh

Attempts have been made to replace the low yielding natural forests by valuable indigenous as well exotic tree species since the beginning of the scientific management of the forests (Hossain 2015). Teak (*Tectona grandis*) was the first species used in plantation forests in 1871 followed by *Swietenia macrophylla* in Chittagong and Chittagong Hill Tracts. Forest Department began establishing plantations of fast growing species such as *Gmelina arborea, Paraserianthes falcataria* and *Anthocephalus chinensis* in Chittagong Hill Tracts and Sylhet Forest Divisions. In 1978 and onwards, extensive trials of *Eucalyptus* and *Acacia* species were started to find out the very fast growing exotics for some degraded sites. *Eucalyptus camaldulensis, E. tereticornis* and *E. brassiana* emerged as the best species for plantations in Bangladesh. Among the *Acacia* species introduced so far in Bangladesh, *Acacia mangium* and *A. auriculiformis* have shown promising growth in poor afforestation sites. So far 94 tree species were introduced in Bangladesh (Hossain and Pasha 2004), of which only few species are commonly planted by Forest Department, farmers, institutes and other organizations (Table 4). Recently another species, e.g. Lombu (*Khaya anthoteca*) introduced by nurserymen in north Bengal areas are planted in many areas but the growth and development of the species is not promising (Hossain 2015). Regarding the exotics, there are also risks of the decline of growth and yield in second and successive rotations, or the infestation of pests and diseases, e.g. Psyllid in *Leucaena leucocephalla*, shoot borer in *Swietenia* and leaf defoliator in *Tectona grandis*. There are numerous examples of plantations that have failed or sites that have been degraded by ill-chosen exotic species. Sometimes, plantation projects are often designed in hasty with scant attention paid to important issues because of time or financial constraints.

Table 4. Exotics frequently used in plantation forests of Bangladesh

Exotic species	Origin	Status in plantations
Acacia auriculiformis	Australia	Extensively used in plantations of BFD, homesteads, marginal lands and becoming invasive in logged over areas
Acacia mangium	Australia /PNG	Planted by individuals but discourage due to heart rot disease
Samanea saman	West Indies	Naturalized, mostly planted in roadside and homesteads
Eucalyptus camaldulensis	Australia	Government ban the plantation of the species but individuals prefer the species very much and extensively planted in some parts of the country
Eucalyptus tereticornis	Australia	Limited plantation, often mixed with *E. camaldulensis* plantations
Gliricidia sepium	S. America	Limited plantations
Hevea brasiliensis	Brazil/ Malaysia	Rubber estates are commercially developing in hill forests and sal forest areas
Leucaena leucocephala	Central America	Promising species but not growing well in acidic soils
Melaleuca leucadendra	Australia	Promising species for waterlogged and low lying areas but have only limited plantations
Paraserianthes falcataria	Java	Planted as fast growing soft wood species, but the tree is susceptible to winds and storms
Pinus caribaea	Honduras	Limited in small scale plantations
Pinus oocarpa	Honduras	Limited in small scale plantations
Swietenia macrophylla	West Indies	Extensively planted in forest, marginal land, institutes and homesteads
Swiwtenia mahagoni	West Indies	Limited plantations often mixed with *S. macrophylla*
Tectona grandis	Myanmar	Naturalized and dominant species in plantation forests
Xylia xylocarpa	Myanmar	Promising species but limited plantations
Khaya anthoteca	India	Plantations in homesteads, roadsides and marginal lands; initial growth is lucrative but growth stunted later

The exotic species growing and gradually dominating in the natural hill forest ecosystems, crop fields, sal forests, fallow land and marginal lands are categorized as tree, shrub, herb and lianas (Hossain and Pasha 2004). Some of the species have luxuriant growth and suppressed the growth of other native species. This results in a loss of native floral diversity of the country. Questions also rise whether the plantations raised with exotics are forests or not? The threat posed to natural habitats by these exotic species is becoming a major concern among the conservationists, ecologists, foresters, policy makers and scientists, especially for the mono-plantations of few exotic species.

Invasive plants and animals are a major threat to natural ecosystems and their species, second only to direct destruction of habitats by humans. The impacts of alien invasive species are immense, insidious, and usually irreversible. Extinctions of native species by aliens are enormous, and the ecological cost is the irreversible loss of native species and ecosystems. The direct economic costs of alien invasive species are also remarkable. That's why there is an

increasing concern among foresters, ecologists, botanists, conservationists and policy makers about the threat of uncontrolled introduction of aggressive tree species in the plantation programs (Table 5). Invasion of exotics may cause major loss of biodiversity and species extinction either due to direct replacement by exotics or indirect effects on the ecosystem. Concern also exists on the degradation of the environment, e.g. the controversial effect of eucalypts on environment. *Parthenium hysterophorus*, a serious alien invasive in India (Kohli et al. 2006) is a serious threat for Bangladesh also. Likewise *Ageratum conyzoides*, a serious weed of agroecosystems in Indian hill tracts (Kohli et al. 2004) has already become a serious weed of the whole of Bangladesh. Though the undisturbed natural forests are resistant to such invasion, but the degraded and secondary forest areas and wastelands are aggressively invaded by some of these invasive species. *Ageratum conyzoides* and *Lantana camara*, both alien invasives of the Kangra Valley in Western Indian Himalayas have reached Eastern Himalayas including Bangladesh (Dogra et al. 2004).

Table 5. Alien exotics in Bangladesh that have a detrimental impact on natural hill forest ecosystems of Bangladesh

Species	Family	Origin	Status
		Tree species	
Acacia auriculiformis	Mimosaceae	Australia	Extensively used in plantation and aggressively occupying the natural ecosystems
Acacia mangium	Mimosaceae	Australia / PNG	Not recommended for further plantings because of heart rot disease
Eucalyptus camaldulensis	Myrtaceae	Australia	Introduced but now ban on further plantings in FD plantations due to its controversial impact on environment
Leucaena leucocephala	Mimosaceae	Central America	Cultivated, wild in coastal areas; suppressed the regeneration of other species
		Weedy vegetation	
Acanthospermum hispidum	Asteraceae	South America	
Cassia occidentalis	Caesalpiniaceae	Tropical America	Common weed of cultivated fields
Cestrum diurnum	Solanaceae	Tropical America	Common weed of wasteland and roadside
Lantana camara	Verbanaceae	Tropical America	Weed of road side and rail line
Ageratum conyzoides	Asteraceae	South America	Common weed of hill ecosystems, prevent regeneration of native species
Alternanthera flocoidea	Amaranthaceae	Brazil	Common weed of waste and cultivated field; aero-allergic pollen species
Arvlosia scarabaeoides	Fabaceae	Australia	Common weed of cultivated and waste land
Chromolaena odoratum	Asteraceae	Central/South America	Common weed of wasteland
Commelina obliqua	Commelinaceae	Java	Common weed of wasteland; suppressed the regeneration of other species in plantation programs
Convolvulus arvensis	Convolvulaceae	Europe	Frequent weed in wasteland
Croton bonplandianum	Euphorbiaceae	South America	Frequent weed of waste place
Eichhornia crassipes	Pontederiaceae	Tropical America	Abundant weed of waste and cultivated land
Evolvulus nummularis	Convolvulaceae	West Indies	Abundant aquatic weed; aggressive growth inhibits other aquatic flora
Hyptis suaveolens	Lamiaceae	Tropical America	Common weed in cultivated and open fields
Ipomoea carnea	Convolvulaceae	America	Common weed of hilly regions
Ludwigia adscendens	Onagraceae	Central America	Common weed of all habitat
		Tropical America	Common weeds in aquatic and marshy habitat
Mikania cordata	Asteraceae		Abundant weed of forest and wasteland; engulf other
Mimosa pudica	Mimosaceae	South America	economic crops by its aggressive growth

Natural forests of Rampahar, Kaptai

Akashmoni- a very common exotic species in Bangladesh

Chapter 2

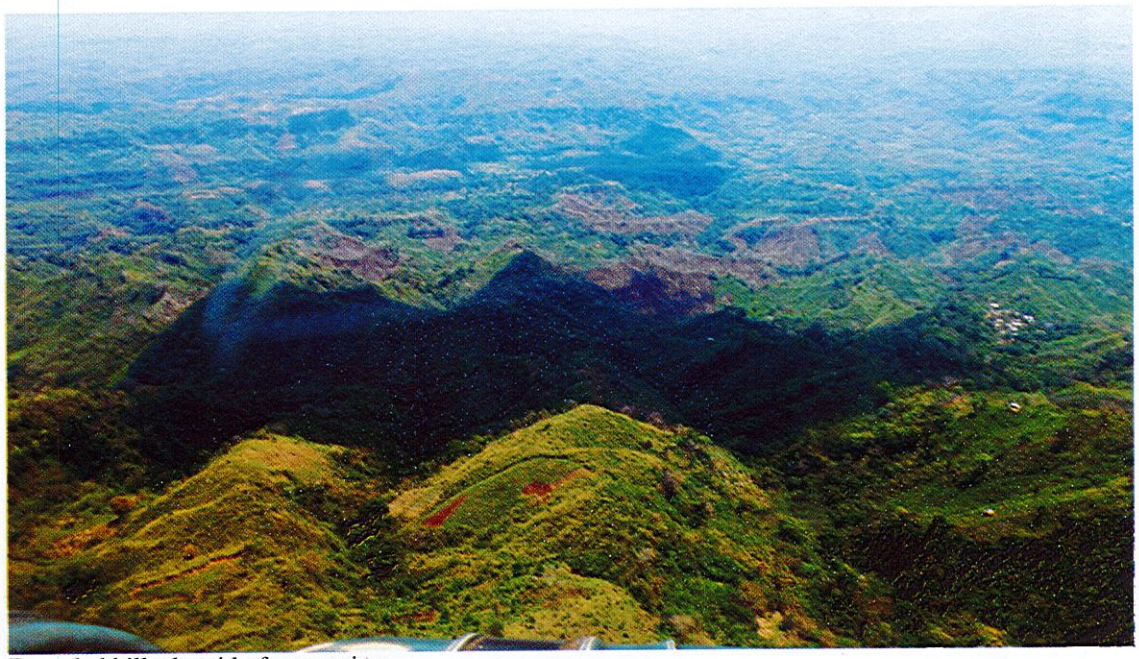
Degradation of Forests and the Disappearance of Tree Species

2.1 Degradation of forests

Global biodiversity is depleting in an alarming rate due to human interferences and environmental degradation, causing high risk of extinction. Human impact on nature has reached at such a high proportion that the world is today witnessing an unprecedented rate of species loss. The present consensus is that the rate of extinction is somewhere between 100 and 1,000 times the pre-industrial background rate. IUCN's Threatened Plant Committee found that about 10% (20,000-30,000) of the worlds flowering plants are dangerously rare or under threat (Eckholm 1980).

Similarly, the forests of Bangladesh have been continuously depleting in terms of both area and quality. Wood fuel is still important in Bangladesh where a high proportion of the population lives in rural areas and do not have access to fossil fuels.

Hill forests are converted to jhum



Denuded hills devoid of vegetation

Denuded hills in Lama

Bangladesh annually lost 2,600 hectares of primary forest between 1990 and 2015 (FAO 2015). There are many forces responsible for forest degradation, collectively and individually and the trends of these forces are very complex. However, the major causes of forest degradation in Bangladesh are agricultural expansion, over-extraction of wood and non-wood resources, infrastructure development, population growth, deforestation, settlement, urbanization and inappropriate management practices (Salam et al. 1999, Hasan and Alam 2006, Hossain et al. 2008). Floral diversity loss is fairly established in Bangladesh, though there are few indepth scientific surveys conducted in the recent past. According to the Encyclopedia of Flora and Fauna of Bangladesh (Ahmed et al. 2008, 2009), at least 13% flora are categorized as threatened in Bangladesh and the disappearance of species is increasing day by day particularly in the hilly areas (AF 2010).

Sal forests are replaced by *Acacia* plantations

2.2 IUCN Red Data Book

Sir Peter Scott, the then Chairman of the IUCN Species Survival Commission (SSC) developed the concept of Red Data Book in 1963 and defined it as "a Register of threatened life that includes definitions of degree of threats". The IUCN Red List of Threatened Species is widely recognized as the most authoritative global assessment of the conservation status of species. Red Lists are a valuable tool to assist conservation planning and decision making. Red Listing involves using available information to assess the conservation status of the taxon in question against the internationally agreed IUCN Red List Categories and Criteria, thus identifying the most rare and threatened species in need of conservation attention. The use of the IUCN Categories and Criteria ensures standardization and allows comparison not only within trees but also with other groups of plants and animals. The IUCN Red List puts available information on a species through several criteria. These criteria ask some questions, from speed of decline of the species in recent times, how widely it is distributed, how many mature individuals are still left, to the chance of them vanishing over the next few years (IUCN 2014).

The production of tree Red Lists contributes to achievement of Target 2 of the Global Strategy for Plant Conservation developed under the Convention on Biological Diversity (CBD). Target 2 calls for *'an assessment of the conservation status of all known plant species, as far as possible, to guide conservation action'* by 2020. A tree may also be nationally or regionally threatened, i.e. its populations are threatened within a particular country or region, rather than across its whole range. The IUCN Red List Categories and Criteria can be adopted to perform national or regional assessments, and various national Red Lists also exist. Article 7 of the CBD calls upon the Parties to identify and monitor important components of biodiversity, including threatened species. Red lists are important tools for identifying threatened species. Species lists are now widely used by conservationists and development practioners. In addition to their value for raising awareness the lists have wide applicability as conservation tools.

2.3 IUCN Red List Categories

IUCN has fostered program for the preparation and publication of 'Red Data Book's to draw attention towards endangered species. There are nine clearly defined categories into which every taxon in the world (excluding micro-organisms) can be classified (**Figure 1**). Complete definitions of the categories are given in Box 1. The first two categories in Figure 1 are relatively self-explanatory. **Extinct** means that there is no reasonable doubt that the last individual has died. **Extinct in the Wild** means that the taxon is extinct in its natural habitat. The following three categories, **Critically Endangered, Endangered** and **Vulnerable**, are assigned to taxa on the basis of quantitative criteria that are designed to reflect varying degrees of threat of extinction; taxa in any of these three categories are collectively referred to as 'threatened'. The category **Near Threatened** is applied to taxa that do not qualify as threatened now, but may be close to qualifying as threatened, and to taxa that do not currently meet the criteria for a threatened category, but are likely to do so if ongoing conservation actions abate or cease (IUCN 2014).

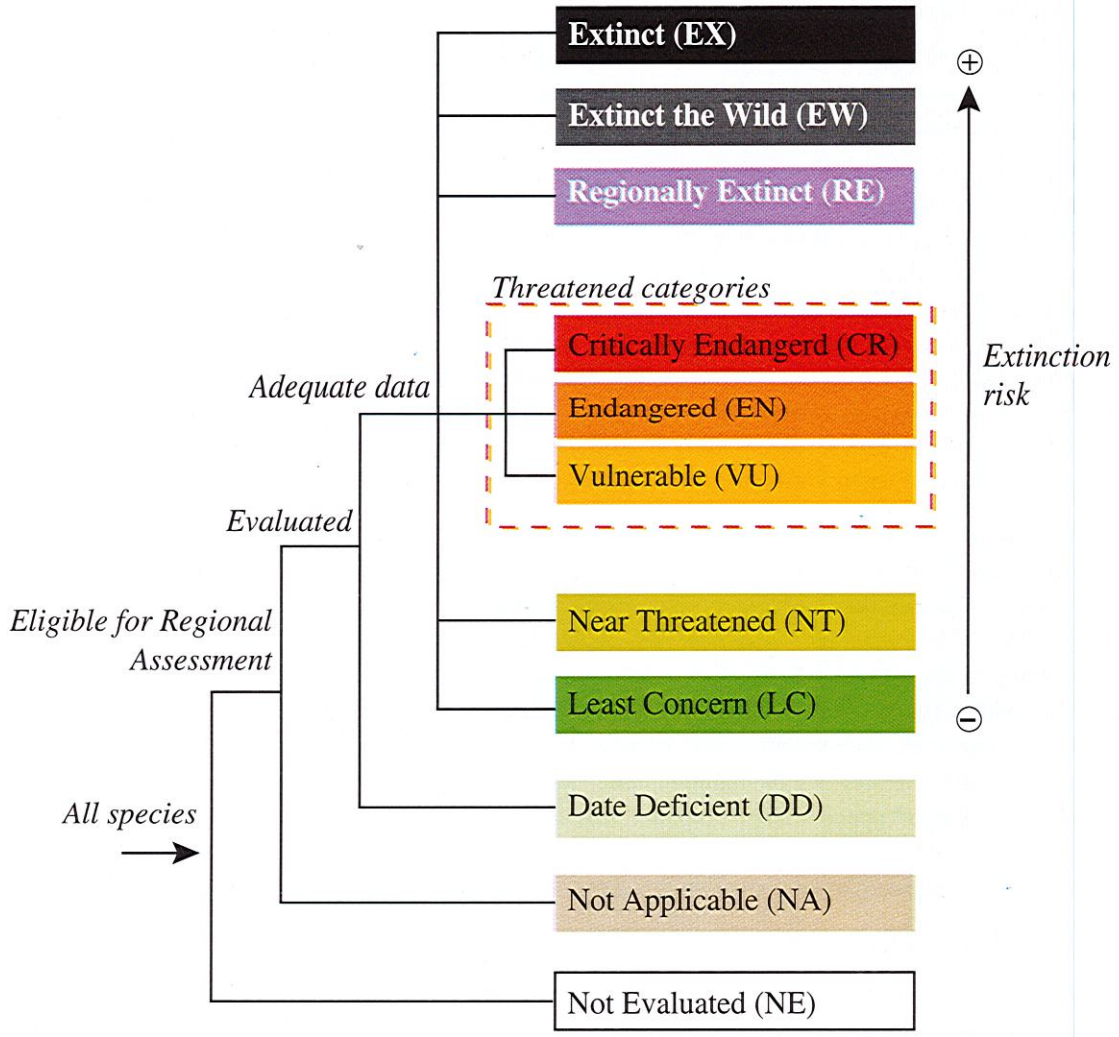


Figure 1. Structure of the IUCN Red List Categories (IUCN 2015)

The category Least Concern is applied to taxa that do not qualify (and are not close to qualifying) as Threatened or Near Threatened. It is important to emphasize that "least concern" simply means that, in terms of extinction risk, these species are of lesser concern than species in other threat categories. It does not imply that these species are of no conservation concern.

The remaining two categories do not reflect the threat status of taxa. The category Data Deficient highlights taxa for which sufficient information is lacking to make a sound status assessment. The category Not Evaluated applies to taxa that have not yet been evaluated against the Red List Criteria.

Box 1: The IUCN Red List Categories (IUCN 2014)

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycles and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

2.4 Tree Red Listing – progress so far

The most commonly cited figure for the fraction of the global flora threatened with extinction—13%—is known to be a serious underestimate, because it does not include a reliable tally of species at risk in the tropical latitudes where most of the world's plants grow (Walter & Gillett 1998, Bramwell 2002). Pitmen and Jorgensen (2002) reported that as many as half of the world's plant species may qualify as threatened with extinction under the World Conservation Union (IUCN) classification scheme. The first analysis of threatened trees was published in the book 'The World List of Threatened Trees' (Oldfield et al. 1998). Over 7,400 of the species assessed qualified as globally threatened. For pragmatic reasons, The World List of Threatened Trees did not cover all of the world's tree species, and there were particularly notable gaps in some taxonomic and geographic areas.

In 2001 a revised version of the IUCN Red List Categories and Criteria was published (version 3.1). Although existing Red List assessments under the old Categories and Criteria are still valid, there is a need to progressively revise assessments using the more recent version. The IUCN/SSC Global Tree Specialist Group aims to fill the gaps in The World List of Threatened Trees and to revise existing assessments using the most up to date categories and criteria, to produce a Global Conservation Assessment of the world's trees by 2020. This is an ambitious target, but good progress is being made. The assessments included in The World List of Threatened Trees have been added to the IUCN Red List and subsequent assessments have been undertaken.

Currently, more than 9,500 trees have been assessed and published on the IUCN Red List, over 6,400 of which are assessed as globally threatened (CR, EN, VU). Over 1,100 trees are assessed as Critically Endangered (CR) on the IUCN Red List and in urgent need of conservation action. Newton and Oldfield (2008) undertook a review of recent progress towards Red Listing the world's tree species. It is estimated that at least an additional 2,500 tree species have been evaluated since 1998, but only a fraction of these have been published on the IUCN Red List. The total number of trees globally threatened with extinction is therefore higher than the number of threatened tree taxa currently published on the IUCN Red List. ***Based on this evidence, it is estimated that over 8,000 tree taxa, 10% of the world's total, are globally threatened with extinction.*** Rivers et al. (2015) reported the compiled list of threatened trees includes 9,641 taxa, of which 1,894 are of Critically Endangered, 3,436 are Endangered and 4,311 are Vulnerable.

2.5 Threatened vascular plants of Bangladesh

There are some reports on the status of threatened plant species in Bangladesh. For example, Huq and Banik (1990) and Khan (1991) reported the endangered forest species of Bangladesh, where both the reports mentioned only one species in common (*Aquillaria agallocha*) to have the status of endangered species (**Table 6**).

Table 6. The endangered forest species of Bangladesh (Huq and Banik 1990, Khan 1991)

Huq and Banik (1990)		Sl. No.	Khan (1991)	
Local name	**Scientific name**		**Local name**	**Scientific name**
Haldu	*Adina cordifolia*	1	Habinishak	*Aglaonema clarkei*
Pitraj	*Aphanamixis polystachya*	2	Malakkha	*Akdrovanda vesiculosa*
Agar	*Aqullaria agallocha*	3	Agar	*Aqullaria agallocha*
Mohua	*Bassia latifolia*	4	---	*Cirrhopetalum roxburghii*
Kesujya	*Bauhinia malabarica*	5	Ajay Ghas	*Cymbopogon osmastonil*
Batna	*Castanopsis tribuloides*	6	----	*Debregeasia dentata*
Lohasirij, Koroi	*Derris robusta*	7	Bamun	*Ealeocarpus lucidus*
Tomal	*Diospyros cordifolia*	8	Katha paharia	*Hippocratea marcantha*
Bhadi	*Garuga pinnata*	9	----	*Homalium schlichil*
Chalmugra	*Hydnocarpus kurzii*	10	Gulancha	*Justicia oreophylla*
Raktan	*Lophopetalum fimbriatum*	11	------	*Knema benghalensis*
Nageswar	*Mesua ferrea*	12	Karpur	*Limnophila cana*
Dakroom	*Mitragyna parvifolia*	13	------	*Mantisia spathulata*
Bansh pata	*Podocarpus neriifolia*	14	Jitti, Reyong	*Marsdenia thyrsiflora*
Muchigandha	*Pterospermum acerifolium*	15	Ganja kull	*Ophiorrhiza villosa*
Narikeli	*Pterygota alata*	16	Pitul pata	*Phrynium imbricum*
Kusum	*Schleichera oleosa*	17	Kalibatna	*Quercus acuminata*
Box Badam	*Sterculia foetida*	18	---	*Rotala simpliciuscula*
Civit	*Swintonia floribunda*	19	Bhela	*Semecarpus subpanduriformis*
Tentul	*Tamarindus indica*	20	Lemchi, Lemshi	*Sonneratia griffithii*
		21	Palaya lata	*Spatholobus listeri*
		22	-----	*Tournefortia roxburghii*
		23	Ghet kachu	*Typhonium listeri*
		24	----	*Vatica scaphula*
		25	----	*Vemonia thomsoni*

Khan et al. (2001) published Red Data Book of Vascular Plants of Bangladesh Vol. 1 listing 106 species of threatened plant species of various categories. Among the species, 26 are tree species including one tree palm, one woody climber and the rest 24 are tree species (**Table 7**). Thereafter, Rahman (2003) and Rahman et al. (2010) reported 76 species as threatened in the wild under different IUCN categories.

Table 7. Threatened vascular plants of Bangladesh (Khan et al. 2001)

No.	Scientific name	Local name	Family	Habit	Conservation status
1	*Buchanania lancifolia*	Chikki	Anacardiaceae	Tree	NE*
2	*Holigarna longifolia*	Jhawa/Barola	Anacardiaceae	Tree	DD
3	*Magifera sylvatica*	Uri Am	Anacardiaceae	Tree	NE
4	*Swintonia floribunda*	Civit	Anacardiaceae	Tree	DD
5	*Desmos longiflorus*	Kulla	Annonaceae	Tree	NE
6	*Sageraea listeri*	Dhaman	Annonaceae	Tree	NE
7	*Uvaria lurida*	Not known	Annonaceae	Woody climber	NE
8	*Bombax insigne*	Not known	Bombacaceae	Tree	DD
9	*Balsamodendron roxburghii*	Not known	Burseraceae	Tree	NE
10	*Canarium bengalense*	Borsam	Burseraceae	Tree	NE
11	*Canarium resiniferum*	Dhup	Burseraceae	Tree	NE
12	*Terminalia citrina*	Hatiyal, Haritaki	Combretaceae	Tree	DD
13	*Cycas pectinata*	Not known	Cycadaceae	Tree	LR (cd)
14	*Anisoptera scaphula*	Boilam	Dipterocarpaceae	Tree	DD
15	*Elaeocarpus acuminatus*	Not known	Elaeocarpaceae	Tree	NE
16	*Lithocarpus acuminata*	Dooba batna	Fagaceae	Tree	NE
17	*Homalium schlichii*	Not known	Flacourtiaceae	Tree	NE
18	*Hydnocarpus kurzii*	Chaulmugra	Flacourtiaceae	Tree	NE
19	*Litsea clarkei*	Not known	Lauraceae	Tree	NE
20	*Calliandra umbrosa*	Not known	Leguminosae	Tree	NE
21	*Magnolia pterocarpa*	Duli champa	Magnoliaceae	Tree	NE
22	*Dysoxylum binectarium*	Rata	Meliaceae	Tree	NE
23	*Knema bengalensis*	Khude Barala	Myristicaceae	Tree	VU
24	*Corypha taliera*	Tali	Palmae	Tree (palm)	CR
25	*Pterospermum semisagittatum*	Lana	Sterculiaceae	Tree	DD
26	*Aquilaria agallocha*	Agar	Thymelaeaceae	Tree	DD

[*CR- Critically Endangered, VU- Vulnerable, LR- Lower Risk, cd- Conservation dependent, DD- Data Deficient, NE- Not Evaluated]

Protected species are species protected by international, national and provincial legislation. Hunting, picking, owning, importing, exporting, transporting, growing, breeding and trading of such species are illegal without valid permits or licences. The names of protected species are listed in international conventions, national acts and provincial ordinances. In Bangladesh, 54 plants are categorized as protected plants giving emphasise for their conservation (Anon 2012). Among the species, 34 are tree, I under-shrub, 3 climber, 4 herb and 10 species are orchids (**Table 8**).

Table 8. Protected plants of Bangladesh

No.	Scientific name	Local name	Family	Habit
1	*Abrus precatorius*	Kunch	Fabaceae	Climber
2	*Aegiceras corniculatum*	Khalshi	Myrsinaceae	Small tree
3	*Amherstia nobilis*	Raj asok/Parijat	Caesalpiniaceae	Tree
4	*Amoora cucullata*	Amur	Meliaceae	Tree
5	*Anisoptera scaphula*	Boilam	Dipterocarpaceae	Tree
6	*Barringtonia racemosa*	Samundarphal	Lecythidaceae	Tree
7	*Bouea oppositifolia*	Mailam	Anacardiaceae	Tree
8	*Calophyllum polyanthum*	Kamdeb	Guttiferae	Tree
9	*Canarium resiniferum*	Dhup	Burseraceae	Tree
10	*Careya arborea*	Kumbi	Lecythidaceae	Tree
11	*Castanopsis armafa*	Katalal batna	Fagaceae	Tree
12	*Cinnamomum camphora*	Karpur	Lauraceae	Tree
13	*Cinnamomum iners*	Tajbahol	Lauraceae	Tree
14	*Cochlospermum religiosum*	Galgal	Bixaceae	Tree
15	*Corypha taliera*	Tali palm	Arecaceae	Tree
16	*Cycas pectinata*	Maniraj cycas	Cycadaceae	Small tree
17	*Cynometra ramiflora*	Shingra	Caesalpiniaceae	Tree
18	*Diospyros montana*	Tamal	Ebenaceae	Tree
19	*Palaquium polyanthum*	Tali	Sapotaceae	Tree
20	*Ficus ripens*	Lata bot	Moraceae	Tree
21	*Ficus rumphii*	Gaya aswatha	Moraceae	Tree
22	*Ficus triangularis*	Trikoni bot	Moraceae	Tree
23	*Hemidesmus indicus*	Anantamul	Apocynaceae	Undershrub
24	*Holarrhena pubescens*	Kurchi	Apocynaceae	Tree
25	*Lumnitzera racemosa*	Khirpa	Combretaceae	Tree
26	*Mentha spicata*	Papermint	Lamiaceae	Herb
27	*Mangifera sylvatica*	Uriam	Anacardiaceae	Tree
28	*Magnolia grandiflora*	Uday padma	Magnoliaceae	Tree
29	*Magnolia pumila*	Jahari champa	Magnoliaceae	Tree
30	*Podocarpus neriifolius*	Banspata	Podocarpaceae	Tree
31	*Pterocarpus dalbergioides*	Paduk	Fabaceae	Tree
32	*Pterygota alata*	Narikeli/Buddha Narikel	Sterculiaceae	Tree
33	*Sapindus mukorosi*	Rita	Sapindaceae	Tree
34	*Schleichera oleosa*	Kusum/Joyna	Sapindaceae	Tree
35	*Sterculia villosa*	Udal	Sterculiaceae	Tree

No.	Scientific name	Local name	Family	Habit
36	*Swintonia floribunda*	Civit	Anacardiaceae	Tree
37	*Tetrameles nudiflora*	Chundul	Datiscaceae	Tree
38	*Trachyspermum ammi*	Jain	Apiaceae	Herb
39	*Vitex peduncularis*	Harina	Verbenaceae	Tree
40	*Vitis quadrangularis*	Harjora	Vitaceae	Climber
41	*Xylocarpus mekongensis*	Passur	Meliaceae	Tree
42	*Bulbophyllum roxburghii*	Bulbophyllum	Orchidaceae	Orchid
43	*Cymbidium aloifolium*	Cymbidium	Orchidaceae	Orchid
44	*Dendrobium maccarthiae*	Dendrobium	Orchidaceae	Orchid
45	*Dendrobium macrophyllum*	Dendrobium	Orchidaceae	Orchid
46	*Dendrobium nobile*	Dendrobium	Orchidaceae	Orchid
47	*Dendrobium primulinum*	Dendrobium	Orchidaceae	Orchid
48	*Eulophia mackinnonii*	Duthie	Orchidaceae	Orchid
49	*Nepenthes khasiana*	Pitcher plant	Nepenthaceae	Orchid
50	*Paphiopedilum* sp.	Ladies slipper	Orchidaceae	Orchid
51	*Rananthera inchootiana*	Red vanda	Orchidaceae	Orchid
52	*Saussurea lappa*	Kuth	Orchidaceae	Orchid
53	*Vanda coerulea*	Blue Vanda	Orchidaceae	Orchid
54	*Vandopsis gifantca*	Ornamental orchid	Orchidaceae	Orchid

Meanwhile, the second volume of Red Data Book of Vascular Plants of Bangladesh published with 120 species in different IUCN categories (Ara et al. 2013), of which 59 small tree to larege tree were categorized as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (**Table 9**). Among the 59 species, 13 are Critically Endangered, 21 are Endangered, and 25 are Vulnerable.

Table 9. Threatened vascular plants of Bangladesh (Ara et al. 2013)

No.	Scientific name	Local name	Family	Habit	Conservation status
1	*Alphonsea ventricosa*	Noga Kola	Annonaceae	Tree	EN*
2	*Ancistrocladus wallichii*	Nk*	Ancistrocladaceae	Small tree	CR
3	*Antidesma khasianum*	Khasia Jam	Euphorbiaceae	Shrub/ Small tree	VU
4	*Antidesma montanum var. salicinum*	Nk	Euphorbiaceae	Shrub/Small tree	VU
5	*Atalantia monophylla*	Ban Kamola	Rutaceae	Tree	EN
6	*Beilschmiedia roxburghiana*	Nk	Lauraceae	Tree	EN
7	*Bhesa robusta*	Salkachra	Celastraceae	Tree	VU
8	*Brownlowia elata*	Moos	Tiliaceae	Tree	VU
9	*Careya sphaerica*	Nk	Lecythidaceae	Tree	CR

No.	Scientific name	Local name	Family	Habit	Conservation status
10	*Casearia kurzii*	Shokshi Gach	Flacourtiacaeae	Tree	EN
11	*Castanopsis castanicarpa*	Huria Batna	Fagaceae	Tree	VU
12	*Chisocheton dysoxylifolius*	Nk	Meliaceae	Tree	VU
13	*Cryptocarya amygdalina*	Bhuiya Gachh	Lauraceae	Tree	EN
14	*Cryptocarya andamanica*	Nk	Lauraceae	Tree	CR
15	*Cyclobalanopsis oxyodon*	Batna	Fagaceae	Tree	EN
16	*Dehassia kurzii*	Modon-mosto	Lauraceae	Tree	VU
17	*Diospyros benghalensis*	Lohamori, Khalta	Ebenaceae	Tree	VU
18	*Diospyros ramiflora*	Oori Gab, Goolul	Ebenaceae	Tree	EN
19	*Dolichandrone spathaecea*	Gorshingiah	Bignoniaceae	Tree	EN
20	*Dryptes assamica*	Ban Bokul	Euphorbiaceae	Tree	EN
21	*Elaeocarpus petiolatus*	Nk	Elaeocarpaceae	Tree	EN
22	*Elaeocarpus prunifolius*	Nk	Elaeocarpaceae	Tree	EN
23	*Elaeocarpus rugosus*	Phul Champa	Elaeocarpaceae	Tree	VU
24	*Euonymus attenuates*	Nk	Celastraceae	Tree	VU
25	*Garcinia anomala*	Thechu	Clusiaceae	Tree	EN
26	*Garcinia lanceaefolia*	Cow, Thisuru	Clusiaceae	Tree	VU
27	*Gardenia resinifera*	Dikamali	Rubiaceae	Tree	CR
28	*Glochidion heyneanum*	Nk	Euphorbiaceae	Tree	EN
29	*Glochidion sphaerogynum*	Kaimula	Euphorbiaceae	Tree	VU
30	*Heritiera papilio*	Papilio Sundori	Sterculiaceae	Tree	CR
31	*Homalium nepalense*	Nk	Flacourtiaceae	Small tree	CR
32	*Horsfieldia amygdalina*	Holdu Barella	Myristicaceae	Tree	VU
33	*Horsfieldia kingii*	Nk	Myristicaceae	Tree	VU
34	*Ilex embelioides*	Nk	Aquifoliaceae	Tree	CR
35	*Ilex odorata*	Nk	Aquifoliaceae	Tree	EN
36	*Knema clarkeana*	Nk	Myristicaceae	Tree	VU
37	*Lepisanthes tetraphylla*	Nk	Sapindaceae	Shrub/Tree	VU
38	*Lithocarpus thomsonii*	Dholi-batna	Fagaceae	Tree	VU
39	*Litsea thomsonii*	Nk	Lauraceae	Tree	VU
40	*Machilus fruticosa*	Nk	Lauraceae	Tree	EN
41	*Mastixia macrophylla*	Nk	Cornaceae	Tree	CR
42	*Mesua floribunda*	Banspatti	Clusiaceae	Tree	CR
43	*Michelia mannii*	Nk	Magnoliaceae	Tree	CR
44	*Michelia panduana*	Nk	Magnoliaceae	Tree	CR
45	*Mitrephora maingayi*	Thabut net	Annonaceae	Tree	EN
46	*Nyssa javanica*	Nk	Nyssaceae	Tree	CR
47	*Phoenix acaulis*	Ban Khejur	Arecaceae	Palm	EN

No.	Scientific name	Local name	Family	Habit	Conservation status
48	*Picrasma javanica*	Nilghanta	Simaroubaceae	Tree	VU
49	*Polyalthia simiarum*	Arjan, Chami	Annonaceae	Tree	VU
50	*Scaphium scaphigerum*	Shampan, Pogan	Sterculiaceae	Tree	VU
51	*Siphonodon celastrineus*	Katt bel	Celastraceae	Tree	EN
52	*Sterculia versicolor*	Nk	Sterculiaceae	Tree	EN
53	*Symplocos macrophylla*	Nk	Symplocaceae	Tree	VU
54	*Syzygium reticulatum*	Nk	Myrtaceae	Tree	EN
55	*Tetradium glabrifolium*	Ban-Neem	Rutaceae	Shrub/ Tree	EN
56	*Trivalvaria dubia*	Nk	Annonaceae	Tree	VU
57	*Turpinia cochinchinensis*	Tauk Shama	Staphyleaceae	Tree	VU
58	*Wendlandia heyneana*	Dhali Rong Gach	Rubiaceae	Shrub/ Tree	CR
59	*Xerospermum laevigatum*	Ban Lichu	Sapindaceae	Tree	VU

[*Nk-Not known, CR- Critically Endangered, VU- Vulnerable, EN-Endangered]

A complete inventory of 13 angiosperm families (Anacardiaceae, Annonaceae, Apocynaceae, Asclepiadaceae, Begoniaceae, Boraginaceae, Cucurbitaceae, Magnoliaceae, Menispermaceae, Myrsinaceae, Periplocaceae, Rubiaceae and Vitaceae) by Rahman (2013) reported 520 species as Endangered, of which 235 plant species were categorized as threatened in different categories (69 were assessed as extinct, 128 endangered, 20 vulnerable and 13 as others (**Table 10**). Among these species, 22 species have already been included as threatened in Khan et al. (2001). Among the remaining 213 threatened species, 55 belong to small to large trees (Rahman 2013).

Table 10. Threatened plants of 13 angiosperm families in Bangladesh (Rahman 2013)

Family	Species No.	No. of Threatened species	Extinct	Critically Endangered	Endangered	Vulnerable	Others
Anacardiaceae	24	17	03	00	12	02	00
Annonaceae	42	28	06	00	17	02	03
Apocynaceae	46	14	02	00	10	01	01
Asclepiadaceae	67	42	19	00	15	07	01
Begoniaceae	08	04	01	00	02	00	01
Boraginaceae	20	04	01	00	01	01	01
Cucurbitaceae	41	19	04	00	14	00	01
Magnoliaceae	11	05	00	00	04	00	00
Menispermaceae	16	09	01	01	05	02	00
Myrsinaceae	22	12	03	00	07	03	00
Periplocaceae	08	07	01	00	06	00	00
Rubiaceae	186	60	22	02	31	04	01
Vitaceae	29	14	06	00	04	00	04
Total	**520**	**235**	**69**	**03**	**128**	**22**	**13**

However, floral diversity loss is fairly established in Bangladesh, though there are few scientific surveys in the recent past. The number of angiosperm flora describes in Encyclopaedia of Flora and Fauna is 3,611 (Ahmed at el. 2008, 2009), of which at least 13% of these species are becoming threatened (**Table 11**). Many of the floras have not been collected or reported since they were first described.

Table 11. Threatened vascular plants of Bangladesh (Ahmed et al. 2008, Irfanullah 2011)

Plant Groups	Total No. of species	Critically Endangered	Endangered	Vulnerable	Threatened species
Pteridophytes	195	0	0	36	36
Gymnosperms	7	0	1	0	1
Dicotyledons	2623	8	80	179	267
Monocotyledons	988	22	46	114	182
Total	3,813	30	127	329	486

Bangladesh needs to focus on completing the Red List of threatened plants for developing conservation programmes. Since Bangladesh has more than 5,000 vascular plants, it will be a huge task to make a Red List. Progress of preparing plant Red List has so far been very slow, thus needs immediate attention. The Bangladesh National Herbarium (BNH) needs to lead the way with IUCN, Bangladesh Forest Department, Bangladesh Forest Research Institute (BFRI), Universities and other research organisations, capitalising on the recent experiences of the animal Red List of Bangladesh (IUCN 2015).

Chapter 3

Conservation of Forest Trees

3.1 Need for conservation

Loss of plant diversity in Bangladesh would probably be severe because of high density human population and the resultant adverse effects on the quality and quantity of land. The country already lost many plant species that were once abundant in this region. Conservation of plants is needed in relation to the needs of agriculture, medicine and industry. Conservation of tree resources is must for sustainable development of the natural resources of a country and is important to maintain the existence of life on earth (Subrahmanyam and Sambamurty 2006). Usually the more diverse the tree species, the forest will be more sustainable with respect to the production of both goods and services. Tree species reduces soil erosion, increases water holding capacity, infiltration and microbial activity ensures stability of nutrient cycle and ultimately the improvement of soil condition. More diversification of species results in more gene conservation. Native trees play a major role in mitigating climate change by contributing to long-term sequestration of carbon in a number of biomes. Tree diversity underpins ecosystem resilience and plays a critical role as part of disaster risk reduction and peace-building strategies (Soeriamegara and Lemmens 1993).

More biodiversity means more production of seeds and other planting materials that enhances more regeneration. Diversified tree species produce more fertile regenerating materials due to cross breeding, hence more success in regeneration processes. Natural forest with more tree species increases the aesthetic values that provide the recreational facilities for tourist and local people. More tree increase employment opportunity through nature based industries such as saw mills, forest based industries, cottage industries, herbal medicinal industries etc. According to Ellison (2016), if biodiversity really matters for the planet, and is essential for humanity's well-being, we need to get real about what it will take to conserve it for future generations and to protect endangered species from extinction, the ecological community must become more politically involved.

The World Summit on Sustainable Development (WSSD) Plan of Implementation considers that the CBD is the key instrument for the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from the use of genetic resources. The Plan of Implementation reinforces the implementation of the CBD Workplan for Forest Diversity agreed at the sixth Conference of the Parties (COP6) to CBD. The conservation methods will, however, vary according to the specific objectives of conservation, and the distribution and biological nature of the material to be conserved (FAO 1989). Method is often used to denote different concepts: *in situ* conservation, *ex situ* conservation, ecosystem conservation, static conservation, selective conservation, conservation in use, and possibly more. A variety of conservation actions can be undertaken for threatened trees, each approach offering different merits. Not all approaches will be suitable for all trees, and the appropriate action will be dependent on the specific tree taxon in question (**Table 12**).

Table 12. Conservation options for threatened tree species

In situ	Tree diversity managed and monitored in natural habitats. This may include establishment of protected areas, monitoring and patrolling of individual species or populations, sustainable harvesting from wild populations and mechanisms to prevent illegal logging.
Ex situ	Tree diversity conserved outside of natural habitats. *Ex situ* collections are held in the form of germplasm (seed banks, cryopreservation, micropropagation) or living plants (conservation collections, reference collections or display specimens).
Reintroduction, recovery and restoration programmes	Research into the reproductive biology, genetics and ecology of tree species informs conservation actions.
Research	Research into the reproductive biology, genetics and ecology of

3.2 Protected Areas (PAs) and conservation of biodiversity in Bangladesh

Protected Areas (PAs) are "Areas especially dedicated to the protection and maintenance of biological diversity and associated cultural resources, which are managed through legal or other effective means". Bangladesh currently has 38 protected areas (**Table 13**). Seven National Parks, 12 Wildlife Sanctuaries, one Safari Park and one Marine Protected Area (MPA) have been declared by the government to conserve wildlife and their habitats since 2010, after the submission of the Fourth National Report to the CBD (MoEF, 2010). Protected Areas now covers 10.72% of total forest area which is 1.8% of the total land area of Bangladesh. The country has increased the PAs including several wetland ecosystems. The declaration of Protected Areas (PAs) in Bangladesh often exists without any management plan or plan of action. There are several PAs in the country with areas of 500 hectares or less which is too small to provide adequate habitat to preserve many species. In practice, these areas remain unprotected and both legal and illegal activities are continuing to diminish the quality of biodiversity of the PAs (Kabir and Muzaffar 2002, Muzaffar et al. 2007, 2011). Functionally, most of the PAs are not really protected from illegal activities till now.

Table 13. Protected areas of Bangladesh

Sl. No.	National Parks	Location	Area (ha)	Established
1	Bhawal National Park	Gazipur	5022.00	11-5-1982
2	Madhupur National Park	Tangail/ Mymensingh	8436.00	24-2-1982
3	Ramsagar National Park	Dinajpur	27.75	30-4-2001
4	Himchari National Park	Cox's Bazar	1729.00	15-2-1980
5	Lawachara National Park	Moulavibazar	1250.00	7-7-1996
6	Kaptai National Park	CHT	5464.00	9-9-1999
7	Nijhum Dweep National Park	Noakhali	16352.23	8-4-2001

Sl. No.	National Parks	Location	Area (ha)	Established
8	Medhakachhapia National Park	Cox's Bazar	395.92	8-8-2008
9	Satchari National Park	Habigonj	242.91	15-10-2005
10	Khadimnagar National Park	Sylhet	678.80	13-04-2006
11	Baroiyadhala National Park	Chittagong	2933.61	06-04-2010
12	Kuakata National Park	Patuakhali	1613.00	24-10-2010
13	Nababgonj National Park	Dinajpur	517.61	24-10-2010
14	Singra National Park	Dinajpur	305.69	24-10-2010
15	Kadigarh National Park	Mymensingh	344.13	24-10-2010
16	Altadighi National Park	Naogaon	264.12	24-12-2011
17	Birgonj National Park	Dinajpur	168.56	24-12-2011

B) Wildlife Sanctuaries

Sl. No.	National Parks	Location	Area (ha)	Established
18	Rema-Kalenga Wildlife Sanctuary	Hobigonj	1795.54	7-7-1996
19	Char Kukri-Mukri WS	Bhola	40.00	19-12-1981
20	Sundarban (East) WS	Bagerhat	31226.94	6-4-1996
21	Sundarban (West) WS	Satkhira	71502.10	6-4-1996
22	Sundarban (South) WS	Khulna	36970.45	6-4-1996
23	Pablakhali WS	Chittagong Hill Tracts	42087.00	20-9-1983
24	Chunati WS	Chittagong	7763.97	18-3-1986
25	Fashiakhali WS	Cox's Bazar	1302.43	11-4-2007
26	Dudpukuria-Dhopachari WS	Chittagong	4716.57	6-4-2010
27	Hazarikhil WS	Chittagong	1177.53	6-4-2010
28	Sangu WS	Bandarban	2331.98	6-4-2010
29	Teknaf WS	Cox's Bazar	11615.00	24-03-2010
30	Tengragiri WS	Barguna	4048.58	24-10-2010
31	Dudhmukhi WS	Bagerhat	170.00	29-01-2012
32	Chandpai WS	Bagerhat	560.00	29-01-2012
33	Dhangmari WS	Bagerhat	340.00	29-01-2012
34	Sonarchar WS	Patuakhali	2026.48	24-12-2011
35	Nazirganj (Dolphin) Sanctuary	Pabna	146.00	01-12-2013
36	Shilanda-Nagdemra	Pabna	24.17	01-12-2013
37	Nagarbari-Mohanganj Dolphin Sanctuary	Pabna	408.11	01-12-2013
C) Marine Protected Area				
38	Swatch of No-Ground	Bay of Bengal	1,738	27-10-2014

d) Botanical Gardens

The Bangladesh Forest Department manages some Botanical Gardens, Safari Parks and several Eco-parks in different parts of the country (**Table 14**). Although these sites are mostly used for recreational purposes, they also harbour a diverse community of flora and fauna. The total area coverage of Botanical gardens and eco-parks is 9,434.18 hectares which is 0.06% of the total country (DoE 2015).

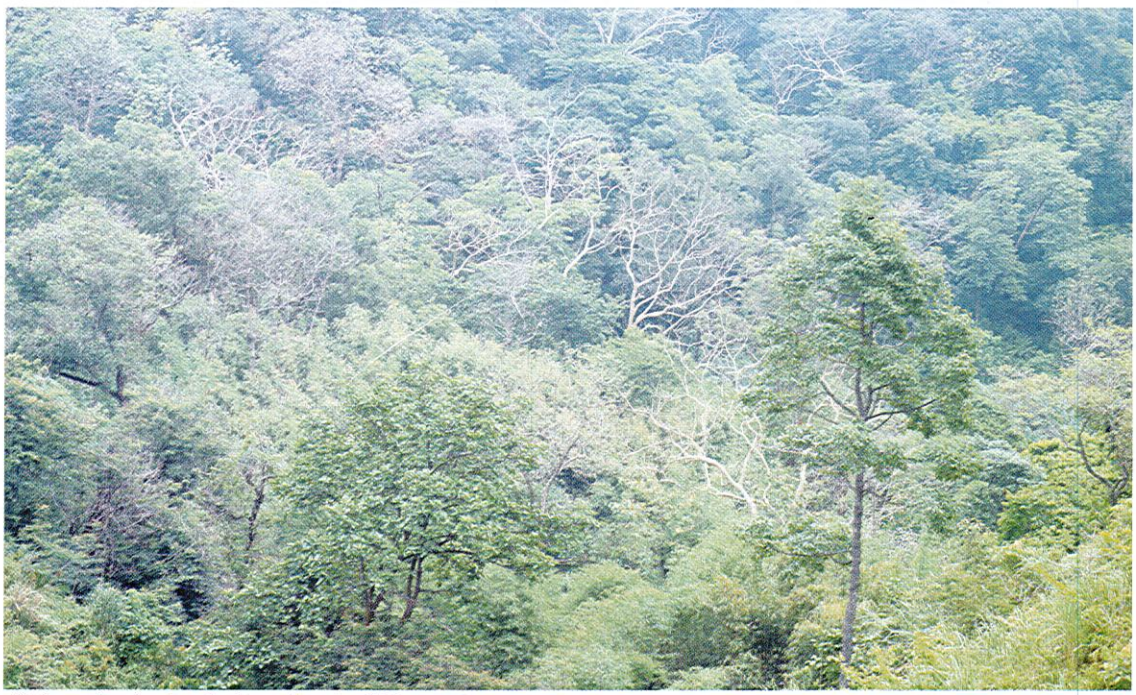
Table 14. Botanical Gardens and Eco-parks of Bangladesh

No.	Protected Areas	Ecosystem	Conservation Focus	Location	Area (ha.)	Date
1	Baldha Garden	Man made	Education, PGR	Dhaka	1.37	1909
2	National Botanical Garden	Man made	Plant species	Dhaka	84.21	1961
3	Bangabandhu Safari Park at Dulahazara, Cox's Bazar	Mixed Evergreen	Wildlife species	Cox's Bazar	600.0	1999
4	Sitakunda Botanical Garden & Eco	Mixed Evergreen	Plant species	Chittagong	808.00	2000
5	Madhabkunda Eco Park	Mixed Evergreen	Natural	Moul	265.68	2001
6	Madhutila Eco Park	Deciduous Forest	Natural	Sherpur	100.00	2001
7	Banshkhali Eco Park	Mixed Evergreen	Natural	Chittagong	1,200.00	2003
8	Kuakata Eco Park	Coastal beach	Natural	Patuakhali	5,661.00	2005
9	Tilagar Eco Park	Mixed Evergreen	Natural	Sylhet	45.34	2006
10	Borshijora Eco Park	Mixed Evergreen	Natural	Moulavibazar	326.0	2006
11	Bangabandhu Sheikh Mujib Safari Park, Gazipur	Deciduous Forest	Education, recreation, wildlife	Gazipur	1,542.51	2014
	Total				**9,434.18**	

3.3 Initiatives of Arannayk Foundation for conservation of threatened tree species

The Arannayk Foundation (AF), also known as the Bangladesh Tropical Forest Conservation Foundation was established in 2003 by the joint initiative of the Governments of the People's Republic of Bangladesh and the United States of America based on the provisions of the US Tropical Forest Act of 1998. The mission of AF is to facilitate the conservation, protection, restoration and sustainable use of tropical forests in Bangladesh. AF has been supporting IFESCU since 2006 for developing effective means and ways to conserving and restoring threatened tree species of Bangladesh. IFESCU research team made an exploratory survey of major forests in the hilly areas in the east and southeast of Bangladesh and identified threatened native tree species of the natural forests. The research team located the remaining individual trees or stands of the selected threatened species and collected seeds or scions from those trees for propagation and conservation. Through trials at the IFESCU nursery, propagation protocols were developed for those species and subsequently planted their seedlings in the Chittagong University campus. So far, the research team has planted seedlings of 60 threatened native tree species in Chittagong University campus which will be the source of seeds and field for research works for the students in near future.

A patch of mixed plantation in CU campus



Old patch of mixed plantation in CU campus

3.4 Conservation of threatened tree species in Chittagong University campus

The University of Chittagong was established in 1966 at Fatehpur of Hathazari Upazila, Chittagong district. The Campus lies some 22 kilometers north of the Chittagong town and lies between about 22°27'30" and 22°29'0" North latitudes and 91°46'30" and 91°47'45" East longitudes and covers about 710 ha (1,754 acres) of land. The Campus stretches over a landscape of green hills, undulating valleys, lakes, moulds plain grass land and green forests. According to geology and landform, the area is divided into two main physiographic units-valleys and hills. The altitude of the hills ranges from 14 to 87 meters. The area enjoys a tropical monsoon climate, charactertized by hot, humid summer and cool dry winter. The land is suitable for all different life forms of both flora and fauna.

The original vegetation of the University campus falls under the tropical wet evergreen and semi-evergreen forests (Islam et al. 1979) but eroded severely due to biotic interferences. It was then converted in to secondary forest (scrubs) with weedy environment, such as thickets with a few scattered trees and thatching grasses. In a view to have quick vegetation cover in these barren hills, both the indigeneous and exotic species have been planded since 1982 under a systematic plantation program by the University and the program is continued till todate. A study reveal the floral diversity of the campus now consists of more than 832 angiospermic species of which 655 are dicots and 177 are monocots (Momem et al. 2006). The Campus also hosts some globally threatened plant species and plays an important role in conservation of germplasms. Besides hilly areas, there are diverse water bodies such as ponds, lakes, streams, reservoirs, canals and moist valleys where luxuriant growth of algae, fern, orchids and other aquatic flora, fauna and microorganisms are found.

University of Chittagong is one of the few installations in Bangladesh with rich floristic composition. Ecologically the area is under sub-tropical region and host of a number of evergreen and deciduous tree species. Plantation programme is also going on since the emergence of the Department of Botany and Institute of Forestry and Environmental Sciences to compensate, conserve and improve the forest genetic resources of the campus. Forest genetic resources can be used as tool for studies, research for new technologies, new findings and use of the forest products etc. Vegetation diversity is generally regarded as a cleansing agent of the air and is a source of freshness and quality of the air. It will also provide safe habitat for wildlife, conserve and improve soil quality and generate opportunities of income and employment for the local poor. One of the purposes of the conservation of biodiversity in Chittagong University Campus is to make it a recreational, conservation, future seed sources and research venue utilizing the native threatened forest genetic resources.

The University authority first initiated a small-scale plantation program in 1973. Except for roadside plantation, the progress was slow till 1982 where an afforestation program was taken up by the then Institute of Forestry. A total of 180 hectares of hilly area has been planted with both exotic and indigenous species so far. Seedling Seed Orchard of both the Civit and Banspata have already been established in the campus through the financial supports of

Arannayk Foundation during 2007-2009 (Hossain et al. 2012, Bhuiyan et al. 2014). The present programme is the continuation of conservation of native tree species from the natural forests of the country.

With the financial support from Arannayk Foundation (AF), the Institute of Forestry and Environmental Sciences of Chittagong University (IFESCU) implementing the identification of threatened tree species through field visit and establish its *ex-situ* conservation at 5 sites in the University campus during 2011-2015 (**Fig. 2**).

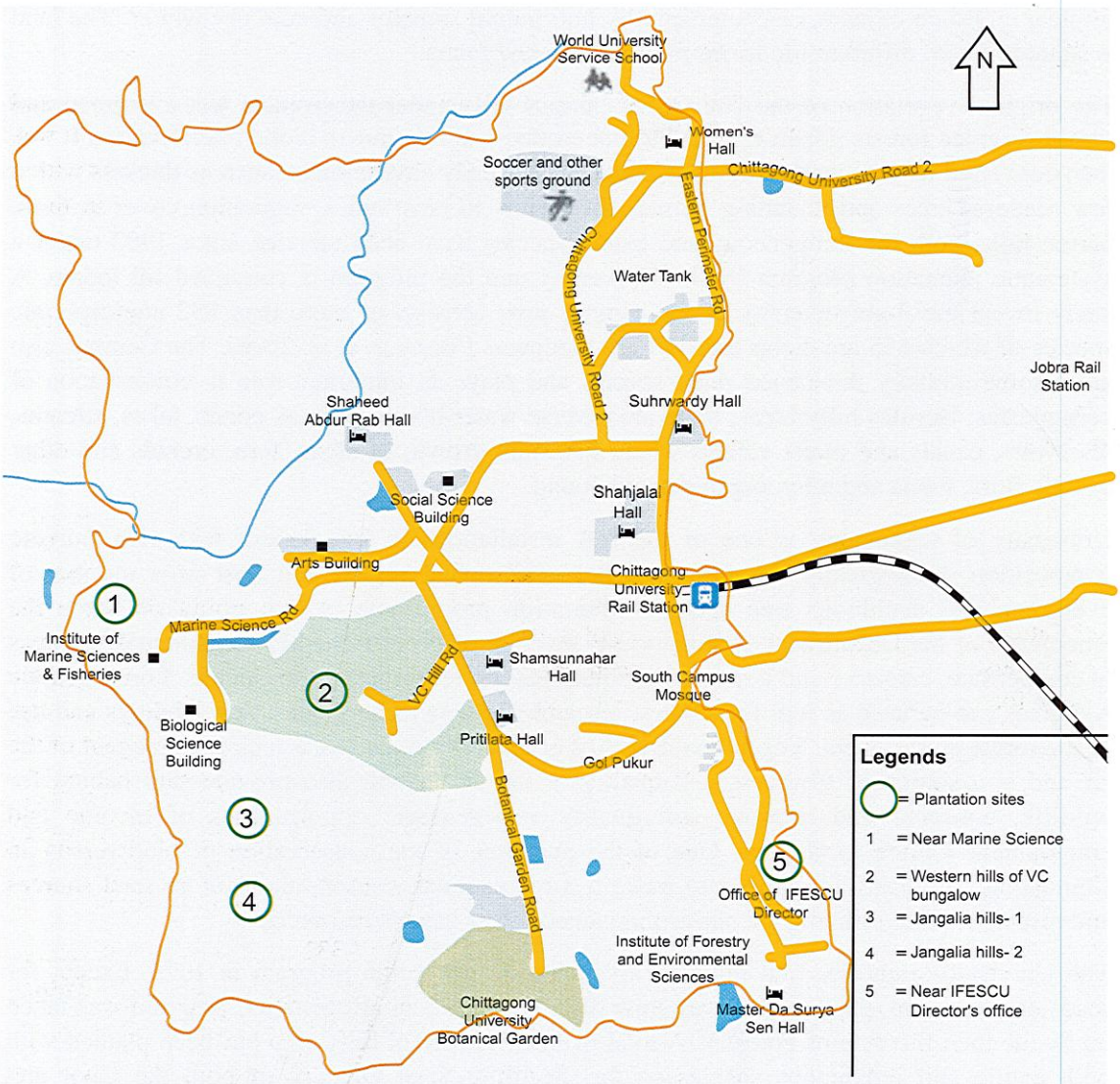


Fig. 2 CU campus map indicating plantations

The methods of the study were as follows:

***3.4.1 Exploration of the status of the native tree species*:** Extensive field visit in the natural forests of Cox's Bazar (Silkhali, Swankhali, Ukhiya, Bagkhali, Rajghat, Bhomorioghona), Chittagong (Bamu, Tankawati, Dudpukuria, Hazarikhil), CHT (Matamuhuri reserve, Sangu reserve, Thanchi VCF, Sitapahar, Pablakhali, Barkol, Bogalake, Naraichari) and Sylhet (Rema Kalenga, Satchari and Lawachara NP) was done to assess the status of the native tree species.

***3.4.2 Identification of the tree species*:** Considering the present density and abundance of the tree species, 60 tree species were selected for the restoration and recolonization of the species in the campus. Provisional Plus Trees were identified in the natural forests for collection of fruits and seeds of the species.

***3.4.3 Selections of the tree species*:** Based on the experirnces of previous field visit and available literature, 60 tree species were selected for the *ex situ* conservation in the campus. Population of some species was very scarce in its natural habitat but the species were not categorized threatened because of limited information. Attempts were taken for collecting the fruits/seeds and raise seedlings in the campus for *ex situ* conservation.

3.4.4 Collection of fruits and seeds: Fruits and seeds were collected to study the seed biology and to raise planting materials (seedlings, vegetative propagules) in the laboratory and nursery of the Institute.

***3.4.5 Raising planting materials*:** About 30,000 planting materials (seedlings, vegetative propagules) of all the species were raised in the laboratory, propagator house and nursery depending on the availability of the species. Care and maintenance of the planting materials were taken since they were ready for outplanting.

3.4.6 Experimental Design: Post-graduate students of Forestry were engaged in field exploration, fruit/seed collection and layout of the experiments for studies of seed biology and nursery raising programs. Seedlings of each species in varying number were raised in the nursery for conservation in the campus and also distributed to FD, NGOs, PAs and others interested in raising plantations of native tree species.

3.4.7 Establishment of seed stands: Seedling seed stands of each species (seedling number depends on the availability of amount of seeds, germination percent, survibility etc.) were established in the University campus for conservation of the threatened tree species and also for future seed sources. About 18,000 seedlings of 60 tree species were planted in the campus.

3.4.8 Care and maintenance of the seed stands: A total of 17,331 seedlings of 60 native threatened tree species were planted out at the University campus during 2011-2015 (**Table 14**). Care, maintenance and growth record of the plantations are taken regularly.

Table 14. Threatened tree species plantation established in Chittagong University Campus

Site No.	Location	Plantation year	Age (yrs.)	No. of seedlings	Area (ha)
1	West of Marine Science building	2011	6	903	0.361
2	West of Marine Science building	2012	5	455	0.182
3	West of VC Bungalow	2012	5	697	0.436
4	Near Director Building, IFESCU	2013	4	300	0.12
5	Jungalia Hill	2013	4	4355	3.92
6	Jungalia Hill (Mixed plantation)	2013	4	760	0.684
7	Jungalia Hill	2014	3	4659	2.912
8	Jungalia Hill (source BFRI)	2014	3	2540	1.02
9	Jungalia Hill	2015	2	2662	1.07
	Total			**17,331**	**10.705**

Threatened tree (*D. alatus*) stands in CU campus

In addition to the plantations of University campus, about 6,780 seedlings of native threatened tree species were distributed to different organizations and institutes for the conservation of the species (**Table 15**).

Table 15. Distribution of seedlings of native tree species to different organizations/Institutes

Sl. No	Organizations	Year	Total species	No. of seedlings distributed
01	Hill Flower, Bandarban	2013	14	1250
02	TAHZINDONG, Bandarban	2013	13	700
03	Rajarkul Botanical Garden, Ramu	2013	09	1400
04	Bangladesh Forest Research Institute, Chittagong	2013	02	35
05	Botany Department, Chittagong University	2013	10	20
06	Sonaichari Botanical Garden, Bhatiary	2013	8	1200
07	Rajarkul Botanical Garden, Ramu	2014	26	2140
08	Botany Department, Chittagong University	2014	06	35
	Total number of seedlings distributed			**6,780**

3.5 Conservation and documentaion of the native tree species in CU campus

Information about the status, distribution, seed biology and initial growth performances of threatened native tree species have been maintained. The information may be useful to individual nurserymen, plant growers, Forest Department, conservationists, students and researchers. The future plan of the *ex situ* conservation programme in University Campus are as follows:

i) Documentation and inventorying of plants of University Campus: Botanical Garden of the University possesses some plant species in different conservation status. But the plants of the botanic gardens and the *ex situ* conservation plots are not well inventoried and documented except the reports of Alam and Pasha (1999) and Momen et al. (2006). So, inventorying of plant resources is most important that will help to demonstrate the amount of genetic and species diversity contain in the *ex situ* conservation populations. This will also help in the future plan for collection of remaining PGRs.

ii) *Computerized data management and information system*: Update data management system of tree species shall enable the interested people for better understanding of the information of threatened species in the campus. A computerized data management system shall help to exchange or disseminate the information in a better way with users of forest germplasm at home and abroad.

iii) Networking with national and international arboretum or botanical gardens: Networking development with other botanical gardens, Protected Areas or conservation centers may play an extremely valuable role in developing and strengthening conservation activities. It may be most effective tool in building new capacity for conservation, policy development, documentation and exchange of information and resources.

iv) Education and developing awareness on plant diversity and conservation: Education and awareness raising programs can play important role in improving the capacity of people to address the benefit of genetic resources and conservation issues. So, the *ex-situ* and *in-situ* onservation sites need to reorient and organize education programs to aware the people, students in plant conservation, sustainable use and the value of biodiversity etc. A variety of techniques may be adopted to convey the messages through guided tours, cultural activities, exhibiting and displaying plant collections etc. Education programs may include as:

- *Education programs for the students*: Education program develop in an aim to provide class room teaching of the students and teachers from the school, colleges and Universities using the *ex situ* conservation areas for the physical study of diversity of plant species and related information (phenology, flowering, fruiting, fruit/seed collection) from the authentic identified and well organized germplasm collection.
- *Public education program*: It aims to develop awareness among the general visitors on the importance of plants and the need for conservation through exhibiting and displaying plant species as live class rooms.
- *Training for the nurserymen/ botanic garden staff*: Short training course may be organized on different aspects of threatened tree species including seed biology, nursery raising and plantation establishment for the educators, nurserymen, malis of Forest Department, managers/supervisors of the botanic gardens to strengthen knowledge and skills on conservation and education programmes.
- *Outreach education programs*: Outreach education programs may be developed for the students and teachers of schools to help them develop plans for using the conservation plots as their outdoor classrooms for raising awareness on threatened plants, conservation and environment.

Threatened tree species planted in CU campus

Chapter 4: Profile of the Threatened Tree Species

1. *Anisoptera scaphula* (Roxb.) Pierre

Synonyms : *Anisoptera glabra* Kurz, *Hopea scaphula* Roxb., *Scaphula glabra* Parker, *Vatica scaphula* (Roxb.) Dyer
Vernacular names : **Boilam**, Boilshora, **Boilsur**, Sada boilam
English name : Mascal Wood Tree
Family : Dipterocarpaceae

Description: *Anisoptera scaphula* (Boilam) is a large resinous tree with a height of 55 m and 285 cm in diameter. The tallest tree of hill forests of Bangladesh reaches to a height of 30-55 m and a girth of 3-4.5 m. Simple leaf varies from 10-16 by 3.5-8 cm, oblong-lanceolate to oblanceolate; Racemes terminal, puberulous; Flower white; Petals broadly ovate, glabrous. Stamens 15-20; ovary conical. Fruit a winged nut and recalcitrant type, green when fresh and yellowish green when ripe, nut length 14-15 cm with wing, diameter 1.3-0.5 cm. Seeds recalcitrant, 1-2 seeds per nut, dark brown when ripe.

Phenology: Boilam is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Naturally distributed in Assam, Bangladesh, Myanmar, Thailand, Vietnam and the Malayan Peninsular in areas with high humidity ranges 70-90% (Ashton 1998).

Distribution in Bangladesh: Native tree of hill forests and grow in small pockets of the forests of Chittagong, CHT and Cox's Bazar. Currently few individuals of Boilam are found in remnant forest patches of Chittagong and Cox's Bazar. Some individuals are found in the yards of forest offices, BFRI campus, IFESCU campus, botanical gardens, plantations etc.

Conservation status and initiatives: Globally the tree is classified as **Critically Endangered** in the IUCN Red List of Threatened Species. In Bangladesh, treated as **Critically Endangered** (Khan et al. 2001), **Threatened** (Hasanuzzaman 2003), **Conservation Dependent** by (Ahmed et al. 2008) and **Protected Plant** (Anon 2012). IFESCU has established small stands of boilam in the campus (**Table 4.1).**

Table 4.1 Boilam plantations in Chittagong University campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	7.7	9.0
2014	3	Jangalia hills	1.9	4.5
2014	3	Near IFES Director's office	1.9	3.2

2. *Aphanamixis polystachya* (Wall.) Parker

Synonyms : *Aphanamixis timorensis* A. Juss., *A. rohituka* (Roxb.) Pierre, *A. tripetala* (Blanco) Merr., *Amoora rohituka* (Roxb.) Wight & Arn

Vernacular names : **Pitraj, Roina**, Baiddiraj, Bajor, Berirat, Tiktaraj, Titra

English name : Amoora

Family : Meliaceae

Description: *Aphanamixis polystachya* (Pitraj) is an evergreen species attaining height up to 20 m with dense, spreading and umbrella shaped crown. Bark is reddish-brown, flaking, inner bark pinkish, often with white latex (Ahmed et al. 2008). Leaves 45-125 cm long, red when young, glabrous or less often petioles. Inflorescence up to 110 cm long in female, 50 cm in male and hermaphrodite. Flowers 4-9 mm across, sweet scented. Fruit a capsule, obovoid, 2-4 cm in diameter, yellowish at first, pink or red at maturity. Seeds 1-3, plano-convex, covered with brownish-red or orange oily aril.

Phenology: Pitraj is an evergreen species

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Native ranges of Pitraj are India, Pakistan, Nepal, Bhutan, Myanmar, Sri Lanka and Bangladesh.

Distribution in Bangladesh: Pitraj naturally occurs in the forests of Chittagong, CHT, Cox's Bazar, Gazipur, Mymensingh, Sherpur, Tangail and Sylhet districts. The tree is also found in the institutional plantations and homesteads forests.

Conservation status and initiatives: Endangered (Huq and Banik 1990) and **Least Concern** according to Ahmed et al. (2009). Population of this species in natural forests is reduced severely. IFESCU planted few seedlings of Pitraj in the campus for *ex situ* conservation programs.

Table 4.2 Pitraj plantations in Chittagong University campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2014	3	Jangalia hills	2.2	-	3.3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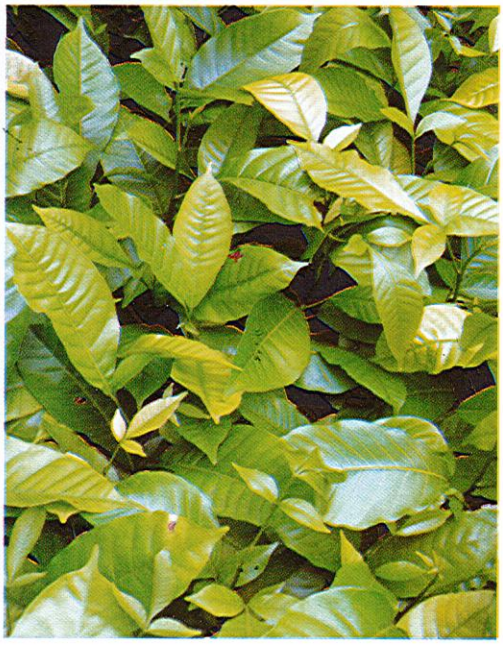


3. **Artocarpus chama** Buch.-Ham. *ex* Wall.

Synonym : *Artocarpus chaplasha* Roxb.
Vernacular names : **Chapalish**, Chambal, Chambul, Cham, Kathalicham
English name : Monkey Jack
Family : Moraceae

Description: *Artocarpus chama* (Chapalish) is a large deciduous tree, up to 30 m tall, with milky latex, alternate, petiolate and stipulate, stipules large, amplexicaul, juvenile leaves very large, up to 90 cm long, lobed or pinnatifid, adult leaves elliptic-ovate. Monoecious flowers densely crowded on globose receptacles, receptacles pedunculate, solitary and axillary. Fruit a syncarpy, globose, tuberculate, 7-10 cm across; seeds oblong, 1.2 cm long.

Phenology: Chapalish is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Chapalish naturally grows in Assam, Sikkim and Andaman Islands of India including Bangladesh.

Distribution in Bangladesh: Chapalish has been recorded from Tangail, Chittagong, CHT, Cox's Bazar and Sylhet forests (Das and Alam 2001).

Conservation status and initiatives: Not Evaluated (Ahmed et al. 2009), but the species seems to be rare in the natural forest habitats. IFESCU planted few seedlings for *ex situ* conservation programs (**Table 4.3**).

Table 4.3 Chapalish plantations in Chittagong University campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2014	3	Jangalia hills	3.2	-	4.3

4. *Artocarpus lacucha* Buch. -Ham.

Synonym : *Artocarpus lakoocha* Roxb.
Vernacular names : **Dewa**, Dewphal, Dewa-cham, Bonkanthal, Borta
English name : Monkey Jack
Family : Moraceae

Description: *Artocarpus lacucha* (Dewa) is a large deciduous tree, up to 20m tall, with a dense spreading crown, young shoots villous tomentose. Leaves simple, alternate, petiolate, petioles 1.0-2.5 cm long, lamina elliptic, ovate or oblong, 15-25 to 6-15 cm, coriaceous. It is monoecious plant. Male receptacle almost sessile, up to 3 cm in diameter, hairy. Female receptacle pedunculate, up to 10 cm in diameter, irregularly lobed. Fruit a syncarpy, globose, irregularly lobed, orange-red when ripe, soft and fleshy, seeds white, oblong.

Phenology: Dewa is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Dewa grows in India, Myanmar, Malaysia and Bangladesh.

Distribution in Bangladesh: It is found in the forests of Chittagong, Cox's Bazar, Sylhet, Dhaka and Mymensingh districts and in the CHT, and also found in many homesteads.

Conservation status and initiatives: Least Concern (Ahmed et al. 2008) but the fact is that natural population is disappearing rapidly because of habitat destruction. IFESCU planted few seedlings for *ex situ* conservation programs in the University campus (**Table 4.4**).

Table 4.4 Dewa plantations in Chittagong University campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2015	2	Jangalia hills	2.3	-	2.6

5. **Bhesa robusta** (Roxb.) Ding Hou.

Synonyms : *Celastrus robustus* Roxb., *Kurrima calophylla* Wall., *Kurrima robusta* Kurz.

Vernacular names : **Salkachra**, Ujja gach, Bon agar, Chapkoi

English name : Not known

Family : Celastraceae

Description: *Bhesa robusta* (Salkachra) is a large tree, up to 40 m tall and 65 cm in diameter, bark rough, brown, peeling off profusely in strips 2-3 cm wide and 2 mm thick. Leaves elliptic or elliptic-oblong, sometimes ovate-oblong, 10-20 × 4-10 cm, base obtuse or rounded, apex acute to shortly acuminate. Inflorescence racemose, up to 15 cm long, peduncles short. Flowers sub-sessile and white. Fruits capsule, narrowly ovoid, with 2 vertical grooves, 3-3.5 × 1-1.5 cm, usually 1-seeded. Seeds are oblong, usually on a knob-like thickened placenta, enveloped by the aril.

Phenology: Salkachra is an evergreen tree. There is about four month's gap between flowering and fruiting of this plant.

Phenology	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Flowering												
Fruiting												
Seed collection												

Global distribution: It naturally grows in Bangladesh, India, Bhutan, Myanmar, Thailand, Indo-China and Malaysia.

Distribution in Bangladesh: In Bangladesh, the species is recorded earlier from Sylhet, Chittagong and CHT (Heinig 1925). Recently, it was reported from Chunati Wildlife Sanctuary (Hossain and Hossain 2014).

Conservation status and initiatives: Near Threatened (Ahmed et al. 2008) and **Threatened** (Ara et al. 2013). Deforestation and habitat destruction are the major threats to this species. Need both *ex-situ* and *in-situ* conservation measures immediately. IFESCU planted few seedlings of the species in the campus (**Table 4.5**).

Table 4.5 Salkachra plantations in Chittagong University campus

Plantation year	**Age (yr.)**	**Plantation site**	**Height (m)**	**Collar dia. (cm)**	**DBH (cm)**
2015	2	Jangalia hills	2.2	-	1.7

6. **Bischofia javanica** Blume

Synonyms : *Bischofia leptopoda* Müll. Arg., *Bischofia oblongifolia* Decne., *Bischofia trifoliata* (Roxb.) Hook., *Bischofia roeperiana* Decne., *Bischofia toui* Decne.

Vernacular names : **Kanjal bhadi**, Laubhadi, Kumia

Family : Euphorbiaceae

English name : Javanese Bisop Wood

Description: *Bischofia javanica* (Kanjal bhadi) is an evergreen, fast growing tree commonly 12-18 m in height with dense, rounded head, smooth branches, and fissured bark. Leaf alternate, long-petioled, trifoliolate (3 leaflets); leaflets opposite, shiny, bronze-toned, oval-elliptic, 15-20 cm long. Flowers tiny, without petals, greenish-yellow, in many flowered clusters (racemes) at leaf axils; male and female flowers on separate plants (dioecious). Fruit a pea-sized capsule, berry-like, fleshy, 4.0-7.0 mm in diameter, weigh 0.06-0.1 g per dry fruit, brown or reddish or blue-black. Seeds are smooth and shining.

Phenology: Kanjal bhadi is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Kanjal bhadi is found throughout southern and southeast Asia to Australia and Polynesia. It also naturally occurs in China, North America and Taiwan.

Distribution in Bangladesh: The tree is found in CHT (Bandarban, Khagrachari, Rangamati), Chittagong and Cox's Bazar distrcts. It is planted in the campus of different institutions, e.g. BFRI, IFESCU etc.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008). BFRI and BFD made some plantations sporadically. Few seedlings were planted at CU campus by IFESCU for conservation purposes (**Table 4.6**).

Table 4.6 Growth of Kanjal bhadi in campus plantations.

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	6.1	9.3

7. **Bouea oppositifolia** (Roxb.) Meissn.

Synonyms : *Mangifera oppositifolia* Roxb., *Bouea burmanica* Blume, *Bouea microphylla* Griff., *Bouea diversifolia* Miq., *Matania laotica* Gagnep.

Vernacular names : **Mailam**, Miriam, Bhallam, Uri Aam, Moyam

English names : Burmese Plum, Marian Plum

Family : Anacardiaceae

Description: Mailam is an evergreen tree, up to 30 m tall, young shoots minutely hairy. Leaves 6-20 × 2-6 cm in size, stipulate, lanceolate or elliptic-lanceolate, entire, apex acuminate, base cuneate, coriaceous, and glabrous. Infloresence 4-10 cm long, puberulous. Flowers are bisexual and pale yellow. Fruit a drupe, ovoid, 2-3 × 0.5-2.0 cm, obliquely compressed, glabrous.

Phenology: Mailam is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Mailam naturally occurs in Bangladesh, India, Manmar and Malaysia.

Distribution in Bangladesh: The plant occurs naturally in Chittagong and Cox's Bazar districts, and the Chittagong Hill Tracts of Bangladesh.

Conservation status and initiatives: Mailam is treated as **Not Evaluated** by Ahmed et al. (2008) and **Endangered** by Rahman (2013). Only few individuals were planted in the University campus by IFESCU (**Table 4.7**).

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2015	2	Jangalia hills	2.1	2.3

8. **Brownlowia elata** Roxb.

Synonyms : *Brownlowia gamosepala* (Turcz.) Burret, *Columbia gamosepala* Turcz., *Humea elata* Roxb.

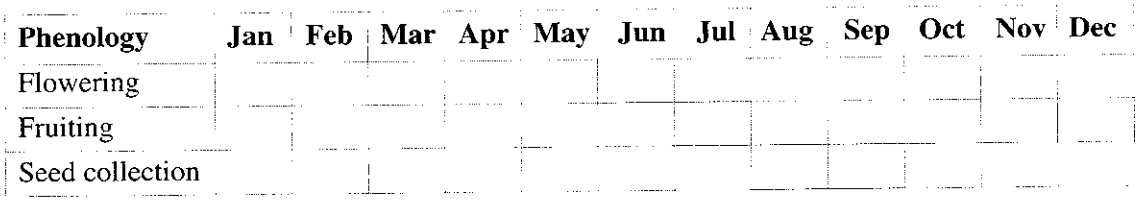
Vernacular names : **Moos**, Mass, Maj, Majot, Mosse, Masjot

English name : Not known

Family : Tiliaceae

Description: *Brownlowia elata* (Moos) is a medium-sized to tall, evergreen tree with much fluted stem. Bark whitish, rather smooth. Leaves cordate or cordate-oblong blade 10-30 cm long, tomentose, acuminate, entire, coriaceous, glossy green above, puberulous and glaucescent beneath. Flowers yellow, on puberulous pedicels and borne in large clusters forming loose, pubescent panicles at the end of the branchlets and in the axils of the upper leaves. Fruit a capsule, 2-4 cm in diameter, 2-valved, ash-grey, suture prominent, 1 rarely 2-seeeded. Seeds solitary with erect embryo.

Phenology: Moos is an evergreen tree.



Global distribution: Moos occurs naturally in Bangladesh, India, and Myanmar (Jannat and Hossain 2016).

Distribution in Bangladesh: Moos is found in the natural forests of Chittagong (Chunati WS, Dudhpurkuria-Dhopachari WS) and Cox's Bazar (Bhomariaghona, Dulahazara, Ukhia, Teknaf etc.).

Conservation status and initiatives: Moos is treated as **Vulnerable** by Ahmed et al. (2008) and **Threatened** by Ara et al. (2013). Moos plantations established in Chittagong University campus and the imitial growth is promising (**Table 4.8**).

Table 4.8 Initial growth of Moos plantations in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2013	4	Jangalia hills	2.2	4.8	
2013	4	Jangalia-mixed plantation	2.2	5.3	-
2014	3	Near IFES Director's office	2.7	2.5	3.3

9. **Butea monosperma** (Lamk.) Taub.

Synonyms : *Erythrina monosperma* Lamk., *Butea frondosa* Roxb.
Vernacular names : **Palash**, Kingshuk, Dhak
English names : Bengal Kino Tree, Flame of the Forest
Family : Fabaceae

Discription: *Butea monosperma* (Palash) is a small to medium-sized tree, often with crooked bole, young branches tomentose, bark rough. Leaves pinnately trifoliolate, rachis 12-25 cm long, geniculate, pubescent when young, stipules short, tomentose, terminal leaflet largest. Flowers large, in rigid axillary raceme, 10-15 cm long, crowded at he ends of leafless branchlets. Inflorescence axis, bracts and calyx covered with dark chocolate or brown velvety hairs. Fruit a pod, 10-15 x 3-4 cm, rigid, pendulous, borne in large cluster in leafless branches, yellowish-brown when ripe, silky tomentose and veined, 1-seeded. Seeds oval, compressed, dark brown.

Phenology: Palash is a deciduous tree. The tree starts blooming with beautiful flowers when it is still leafless.

Phenology	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Palash is naturally found in Bangladesh, India, Pakistan, Sri Lanka, Nepal, Myanmar, Indonesia, Thailand, Indo-China and introduced in New Guinea.

Distribution in Bangladesh: Grows wild in the forests of Dhaka and Mymensingh districts. It is also found in homesteads and planted as a roadside tree in most of the districts of the country.

Conservation status and initiatives: Consrvation status is **Least Concern** by Ahmed et al. (2009), but, fact is that the natural population is disappearing drastically because of habitat destruction. IFESCU planted few seedlings of Palash in the campus (**Table 4.9**).

Table 4.9 Palash plantations in Chittagong University campus

Plantation year	**Age (yr.)**	**Plantation site**	**Height (m)**	**DBH (cm)**
2011	6	West of Marine Science Institute	4.7	5.3


পলাশ

10. *Calophyllum inophyllum* L.

Synonyms : *Balsamaria inophyllum* Lour., *Calophyllum bintagor* Roxb., *Calophyllum blumei* Wight

Vernacular names : **Ponyal**, Kath Champa, Sultan Champa, Punang

English names : Alexandrian Laurel, Dilo-oil Tree, Borneo Mahogany

Family : Clusiaceae

Description: *Calophyllum inophyllum* (Ponyal) is a medium-sized, beautiful, glabrous tree, about 20-30 m tall. Stem angular, bark dark grey or blakish-brown, smooth in young trees and deeply fissured when mature, exuding clear, golden-yellow latex. Leaves simple, opposite, 10-18 × 6-8 cm. Racemes simple, axillary, consisting of 5-15 flowers. Flowers sweet-scented, white, 2-3 cm across, both male and hermaphrodite flowers in the same clusters. Fruit a drupe, 3-4 cm across, globose yellow or greenish, becomes pale-brown when dry, pericarp pulpy, 3-4 mm thick, 1-seeded.

Phenology: Ponyal is an avergreen tree. The branches and leaves create a dense foliage.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Ponyal is native of East Africa, distributed in Bangladesh, India, Sri Lanka, Malaysia, Polynesia, New Caledonia, Madagascar to Australia and the Pacific.

Distribution in Bangladesh: Naturally the plant occurs in Sundarbans, coastal areas, forests of Chittagong and sometimes planted here and there as an ornamental plant.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008). Field observation indicates that population is decreasing drastically mainly due to habitat destruction. IFESCU planted seedlings in the campus for *ex situ* conservation (**Table 4.10**).

Table 4.10 Initial growth of Ponyal seedling in the campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	4.5	6.5


পুন্নাগ

11. **Canarium resiniferum** Bruce *ex* King

Synonyms : *Canarium strictum* Roxb. *Canarium sikkimense* King
Vernacular names : **Dhup**, Dhoop, Pairag, Beri-rata, Bororata, Dhunia-rata
English names : Black dammar, Yunnan canarium, Indian white Mahogany, Black dammer
Family : Burseraceae

Description: *Canarium resiniferum* (Dhup) is a tall tree grows up to 30m height and 60-80cm dbh. Trunk is clear bole, bark brownish, lenticellate. Dark brown to black resin oozes from cut end of trunk. Leaves are compound, imparipinnate, alternate, leaflets 3-9 pair with odd one at apex. Flowers are bisexual or polygamous. Inflorescence axillary panicles, rusty tomentose, about 1 cm long, yellow to dull white, shortly stalked and mildly fragrant. Fruits are drupe, blue-black to dark grey when ripe, 2.5-5.0cm long, 2.1-2.3cm wide, ellipsoid, pointed at ends, mesocarp fleshy, aromatic and seeds trigonous, usually 3 celled and 1 seeded. Seeds orthodox, brown in color, 3.5-3.8cm length, 1.3-1.4cm width, weigh 2.5-3.5g, pointed at both end.

Phenology: Dhup is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Dhup is found in Bangladesh, India, Mynmar, and China.

Distribution in Bangladesh: Dhup is rarely found in the moist evergreen forests of CHT, Cox's Bazar, Chittagong and Sylhet. Few individuals are found in Lawachara National Park and Adampur forest of Moulavibazar.

Conservation status and initiatives: Threatened (Khan et al. 2001, Hasanuzzaman 2003), **Data Deficient** (Ahmed et al. 2008) and **Protected Plant** (Anon 2012), but field observation indicate that population of the species drastically reduced in its natural habitat and can be categorized as **Critically Endangered**. IFES maintains the plantations for *ex situ* conservation in the campus (**Table 4.11**).

Table 4.11 Initial growth of Dhup seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of Marine Science Institute	2.50	5.8
2013	4	Jangalia hills	1.90	5.7
2014	3	Near IFES Director's office	3.0	3.5
2015	2	Jangalia hill	0.35	1.8

12. *Cassia fistula* L.

Synonyms : *Bactyrilobium fistula* Willd., *Cassia bonplandiana* DC., *Cassia excelsa* Kunth, *Cassia fistuloides* Collad., *Cassia rhombifolia* Roxb., *Cathartocarpus excelsus* G. Don

Vernacular names : **Sonalu**, Sonal, Bandar lathi, Sonali, Shondal, Suvarnaka, Desi Asal

English name : Golden shower tree

Family : Caesalpiniaceae

Description: *Cassia fistula* (Sonalu) is a medium-sized deciduous tree attained 10-20 m tall and dbh 40-50 cm. Stem bark pale grey, smooth and slender when young but dark brown and rough when old. Leaves are 15-60 cm long, and pinnate with three to eight pairs of leaflets (7-21 cm long and 4-9 cm broad), entire. Flowers bright yellow in terminal, drooping racemes, 30-60 cm long. Fruit is indehiscent pod, green when immature, dark brown to black when ripe, 40-60 cm long and 1-2 cm broad, cylindrical, woody, smooth and chambered within, filled with dark brown to black sweetish pulp, long persistent on the tree up to the next flowering season, containing 25-100 seeds. Seeds lenticular, light brown and lustrous, orthodox, brownish colored, flattened.

Phenology: Sonalu is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

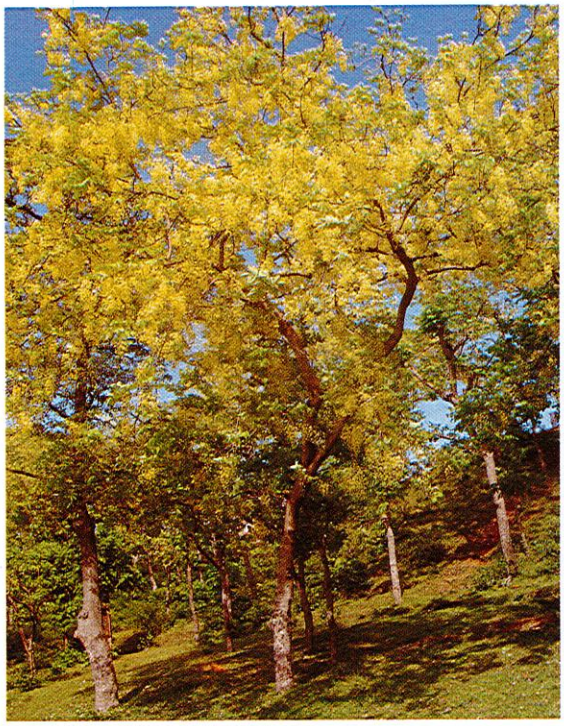
Distribution: Sonalu is native to Tropical Asia including Bangladesh, India, Sri Lanka, Pakistan, Bhutan, Malaysia and Thailand.

Distribution in Bangladesh: It is naturally found in Sal and hill forests. It is also a common ornamental plant along roadsides, gardens and homesteads.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008). But, the population is becoming scarce due to habitat destruction and degradation. Plantation in homesteads and office compounds for ornamental purposes may reduce the concern of disappearing the species. IFESCU established Sonalu plantation in the campus (**Table 4.12**).

Table 4.12 Initial growth of Sonalu seedlings planted in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	Jangalia hills	1.6	1.9




সোনালু


সোনাল

13. Chukrassia tabularis A. Juss.

Synonyms : *Chickrassia nimmonii* J. Graham *ex* Wight, *Chickrassia tabularis* Wight & Arn., *Chickrassia velutina* W & A, *Chukrasia chickrassa* (Roxb.) J. Schultze-Motel, *Chukrasia nimmonii* Graham *ex* Wight

Vernacular names : **Chikrassi**, Chikrassy, Haithna-poma

English names : Indian Mahogany, Chittagong wood

Family : Meliaceae

Description: *Chukrassia tabularis* (Chickrassi) is a tall tree with cylindrical bole and spreading crown. Bark is thick and rusty brown. Leaves pinnately compound, 30-50 cm long; leaflets 10-24, alternate. Flowers white in terminal, panicles, slightly hairy. Fruit a capsule, ellipsoidal, woody, brown or blackish outside. Seeds numerous, transversely and closely packed, elliptic, flat with dark brown wings. Seeds are 0.8-1.8 × 0.4-1.0 cm in width and arranged in layers, inside distinct locules.

Phenology: Chickrassi is a deciduous tree (Hasnat et al. 2016).

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

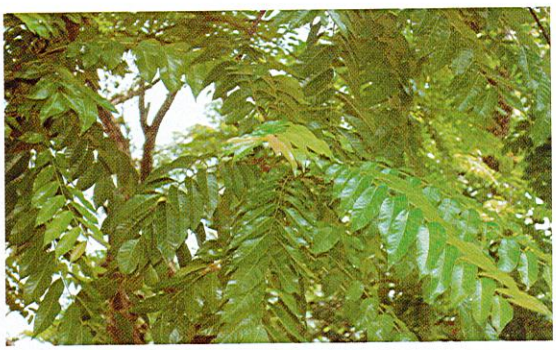
Global distribution: Chikrassi is native to Bangladesh, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Sri Lanka, Thailand, and Vietnam.

Distribution in Bangladesh: It occurs in the forests of Chittagong, CHT, Cox's Bazar and Sylhet, rather rare in occurrence. Chikrassi is planted in some plantations of Forest Department.

Conservation status and initiatives: Least Concern (Ahmed et al. 2009). Naturally growing Chikrassi is seldom seen in forests. *Ex situ* conservation in the University campus is promising (**Table 4.13**).

Table 4.13 Initial growth data of Chikrassi seedlings in University campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2014	3	Jangalia hills	1.6	1.8	-
2014	3	Hills near IFESCU Director's building	3.8	-	3.7



14. *Cinnamomum iners* Reinw. *ex* Bl.

Synonyms : *Cinnamomum aromaticum* Zoll., *Cinnamomum curtisii* Lukman., *Cinnamomum gracile* Miq., *Cinnamomum nitidum* Blume

Vernacular names : **Tez-bohu,** Kosturi, Tez-matan, Karuyed

English name : Wild cinnamom

Family : Lauraceae

Description: *Cinnamomum iners* (Tez-bohu) is a medium sized evergreen tree; bark grey, smooth. Leaves opposite, oblong-lanceolate, 10-20 cm long, acuminate, young leaves pinkish. The 3-nerved leaves look like 'tejpata' or 'darchini' but no smell. Flowers small, white in slender, long-peduncled, glabrous or somewhat silky cymose panicles. Fruit a nut, elliptically oblong, smooth, brown, about 1.5 cm long; crowned by 6-lobed cup shaped persistent perianth.

Phenology: Tez-bohu is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

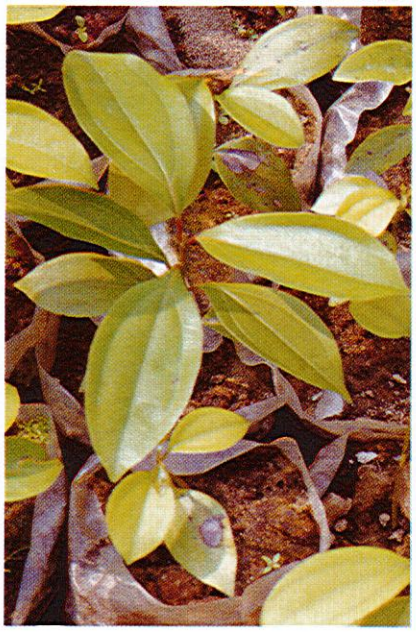
Global distribution: Tez-bohu naturally grows in Bangladesh, India, Myanmar, Malaya Peninsula and Indonesia.

Distribution in Bangladesh: It occurs in the natural forests of Chittagong, Cox's Bazar and CHT.

Conservation status and initiatives: Conservation status is reported as **Not Evaluated** (Ahmed et al. 2008) and **Protected Plant** (Anon 2012). Population in the natural forests is drastically reduced due to deforestation and over exploitation. Plantations were established in Chittagong University campus (**Table 4.14**).

Table 4.14 Initial growth of Tez-bohu seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of VC Bungalow	2.7	6
2013	4	Jangalia-mixed plantation	4.7	6.4
2013	4	Jangalia hills	2.8	5.3
2014	3	Hills near IFES Director's office	2.9	3.1



15. *Cordia dichotoma* Forst. f.

Synonyms : *Cordia suaveolens* Blume, *Cordia griffithii* C.B. Clarke, *Cordia premnifolia* Ridl.

Vernacular names : **Bohal**, Bole gota, Bohary, Bahubara, Bahoduri, Larhora, Boula

English names : Indian Cherry, Sebesten Plum, Soap Berry, Clammy Cherry

Family : Boraginaceae

Description: *Cordia dichotoma* (Bohal) is a medium-sized, deciduous tree up to 20 m tall with crooked trunk and drooping branches, bark ashy-grey or brownish. Leaves simple, alternate, 4-10 × 3-7 cm, ovate to ovate-lanceolate. Inflorescence terminal or axillary, few-flowered. Flowers white, small, sessile, fragrant, male and hermaphrodite flowers being found in the same tree. Fruit drupaceous, ovoid to egg-shaped berry, yellow, pinkish to nearly blackish when ripe, 1-seeded. Seed ovoid, flattened, embedded in sweet, viscid and almost transparent pulp.

Phenology: Bohal is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Naturally grows in Bangladesh, Australia, Cambodia, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Pacific Islands, Pakistan, Thailand and Vietnam.

Distribution in Bangladesh: Bohal occurs sporadically in natural forests, village thickets and around homesteads in rural Bangladesh.

Conservation status and initiatives: Least Concern (Ahmed et al. 2008). Habitat destruction is main threat of this species in its natural distribution. IFESCU has established a plantation in the hills of CU campus (**Table 4.15**).

Table 4.15 Initial growth of Bohal seedlings in the plantations of CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2015	2	Jangalia hills	1.74	2.4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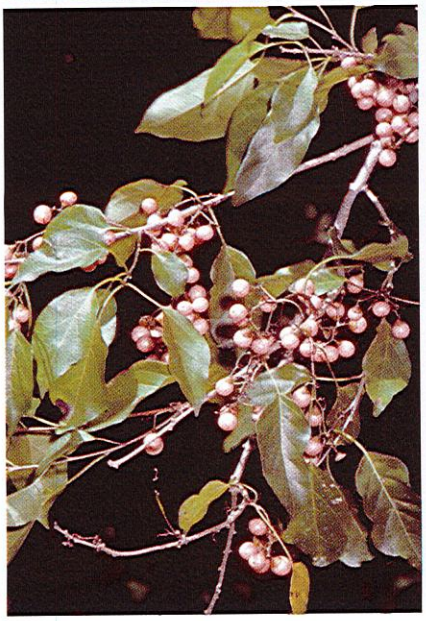


16. **Derris robusta** (Roxb. *ex* DC.) Benth.

Synonyms : *Dalbergia robusta* Roxb. *ex* DC., *Dalbergia krowee* Roxb., *Brachypterum robustum* (Roxb.) Dalz. & Gibs.

Vernacular names : **Jamurja** Jangaria, Miringa, Korai

English name : Not known

Family : Fabaceae

Description: *Derris robusta* (Jamurja) is a medium-sized deciduous tree with 10-16 m height. Leaves 10-15 cm long, leaflets 2.5-5.0 cm. Flowers are densely fascicled, pedicels 1-2 cm long, finely grey-downy. Corolla whitish, 6-8 mm long, standard erect with a round blade. Fruit a pod, 1-5 seeded narrowed at both ends, glabrous, wing distinct.

Phenology: Jamurja is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

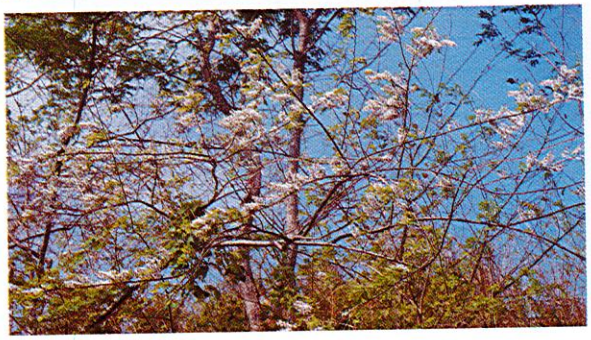
Global distribution: Naturally the plant occurs in India, Myanmar, China and Bangladesh.

Distribution in Bangladesh: In Bangladesh, Jamurja occurs in natural forests of Mymensingh, Chittagong, Cox's Bazar districts and the CHT.

Conservation status and initiatives: Endangered (Huq and Banik 1990) and **Least Concern** (Ahmed et al. 2009). IFESCU has established few seedlings in the *ex situ* conservation plots of the campus. (**Table 4.16**).

Table 4.16 Jamurja plantations in Chittagong University campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2016	1	Jangalia hills	1.8	2.1	-



17. *Dillenia pentagyna* Roxb.

Synonym : *Dillenia baillonii* Pierre *ex* Lanessan
Vernacular names : **Hargaja**, Ban chalta, Ajuli, Ajugi
English name : Not known
Family : Dilleniaceae

Description: *Dillenia pentagyna* (Hargaja) is a medium-sized deciduous tree, 20-25 m tall, bark smooth and greyish. Leaves simple, alternate, oblong-lanceolate to oblong-obovate, 20-50 × 10-30 cm, margin entire to dentate, obtuse or cuneate at the base, obtuse at the apex. Flowers yellow, fragrant, pedicels 2.5-6.0 cm long, bracts hairy. Fruits drooping, subglobose, indehiscent, fleshy, 1-2 seeded. Seeds ovoid, 5×3.5 mm, black, glabrous, exarillate.

Phenology: Hargaja is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

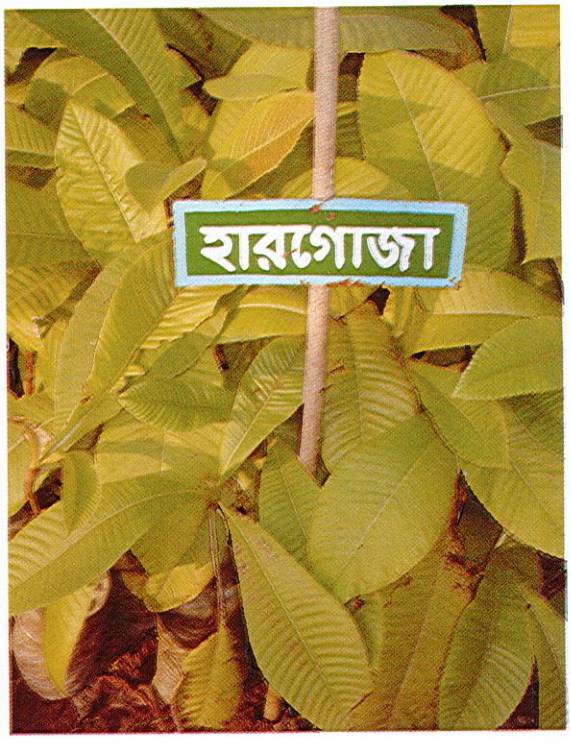
Global distribution: Hargaja grows naturally in Bangladesh, India, Myanmar, Indonesia, Southern China, Thailand, the Andaman Islands, Central and Eastern Java.

Distribution in Bangladesh: The tree is found in Madhupur sal forests, Sylhet and Chittagong districts, and in CHT.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008). Population in natural forests is drastically reduced due to habitat destruction. IFESCU has planted few seedlings in the hills of the campus (**Table 4.17**).

Table 4.17 Hargaja plantations in Chittagong University campus.

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	West of Marine Science Institute	2.2	3.0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18. *Dipterocarpus alatus* Roxb. *ex* G. Don.

Synonym : *Dipterocarpus incanus* Roxb., *D. philippensis* Foxw.
Vernacular names : **Dholi-garjan**, Dhullya-garjan, Dulia-garjan, Mashkaliya-garjan, Sil-garjan.
English names : Indonesian gurjun, leafed apitong
Family : Dipterocarpaceae

Description: *Dipterocarpus alatus* (Dholi-garjan) is a lofty evergreen tree with tall, cylindrical and ash-grey bole. The tree grows up to 25-30 m height having comparatively small crown. Bark is grey, smooth, leaves elliptic to elliptic-ovate, 10-15 cm long, acuminate, base cuneate to rounded entire or slightly wavy and ciliate. Flowers large and sessile bloom in 3-7 flowered greyish-tomentose racemes in axils of young leaves. Fruit a nut, pubescent, about 2.5 cm long and somewhat broader. Fruit are recalcitrant, green when fresh and brownish green when ripe.

Phenology: Evergreen, though partial leaf shedding is observed sporadically in some locations.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Dholi-garjan naturally grows in Bangladesh, Myanmar, Andaman, Thailand and Combodia.

Distribution in Bangladesh: In Bangladesh, the tree occurs sporadically in the forests of Cox's Bazar (Shil khali and Dulahazara) and Chittagong. In Chittagong city, it is found as road-side avenue tree near railway station. Some individuals of this plant are also planted near Dokhola Range Office of Madhupur National Park (MNP) and Hazarikhil Wildlife Sanctuary (HWS).

Conservation status and initiatives: Dholi-garjan is treated as **Least Concern** (Ahmed et al. 2008), but field observation indicates the disappearance of trees due to habitat destruction. Few plantations of Dholi-garjan are found in Forest Department and other institutions. Dholi-garjan plantation was established at University campus in 2011 and 2014 (**Table 4.18**).

Table 4.18 Initial growth of Dholi garjan seedlings in campus planations.

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2011	6	West of Marine Science Institute	4.5	-	7.5
2014	3	Jangalia hills	1.7	2.45	

19. *Dipterocarpus costatus* Gaertn.

Synonyms : *Dipterocarpus angustifolius* Wight & Arn., *Dipterocarpus artocarpifolius* Pierre, *Dipterocarpus insularis* Hance, *Dipterocarpus parvifolius* F.Heim

Vernacular names : **Baittya Garjan**, Sil Garjan, Guti Garjan, Kesho Garjan, Dulia Garjan, Chikunia

English Name : Not known

Family : Dipterocarpaceae

Description: *Dipterocarpus costatus* (Baittya garjan) is a large tree attaining a height of 25-40 m with 80-110 cm in diameter. Bark is thick, pale brown, fissured and peeling in rounded flakes. Leaves simple, alternate and spiral, stellately hairy, ovate, apex acute, base slightly rounded to cordate, margin entire. Flowers arranged in 3-6 flowered inflorescence, axillary, bisexual. Fruit a 2-winged nut upto 12 cm long, body with 5 narrow ridges. Fruits are recalcitrant and dark brown when ripe. Nuts are hairy, longitudinally 5-ribbed, 1.6-2.5 cm long and 1.2-2.2 cm wide.

Phenology: Baittya garjan is an evergreen tree though number of leaves reduces in dry season.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

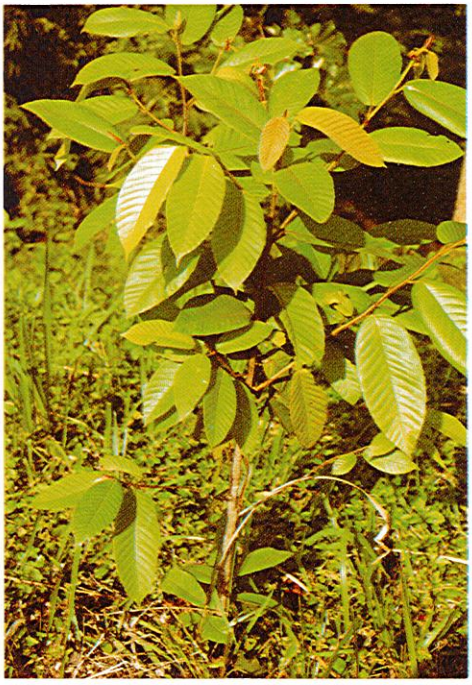
Global distribution: Baittya garjan is native to Bangladesh, Combodia, India (Andaman Islands), Laos, Malaysia (Peninsular Malaysia), Myanmar, Thailand, and Vietnam.

Distribution in Bangladesh: It is distributed in the forests of Chittagong, CHT and Cox's Bazar districts. It is planted as long rotation species in several degraded forests and also in the premises of some forest officies.

Conservation status and initiatives: Baittya garjan is treated as **Conservation Dependent** by Ahmed et al. (2008). Habitat destruction is the major threat in reducing the population of the species. *In-situ* conservation measure is essential for maintaining the remaining individuals in the natural forests. IFESCU established plantations of Baittya garjan in the hilly terrain of the campus (**Table 4.19**).

Table 4.19 Growth performance of Baittya garjan seedlings in the campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	3.7	6.0
2014	3	Jangalia hills	1.8	3.1



20. **Dipterocarpus turbinatus** Gaertn.

Synonyms : *Dipterocarpus laevis* Buch.-Ham., *Dipterocarpus indicus* Bedd.
Vernacular names : **Tellya garjan**, Teli garjan, Kali garjan, Kuroil
English name : Garjan-oil Tree
Family : Dipterocarpaceae

Description: *Dipterocarpus turbinatus* (Tellya garjan) is a very large, lofty mangificant tree with height of about 50 m having a straight, clean cylindrical bole with 120-160 cm dbh. Bark thick grey-brown, vertically fissured. Leaves simple, 12-36 × 5.5-20 cm, ovate to ovate-lanceolate or elliptic-oblong, more or less undulated or entire at margin, very glossy above, glabrous, thick, lateral veins 12-24 pairs. Flowers are white or pinkish, very fragrant. Fruit a nut, 5×2.4 cm sized.

Phenology: Tellya garjan is a semi-deciduous tree, shedding most of the leaves just before the time of appearance of new leaves during January-February in Bangladesh.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

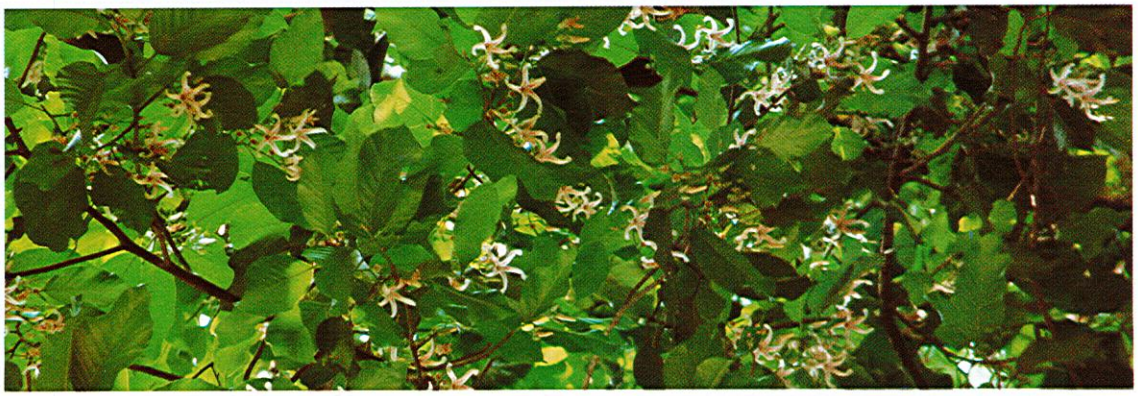
Global distribution: Tellya garjan naturally grows in Bangladesh, India (Assam & Andaman Islands), Myanmar, Thailand, Cambodia and Indonesia.

Distribution in Bangladesh: In Bangladesh, the tree occurs in the forests of Chittagong, Cox's Bazar, Sylhet and CHT.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008), but original population is very scarce in natural habitat. BFD has some trees of this species in their long rotation plantations. IFESCU planted this species in the CU campus (**Table 4.20**)

Table 4.20 Initial growth performance of Tellya garjan in the campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	6.8	8.4



21. **Duabanga grandiflora** (Roxb. *ex* DC.) Walp.

Synonyms : *Lagerstroemia grandiflora* Roxb. *ex* DC., *Duabunga sonneratioides* Buch.-Ham.

Vernacular names : **Bandarhula**, Kahdula jarul, Ramdalu, Lalpati, Kacha

English name : Not known

Family : Sonneratiaceae

Description: *Duabanga grandiflora* (Bandarhula) is a large tree up to 40 m tall, with a cylindrical bole up to 1.5 m in diameter. The tree has long horizontal branches drooping at the tips and with large opposite leaves arranged in two rows. Leaves opposite, arranged in two rows, reddish when young; oblong, 15-30 × 7-12 cm and shortly acuminate. Flowers large, white, 5-8 cm across; flowers are produced in corymbose heads at the tips of dropping branches. Fruit a capsule seated on thick, spreading persistent calyx, coriaceous, about 8 cm across, splitting into 4-8 valves. Seeds numerous, minute, blackish (Das and Alam 2001).

Phenology: Bandarhula is an evergreen tree, but partial leaf-shedding noticed in some cases.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

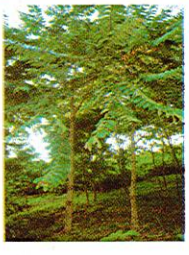
Global distribution: Bandarhula has a wide natural distribution in south Asia including Bangladesh.

Distribution in Bangladesh: Occurs in the forests of Chittagong, CHT, Cox's Bazar and Sylhet usually growing in hills of open grass land by the side of streams and moist ground.

Conservation status and initiatives: Bandarhula is treated as **Least Concern** by Ahmed et al. (2008). IFESCU established small plots in the campus with the support of Arannayk Foundation. Initial growth of the species is very promising (**Table 4.21**). Flowering and fruiting stared in the plantations of CU campus at the age of six years.

Table 4.21 Initial growth performance of Bandarhola in the plantations of CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marin Science Building	17.4	18.4



22. Elaeocarpus tectorius (Lour.) Poir.

Synonym : *Craspedum tectorium* Lour., *Elaeocarpus robustus* Roxb.
English name : Olive
Vernacular names : **Belfoi, Jalpai**, Chekio
Family : Elaeocarpaceae

Description: *Elaeocarpus tectorius* (Jalpai) is a medium-sized to large tree, usually 20 m tall, bark greenish-grey. Leaves ovate-oblong, 10-20 × 5-10 cm, serrate acuminate, rounded at the base, thinly coriaceous, glabrous above, tomentose beneath; pinkish brown when young. Flowers white, fragrant and develops in racemes of 6-12 cm long. Fruit a drupe, about 2.5 cm long, ovoid, greenish, yellow or bluish green when young, 4.0-4.5 cm length, 2.7 cm width, 14-18 gm weight, single seeded, ovoid and rounded at the end. Seeds are orthodox.

Phenology: Jalpai is an evergreen tree species.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Natural distribution of Jalpai is in Bangladesh, India, Nepal, Bhutan, Sri Lanka, Malacca, Myanmar, Malaysia and Sikkim.

Distribution in Bangladesh: It occurs in the forests of Chittagong, CHT, Cox's Bazar, Sylhet, Dhaka and Mymensingh and usually growing in moist places.

Conservation status and initiatives: Least Concern by Ahmed et al. (2008), but field observation showed that its population is reduced drastically due to over extraction and forest degradation. Conservation in the natural habitat (*in-situ*) is suggested. IFESCU has established a plantation of Jalpai in the campus (**Table 4.22**).

Table 4.22 Initial growth performance of Jalpai seedlings in the CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	Jangalia hills	1.9	2.2

23. **Engelhardtia spicata** Leschen *ex* Bl.

Synonym : *Engelhardtia villosa* Kurz.
Vernacular names : **Jhumka Bhadi**, Chorkanta-lej, Kichra Bhadi, Kajkera Bhadi, Kaimula, Jaila, Lal Banak, Loha Bhadi
English name : Great Malay Beam
Family : Juglandaceae

Description: *Engelhardtia spicata* (Jhumka bhadi) is a medium-sized to large tree grows up to 35 m tall tree. Bark rough, greyish-brown, leaves imparipinnate or paripinnate, leaflets 4-13, narrow-oblong, oblong lanceolate or elliptic-lanceolate. Male flowers in slender catkins, 5-20 cm long, often panicled. Female flowers in pendulous spikes, 15-34 cm long, middle bract in fruits 5-8 cm long. Nut globose, borne in clusters, each with 3 wing-like hairy bracts.

Phenology: Jhumka bhadi is a deciduous tree that sheds leaves during December-January.

Phenology	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

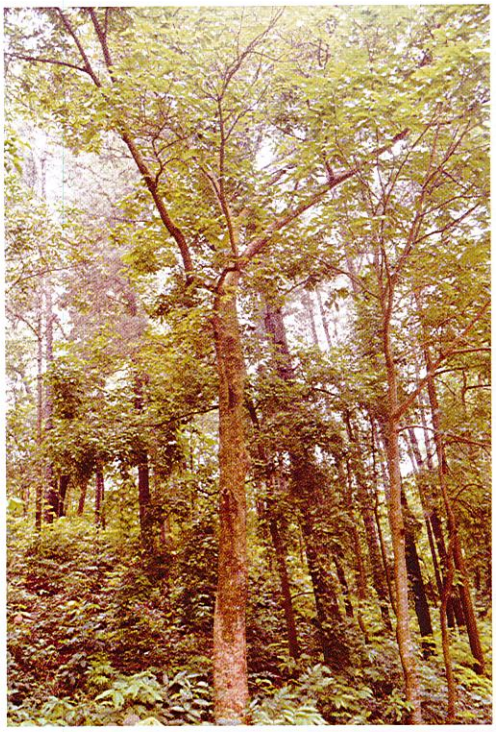
Global distribution: Grows naturally in Bangladesh to Himalayas extending to Myanmar and Assam hills.

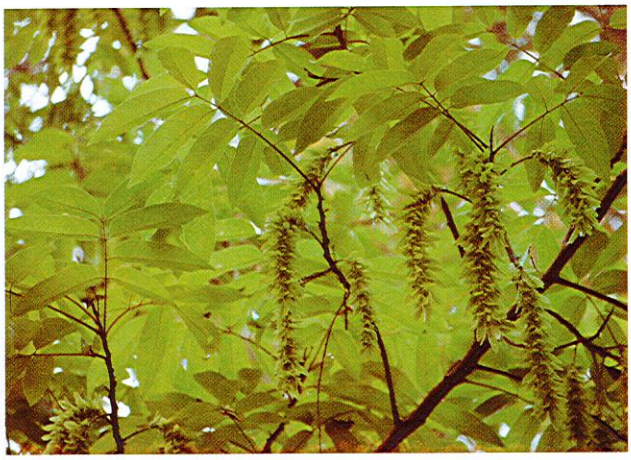
Distribution in Bangladesh: Occurs in the forests of Sylhet Chittagong and Cox's Bazar.

Conservation status and initiatives: Jhumka bhadi is **Vulnerable** by Ahmed et al. (2008). *In-situ* and *ex-situ* conservation measures are proposed. IFESCU established a small plantation of Jhumka bhadi in the campus (**Table 4.23**).

Table 4.23 Jhumka bhadi plantations in CU campus

Plantation year	**Age (yr.)**	**Plantation site**	**Height (m)**	**Collar dia. (cm)**	**DBH (cm)**
2016	1	Jangalia hills	1.1	2.0	-





24. Fernandoa adenophylla (Wall. *ex* G. Don)

Synonyms : *Bignonia adenophylla* Wall. *ex* G. Don, *Spathodea adenophylla* (Wall. *ex* G. Don) Benth., *Heplophragma adenophyllum* (Wall. *ex* G. Don) P. Dop.

Vernacular names : **Barapatta**, Dakrum, Kawatuti, Parul, Bon-sal, Koira-aswal

English name : Not known

Family : Bignoniaceae

Description: *Fernandoa adenophylla* (Barapatta) is a deciduous tree of about 12 m tall. Leaves imparipinnate, 30-45 cm long, rachis hairy. Inflorescence large panicles, terminal, woolly. Flowers large, yellowish brown in dark brown tomemntose large panicles at the end of branchlets. Fruit a cylindrical capsule of 80 cm long and 2 cm in diameter, twisted, loculicidally 2-valved. Seeds compressed of 3.5 cm long, with 2 membranous wings on either side.

Phenology: Barapata is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

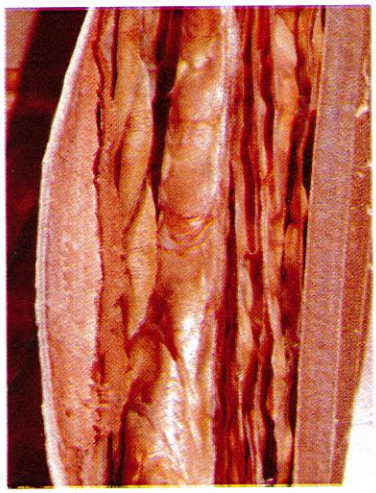
Global distribution: The tree is naturally found in Bangladesh, India, Myanmar, Vietnam, Thailand and Malaysia.

Distribution in Bangladesh: In Bangladesh, Barpatta is found in Sylhet, Tangail, CHT and Chittagong forest areas. Roadside trees found in Rangpur city.

Conservation status and initiatives: The species is treated as **Least Concern** by Ahmed et al. (2008). Plantations established in Jangalia hills of the University campus (**Table 4.24**).

Table 4.24 Initial growth performance of Barpatta in the CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of VC Bungalow	5.6	6.2
2014	3	Jangalia hills	2.2	2.1
2014	3	Near IFESCU Director's office	2.1	2.7



25. **Firmiana colorata** (Roxb) R. Br.

Synonyms : *Sterculia colorata* Roxb., *Erythropsis roxburghiana* Schott & Endl.
Vernacular names : **Udal,** Ujal, Pata-gota, Naichicha Udal
English name : The Coloured *Sterculia*
Family : Sterculiaceae

Description: *Firmiana colorata* (Udal) is a medium sized tree with spreading crown and fluted stem. Bark blackish grey or ashy, smooth, blaze whitish, very fibrous. Leaves crowded at the end of branchlets, 10-25 cm long and nearly as broad, deeply 3-5 lobed. Flowers scarlet or orange red, solitary or in clusters of 2-3 in short panicles from the axils of fallen leaves, the whole inflorescence densely covered with orange-red or dark brown stellate hairs. Fruits a follicle, 5-8 cm long, each on a short, twisted stipe and opening much before maturity with 1-2 roundish seeds attached on the margins. Fruits light brown in color after maturity, Seeds are recalcitrant, deep brown to yellowish in color.

Phenology: Udal is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

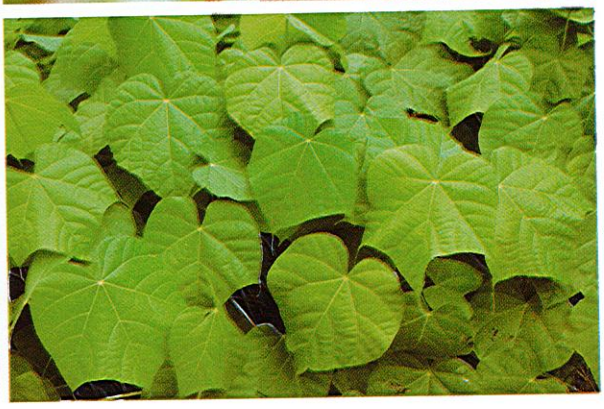
Global distribution: Udal naturally grows in Bangladesh, Sri Lanka, India, Nepal, Bhutan, Myanmar, Thailand, China and Indonesia.

Distribution in Bangladesh: In Bangladesh, the plant naturally occurs in the forests of Chittagong, Cox's Bazar, CHT, Sylhet, Dhaka and Mymensingh.

Conservation status and initiatives: Ahmed et al. (2008) reported Udal as **Not Evaluated**. However, the population of this tree in the natural ecosystems is reduced drastically due to habitat destruction. IFESCU established plantations in 2013 and 2014 for *ex situ* conservation purpose (**Table 4.25**).

Table 4.25 Initial growth performance of Udal seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2012	5	West of VC Bungalow	3	-	5.5
2013	4	Near IFESCU Director's office	2.4	-	3.3
2014	3	Jangalia hills	0.8	1.9	-



26. Gardenia coronaria Ham.

Synonym : *Gardenia costata* Roxb.
Vernacular name : **Kannyari**, Bela, Ankamal, Bankamal, Bata, Bela, Botta, Koinar, Koniara, Painna Phul
English name : Not known
Family : Rubiaceae

Description: *Gardenia coronaria* (Kannayari) is small to medium-sized tree. Bark greyish, smooth or splitting in small cylindrical pieces. Leaves obovate, 10-25 cm long, narrowed at the base with short puberulous petiole, entire or obscurely crenate at the apex, scabrous beneath; lateral veins 11-13 pairs. Flowers white, turning yellow on fading large, solitary, fragrant, axillary. Fruit up to 2.5 cm, ellipsoid, marked by 5-10 longitudinal angles or lines, smooth between the ribs, beaked and crowned by calyx-limb. Seeds small and numerous within the fruit.

Phenology: Kannyari is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

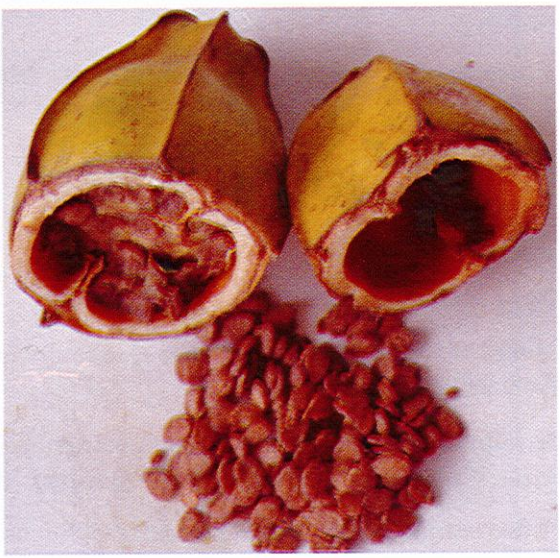
Global distribution: Globally the tree is naturally found in Bangladesh, India and Myanmar.

Distribution in Bangladesh: In Bangladesh, it occurs naturally in the forests of Chittagong, Cox's Bazar, CHT, and Sylhet, rather scattered in distribution.

Conservation status and initiatives: According to Ahmed et al. (2008), the species is in **Vulnerable** condition from conservation point of view. *In situ* conservation measures should be taken by enrichment plantation in its natural distributin. IFESCU with financial support of Arannayk Foundation established plantations in the hilly terrain of University campus (**Table 4.26**).

Table 4.26 Initial growth performance of Kannyari plantations in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	Near Marine Science Institute	5.5	7.0
2012	5	West of VC Bungalow	5.1	5.3
2015	2	Jangalia hills	2.7	2.8




GARDENIA CORONARIA
D.S.-05-02-11

27. **Haldina cordifolia** (Roxb.) Ridsdale

Synonyms : *Adina cordifolia* (Roxb.) Hk. F. *ex* Brandis, *Nauclea cordifolia* Willd.

Vernacular name : **Haldu**, Kaika, Dakrum, Bangka, Dako, Kelikadam, Petpuria, Dhakadam, Kalakadam, Keli Kadam, Dakom

English names : Yellow Teak, Saffron Teak.

Family : Rubiaceae

Description: *Haldina cordifolia* (Haldu) is a large tree with spreading crown. Trunk often buttressed at the base and fluted. Bark ashy grey, thick, exfoliating in patches leaving irregular depressions on the trunk. Leaves cordate, orbicular blade 10-20 cm in diameter, abruptly acuminate. Flowers yellow, in globose pedunculate heads, each angular, truncate and crowned with calyx lobes, free, pubescent on the villous pubescent receptacle and each separating into 2 dehiscent cocci. Seeds may, minute and winged.

Phenology: Haldu is a deciduous tree and seed becomes mature in February-March (Hasnat et al. 2016).

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

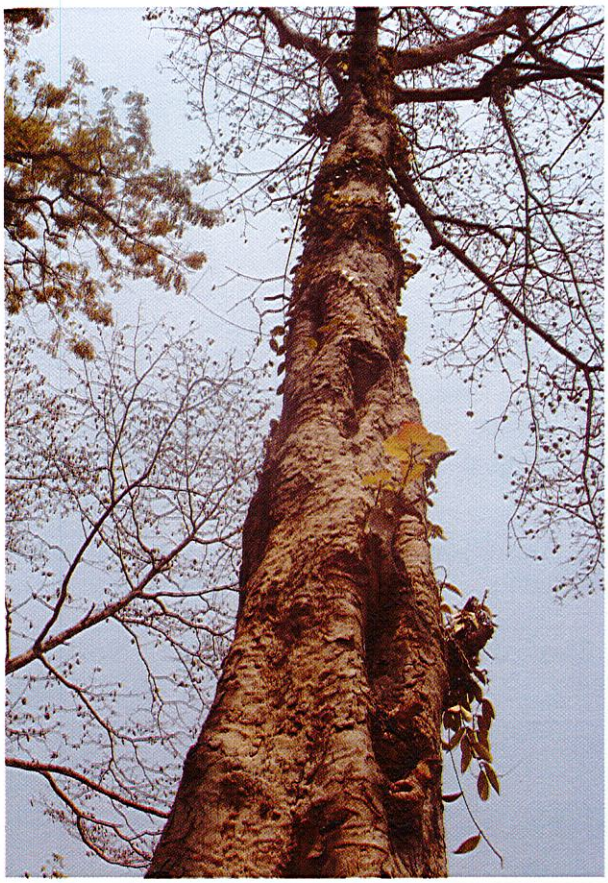
Global distribution: Haldu grows naturally in Bangladesh, Sri Lanka, India, South China, Vietnam and Thailand.

Distribution in Bangladesh: Haldu occurs in the moist deciduous forests of Chittagong, Cox's Bazar, CHT, Sylhet, Dhaka and Mymensingh. There are some trees left in jhum lands of CHT.

Conservation status and initiatives: According to Ahmed et al. (2008), the species is categorized as **Conservation Dependent**. Conservation measures in the form of *in situ* and *ex situ* are necessary for retaining the remnant trees in its natural habtat. IFESCU established plantations of Haldu in the campus for *ex situ* conservation purposes (**Table 4.27**).

Table 4.27 Initial growth performance of Haldu seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2012	5	West of VC Bungalow	5.9	-	7.22
2013	4	Near IFESCU Director's office	3.4	-	3.1
2014	3	Jangalia hills	1.2	1.6	-



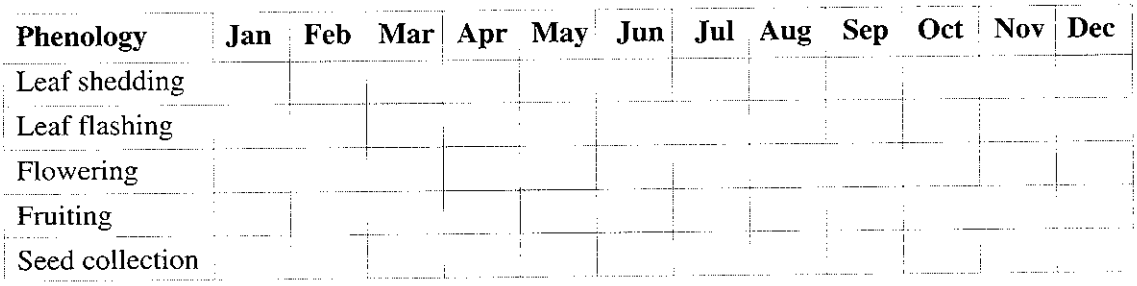

কাইকা/হলুদ

28. *Hopea odorata* Roxb.

Synonyms : *Hopea decandra* Buch. -Ham. *ex* Wight, *Hopea vasta* Wall. *ex.* DC.
Vernacular name : **Telsur**, Teksol, Tersol
English name : White thingan
Family : Dipterocarpaceae

Description: *Hopea odorata* (Telsur) is a large tree with tall, clear, cylindrical bole, young shoots whitish hairy. Bark blackish-brown, longitudinally and deeply fissured. Leaves ovate or oblong-lanceolate on slender petiole, blunt, acuminate with unequal base. Flowers small, white, scented, in whitish-tomentose, terminal, one-sided raceme. Fruit a nut recalcitrant with 2 wings, about 0.7-0.9 cm long without wing, blunt, somewhat narrowed at the puberulous base, wing length 4.2 – 6.0 cm and width 0.9-2.0 cm, tapering at both ends. Number of seeds per kg is 3,583 and moisture content is 15.33%.

Phenology: Evergreen to semi-deciduous tree. Telsur partially sheds leaves in the dry seasons depending on the surrounding enviroinment including water stress, soil condition etc.



Global distribution: Telsur is widely distributed from Bangladesh, Indo-China, Thailand, Borneo and Malaysia to the Andaman Islands.

Distribution in Bangladesh: In Bangladesh, Telsur occurs naturally in the forests of Cox's Bazar, Chittagong and CHT, and also planted as road-side avenue tree.

Conservation status and initiatives: Least Concern accoding to Ahmed et al. (2008). But, rarely found the natural populations growing in the forests. Some plantions of Telsur are found in BFD, educational and research institutes. IFESCU established plantations of Telsur in the campus for *ex situ* conservation purpose (**Table 4.28**).

Table 4.28 Initial growth performance of Telsur plantations in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	5.5	4.7
2014	2	Jangalia hills	2.4	2.1


তেলসুর

29. Hydnocarpus kurzii (King) Warb.

Synonyms : *Taraktogenos kurzii* King, *Hydnocarpus heterophyllus* Kurz.
Vernacular name : **Chalmugra**, Chaulmugra, Dulmugri
English name : Chalmugra
Family : Flacourtaceae

Description: *Hydnocarpus kurzii* (Chalmugra) is a small to medium-sized tree. Bark greenish-grey or rusty, lenticellate; inner bark yellowish-brown. Leaves alternate, oblong-lanceolate, 15-45 cm long; entire, thickly coriaceous, cuneate at the base; lateral veins oblique. Flowers yellow, dioecious, in few-flowered axillary cymes. Fruit a berry, chocolate brown, velvety, about 7.5 cm dia., globose with a stout beak (remains of stigma). Seeds numerous, about 2.5 cm long, tightly packed in the fruit.

Phenology: Chalmugra is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Chalmugra is found in Bangladehs, India, Myanmar, Thailand and Peninsular Malaysia.

Distribution in Bangladesh: In Bangladesh, Chalmugra occurs in the forests of Chittagong, Cox's Bazar, CHT, Sylhet and usually growing as an under storey (Das and Alam, 2001).

Conservation status and initiatives: The species is categorized as **Endangered** (Huq and Banik 1990), **Threatened** by Khan et al. 2001, Hasanuzzaman (2003), **Conservation Dependent** (Ahmed at al. 2008). Plantations of Chalmugra were established by IFESCU in the University campus (**Table 4.29**).

Table 4.29 Initial growth performance of Chalmugra seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	Jangalia hills	1.2	1.4


চালমুগরা

30. *Hymenodictyon orixensis* (Roxb.) Mabberley

Synonyms : *Hymenodictyon excelsum* (Roxb.) Wall., *Cinchona orixensis* Roxb., *Hymenodictyon obovatum* Wight

Vernacular name : **Bhutum**, Kali-kadam, puti-dadam, Bhui-kadam, Gomria Gamar

English name: Not Known

Family : Rubiaceae

Description: Bhutum is a medium sized to large tree with spreading branches; young parts velvety-pubescent. Bark greyish-brown, thick, corky and furrowed. Leaves elliptic-ovate 10-20 cm long, acuminate, narrowed into a petiole of 2-8 cm long; membranous, pubescent, lateral veins 7-10 pairs. Flowers white, fragrant, in dense, cylindrical, drooping, terminal compound racemes with thick foliaceous, persistent, linear or lanceolate bracts. Fruit a capsule, ellipsoid, woody, 1.2-2.5 cm long, reddish brown when ripe, on recurved (bent) pedicels; 2-valved. Seeds many and lenticulars about 1.3 cm long.

Phenology: Bhutum is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												

Global distribution: Bhutum naturally occurs in India, Myanmar, Vietnam, Thailand and Malaysia.

Distribution in Bangladesh: It occurs in the dry forests of Chittagong, Cox's Bazar, CHT, Dhaka-Mymensingh, Sylhet, Dinajpur and Comilla districts of Bangladesh.

Conservation status and initiatives: Bhutum is reported as **Vulnerable** by Ahemed et al. (2008). Conservation measures are essential in the form of enrichment plantations and *ex situ* conservation. Average height (m) and dbh (cm) of the seedlings planted in the University campus are as follows (**Table 4.30**).

Table 4.30 Initial growth performance of Bhutum seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2012	5	West of VC Bungalow	3.4	-	4.9
2014	3	Jangalia hills	1.2	1.6	-
2014	3	Near IFES Director's office	2.5	-	4.5

31. **Lagerstroemia parviflora** Roxb. var. bengalensis Clarke

Synonyms : *Fatioa napaulensis* DC., *Lagerstroemia fatioa* Bl., *L. lanceolata* Wight & Arn., *Murtughas parviflora* Kuntze

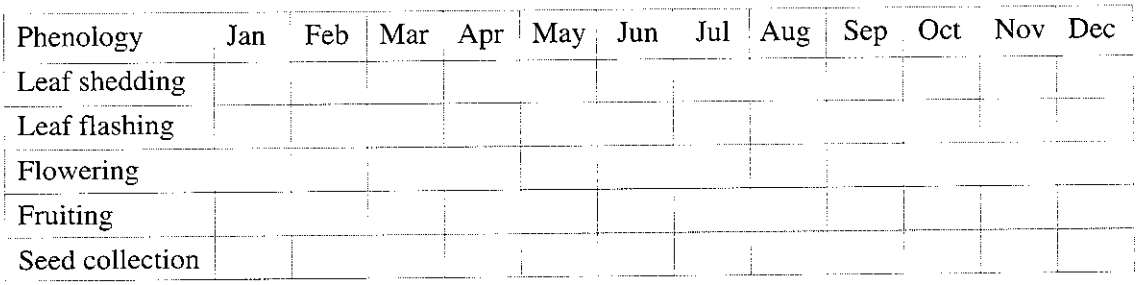
Vernacular names : **Sidha**, Sidha-Jarul, Batura , Tilla-jarul, Ghugra

Enlgish name : Not known

Family : Lythraceae

Description: *Lagerstroemia parviflora* (Sidha-Jarul) is a medium-sized to tall tree. Bark smooth grey or brown, peeling off in thin strips. Leaves elliptic-oblong, 5-10 × 2.5-4.0 cm. Flowers small, white, fragrant, in much branched axillary or terminal panicles of cymes. Fruit dried brown or blackish, 1.5-1.9 × 1.0-1.2 cm, woody, oblong, seated on woody stalk and persistent calyx, dehiscent into 4-valves; ovoid capsules hang in clusters from leafless trees. Seeds brownish, orthodox, 1.0-1.5 × 4.0-5.0 mm, weigh 48-59 seeds/g, have a terminal wing which is thickened and curved at the back.

Phenology: Sidha-Jarul is a deciduous tree.



Global distribution: Sidha-Jarul naturally grows in Bangladesh, India, Myanmar and Nepal.

Distribution in Bangladesh: In Bangladesh, it occurs in the forests of Chittagong, Comilla, Dhaka, Dinajpur, Sylhet and Tangail districts.

Conservation status and initiatives: Least Concern (Ahmed et al. 2009), but field observations showed that mother tree populations of Sidha is reducing alarmlingly in the natural habitat. Plantations were established by IFESCU with support of Arannayk Foundation in the University campus (**Table 4.31**).

Table 4.31 Initial growth performance of Sidha Jarul seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of VC Bungalow	3.5	3.4
2013	4	Jangalia hills	2.9	2.1

32. Lithocarpus acuminata (Roxb.) Rehder

Synonym : *Quercus acuminata* Roxb.
Vernacular names : **Kala batna**, Kanta-gola batna, lota batna, Kali batna, Lota batna
English name : Not Known
Family : Fagaceae

Description: *Lithocarpus acuminata* (Kala batna) is a large tree. Leaves broadly lanceolate, 15-30 cm long, shining on both surfaces; petiole about 1.2 cm long. Flowers in spikes, male spike erect, female spike solitary. Fruit a nut (acron), ovate, smooth, brown, rather longer than common acron; cup saucer-shaped. Fruit a nut type, brown, 1.2 -1.8 cm length, 1.5 -1.7 cm width, 1.5 -2.0 g weight per fruit, ovate, smooth. Seeds are orthodox, streaked and flaked with brown, black and red colors, 1.3 cm diameter.

Phenology: Kala batna is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Naturally found in Nepal, Bangladesh, Indo-China, and South-West China.

Distribution in Bangladesh: Kala batna occurs in the evergreen forests of Chittaogng, CHT, Cox's Bazar and Sylhet.

Conservation status and initiatives: Threatened (Hasanuzzaman 2003), **Endangered** (Ahmed et al. 2008). Loss of habitat is the major threat to the existence of this species. Both *ex-situ* and *in-situ* conservation measures are essential to save the species from extinction. Kala batna plantations were established by IFESCU in the hilly terrains of the campus (**Table 4.32**).

Table 4.32 Initial growth performance of Kala batna seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of VC Bungalow	6.5	4.9
2013	4	Jangalia-mixed plantation	2.7	3.5
2014	3	Near IFES Director's office	2.5	4.6

33. *Lophopetalum wightianum* Arn.

Synonyms : *Lophopetalum fimbriatum* Wight., *Lophopetalum winkleri* Loes.
Vernacular names : **Raktan**, Sutrong
English name : Not known
Family : Celastraceae

Description: *Lophopetalum wightianum* (Raktan) is a tall glabrous tree, up to 60 m tall and 195 cm diameter; stem fluted, sometimes with buttresses. Bark grey, rough with horizontal wrinkles or coarsely fissured. Leaves simple, usually opposite, sometimes alternate; petiole 0.8-2.5 cm long, apex acute to acuminate, base rounded, margin entire. Inflorescence panicles up to 12 cm long; flower petals dull red, disk bright red. Fruit a capsule, 3-4 angled, elongated; seeds many, membranous, white, papery winged.

Phenology: Raktan is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Raktan is naturally found in Bangladesh, Brunei, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Pakistan, Singapore, Thailand, and Vietnam.

Distribution in Bangladeh: In Bangladesh, it occurs in the forests of Chittagong, Cox's Bazar, CHT and Sylhet (Prain 1903, Heinig 1925). At present, it occurs sporadically throughout those regions. There is a beautiful avenue of the tree on the approach road of Lowachara Forest Rest House in Srimongal, Moulvibazar.

Conservation status and initiatives: Endangered (Huq and Banik 1990) and **Near Threatened** according to Ahmed et al. (2008). IFESCU established some plantations of Raktan in the campus (**Table 4.33**).

Table 4.33 Initial growth performance of Raktan seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2012	5	West of VC Bungalow	3.7	-	4.9
2013	4	Jangalia hills	4.4	-	3.2
2014	3	Near IFES Director's office	3.4	-	3.9
2015	2	Jangalia hills	1.8	2.5	-

34. **Mallotus philippensis** (Lamk.) Muell.-Arg.

Synonyms : *Croton philippense* Lamk., *Croton punctatus* Retz., *Rottlera tinctoria* Roxb.

English names : Kamala Tree, Monkey Face Tree, Red Berry

Vernacular names : **Sinduri**, Kamalaguli, Kamela, Kingur, Punag, Tung

Family : Euphorbiaceae

Description: *Mallotus philippensis* (Sinduri) is a small to medium-sized tree, up to 15 m tall. Stem often fluted; branchlets, young leaves and inflorescence rusty-pubescent. Leaves alternate or sub-opposite, stipulate, stipules minute, petiolate, petioles 2-6 cm long, leaf blade ovate to ovate-lanceolate, 5-15 × 2-8 cm. Male inflorescence terminal, spicate or racemose. Male flowers subsessile, or with 1 mm, ovate-lanceolate to lanceolate, acute. Female inflorescence as in the male but less crowded and shorter. Female flowers sessile or subsessile. Fruits 8-10 × 5-6 mm, 3-lobed, occasionally 4-lobed. Seeds globose, smooth, black.

Phenology: Sinduri is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Sinduri naturally occurs in widespread from Bangladesh, West Himalaya and Sri Lanka to China and throughout South-East Asia to East Australia and Malaysia.

Distribution in Banglasdesh: In Bangladesh, Sinduri is found in Sal and hill forests of the country.

Conservation status and initiatives: Conservation Dependent according to Ahmed et al. (2008). Regeneration and reproduction through seeds and coppices are profuse but protection from firewood collection is essential. IFESCU established a small plantation with seedlings in the campus.

35. *Mangifera sylvatica* Roxb.

Synonym : Not known
Vernacular names : **Uriam**, Laksmi-am, Jangli-am, Kosh-am
English names : Wild Mango, Forest Mango.
Family : Anacardiaceae

Description: *Mangifera sylvatica* (Uriam) is a large and tall tree with dense globose crown and tall, cylindrical bole. Bark ashy-grey or silvery, fissured or irregularly cracked; blaze greenish-yellow exuding a whitish gum. Leaves lanceolate, narrower and longer than leaves of *M. indica* (Aam), margin undulated, coriaceous, glabrous and opaque on both the surfaces. Flowers pinkish-white in glabrous panicles of more than 30 cm long. Fruit a drupe, 7-10 cm long, obliquely tapering acuminately slightly compressed.

Phenology: Uriam is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Uriam is found in Bangladesh, India, tropical regions of eastern Himalayas (Deb 1981).

Distribution in Bangladesh: In Bangladesh, it occurs naturally in the forests of Chittagong, Cox's Bazar, Chittagong Hill Tracts and Sylhet.

Conservation status and initiatives: Threatened (Khan et al. 2001, Hasanuzzaman 2003), **Vulnerable** (Ahmed et al. 2008) and **Protected Plant** (Anon 2012). Deforestation and habitat destruction is the major threat of its vulnerable condition. Both *in-situ* and *ex-situ* conservations are suggested to prevent further ruination of this species. IFESCU established plantations of Uriam in the campus with support from Arannayk Foundation (**Table 4.35**).

Table 4.35 Initial growth performance of Uriam seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2013	4	Jangalia hills	3.0	-	2.4
2014	3	Jangalia hills	1.7	1.3	-


উরি আম

36. Michelia champaca L.

Synonym : *Michelia rheedii* Wight
Vernacular name : Champa
English name : Champak
Family : Magnoliaceae

Description: *Michelia champaca* (Champa) is a medium to large tree, up to 25 m tall, bark dark grey, young shoots rusty tomentose. Leaves 8-25 × 4-10 cm, ovate to elliptic-lanceolate, thinly coriaceous, shiny and glabrous above, minutely pubescent beneath. Flowers solitary, axillary, 3.5-6.0 cm across, pale yellow, becoming orange, fragrant, pedicels up to 1.5 cm long, minutely tomentose. Fruiting receptacles 8-15 cm long, ripe carpels woody, ovoid to ellipsoid, 1-2 cm long, white speckled. Seeds many, enclosed by fleshy red aril.

Phenology: Champa is an evergreen to semi-deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Champa naturally grows in Bangladesh, Malaysia, Myanmar, India, Nepal, Sri Lanka, Bhutan, China, Japan and Thailand.

Distribution in Bangladesh: Champa occurs in the forests of Chittagong, Cox's Bazar, Sylhet and CHT. It is also planted as a roadside ornamental tree and in parks and gardens.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2009). IFESCU established a small plantation in the campus (**Table 4.36**).

Table 4.36 Champa plantations in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	4.2	4.7


চম্পা
(CHAMPA)

37. **Miliusa velutina** (Dunal) Hook. f. & Thorn.

Synonyms : *Uvaria velutina* Dunal, *Guatteria velutina* (Dunal) A. DC., *Uvaria villosa* Roxb.

Vernacular names : **Gandhi-gazari**, Bhul-gajari

English name : Not known

Family : Annonaceae

Description: *Miliusa velutina* (Gandhi-gazari) is a medium sized tree up to 15 m tall, stem glabrous, young branches tomentose. Leaves petiolate, petioles 2-8 mm long, lamina 12-31 × 6.5-16 cm, broadly elliptic-ovate to obovate, cordate, acute to acuminate. Inflorescence extra-axillary or terminal on short lateral branches, 3-6 flowered. Carpel 2-3 mm long, ovary densely woolly dorsally, stigma clavate. Monocarps 2 × 1.6 cm, many, ovoid, pilose, 1-2 seeded. Seeds 1-2 × 5-8 mm long, stipe tomentose.

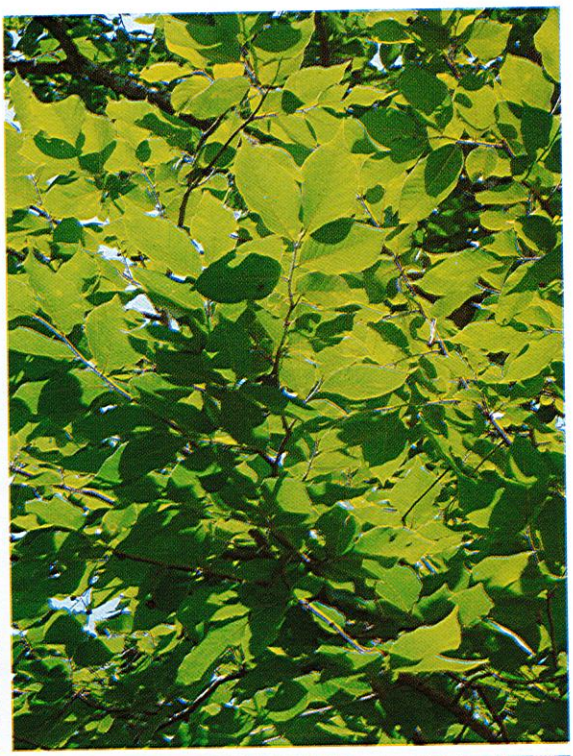
Phenology: Gandhi-gazari is a deciduous tree.

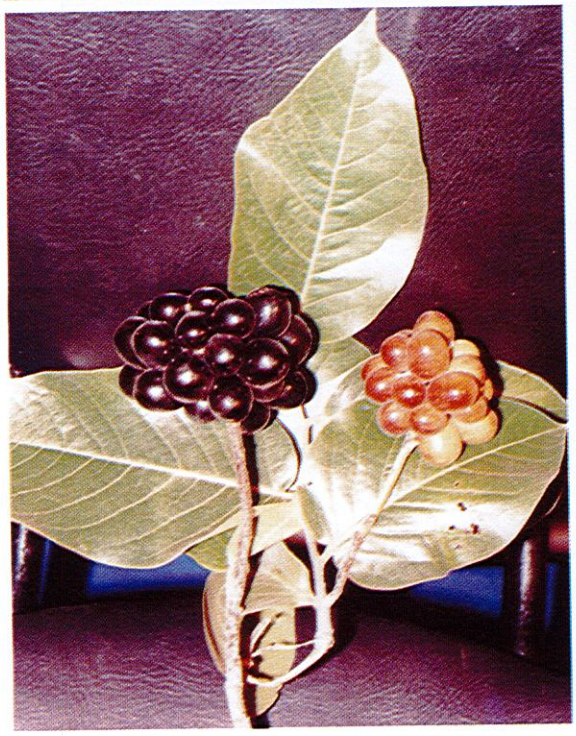
Phenology	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Gandhi-gazari is found in Bangladesh, Pakistan, India, Nepal, Myanmar, Cambodia, Laos, Thailand and Vietnam.

Distribution in Bangaldesh: It occurs in sal forests of Dhaka, Gazipur, Tangail, Mymensingh and Sherpur districts.

Conservation status and initiatives: Least Concern by Ahmed et al. (2008). IFESCU established a small plantation of this species in the campus. Protection of the natural regeneration sites and assisting natural regeneration for enhancing *in-situ* conservation is recommended.






গান্দি পত্তার

38. **Oroxylum indicum** (L.) Kurz.

Synonyms : *Bignonia indica* L., *Bignonia pentandra* Lour., *Calosanthes indica* (L.) Blume

Vernacular names : **Thona, Kanaidinga**, Khana, bhinga, hona, sonapati, kalidanga

English names : Indian trumpet flower, Midnight Horror, Broken Bones Plant

Family : Bignoniaceae

Description: Thona is a small to medium-sized, glabrous tree, grows up to 20 m tall; branchlets, rachis and petioles with numerous, white, prominent lenticels. Bark thick, greyish brown; inner bark yellowish green. Leaves pinnately compound, 120-180 cm long, bipinnate, or tripinnate near the base, unipinnate at the apex. Flowers fleshy, large, in erect terminal racemes, open during night and emit a bad smell. Fruit a capsule, flat, 45-75×5-8 cm, often curved like sword; blackish woody, when mature dehiscing at the edges, each fruit weigh 77-126 g. Seeds with a broad, transparent wing, orthodox, whitish in color, 5-7 cm long including the hyaline wing and 3.2 -3.8 cm wide, seeds per fruit is around 500-550.

Phenology: Thona is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Thona naturally grows in Bangladesh, India, Myanmar, Thailand, China, Cambodia, Malaysia, Indonesia and the Phillippines.

Distribution in Bangladesh: It occurs in the forests of Chittaogng, CHT, Cox's Bazar, Dhaka, Tangail, Mymensingh and often found in forest outskirts. It is also found in village shrubberies and homesteads throughout the country.

Conservation status and initiatives: Least Concern by Ahmed et al. (2008). Small plantation of the species is established in the University campus (**Table 4.38**).

Table 4.38 Initial growth performance of Thona in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	West of VC Bungalow	3.5	3.1

39. **Palaquium polyanthum** Benth.

Synonyms : *Dichopsis polyantha* Benth. &Hook.f., *Bassia polyantha* Wall.
Vernacular names : **Tali**, Dudhi, dudha, Kurta, Lali, Taiban, Salua
English name : Palaquium
Family : Sapotaceae

Description: *Palaquium polyanthum* (Tali) is a medium-sized to tall tree up to 20 m tall. Stem and branches with milky latex; branchlets horizontal. Bark smooth, dark brown with greenish-white horizontal patches. Leaves simple, alternate, petiolate, crowded at the ends of branchlets, blade 15-30 cm long, young leaves covered with velvety brown hairs, lateral veins numerous, sub-parallel. Flowers white, fragrant in axillary fascicles. Fruit a berry, obovoid, about 4.0 cm long, velvety brown.

Phenology: Tali is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Tali naturally occur in Bangladesh, India, Myanmar etc.

Distribution in Bangladesh: In Bangladesh, Tali is found in the evergreen forests of CHT (Kaptai), Chittagong, Cox's Bazar and Sylhet.

Conservation status and initiatives: Tali is treated as **Not Evaluated** (Ahmed et al. 2008). A few individuals are reported from Kaptai and Hazarikhil WS. IFESCU established Tali plantation in the campus for *ex situ* conservation of this species (**Table 4.39**).

Table 4.39 Initial growth performance of Tali seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	Jangalia hills	1.7	2.1

40. Podocarpus neriifolius D. Don.

Synonyms : *Podocarpus discolor* Bl., *Podocarpus leptostachya* Bl., *Nageia neglecta* (Bl.) O. Ktze., *Podocarpus decipiens* Gray

Vernacular names : **Banspata**, jinari, bao-patta, raja-gach

English names : Oleander Podocarpus, Brown pine

Family : Podocarpaceae

Description: Banspata is a large evergreen tree with whorled branches. Bark brown, thin, peeling off in papery flakes. Leaves scattered on the branchlets and appear arranged in two rows forming arches, linear, lanceolate, 12-25 cm long, almost sessile, thick, leathery, mid-rib prominent on both surfaces. Flowers dioecious; male flowers cylindrical catkin-like, axillary or terminal, filament short; female flowers with 2-4 scales, one or two of which bear in their axils a fertile scale folded over and united into an inverted ovule, usually only one mature, the sterile ovules often fuse with the upper part of the stalk and developing into a swollen fleshy, black coloured edible receptacle, upon which the seeds is borne. Seeds ovate, 3-4 cm long and dark green.

Phenology: Banspata is an evergreen gymnosperm.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Banspata is found in Bangladesh, Nepal, India, Bhutan, Malay, China, and Andamans.

Distribution in Bangladesh: Banspata is the only conifer (soft wood) growing naturally in the forests of Chittagong Hill Tracts (Publakhali) and Cox's Bazar (Ukhia). This species regenerate naturally but due to clear felling it has become endangered (Bhuiyan et al. 2014).

Conservations status and initiatives: Endangered (Huq and Banik 1990) and Ahmed et al. (2008) and **Protected Plant** (Anon 2012). IFESCU established some plantations of Banspata in the campus (**Table 4.40**).

Table 4.40 Initial growth performance of Banspata seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	West of Nipoban School	2.7	2.1
2014	3	Near IFES Director's office	2.8	2.6

41. **Protium serratum** (Wall. *ex* Colebr.) Engl.

Synonym : *Bursera serrata* Wall. *ex* Colebr.
Vernacular names : **Gutguttya**, Neur, Neul, Niyar, Nihor, Heru, Hajna, Loha-bhadi
English name : Indian Red Pear
Family : Burseraceae

Description: *Protium serratum* (Gutguttya) is a medium to large tree. Bark brownish or light grey, fissured, peeling off in irregular flakes; blaze pinkish or reddish brown. Leaves imparipinnate, rachis pubescent; leaflets opposite, 5-11, elliptic-oblong, 7-10 cm long, serrate or nearly entire. Flowers pentamerous, small, greenish, in axillary lax (diffuse), pubescent panicles. Fruit a drupe on thick peduncles, 2-3 furrowed, up to 2 cm across, red when ripe, containing 1-3 seeds.

Phenology: Gutguttya is an evergreen or semi-deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008), but few scattered individuals only found in natural habitats. Both *in-situ* and *ex-situ* conservation initiatives of this species is necessary. Plantations were established in the campus with support from Arannayk Foundation (**Table 4.41**).

Table 4.41 Initial growth performance of Gutguttya seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marine Science Institute	5.9	7.2
2013	4	Jangalia hills mixed plantation	4.7	5.3
2014	3	Near IFES Director's office	2.5	2.6


Gutgutya
Protium serratum

42. *Pterospermum acerifolium* (L.) Willd.

Synonym : *Pentapetes acerifolia* L.
Vernacular names : **Muskanda**, Machkunda, Moos; Kanak champa, Hattipaila
English names : Mapple-leaved Bayur, Dinnerplate
Family : Sterculiaceae

Description: *Pterospermum acerifolium* (Muskanda) is a large, attractive tree with smooth and grey bark. Leaves large, polymorphous, 18-40 × 12-30 cm. Flowers large, white, fragrant, solitary or in 2-3 flowered cymes; with 5 sepals, 5 reflexed petals, 15 stamens and 5 carpels. Fruit a capsule, 5-10 cm long, 5-valved, rusty brown-glabrescent and with many seeds. Seeds ovate, brown and membranous with a thin wing.

Phenology: Muskanda is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

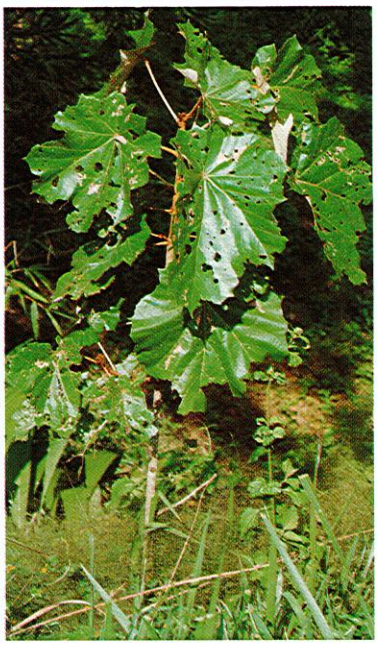
Global distribution: Muskanda is found in India, Myanmar, Nepal and Bangladesh.

Distribution in Bangladesh: In Bangladesh, it grows in the forests of Tangail, Chittagong, Cox's Bazar, Sylhet and CHT. The species is often planted as an ornamental in homes, gardens, parks and avenues.

Conservation status and initiatives: Endangered (Huq and Banik 1990) and **Least Concern** according to Ahmed et al. (2008). But field observations indicate that the population of Muskanda is being reducing gradually with the loss of habitat and deforestation. IFESCU established Muskanda plantations in the campus (**Table 4.42**).

Table 4.42 Initial growth performance of Muskanda seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2011	6	West of Marine Science Institute	7.8	-	9.1
2014	3	Near IFES Director's office	1.8	2.7	-



43. *Pterospermum semisagittatum* Ham.

Synonym : *Eriolaena roxburghii* Spreng.
Vernacular name : **Lana-assar**, Bara-assar, Laona assar
English name : Not known
Family : Sterculiaceae

Description: *Pterospermum semisagittatum* (Lana-assar) is a small to medium-sized deciduous tree, bole ash-grey. Leaves 7-22 cm long, sessile, from an unequal base, one basal lobe rounded and other lobe longer and triangular, stipules deeply segmented, segment yellowish, filiform. Flowers large, white on short axillary peduncles supported by a wooly much dissected filiform bracteole. Fruit a capsule, woody, cylindrical, rusty-tomentose, about 7.5 cm long, 5-celled, with many seeds. Seeds compressed with a thin wing.

Phenology: Lana-assar is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Lana-assar is found in Bangladesh India, Sri Lanka, Thailand, Myanmar and Indo-China.

Distribution in Bangladesh: It occurs in the forests of Chittagong, Cox's Bazar, CHT and Madhupur sal forests of Tangail.

Conservation status and initiatives: Threatened (Khan et al. 2001, Hasanuzzaman 2003), **Least Concern** (Ahmed et al. 2008). IFESCU established Lana-assar plantations in the campus (**Table 4.43**).

Table 4.43 Initial growth performance of Lana-assar in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2014	3	Jangalia hills	0.7	1.1	-
2014	3	Near IFES Director's office	2.6	-	3.5

44. *Pterygota alata* (Roxb.) R. Br.

Synonym : *Sterculia alata* Roxb.
Vernacular names : **Buddha-narikel**, Narikeli
English name : The Buddha's coconut tree
Family : Sterculiaceae

General description: *Pterygota alata* (Bddha-narikel) is a very large tree, up to 50 m tall, often buttressed, with several narrow wide spreading buttresses at the base. It has short horizontal branches and a narrow conical crown. Bark greyish brown with horizontal wrinkles and shallow vertical fissures. Leaves simple, usually clustered at the end of the branchlets, broadly ovate with a cordate base, 10-16 × 7-12 cm. Flowers brownish-yellow, unisexual. Fruit a follicle, large, woody, 7-12 cm in diameter, obliquely globoose, having winged seeds in 2 rows.

Phenology: Buddha-narikel is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

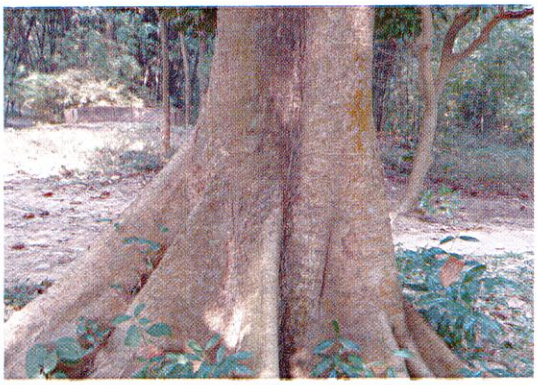
Global distribution: Buddh-anarikel is found in the natural forests of Bangladesh, Bhutan, China, Indonesia, Laos, Myanmar, Nepal and Thailand.

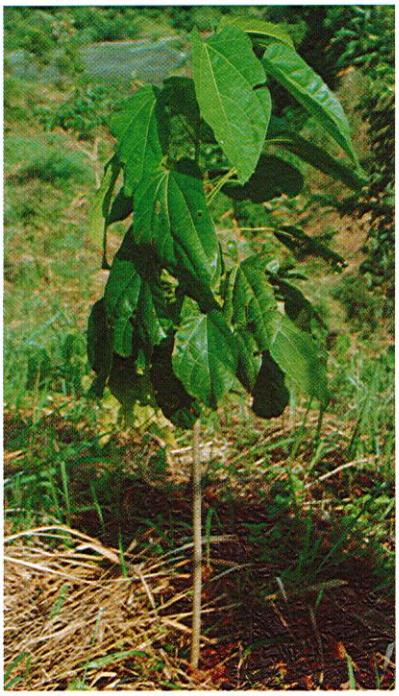
Distribution in Bagladesh: It is sporadically found in Chittagong, Cox's Bazar and CHT. Also found few individuals in the plantations.

Conservation status and initiatives: Endangered (Huq and Banik 1990) and **Least Concern** (Ahmed et al. 2009). IFESCU established plantations in the campus for conservation of this species with support from Arannayk Foundation (**Table 4.44**).

Table 4.44 Initial growth performance of Buddha-narikel seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of Marine Science Institute	3.4	4.5
2012	5	West of VC Bungalow	4.2	3.8
2013	4	Jangalia-mixed plantation	3.0	3.5
2014	3	Near IFES Director's building	3.1	3.4
2014	3	Jangalia hills	1.8	3.8





45. Sapindus saponaria L.

Synonyms : *Sapindus mukorossi* Gaertn., *Sapindus saponaria* L.f. var. *microcarpa* (Jardin) Radlk., *Sapindus saponaria* L. var. *jardiniana* F.B.H. Brown

Vernacular names : Ritha, Chhotoritha

English name : Soap Nut Tree

Family : Sapindaceae

Description: *Sapindus saponaria* (Ritha) is a medium-sized tree, up to 15 m tall and 1 m in girth, bark dark or pale grey somewhat rough, exfoliating in irregular woody scales. Leaves 1-5 jugate, up to 40 cm long, petioles terete to triangular, marginated to winged, 2-5 cm long, hardly to distinctly swollen at the base. Inflorescence up to 25 cm long, panicle densely fulvous tomentose. Flowers regular, cream-white. Petals 5, purple, oblong-ovate to ovate. Fruit a drupe, solitary or in pair, fleshy, sub-globular, 1.0-1.2 cm in diameter, glabrous. Seeds sub-globular, 0.8-1.0 cm in diameter.

Phenology: Ritha is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

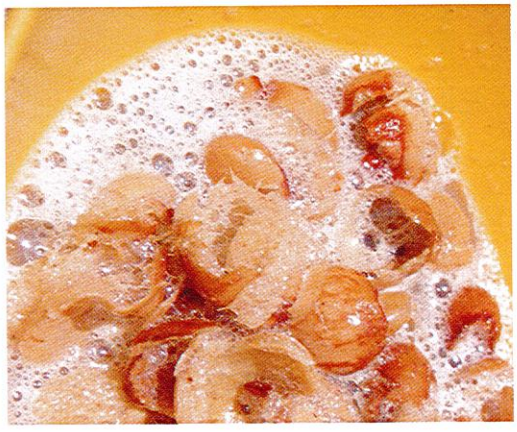
Global distribution: Ritha probably originated in tropical and subtropical America. It is widely cultivated and nautralized in tropics and subtropics.

Distribution in Bangladesh: It occurs only under cultivated condition.

Conservation status and initiatives: Near Threatened (Ahmed et al. 2008) and **Protected Plant** (Anon 2012). IFESCU and BFRI established small plantations of this species for *ex situ* conservation (**Table 4.45**).

Table 4.45 Growth of Ritha seedlings in the plantations of CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	Jangalia hills	1.7	2.8



46. *Saraca asoca* (Roxb.) de Wild.

Synonym : *Jonesia asoca* Roxb.
Vernacular name : **Ashok**
English name : Ashoka tree
Family : Caesalpiniaceae

Description: *Saraca asoca* (Ashok) is a fast growing, small to medium-sized tree, 6-9 m tall with drooping branches and leaves. Leaves even pinnate, rachis 10-23 cm long, leaflets 3-5 pairs, 9-25 × 2.5-10 cm, oblong to lanceolate, acute to acuminate. Inflorescence racemose, compact, arising from the end of the leafy branches or nodes of old wood, often growing on trunk. Flowers apetalous, orange-yellow to red, about 5 cm long. Pods 10-15 × 2-5 cm with 5 mm long stripe, flattened, woody, beaked at the apex. Seeds large, thick and compressed, reddish-brown.

Phenology: Ashok is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: Ashok is native to Bangladesh, Malay Peninsula of the East Irrawraddy river. It is also found in South and South-East Asia.

Distribution in Bangladesh: In Bangladesh, Ashok is planted along roadsides, gardens, parks, office yards and in homesteads. It grows wild in the forests of Chittagong, CHT, Sal forests of Mymensingh and Tangail.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008). Habitat destruction is the major threat to occurrence of the species in its natural distribution. As the species is planted sporadically in many places of Bangladesh for aesthetic purpose, hence *in-situ* conservation initiative is necessary. Ashok seedlings were planted for conservation purpose in the hilly terrain of Chittagong University campus (**Table 4.46**).

Table 4.46 Initial growth performance of Ashok seedlings in the conservation plots of campus.

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	Jangalia hills	1.7	2.8


অশোক

47. *Scaphium scaphigerum* (Wall. *ex* G. Don) Guibourt & Planch.

Synonyms : *Scaphium wallichii* Scott & Endl., *Sterculia scaphigera* Wall., *Clompanus scaphigera* (Wall. *ex* G. Don) Kuntze

Vernacular names : **Shampan**, Semen sterculia, Pogan, Shogan, Sugan

English name : Not Known

Family : Sterculiaceae

Description: *Scaphium scaphigerum* (Shampan) is a large tree, up to 35 m tall, all parts glabrous, bark greenish-brown. Leaves ovate-oblong, 15-30 × 12-15 cm, strongly 3-veined at the base, bluntly acuminate at the apex, entire along margin. Flowers in short, robust, much branched, puberulous panicles at the end of the thick branchlets. Sepals 5, slightly united at the base, petals absent. Male flowers with 10-15 stamens whereas female flowers with 5 carpels, free, glabrous. Fruit a large follicle, boat-shaped, 15-18 × 7-9 cm, membranous, 1-2 seeded, with 1 (rarely 2) pubescent and wingless seed.

Phenology: Shampan is a decedious tree.

Phenology	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

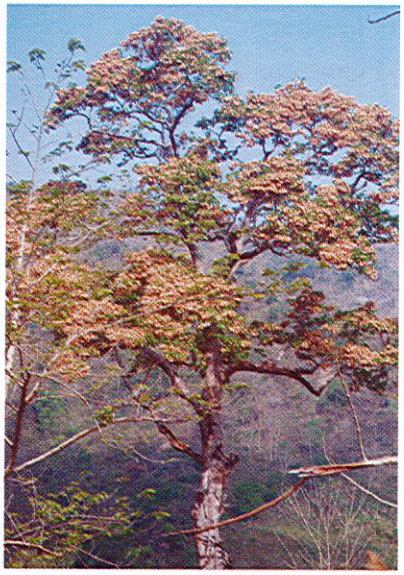
Global distribution: Shampan is found in Bangladesh, India and Myanmar.

Distribution in Bangladesh: It is found in the forests of Chittagong, Cox's Bazar, and CHT.

Conservation status and initiatives: Least Concern (Ahmed et al. 2008). Degradation of natural forests is the main threat to Shampan. Conservation in the form of both *ex-situ* and *in-situ* is proposed. IFESCU established plantations of Shampan in the campus (**Table 4.47**).

Table 4.47 Initial growth performance of Shampan seedlings in the CU campus.

Plantation year	**Age (yr.)**	**Plantation site**	**Height (m)**	**DBH (cm)**
2012	5	West of Marine Science Institute	2.8	2.2
2013	4	Jangalia hills-1	2.4	1.9
2014	3	Jangalia hills-2	1.2	1.5
2014	3	Near IFES Director's office	1.8	3.1



48. *Schima wallichii* (DC.) Korth.

Synonyms : *Gordonia chilaunia* Buch. -Ham. *ex* D. Don, *Gordonia wallichii* DC., *Schima brevipes* Craib

Vernacular names : **Kanak**, Mon Champa, Bonak

English name : Needle Wood Tree, Schima

Family : Theaceae

Description: *Schima wallichii* (Kanak) is a large tree, up to 30 m tall. Stem and branches glabrous, bark very thick, brownish to almost black. Leaves alternate, 8-20 × 3-8 cm, elliptic-lanceolate, usually entire, coriaceous, apex acute or acuminate. Flowers white, fragrant, solitary, axillary, bracts small, caduceus. Fruit a capsule, subglobose, silky when young and glabrous when old. Seeds 2-6 in each cell, glabrous and winged.

Phenology: Kanak is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

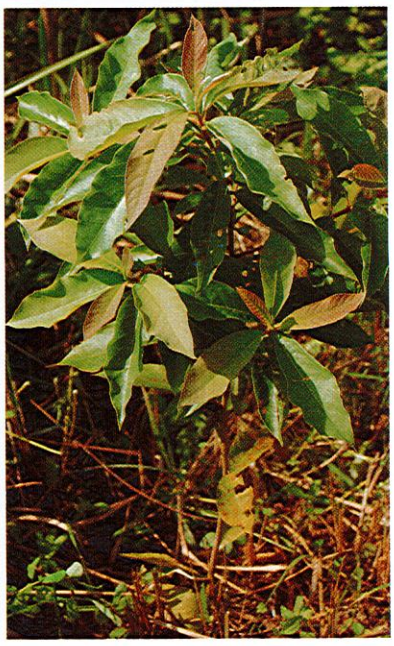
Global Distribution: Kanak is found widely in Bangladesh, India, Nepal, Bhutan, Myanmar, Thailand and China.

Distribution in Bangladesh: It is found in the hill forests of Chittagong, CHT, Sylhet, Tangail and Mymensingh districts.

Conservation status and initiatives: Least Concern (Ahmed et al. 2009). Population of mature and mother trees of Kanak is reduced severely in the natural habitat because of over extraction and illegal felling. Kanak was plantated in CU campus for *ex-situ* conservation with support from Arannayk Foundation (**Table 4.48**).

Table 4.48 Initial growth of Kanak seedlings in the CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	1.7	Jangalia hills	1.7	1.9



49. *Schleichera oleosa* (Lour.) Oken.

Synonyms : *Pistacia oleosa* Lour., *Schleichera trijuga* Willd., *Schleichera aculeata* Kostel.

Vernacular names : **Kusum**, Joyna, Lakkha

English names : Ceylon Oak, Gum Tree, Honey Tree

Family : Sapindaceae

Description: *Schleichera oleosa* (Kusum) is a medium-sized to large tree, up to 40 m tall, trunk up to 2 m in diameter. Leaves 2-4 jugate, young leaves deep purple; petioles terete, rachis triangular, leaflets elliptic to obovate, 4-25 × 3-9 cm, coriaceous, dark brown or greyish-green above, light brown to greenish beneath. Inflorescence 6-15 cm long, sparsely hairy. Flowers pale yellow or pale green. Fruit broadly ovoid to sub-globular, 15×13 mm when 1 seeded or transversely ellipsoid, slightly flattened, bi-lobed, 17-20 × 18 mm when 2-seeded, narrowed at the base, pointed at the apex, yellow. Seeds subglobular, 12×10 mm, testa dull brown and arils yellow.

Phenology: Kusum is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

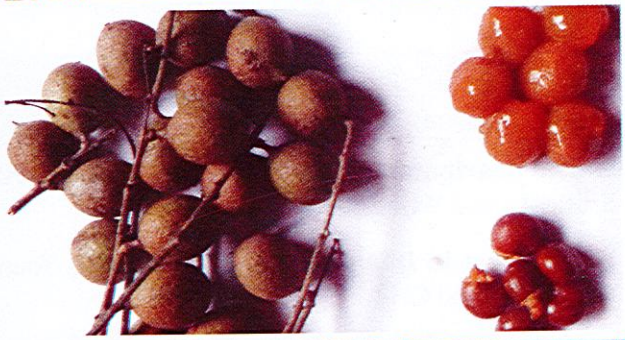
Global distribution: Kusum grows naturally in Bangladesh, Tropical South-East Asia from Sri Lanka and the western Deccan to Indo-China.

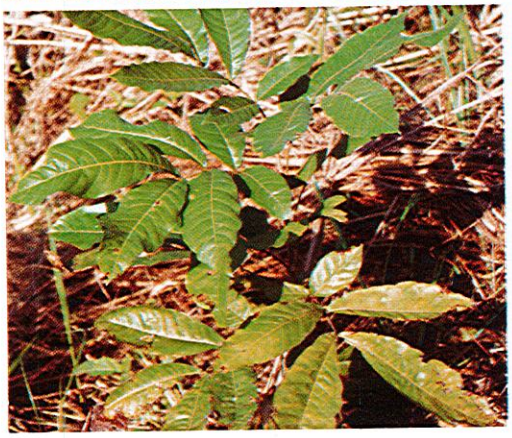
Distirbution in Bangladesh: In Bangladesh, Kusum grows in Sal forests of Mymensingh and Tangail (Hasnat et al. 2014, Jannat et al. 2016).

Conservation status and initiatives: Endangered (Huq and Banik 1990), **Not evaluated** (Ahmed et al. 2008) and **Protected Plant** (Anon 2012). IFESCU established Kusum plantations in the campus (**Table 4.49**).

Table 4.49 Initial growth performance of Kusum seedlings in the CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2013	4	Jangalia mixed plantation	2.4	-	4.3
2014	3	Near IFES Director's office	1.8	2.4	-





50. Sterculia foetida L.

Synonym : *Sterculia polyphylla* R.Br.
Vernacular names : **Udal**, Udal Badam, Jongli Badam
English names : Poon Tree, Wild Almond Tree, Java Olive, Dung Tree
Family : Sterculiaceae

Description: *Sterculia foetida* (Udal) is a medium-sized to fairly large deciduous tree, up to 40 m tall, bark whitish, young shoots hairy. Leaves crowded at the ends of thick branchlets, digitately compound, 5-10 foliate, leaflets 7.5-14.0 × 2.0-4.5 cm, elliptic-lanceolate, coriaceous and glabrous beneath when mature. Inflorescence axillary or subterminal, paniculate. Flower buds ovoid, 10 × 5 mm, dull red, yellow or purplish, with offensive smell, pedicels 1.5 - 2.5 cm long. Fruit a follicle, smooth, boat-shaped, woody, short beaked, smooth outside, fibrous inside, 10-15 seeded, red when mature. Seeds black, hard, smooth, oblong or ovoid-oblong.

Phenology: Udal is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

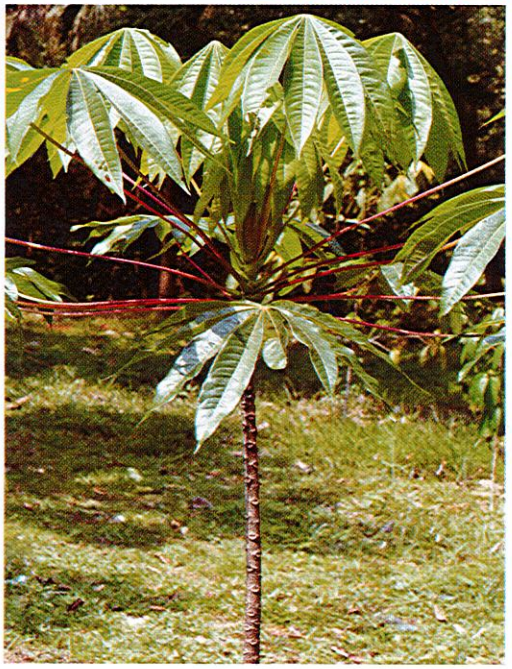
Global distribution: Udal is a native of tropical Africa. It is found in Bangladesh, Myanmar, Sri Lanka and Western India.

Distribution in Bangladesh: Udal is usually found in the forests of Tangail, Mymensingh, Chittagong and CHT.

Conservation status and initiatives: Endangered (Huq and Banik 1990) and **Not Evaluated** (Ahmed et al. 2009). IFESCU raised and planted few seedlings of Udal in the University campus (**Table 4.50**).

Table 4.50 Udal plantations in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2015	2	Jangalia hills	3.1	3.0



51. *Spondias pinnata* (L.f.) Kurz

Synonyms : *Mangifera pinnata* L.f., *Spondias mangifera* Willd.
Vernacular names : **Bon-amra**, Amra, Deshi-amra, pial, piala
English name : Hog Plum
Family : Anacardiaceae

Description: *Spondias pinnata* (Bon-amra) is a medium-sized to large tree, glabrous, deciduous with a pleasant smell (from leaves and twigs). Bark greyish, smooth but often with horizontal wrinkles and vertical fissures, blaze reddish-brown. Leaves imparipinnate, crowded at the ends of branchlets, 30-45 cm long, elliptic-oblong, acuminate, entire, membranous, shining, turning yellow before shedding. Inflorescence of 14-28 cm long panicles, terminal or axillary. Flowers bisexual, polygamous, yellowish-green, scented. Fruit a drupe, ovoid, greenish-yellow when ripe, 4-5 cm long. Seeds 100-130 per kilogram.

Phenology: Bon-amra is a deciduous species.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

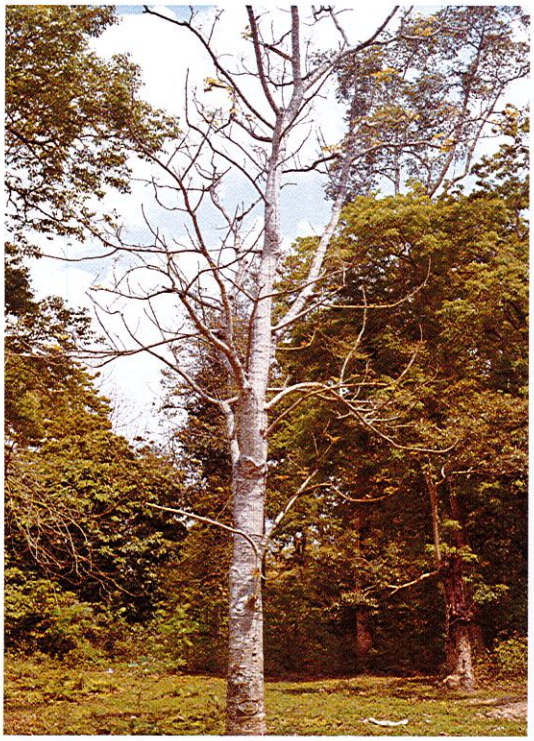
Global distribution: The species naturally grows in Bangladesh, India and Myanmar.

Distribution in Bangladesh: In Bangladesh, it sporadically grows in the forests of CHT, Cox's Bazar, Chittagong, Sylhet, Dhaka, Mymensingh and Dinajpur. It is also found in village shrubberies and mango groves throughout the country.

Conservation status and initiatives: Least Concern according to Ahmed et al. (2008) but population and abundance in the natural distribution is drastically decreasing. Bangladesh Agricultural Research Institute (BARI) and Bangladesh Agricultural University (BAU) maintain some plants on respective premises (Ahmed et al. 2008). Plantations were established in the University campus during 2012 and 2013 (**Table 4.51**).

Table 4.51 Growth of Bon-amra seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of VC Bungalow	3.6	3.7
2013	4	Jangalia hills	1.5	2.3



52. *Sterculia villosa* Roxb. *ex* Smith

Synonyms : *Sterculia ornata* Wall. *ex* Kurz, *Sterculia armata* Mast.
Vernacular names : **Udal**, Chandul
English name : Not known
Family : Sterculiaceae

Description: *Sterculia villosa* (Udal) is a small to medium-sized tree, 10-15 m tall, bark grey, smooth, about 2.5 cm thick, branches whorled, horizontal, spreading, branchlets thick with heart-shaped scars of fallen leaves, young, shoots tomentose. Leaves simple, crowded at the ends of branchlets when young, 30-40 cm long, cordate at the base, 5-7 lobed, petioles 15-40 cm long, minutely tomentose. Flowers pinkish-yellow, in crowded drooping panicles, male and female flowers intermixed. Male flowers with 10 stamens whereas female flowers with 5 carpels. Fruit a follicle, 3-5, oblong, sessile, leathery, rusty pubescent, many-seeded, red when ripe, with 3-5 oblong, smooth and black seeds.

Phenology: Udal is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

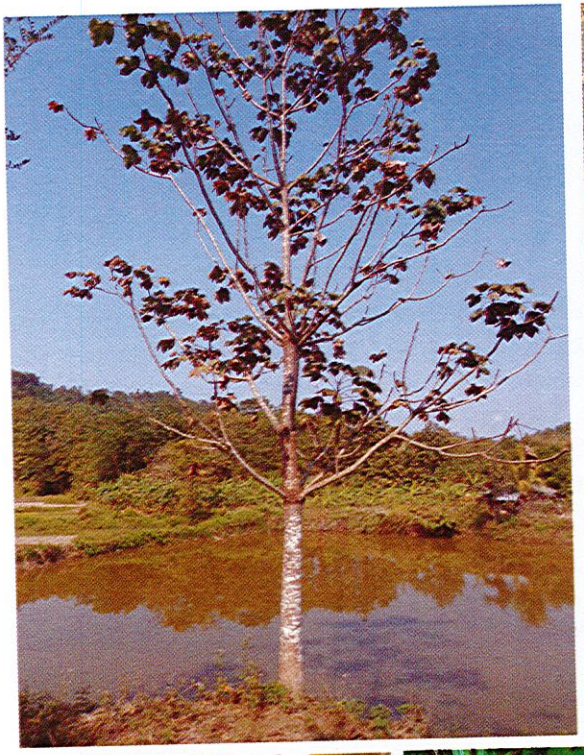
Global distribution: Udal is widely found in Bangladesh, India, Bhutan, Nepal and Myanmar.

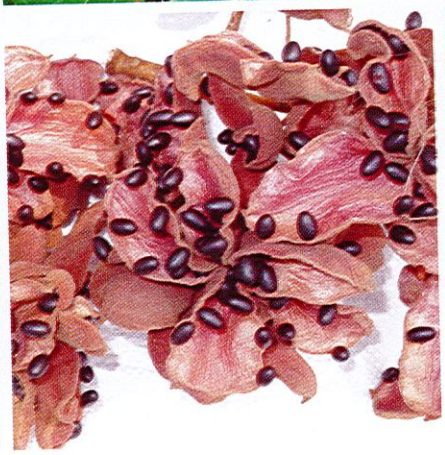
Distribution in Bangladesh: It is found in the forests of Chittagong, Cox's Bazar, CHT, and sal forests in the Dhaka-Mymensingh. It is also found in homesteads of Chittagong region.

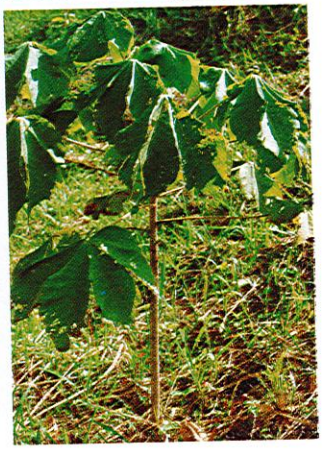
Conservation status and initiatives: Least Concern (Ahmed et al. 2009) and **Protected Plant** (Anon 2012). But large individuals has been reduced alarmingly in the forests due to over extraction for medicinal purpose and making ropes from bark. *In-situ* conservation is proposed through strengthening the forest protection and banning collection of any plant parts or seedlings of this species from the forest. IFESCU established Udal plantations in the campus (**Table 4.52**).

Table 4.52 Initial growth performance of Udal seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of VC Bungalow	3.9	7.1
2014	3	Near IFESCU Director's office	2.8	2.7
2014	3	Jangalia hills	2.1	







53. **Stereospermum colais** (Buch.-Ham. *ex* Dillw.) Mabberley

Synonyms : *Stereospermum personatum* (Hassk.) Chatterjee, *Stereospermum chelonoides* Clarke non. A. DC.

Vernacular names : **Dharmara**, Kamrang, Pahari-awal, barul-jata, atkapali

English name : Yellow Snake Tree

Family : Bignoniaceae

Description: *Stereospermum colais* (Dharmara) is a medium size to large deciduous tree, bole often fluted, up to 25 m tall. Bark rather thick, yellowish or ashy grey, with characteristic shallow horizontal depression. Leaves imparipinnate, 30-45 cm long; leaflets 3-5 pairs, elliptic-oblong, entire or serrulate, with unequal base. Flowers scented in slender glabrous panicles with articulated branching. Fruit a capsule, 35-50 cm long, 0.8 -1.0 cm width, color is brownish when ripe, obscurely 4-angled, spirally twisted. Seeds are wedge-shaped and thick; with diverging, concave, membranous, pellucid wings and 78-82 seeds per gm.

Phenology: Dharmara is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

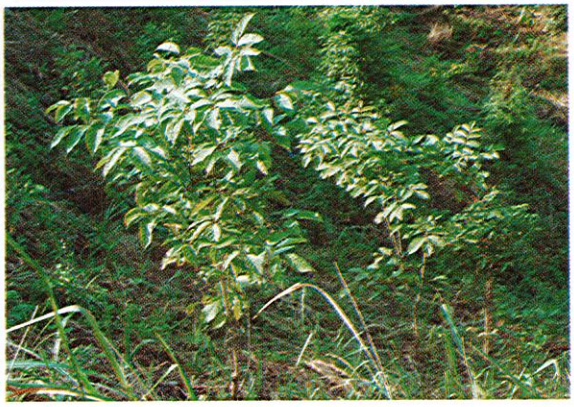
Global distribution: Dharmara grows naturally in Bangladesh, India, Sri Lanka, Thailand and Indonesia.

Distribution in Bangladesh: It occurs in the forests of Chittagong, Cox's Bazar, CHT, Sylhet, Dhaka-Mymensingh and usually growing on dry hill slopes of mixed deciduous forests.

Conservation status and initiatives: Not Evaluated (Ahmed et al. 2008). Over extraction for construction purpose is the main reason for its being rare in the forests of Bangladesh. IFESCU planted Dharmara seedlings in the campus (**Table 4.53**).

Table 4.53 Initial growth of Dharmara seedlings in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2012	5	West of VC Bungalow	4.9	5.5
2013	4	Jangalia hills mixed plantation	4.6	5.4
2014	3	Near IFESCU Director's office	3.0	2.3



54. Swintonia floribunda Griff.

Synonyms : *Swintonia grifithii* Kurz, *Swintonia helferi* Hook. f.
Vernacular names : **Civit**, am-chundul, moilam chibuk
English name : Not Known
Family : Anacardiaceae

Description: *Swintonia floribunda* (Civit) is a lofty glabrous tree; often buttressed which may extend to a height 7 m or more. Bark greyish, smooth, with shallow vertical fissures. Leaves crowded towards ends of branchlets, lanceolate, 10-15 cm long, thin coriaceous and glossy green above. Inflorescence of 15-30 cm long panicles, terminal or axillary, profusely branched. Flowers are bisexual, pale-yellow and 3-4 mm across. Fruit a drupe, unripe drupe sessile, seated on 5 oblong-linear, reflexed, about 5.0-7.5 cm long and 5-9 mm wide, single seeded, pale green when fresh and brownish color when ripe, longitudinally veined purplish wing-shaped petals.

Phenology: Civit is an evergeen plant.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

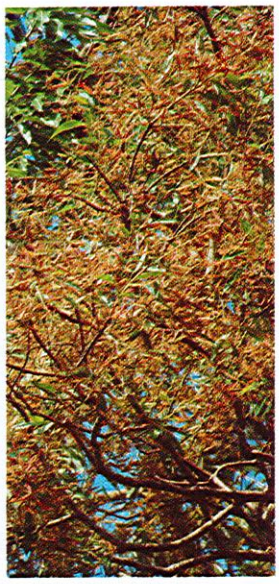
Global distribution: Civit is found in South and South-East Asia, particularly in the lowland and hill forests of Myanmar, Bangladesh, Andaman and Nicobar Islands, Thailand, Vietnam, Peninsular Malaysia and Sumatra.

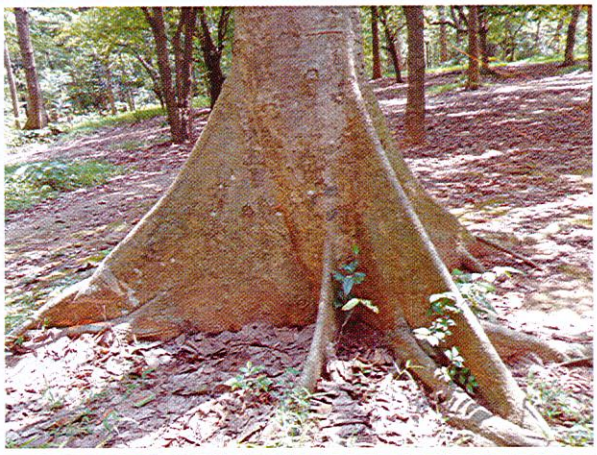
Distribution in Bangladesh: Civit naturally occurs in the hill forests of Cox's Bazar, Chittagong and CHT.

Conservation status and initiatives: Endangered (Huq and Banik 1990), **Threatened** (Khan et al. 2001, Hasanuzzaman 2003), **Vulnerable** (Ahmed et al. 2008) and **Protected plant** (Anon 2012). Both *in-situ* and *ex-situ* conservation measures are suggested for national conservation approaches. IFESCU established plantations in the campus with support from Arannayk Foundation (**Table 4.54**). Civit also starts flowering and fruiting in the campus in 2017.

Table 4.54 Growth of Civit in different plantations of CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2015	2	Jangalia hills	4.1	3.8
2014	3	West of Nipoban School	5.9	7.1
2013	4	West of Nipoban School	6.5	6.4
2012	5	North of Marine Science	7.3	7.9






সিডিট

55. *Syzygium firmum* Thw.

Synonyms : *Syzygium grandis* (Wt.) Wall., *Syzygium montanum* Thw.
Vernacular names : **Dhaki Jam**, bhatti jam, dhaki jam, titi jam
English name : Sea apple
Family : Myrtaceae

Description: *Syzygium firmum* (Dhaki jam) is a medium to large tree that grows up to 35 m tall and 3 m girth, sometimes stem with buttress. Leaves opposite, petioled, petioles stout, 1-2 cm long, lamina 13-24 × 5-14 cm, broadly elliptic to ovate-elliptic. Inflorescence of dense corymbose panicles of cymes, up to 15 cm long and terminal. Flowers white, 4-merous, sessile, 1.5-2.0 cm across. Fruits 3-4 × 1-2.5 cm, obovoid or nearly subglobose, with up to 1 cm diameter. Fruit greenish when young and purple ash when ripe; juicy and shining when fully ripe, only one globose seed. Seeds are recalcitrant.

Phenology: Dhaki jam is an evergreen tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Fruiting												
Seed collection												

Global distribution: The species is native to Andaman Islands, Assam, Bangladesh, Borneo, Cambodia, China, India, Laos, Peninsular Malaysia, Singapore, Sri Lanka, Sumatra, Thailand and Vietnam.

Distribution in Bangladesh: It grows in the forests of Sylhet, Chittagong, CHT and Cox's Bazar districts.

Conservation status and initiatives: Ahmed et al. (2008) categorized this speices as **Least Concern**. IFESCU established a planation of Dhaki Jam in 2011 for conservation of the species in the hilly terrain of the campus (**Table 4.55**).

Table 4.55 Growth of Dhaki Jam in the plantations of CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marin Science Institute	7.7	9.9


জাকিজাম

56. Tetrameles nudiflora R. Br.

Synonym : *Tetrameles horsfieldii* Steud.
Vernacular names : **Chandul**, Maina Kat, Taru, Toirol
English name : Tetrameles
Family : Datiscaceae

Description: *Tetrameles nodiflora* (Chandul) is a deciduous tree, growing up to 50 m tall, buttresses towards the base and leaf scars on the branchlets. Leaves 8-15 × 7-12 cm, broadly or suborbicularly ovate, acuminate, base cordate, irregularly toothed, veins 5-7 from the base, thinly pubescent or glabrate above, softly pubescent beneath, petioles 5-12 cm long. Flowers dioecious apetalous, tetramerous, appearing before the leaves. Male flowers pubescent panicles, fasciculate at he ends of branchlets. Female flowers sessile or nearly so in numerous, pendulous, pubescent, spicate. Fruit a capsule, 2-5 mm long, obovoid, dotted with minute white dots outside. Seeds numerous, minute.

Phenology: Chandul is a deciduous tree. Leaves shed in early January.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

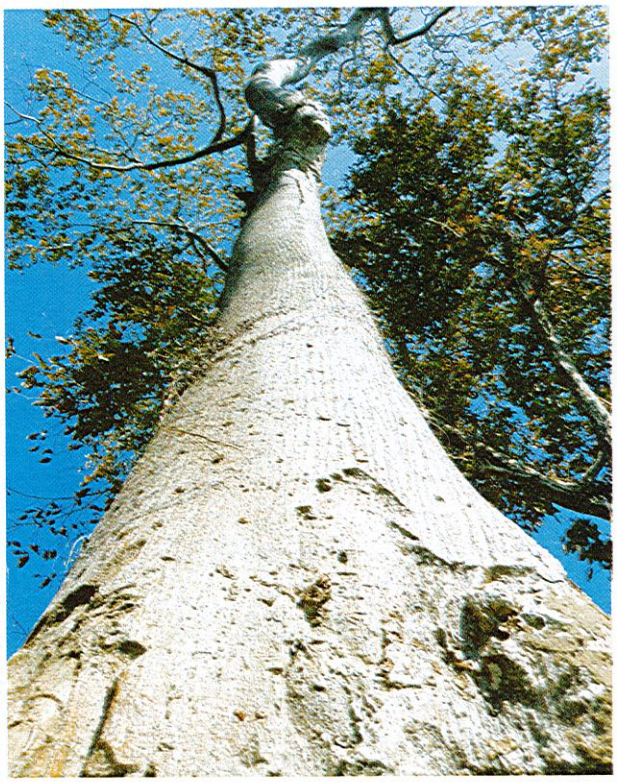
Global distribution: Chandul naturally grows throughout India to Malay Peninsula, Bangladesh.

Distribution in Bangladesh: It occurs naturally in the forests of Sylhet and Chittagong, and CHT.

Conservation status and initiatives: Non Evaluated (Ahmed et al. 2008) and **Protected Plant** (Anon 2012). IFESCU planted some seedlings of this species in the campus (**Table 4.56**).

Table 4.56 Chandul plantations in the CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	Collar dia. (cm)	DBH (cm)
2016	1	Jangalia hills	0.8	1.2	-



57. *Toona ciliata* M. Roem.

Synonyms : *Cedrela toona* Roxb., *Cedrela hexandra* Wall., *Toona hexandra* (Wall.) M. Roem.

Vernacular names : **Toon**, Piyatoon, Peo, Kuma, Prias, Chikado, Nandibriksha, Suruj

English names : Indian Mahogany, Toon, Australian Red Cedar, Cedar, Singapore Cedar

Family : Meliaceae

Description: *Toona ciliata* (Toon) is a medium to large-sized tree, up to 37 m tall, crown rounded, spreading, occasionally dense, bark greyish-white to brown. Leaves 20-65 cm long, usually 9-15 jugate, petioles 6-11 cm long, glabrous to pilose. Inflorescence up to 55 cm long, pendent. Flowers fragrant. Fruit a capsule, 1.5-3.5 × 1.2-1.3 cm, valves reddish-brown, smooth, with small scattered lenticels, 36-39 seeds per fruit. Seeds orthodox, brown in color, winged at ends, apex narrowly obtuse.

Phenology: Toon is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

Global distribution: Toon is distributed in Bangladesh, Pakistan through India, South China, Myanmar, Thailand, Malaysia, Indonesia, the Philippines, Moluccas and New Guinea, and eastern Australia.

Distribution in Bangladesh: In Bangladesh, this species is found almost throughout the country.

Conservation status and initiatives: Least Concern (Ahmed et al. 2008). Habitat destruction and over extraction by the timber traders and local people are the major threat to this species. IFESCU established plantations of Toon in the campus (**Table 4.57**).

Table 4.57 Growth of Toon in the plantations of CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Marin Science Institute	7.9	12.3
2015	2	Jangalia hills	3.1	2.8


তুন, সুরুজবেদ, রঙ্গি


তুন/সুরুজবেদ

58. *Vitex glabrata* R. Br.

Synonyms : *Vitex bombacifolia* Wall. *ex* C.B. Clarke, *Vitex cunninghamii* Schauer, *Vitex elegans* Griff., *Vitex minahassae* Koord.

Vernacular names : **Arsol**, Ashal, Batri, Goda, Horina

English names : Black-plum, Smooth chastetree, Smooth chastetree

Family : Verbenaceae

Description: *Vitex glabrata* (Arsol) is a tall tree, up to 30 m high, bark ashy-grey, corky, smooth, often vertically fissured. Stem exaggeratedly fluted and buttressed. Leaves 3-5 foliolate, leaflets 5-15 ×1.0-7.5 cm, obovate-oblong or elliptic-oblong, usually entire, acute or acuminate at the apex. Inflorescence of dichotomous, lax, corymbiform, pedunculate cymes. Flowers purple or yellow, 1.2 cm long, white with a dash of blue. Fruit a drupe, 1.2-1.5 cm long, oblong-obovoid, succulent.

Phenology: Arsol is a deciduous tree.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

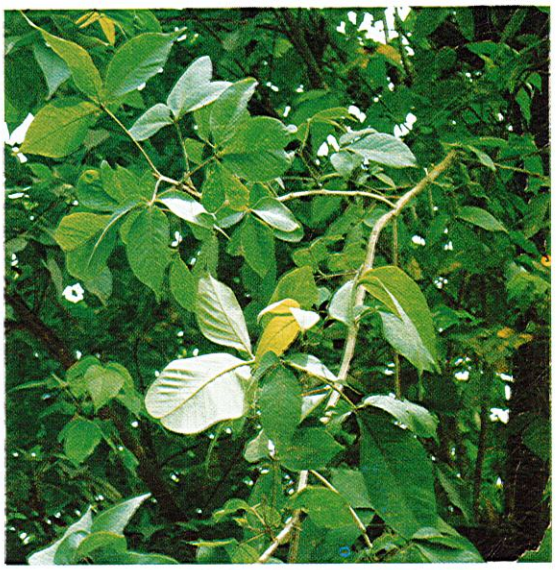
Global distribution: Arsol is found in Bangladesh, India, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, Singapore, Thailand, Vietnam, Australia, United States of America etc.

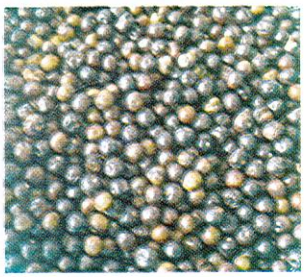
Distribution in Bangladesh: It occurs in the forests of Chittagong, CHT, Cox's Bazar and Sylhet districts.

Conservation status and initiatives: Least Concern (Ahmed et al. 2008). *Ex situ* conservation programme is recommended for conservation of this species (**Table 4.58).**

Table 4.58 Growth of Arsol plantations established in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2014	3	Near IFES Director's office	3.6	2.1





59. Vitex peduncularis Wall.

Synonyms : *Vitex alata* Roxb., *Vitex morava* Buch.-Ham. *ex* Wall.
Vernacular names : **Goda**, Arsol, Boruna, Awal
English name : Longspike chaste tree
Family : Verbenaceae

Description: *Vitex peduncularis* (Goda) is a medium-sized to large deciduous tree, grows up to 6-12 m high, stem and branches slender, obtusely 4-angular. Leaves opposite, compound with 3 foliolate, leaflets petioluled, lanceolate, entire, 11.2 × 2.5 cm, acuminate. Inflorescence panicles and long peduncled. Flowers greenish-white with white corolla. Fruit drupe, black when ripe, 5 mm in diameter.

Phenology: Arsol is a deciduous plant that shedes leaves during December-January.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

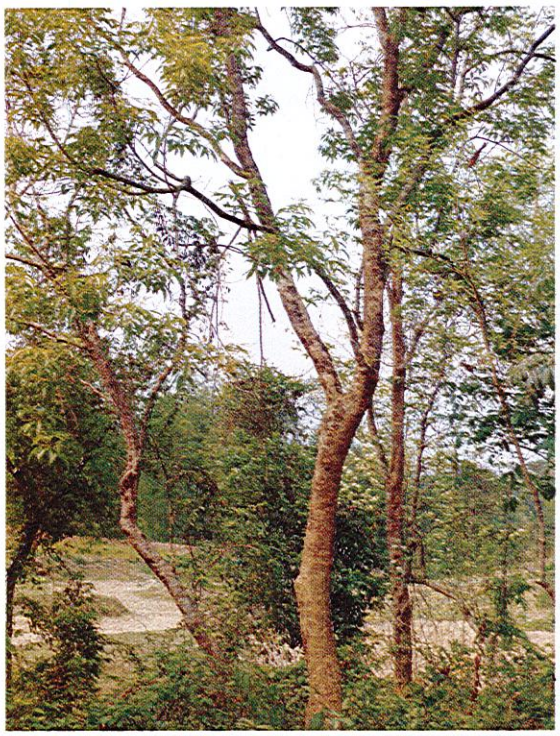
Global distribution: It is found in Bangladesh, Cambodia, India, Laos, Myanmar, Nepal, Thailand and Vietnam.

Distribution in Bangladesh: It is found in the forests of Chittagong, CHT, Cox's Bazar, Sylhet, Gazipur and Tangail.

Conservation status and initiatives: Not Evaluated but seems to be rare (Ahmed et al. 2008). Habitat destruction are the major threats to this species. Both *in-situ* and *ex-situ* conservation measures should be taken immediately for this species. IFESCU established plantations of this species in the campus (**Table 4.59**).

Table 4.59 Growth of Goda seedlings in the plantations of CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2013	4	Jangalia hills	4.1	2.4
2013	4	Jangalia-mixed plantation	4.4	2.9
2014	3	Near IFES Director's office	4.3	2.8



60. Zanthoxylum rhetsa (Roxb.) DC.

Synonyms : *Fagara rhetsa* Roxb., *Zanthoxylum budrunga* (Roxb.) DC., *Zanthoxylum limonella* (Dennst.) Alston

Vernacular names : **Bajna**, Bazinali, Kantahorina, Tambol

English name : Not known

Family : Rutaceae

Description: *Zanthoxylum rhetsa* (Bajna) is a medium-sized, deciduous, spiny tree, up to 13 m tall. Leaves paripinnate or imparipinnate, 30-45 cm long, leaflets 16-25, opposite, oblong to elliptic-oblong, 6-14 × 1.5-3.0 cm, entire, acuminate, oblique at the base. Panicles terminal or axillary, 8-14 cm long. Flowers 4-merous, up to 2.5 mm long, petals white or pale yellow. Fruit a follicle, subglobose, 6-8 mm in diameter, 2-valved, orange or reddish-yellow when ripe. Seed solitary, globose, 4-6 mm long, bluish-black, shining as dried black pepper.

Phenology: Bajna is a deciduous plant.

Phenology	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaf shedding												
Leaf flashing												
Flowering												
Fruiting												
Seed collection												

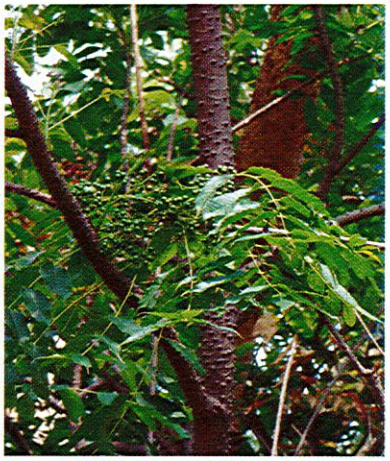
Global distribution: Bangladesh, South and South-East Asia, the Philippines and southern Papua New Guinea.

Distribution in Bangladesh: It is found in the forests of Chittagong, CHT, Cox's Bazar, Sylhet, Dhaka, Gazipur, Tangail and Mymensingh.

Conservation status and initiatives: Least Concern (Ahmed et al. 2008). IFESCU planted some seedlings of Bajna in the campus (**Table 4.60**).

Table 4.60 Bajna plantations in CU campus

Plantation year	Age (yr.)	Plantation site	Height (m)	DBH (cm)
2011	6	West of Nipoban School	3.2	3.3



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