

# NON-TIMBER FOREST PRODUCES AND THEIR CONSERVATION IN BUXA TIGER RESERVE, WEST BENGAL, INDIA

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BY

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UNDER THE SUPERVISION OF  
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31 AUG 2015

This small piece of work is  
dedicated to my teachers  
and my family

## DECLARATION

I declare that the thesis entitled 'Non-Timber Forest Produces and Their Conservation in Buxa Tiger Reserve, West Bengal, India' has been prepared by me under the guidance of A. P. Das, Professor of Botany, University of North Bengal. No part of this thesis has formed the basis for the award of any degree of fellowship previously.

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## TO WHOM IT MAY CONCERN

This is my privilege to endorse that Mr. Animesh Sarkar, M.Sc. in Botany has carried out a piece of research work under my supervision. His thesis entitled "**Non-Timber Forest Produces and their Conservation in Buxa Tiger Reserve, West Bengal, India**" is a genuine work and presenting the result of his original research. The thesis is being submitted for the award of **Doctor of Philosophy** (Science) degree in Botany in accordance with the rules and regulations of the University of North Bengal.

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# ABBREVIATIONS

<b>BTR</b>	Buxa Tiger Reserve
<b>FD</b>	Forest Department
<b>BBBL</b>	Bhutia Basti Bengal Line
<b>SDI</b>	Simpson's Diversity Index
<b>SWID</b>	Shannon – Weaver Diversity Index
<b>C</b>	Crown
<b>G</b>	Ground
<b>CD</b>	Collar Diameter
<b>DBH</b>	Diameter at Breast Height
<b>D</b>	Density
<b>F</b>	Frequency
<b>Dm</b>	Dominance
<b>RD</b>	Relative Density
<b>RF</b>	Relative Frequency
<b>RDm</b>	Relative Dominance
<b>IVI</b>	Importance Value Index
<b>UG</b>	User Group
<b>Fig</b>	Figure
<b>pH</b>	Negative logarithm of Hydrogen ion concentration
<b>Org</b>	Organic
<b>gm</b>	Gram
<b>C%</b>	Carbon percent
<b>N%</b>	Nitrogen percent
<b>ppm</b>	Perc per million
<b>P</b>	Phosphorus
<b>K</b>	Pottasium
<b>S</b>	Sulpher
<b>OC</b>	Organic carbon
<b>NREGS</b>	National Rural Employment Gurantee Scheme
<b>cft</b>	Cubic foot
<b>Rs.</b>	Rupees
<b>JFM</b>	Joint Forest Management
<b>FPC</b>	Forest protection committee
<b>EDC</b>	Eco-development committee
<b>JEDC</b>	Jainti eco-development committee
<b>BBEDC</b>	Bhutia Basti Bengal Line eco-development committee

<b>M<sup>3</sup></b>	Meter qube
<b>m</b>	Meter
<b>Avg.</b>	Average
<b>CO<sub>2</sub></b>	Carbon di-oxide
<b>NTFP</b>	Non-Timber Forest Product
<b>HRM</b>	Human resource management

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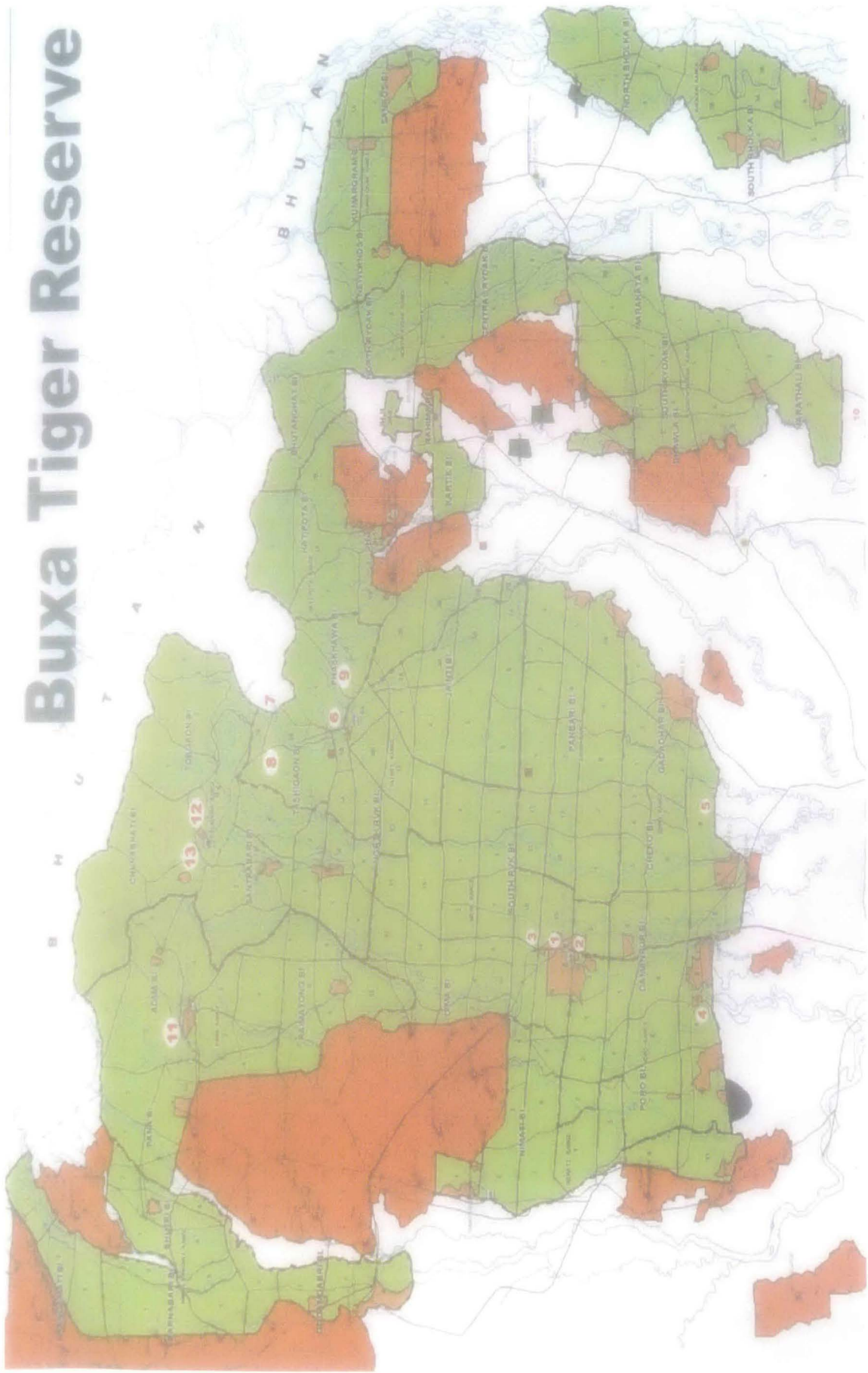
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# Buxa Tiger Reserve



MAP OF BUXA TIGER RESERVE



CHAPTER: I

# INTRODUCTION

# CHAPTER: I

## INTRODUCTION

### 1.1. BACKGROUND

The relationship between human beings and their environment is constantly evolving and changing, and thus, provides numerous avenues for a fascinating study into this dynamic relationship. Prehistoric man was completely dependent on forests for their survival. Every component of their livelihood was natural product. However, apart from food, shelter and building materials, only a few other articles were essential to meet up their needs like making of hunting instruments, dresses, satisfying evil forces which (they believed) were causing distress and diseases to man and their pets, etc (Tucker, 2008). Requirement of firewood was less and dead timbers were abundant in the forest for this.

Over time, humans learned to use a wide array of forest products for their sustenance, comfort and happiness. Over centuries humans continued to increase their dependence on forests and other natural products, and this unabated process of natural resource extraction and usage by humans, has contributed to widespread environmental degradation and damage (Das, 2012). In this aspect Moore (1995) and Salem *et al* (<http://www.unep.org>) argued that, "Economic growth by its very nature creates negative spill over effects for the environment". Today humans continue to extract resources from the environment and dump the waste back into the environment, in the past two hundred years, the rate of forest extraction continued to increase with the improvement of health care techniques, as the population structure also continued to increase in parallel.

Today humans have learned to exploit forests in innumerable ways and the forest areas on this planet are dwindling steadily at every moment. Every year we are losing 5.2 million hectares (0.13%) of forest cover around the world (FAO, 2010) and in every hour we are losing three species (Dattagupta, 1999). During 1990 – 2000 the planet has lost 16 million hectares of forest cover every year and this trend is continued (FAO, 2010). In general, the ratio between the rates of deforestation and reforestation is 10:1 around the world and 5:1 in Asia (Bagchi, 2001). In 1980 the rate of global energy consumption was 10 TW (Terra Watt); by 2025 the same global population would require 55 TW (Brundtland, 1987) and these requirements will be fulfilled by the exploitation of the existing renewable and the non-renewable resources.

People living in forest villages are known to take care of forests for their own survival. The close interaction of local communities with the forests and their dependence on various forest products is one of the most important factors identified as contributing to the continued survival of forests (Gokhale *et al*, 2004). However, this precarious balance is threatened due to high discount rates and short-term decision-making, rural households are reported to be participating in increased unsustainable practices to ensure survivability (Shone and Caviglia-Harris, 2006).

Human dependence on nature for fulfilling various need continues to increase every day, and this dependence is not only restricted to the forest products, but extends beyond excavation of minerals, acquiring land for urbanisation and the construction of factories, exploitation of oceanic biodiversity etc. Everything is increasing at an exponential rate. This increasing over dependence is causing irreparable damage to the nature and modifying the habitat availability and quality in such a way that numerous species are being ousted on a daily basis (Sarkar *et al*, 2009) as human influence continues to impact the environment. The most sever impacts are being felt by forests that have been cut, degraded and modified to suit human needs and if this trend continues unmitigated (FAO, 2010). There is an ever increasing threat of forest cover declining to critical threshold levels. Given this, it is important to recognize factors that influence forest growth.

## 1.2. ROLE OF FORESTS FOR THE SOCIETY

“Achievement of all the Millennium Development Goals will depend on maintaining the environmental goods and services that are crucial to human productivity” (Cottray *et al*, 2006). We exploit tangible benefits from the environment like water, stones, minerals, timber, NTFPs etc – and are considered as environmental goods. From the ecological or amenity perspective, forests absorb carbon, regulate soil, water levels and nutrients, protect biodiversity, improve resilience and adaptation capacity – and are considered as its services (Prakash *et al*, 2010; Bishop, 1998). Like sea and other hydro-ecosystem, forest ecosystem plays a prominent role in controlling environmental well being. Broadly forest services are ecological, socio-cultural and economical. Richards *et al*. (2003) classifies forest services in the following way:

### “1. *Direct use values*:

- extractive uses-marketed or subsistence forest products
- non-extractive uses- ecotourism, recreation and scientific studies, cultural or spiritual values to forest users.

2. *Indirect use values*: Forest users and people outside the forest receive forest benefits as environmental or ecological services.

3. *Option values*: Various stakeholders keeping open the option of receiving future direct and indirect use values through undiscovered environmental, pharmaceutical or scientific values of forests.

4. *Non-use values*: It accrues mainly to people who do not use the forest, but who value the fact that it exists – its biodiversity.

5. *Bequest value*: The value (to current users) being able to pass on the forest in its present condition as an inheritance to future generations.”

## 1.3. DIFFERENT FACTORS INFLUENCING FOREST GROWTH

Forest growth depends on the combination of environmental factors such as climate, soils, slope and aspect, and elevation, all of which affect not only to determine the vegetation type, but how fast they grow and their form at maturity, as well as determine the micro-climate of a site (McCoy, 1995). Extreme temperature has large impact on the survival and distribution of plants (Blennow, 1997). Such effects vary with distance from the forest edge, canopy structure, topography (which influences aspect and drainage), and soil type (Grimmond *et al*, 2000). Linking environmental variation to population dynamics is necessary to understand and predict how the environment influences species abundance, distributions and other ecological factors in a forest system (Dahlgren, 2008) or in a vegetation.

## 1.4. NON-TIMBER FOREST PRODUCTS (NTFP)

Socio-cultural environment grew within the human society for its own survival and a separate knowledge base developed in the form of ethno-botany or ethno-medicine (Vandebroek *et al*, 2011). ‘Scientific research is revealing an ever increasing number of links between biodiversity and human health, not only in terms of food resources or food security, but also with regard to materials to treat and cure diseases’ (Pandey *et al*, 2010; Chakravorty *et al*, 2011). Medicinal plants – which are very important NTFPs - constitute the principal source of ingredients for traditional medicine (Almeida *et al*, 2006; Kumar *et al*, 2011; Machkour-M’Rabet *et al*, 2011). 4,22, 000 flowering plants are reported from the world (Govaerts, 2001), of which more than 50,000 are used for medicinal purposes ( Schippmann *et al*, 2002). In India medicinal properties have been assigned to several thousands – 43% of the total flowering plants (Pushpangadan, 1995). The use of different plant substances for medicine is a bridge, linking conservative users of all groups and religions. Forest dwellers inherit a rich traditional knowledge and are very much concerned about their degradation in wild (Uniyal *et al*, 2006). Ethnobotany, ethnobiology, ethnoecology (including ethnopedology and ethnoclimatology), traditional

environmental knowledge, ethnoveterinary, folk medical, and pharmaceutical knowledge are now recognized as being inextricable components of culture, and therefore worthy of being protected and sustained (Pieroni *et al.*, 2005). In addition to their medicinal value some plants have dye yielding properties and plays important economic role in the local communities. Dye substances of plant origin are present in many wild and cultivated species (Guarrera, 2006), and thus, dye is another very important NTFP to be considered. Approximately 450 taxa are known to yield dyes in India alone, of which 50 are considered to be the most important (Chandramouli *et al.*, 1995). It is interesting to note that over “2000 pigments are synthesized by various parts of plants, of which only about 150 have been commercially exploited” (Siva, 2007). Dye yields from plants are environment friendly compared to recent day’s synthetic dyes (Siva, 2007; Gokhale *et al.*, 2004). However, dyes are one of the most important uses of the plants, as it relates with cultural practices, rituals, arts and crafts, fabrics and to satisfy personal embodiment (Gaur, 2008). Excluding the above mentioned uses of NTFPs, some other uses are noticed viz. rope making, plate from leaves, collecting and selling wild mushroom and honey (Moerman, 1998). People also harvest and use different fruits and nuts, vegetables, mushrooms for their subsistence (FAO, 2010). Around 75,000 flowering plants are edible of which about 3000 are regarded as source of food (Krishnamurthy, 2003). In addition to use of different floral species forests provide us some other benefits – carbon sequestration, supply of clean water and soil formation – which may count as NTFPs.

#### 1.4.1. RATIONALE TO CONSERVE NTFPS

The conventional view of villagers using forests solely to provide fuel-wood and fodder must be challenged in the light of the multiplicity of products those are provided by forests. However, the forests managed by Governments were simply to sustain the forests’ productive role for the timber industry (Khanal, 2006). With the promulgation of Wildlife protection Act, access to collection of NTFP and fishing has been prohibited in some states causing deteriorating relationship between forest department and forest user groups (Das, 2005). A full understanding of the complexity of forest usage by local people leads also to a need to change management strategies for these areas (Malhotra *et al.*, 1993). Indigenous management systems tend to be responsive to external factors such as demographic, economic, political and ecological change, which may lead to an increase of tenure insecurity and to destructive harvesting practices (Berg *et al.*, 2000).

Recently, management of NTFP has caught the attention of conservation scientists as a means of ensuring forest conservation and as an alternative to conversion (Srivastava, 2007; Hiremath, 2004). Non-timber forest products (NTFPs) are wild plant and animal products harvested from forests, such as wild fruits, vegetables, nuts, edible roots, honey, palm leaves, medicinal plants, poisons and bush meat (Andel, 2006; Forest Practices Board, 2004). It is different from timber and important as a conservation strategy as the assumption is that the forest will remain standing and more or less biologically intact under sustained NTFP harvesting (Neumann and Hirsch, 2000). NTFP plays an important role for ecological conservation, building socio-ecological relationship and economic development of a region (Forest Practices Board, 2004). Some studies have found critical links between plants and other plant and animal species (O’Hara, 1999). This link creates ecological and socio-cultural environment in an area. Looking several aspects of NTFP’s importance we have to frame suitable management strategy for its sustenance.

So far, we have experienced several management practices to manage forest resources. Government, private, community, government and forest people and present model public-private partnership approaches in management are operative. Several significant flaws are noted in several management practices and observed community manage forest resources comparatively well than other systems. In terms of harvest of forest products, a heterogeneous interest considerably plays positive role for the management and sustenance of a forest. Joint Forest Management (JFM) in Indian context may be fruitful if the power of management is solved and government provides local users de-jure right on the property they manage. A leasehold forest for the poor is an approach to

address the problems of both poverty and land degradation (Kunwar and Adhikar, 2007). Social research can help in developing strategies for the management and sustainable use of forest resources (Monteiro *et al*, 2006). The present generation should pass on to the children of future generations an adequate supply of natural capital which they will need to live adequately (Cowles, 1995). The Environment (Protection) Act, 1986 empowers the Government of India to take all measures required to protect and improve the quality of environment (Datta *et al*, 2006). So, preparation of National NTFP policy to institutionalize the harvest and sale of Non-Timber Forest Produces (NTFP) may be the answer of this question.

#### 1.4.2. NTFP IN POVERTY ALLEVIATION

Excluding the timber, all other plant parts are also useful to the people. “NTFP is not only an important food source for people and their livestock but also contributes substantially to household cash income” ([http://www.cifor.org/publications/corporate/cd-roms/bonn-proc/pdfs/posters/T2\\_FINAL\\_PujaSawhney.pdf](http://www.cifor.org/publications/corporate/cd-roms/bonn-proc/pdfs/posters/T2_FINAL_PujaSawhney.pdf)). Despite the small cash incomes from trade, they provide an important contribution that complement the diverse livelihood strategies within a household, especially for the poorer sectors of rural society (Shackleton and Shackleton, 2004). Therefore, the harvesting of NTFPs contributes to poverty reduction, securing both food and income for local communities (Das, 2005). According to the United Nations Food and Agriculture Organization (FAO, 2010), it has been estimated that , millions of household depends heavily on NTFP products for income generation worldwide and NTFP marketing is approximately US\$16839 million worldwide.

Even though the major bottlenecks affecting productivity of NTFPs is the poor market access and the absence of proper infrastructure (Feto, 2009). In Sri Lanka, communities living in the Peak Wilderness Sanctuary derive up to 53 % of their income from NTFP's or up to 58 %, if subsistence products are taken into account (Wickremasinghe, 1993). However, the vicious circle of increased poverty, with reduced bargaining capacity by collectors, can lead to an increase in unsustainable harvesting intensities as collectors require harvesting more to obtain the same income (Ruiz-Perez, 2005). A combination of conflicting plant parts harvesting and use regimes result in distinct ecological effects of NTFP use (Runk *et al*, 2004). Recently people are recognizing the importance of NTFPs from their long standing view over forests as the only source of timber (Pandit *et al*, 2004). People have started realizing its substantial subsistence, environmental, economic and cultural impacts. Around 10 % of the 7,000 estimated plant species of Nepal have been officially cited everywhere as NTFPs (Khanal, 2006). NTFP is potentially obtainable from about 3000 species found in the forests of India (Das, 2005).

#### 1.4.3. VALUATION OF NON-TIMBER FOREST RESOURCES

In many developing countries, rural populations exploit non-timber forest products such as vines and edible fruit for both subsistence and sale, but this activity is rarely recorded and is thus easily ignored by forest authorities (Bishop, 1998). “Under-valuation of material goods alone from the forests of India is reflected in their estimated (real) value of about US\$ 43.8 billion compared to forestry's share of GNP of US\$ 2.9 billion. The difference will increase further if an imputed value is assigned to the environmental contributions of forests” (Verma and Kumar, 2006). Collection and processing of NTFP is a significant economic activity (Das, 2005.). Pandit *et al* (2004) recorded 132 species of plants or their parts are used as NTFP in Jaldapara Wildlife Sanctuary. People of Jainti harvests around 35 commercial plant species for selling and their average monthly income is around Rs.2716/- (Sarkar and Das, 2012).

#### 1.4.4 INDIA'S PERSPECTIVE

Incidentally 347.217 million hectare — approximately 14 percent of global forest has been designated as protected area (PA) around the world, to conserve biodiversity in their natural habitats (FAO, 2007). However, such reserves are cornerstone of biodiversity conservation within a confined area (Folke *et al*, 2002).

India is rich in biodiversity, harboring about 8 % of the total world biodiversity. Around 45,000 plant species are present in India (MoEF, 2005a, [www.ifs.nic.in/rt](http://www.ifs.nic.in/rt)). The extent of annual depletion of forest cover prior to 1990 was 0.03 % (MoEF, 2005b). Thanks to recent policy initiatives, the decline in forest cover has been arrested. Forest cover increased at an annual rate of 0.57 percent (0.36 million ha) between 1990 – 2000 (FAO, 2005; FAO, 2007). However, the tempo could not be maintained and the annual rate of increase fell to 0.04 % (0.03 million ha) between 2000 – 2005 (FAO, 2005). Further, it will be wrong to assume that such a positive national trend is visible uniformly across the country. For example, the trend of deforestation has been continuing unabated in East Himalayan region (Das *et al.*, 2010). It should be noted that around 15.6 million hectare (23.04 %) of recorded forest area is under Protected Area (PA) network in India (FAO, 2005), being the last available habitat for different endangered species.

Buxa Tiger Reserve (BTR) is an extension of Sub-Himalayan West Bengal with an area of 760.87 sq km and the 15<sup>th</sup> Tiger Reserve in India. This is the house of 597 floral species (Pestonjee and Dutta, 1999). A considerable proportion of these species are used as NTFPs. Core area of BTR is inhabited by at least 112 species of NTFPs (Sarkar and Das, 2012). This is an important place to understand the socio-ecological dimension (Das, 2005).

### 1.5. CARBON SEQUESTRATION

Carbon (C) pool of a forest can actively be influenced by adapted forms of forest management that increase forest productivity and, thereby, increase the C input to the soil (Jandl *et al.*, 2006; FAO, 2010). This can have tremendous effect on the growth and availability of NTFPs, which can be crucial in sustaining communities that are dependent on these products for their livelihood and sustenance. In addition to that, it may help people to enter to the upcoming carbon market.

### 1.6. SOIL AND WATER – ROLE OF FOREST

Forests affect the rates of soil formation or erosion ([www.forestfacts.org/l\\_3/forests\\_5.htm](http://www.forestfacts.org/l_3/forests_5.htm)). “The dynamic interaction between vegetation and soil is so strong that it’s unclear which is dominant” ([www.forestinfo.org/Products/eco-links/05-4ForestSoil.PDF](http://www.forestinfo.org/Products/eco-links/05-4ForestSoil.PDF)). Accumulation of organic substances in soil may depend on the plant roots (Plyusnin, 2003). Chemical composition of soil regulates the growth of vegetation type and their health. It’s retaining water and in catchments forests generally result in cleaner water to downstream (IUCN, 2008).

### 1.7. UNDERSTANDING THE BTR VEGETATION

Forests of BTR are very old, quite stable and probably are in its climax. At the same time, these forests are also facing anthropogenic interaction for over the last 100 years mainly by the outsiders and/or migratory human settlements. The problems created through such interaction were visible and it was also essential to evaluate the situation scientifically. On the other hand the rate and intensity of the interaction was increasing quite fast with the increasing numbers of settlers, and of different added kinds of exploitations.

**CHAPTER: II**

**STUDY AREA**

## CHAPTER: II

# STUDY AREA

Located in the foothills of the Eastern Himalaya, Buxa Tiger Reserve (BTR) is blessed naturally a wide range of forest ecosystems. This forest area is inhabited by different groups of tribal communities *viz* Koch, Mech and Rava (Sarkar, 2011). Past glory of this forest is diminishing fast. However, it is important to conserve its forested vegetation for the survival of its cat and elephant populations. This stretch of forest serves as the international route for elephant migration between India and Bhutan. It is also the home for a wide range of wild plants and animal. Buxa National Park is one of the most interesting places in Jalpaiguri – for academic and tourism services.

### 2.1. LOCATION

Geographically BTR is lying between the latitudes of 26° 30' and 26° 55' N and the longitudes of 89° 20' and 89° 55' E. The overall topography of the area is an amalgamation of plains and hills. The mountainous tract is an extension of the outer spurs of the Eastern Himalaya. Also, this is the only tiger reserve located in the northern part of West Bengal. This Protected Area is sharing its boundary with the international border with Bhutan on the North and the eastern boundary touches the Indian state of Assam. Western and Southern boundaries are demarcated by several Tea Estates (T. E.) within the Indian territory.

It is the easternmost extension of extreme bio-diverse Northeast India and represents a part of the highly enriched and diversified IUCN recognized Himalaya Biodiversity Hotspot. The fragile “Terai Eco-System” constitutes a part of this Reserve (Rangini *et al*, 2013; <http://projecttiger.nic.in/buxa.htm>). Phipsu Wildlife Sanctuary of Bhutan lying contiguous on its north and the Manas National Park on the east boundaries.

It is connected with the sub-divisional town (Alipurduar) and block town (Hamiltonganj) by roads. While the forest department maintains some parts of this road, the remaining portion maintained by the Public Works Department of the Government of West Bengal.

### 2.2. DIFFERENT PHYSICAL ATTRIBUTES

#### 2.2.1. Topography

BTR is primarily situated in Bhabar and Terai areas consisting of slightly undulating land. Mountainous with elevation areas observed towards its northern boundary. The elevation ranges from 60 to 1750 m. (Sivakumar & Prakash, 2004). Hilly areas are steep and precipitous.

#### 2.2.2. Geology

BTR lies in the foot hills of the Himalayas. The Management Cum Working Plan of BTR by Das (2000) mentioned that, “At an altitude of 1800 m Himalayan formation of Darjeeling gneiss is observed. The



great boundary fault (Gondwanas) lies on South of it and followed by Shiwalik hills, Bhabar tract and finally ill drained clayey Terai tract.”

### 2.2.3. DRAINAGE:

The area of BTR is intersected by several *nullahs* (streams) and rivers, most of these have been originated in Bhutan. Principal rivers passing through BTR are Rydak, Sankosh, Jainti, Bala and Dima. However, major part of the National Park area lies in between two rivers Jainti and Bala.

### 2.2.4. Soil

The dominant soil textures of BTR are clay loam and sandy loam (Chakrabarti *et al*, 2002). Southern part of the reserve is flat and harboring the major portion of BTR. Soil is uniform throughout consisting of light, friable loam varying in depth (Das, 2000).

### 2.2.5. Archeology

At an altitude of 787 m above m.s.l. the historic Buxa fort is located. This fort is very much attached with country's freedom movement. Several freedom fighters were kept in exile in this fort. The sacred Mahakal temple of Lord Shiva is visited by more than 10,000 devotees every year during *Shiv Chaturdashi* and onwards (<http://projecttiger.nic.in/buxa.htm>).

## 2.3. CLIMATE

Varied topography and elevations generally provides the area with an unique climatic set-up. Physical differences across the reserves are playing great role on the wind movement in its different parts. This also greatly controls the ambient temperature and overall precipitation. Altitudinal variation greatly influence its temperature that controls other factors like wind speed and relative humidity. Alluvium plain and mountainous configuration has put the reserve in the moist tropical zone. This climatic uniqueness makes the reserve into a biologically diverse area. Four distinct climatic seasons are observed in BTR

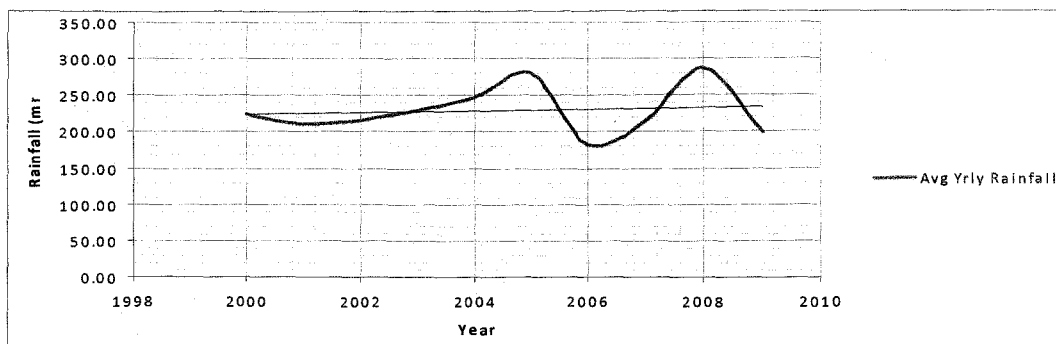
- i) Summer
- ii) Monsoon
- iii) Autumn and
- iv) Winter.

### 2.3.1. Rainfall

South –West monsoon is the primary source of rainfall. June to September is the main period of precipitation. December is the driest season with minimum or no rainfall. However, most of the winter rain receives in March. April to May is the time of hails and thunder with some pre-monsoon precipitation. The average annual rainfall in the reserve is 410 cm (Das, 2000; Sivakumar & Prakash, 2004). Rainfall data has been analyzed in Fig 2.1 and Table 2.1.

### 2.3.2. Temperature

Area is lies in moist tropical zone. Average minimum and maximum temperature varies between 32°C to 12°C (Sivakumar & Prakash, 2004). Highest recorded temperature was 39°C in 1899 and lowest was 2°C in 1887 (Das, 2000). Nights are always cooler, even pleasant in summer. Monthly average temperature during the years 2000 to 2009 has been presented in Table 2.2.



**Fig 2.1.** Average yearly rainfall data during 2000 to 2009

**Table 2.1.** Record of rainfall (in cm) in BTR during 2000 to 2009

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Average / month
2000	0	48	20	259.5	300	719	361	522	384	78	0	0	224.29
2001	0	17	6	86	362.5	719	361	522	384	78	0	0	211.29
2002	26.3	0	124.1	353.9	143	442.5	926	84.5	446.5	39.5	0	0	215.53
2003	0	19	95	225	344.6	689	734	269	112	211.1	0	41	228.31
2004	0	0	16	216	296	444	892	144	656.4	306	0	0	247.53
2005	0.5	3	70	18.7	230.5	816.1	807.6	824	86	504.2	0	0	280.05
2006	0	13	1.3	61.3	282.1	634.1	340.6	141.6	461.7	212	18.2	14	181.66
2007	0	73	12.6	162.2	262.4	636.1	448.6	414.7	437.9	131.8	0	0	214.94
2008	26	4.4	81.5	184.2	290.1	580.6	557.2	1044.8	423.6	239.6	0	3.2	286.27
2009	0	0	25.8	91.1	246.7	770.2	244	519	249.6	250.1	0	0	199.71

**2.3.3. Relative humidity**

Due to its location, the reserve remains humid around the year. Maximum and minimum relative humidity varies between 80 % and 95 % and never observed below 75 %. June to September is most humid and December to February are less humid months. A detail of yearly RH % for the period 2000 to 2009 is given in Table 2.3.

**2.3.4. Wind velocity**

The reserve generally does not face any heavy or strong storm probably due to its locational advantage. However, mild form of storm is an annual feature and causes some damage to the vegetation every year. In 1942 – 43 a heavy cyclone hit the reserve causing enormous damage (Das, 2000).

**2.4. ECOLOGICAL SIGNIFICANCE**

It is located in the confluence of three major Bio-geographic zones (Das, 2000):

- Lower Gangetic plains;
- Central Himalayas; and
- Brahmaputra Valley.

So, it is expected that the biological amalgamation of the area should represent some unique features. So far, there was no such attempt to understand this expected uniqueness of this biozone.

**2.5. Vegetation Type**

**Table 2.2.** Record of monthly minimum and maximum temperature in °C during 2000 to 2009

Year	January		February		March		April		May		June		July		August		September		October		November		December	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2000	22.7	10	24.4	10.5	28.2	15.8	30.8	20.7	31	22.5	31.6	23.7	31.7	25.2	31.4	25.2	31.1	24	31.6	22.4	27.5	17.1	24.7	10.9
2001	22.8	8.7	25	11.9	30.6	15.1	31.7	20.2	31.2	22.4	31.6	23.7	31.7	25.2	31.4	25.2	34.1	24	31.6	22.4	27.5	17.1	24.7	10.9
2002	23.2	10.7	26.6	11.5	29.3	15.6	28.8	17.6	30.1	21.7	31	24	30.4	24.2	30	22.4	32	23.6	30.8	21.3	28	16.4	24.3	12.6
2003	22.1	8.4	22.5	9.9	27.7	13.6	30.5	19.5	32.1	21.1	33.9	22.6	32.7	24.2	34.4	25.6	34.5	24.5	31.3	21.6	28.9	17.2	25.6	12.6
2004	22.6	9.3	26	11	30.8	17.2	28.5	19.3	31.9	21.3	32.1	22.7	31.3	23	33.9	24.9	32.1	23.6	30.2	19.6	29	14.6	27.2	11.3
2005	23.8	8.5	26.2	13.1	29.3	15.2	31	17.5	30.6	18.7	31.6	22.6	29.5	25.2	32.1	25	33.2	24.8	29.4	20.8	27.9	15.4	25.9	11.6
2006	22.4	10.9	27.2	15.4	30.8	16	30.8	20.5	27.2	22.7	30.9	24.4	32.1	25.6	32.7	25.6	31	24.2	30.9	21.1	26.8	16.5	24.5	12.3
2007	22.1	8.9	23.5	13.2	28.3	15.2	29.6	20.1	32.5	23.2	30.7	24.3	30.5	24.8	32	25.8	30.9	24.5	30.9	22	28.7	16.9	24.6	11.1
2008	24.5	10.6	23.7	10.4	28.4	16.8	30	20.2	31.2	22.2	30.6	24.2	30.9	25.1	30.7	24.6	31.6	24.3	31.2	21.5	28	15.1	24.5	14
2009	23.6	11.6	27.7	13.1	31	15.5	29.3	18	31.6	18.9	32.6	21.8	32.7	24.1	31.5	24.2	33.1	23.6	31.2	20.1	27.8	14.8	24	11.2

**Table 2.3.** Recorded relative humidity (RH %) during 2000 to 2009

Year	Maximum (06:32 hrs.)	Minimum (13:32hrs.)
2000	94.00	79.33
2001	82.48	77.25
2002	89.67	76.92
2003	90.50	75.67
2004	90.08	71.00
2005	90.67	76.08
2006	93.33	75.17
2007	92.67	69.33
2008	92.42	70.83
2009	88.58	73.58

Vegetation of BTR area is broadly classified as tropical moist-deciduous forest with following different sub-types as recognized by Champion & Seth (1968):

- i. Northern dry deciduous seral Sal, Khair, Sissoo, Simul association (5B/1S<sub>2</sub>)
- ii. Eastern Bhabar & Terai Sal (3C/C<sub>1b</sub> & 3C/C<sub>1c</sub>)
- iii. East Himalayan Moist Mixed Deciduous forest (3C/C<sub>3b</sub>)
- iv. Sub-Himalayan secondary Wet Mixed forest (2B/2S<sub>3</sub>)
- v. Eastern Sub-Montane Semi Evergreen forest (2B/C<sub>1b</sub>)
- vi. Northern Tropical Evergreen forest (1B/C<sub>1a</sub>)
- vii. East Himalayan Subtropical Wet Hill Forest (8B/C1); and
- viii. Moist Sal, Savannah (3C/DSI) and Low alluvium savannah woodland (3C/3/1S<sub>1</sub>).

However, core area of BTR consists of mainly two type of forests –

- i. Northern dry deciduous seral Sal, Khair, Sissoo, Simul association (5B/1S<sub>2</sub>); and
- ii. Eastern Bhabar & Terai Sal (3C/C<sub>1b</sub> & 3C/C<sub>1c</sub>).

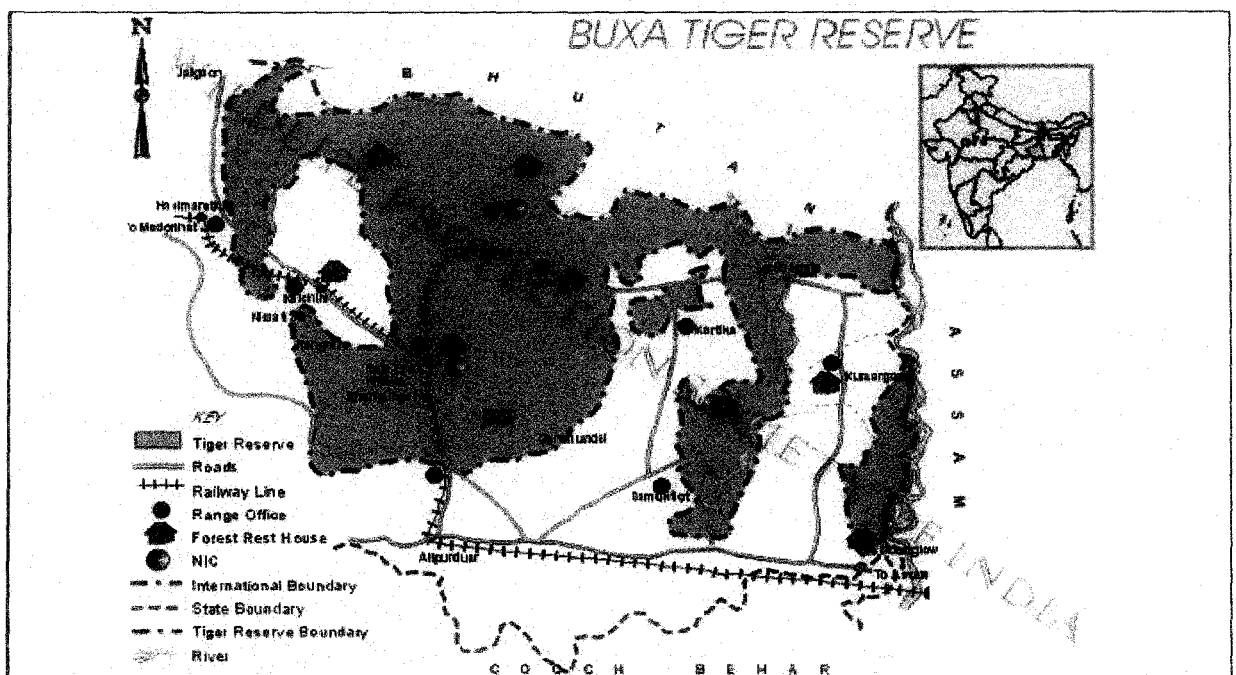


Fig 2.2. Forest area map of Buxa Tiger Reserve [Source: <http://www.wpsi-india.org/tiger/buxa.php>]

## 2.6. BIOLOGICAL RESOURCES

### 2.6.1. Flora

BTR is known to harbor 283 species of trees, 81 species of shrubs and herbs, 33 species of climbers, 150 species of orchids, 36 species of grasses and sedges and 7 species each of canes and bamboos (Pestonjee & Datta, 1999). However, the report of the occurrence of 60 % of endemic species in BTR vegetation by [www.sanctuaryasia.com](http://www.sanctuaryasia.com) is highly doubtful and is disagreeable in all probabilities.

## 2.6.2. Fauna

In terms of faunal diversity, the reserve provides habitat to 67 species of mammals, 230 species of birds, 28 species of fishes, 35 species of reptiles and 4 species of amphibians (Pestonjee & Datta, 1999). Out of these species 21 among the mammals, 7 among the birds and 10 among the reptiles are in the red list of endangered species (<http://projecttiger.nic.in/buxa.htm>).

## 2.7. SETTLEMENTS

National Park area of BTR is commonly known as Jainti forest and inhabited by two human settlements – Jainti village and Bhutia Busty Bengal Line village. People of these villages are completely depend on the forest resources of Jainti forest. Excluding these two settlements, people of Nurpur village also depends on this forest for commercial as well as subsistence purposes.

## 2.8. COMMUNICATION NETWORK

National Highway No. 31C roughly runs along its southern boundary. However, the core area under Jainti Range is 30 km away from Alipurduar town. Nearest railway station is Rajabhatkhwa . It is 15 km away from the study area. Jainti is located around 246 km from the nearest airport Bagdogra which is about 13 km away from Siliguri town (Fig. 2.2).

## 2.9. FOREST HISTORY

Till 1865 this forest area was the property of Coochbehar raja. Bhutan king was then superior in this area and with the request by Coochbehar raja to the East India Company in 1774 a treaty was signed between Bhutan king and the company to control the aggressions of Bhutanese (Das, 2000). But, the permanent settlement was made during 1865 and a treaty between Bhutan king and the British Government had been signed. During 1874-75 Jalpaiguri Forest Division was created and the present Buxa area was a part of

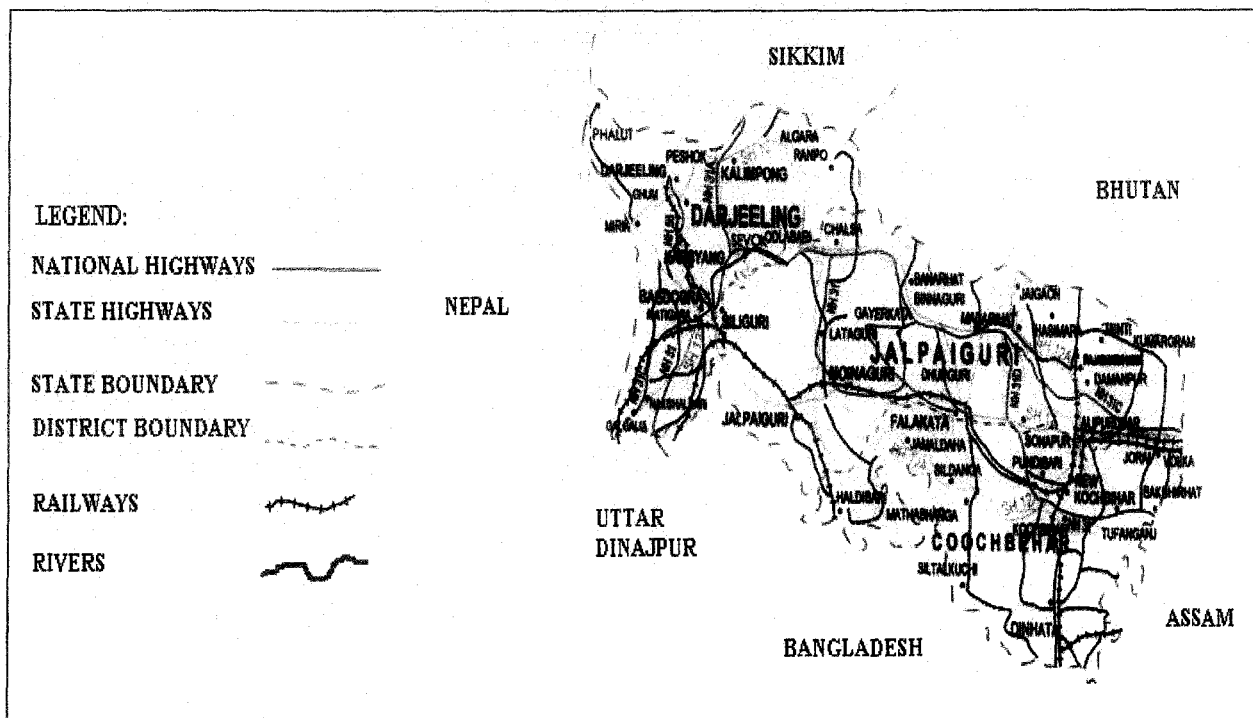


Fig 2.3. Communication network map of Buxa Tiger Reserve [Source: <http://pwdwb.in/images/MAP1.jpg>]

that division. In 1877-'78 Buxa Division was announced and it became a Reserved Forest during 1879. Historical information about the Jainti forests is not available in details but, till 1930 it was a block under Buxa-Duar Range. In 1983 Buxa Tiger Reserve (BTR) has been notified by the National Government and in 1997, 117.10 sq km of Jainti has been declared as a National Park (Das, 2005).

## 2.10. CONSERVATION HISTORY

This area has been under the control of the Forest Department (FD) since 1865 but no management record was available till 1875 when for the first time a scheme for systematic management was prepared by Dr. William Schlich [1874-75 to 1905-06], resulting in the preparation of its First Working Plan (Chaudhury, 2009). Under this Plan *Shorea robusta* over 5ft girth were removed departmentally over 1/8<sup>th</sup> of the Rajabhatkhawa Block annually from 1875-76 to 1882-83. The second working plan [1905-06 to 1919-20] by C.C. Hatt prescribed selection felling followed by natural regeneration (Chaudhury, 2009). Around 1911 it was realized that fellings tended to increase the already dense evergreen undergrowth of these forests. The third Working Plan of Shebbear (1920-21 to 1924-25) prescribed artificial regeneration of clear felled areas by means of *Taungia*<sup>1</sup> plantation because natural regeneration of Sal was known to have failed (Das, 2000). In the fourth working plan of Homfray (1929-30 to 1948-49) felling was made from miscellaneous trees on a 20 years cycle from the wet mixed areas along the edges of the annual coupes to meet the fuel-wood demand (Chaudhury, 2009). Dry Sal felling was done on a 5 years cycle according to a fixed program. This plan also emphasized the need for maintenance and improvement of grasslands. In the 5<sup>th</sup> working plan (1945-46 to 1964-65) two new working circles were created i.e. Sanctuary and Protection Working Circles. All types of extraction including thatch were prohibited in this plan except limited felling of timber trees by departmental agencies. In the 6<sup>th</sup> (1965-66 to 1974-75) and 7<sup>th</sup> (1975-76 to 1984-85) working plan Teak conversion from natural vegetation was done to eradicate herbs and shrubs (Das, 2009). In the sixth working plan a vast area was converted into wet mixed forest to meet the fuel-wood demand of the tea gardens and the supply need of local wood based industries.

Thus the first and second working plan of Buxa Division worked mostly on uneven aged forests. Extraction of timber was done based on certain exploitable girth. From third working plan onwards clear felling followed by artificial regeneration was introduced. Since then uneven aged crops were converted to even age crop through plantations.

Buxa Tiger Reserve (BTR) was constituted in 1983. It includes forest area under Buxa Tiger Division and some area from Coochbehar Forest Division. 314.52 sq km area of BTR had been declared as Buxa Wildlife Sanctuary (BWLS) (Das, 2000; Chakrabarti *et al*, 2002). The core area of BWLS (117.10 sq km) was declared as National Park in 1992. Final notification regarding the constitution of National Park came in 1997 in the notification No.3403-For/11B-6/95 dt. 05.12.1997 of the Government of India (<http://projecttiger.nic.in/buxa.htm>).

First management plan of BTR (1983-84 to 1989-90) was to identify different limiting factors of the habitat and to mitigate these by ameliorative management and compulsory development. The 2<sup>nd</sup> management plan for core zone of the reserve (1990-91 to 1999-2000) took into consideration of the anthropogenic stress on the protected area. An Eco-Development Scheme was taken up and activities like distribution of seedlings for farm forestry, improvement of village roads, construction of culverts and bridges, provision of drinking water, irrigation facilities, community pond etc. were undertaken in the fringe areas and forest villages. However, the almost sudden decision to convert a territorial division into a Tiger Reserve is yet to be accepted by the residents of the localities in and around BTR (Pestonjee & Datta, 1999).

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<sup>1</sup> *Taungia*: This system is associated with the practice of cultivation in the vacant space between two rows of seedlings in new plantations. This system incurred a cost-effective maintenance of new plantations: no extra efforts were necessary to supply extra manure to the seedlings or remove weeds. Protection of seedlings from browsing and grazing were automatically taken care of.

CHAPTER: III

# METHODOLOGY

## CHAPTER: III

# METHODOLOGY

Present dissertation covers several aspects viz. enumeration of floral species, subsistence and commercial uses of various species, understanding the ecological significance of different floristic elements and socio-ecological linkage for better management of this forest area etc.

For the entire work vegetation sampling is the first step and linking the vegetation and its elements with the socio-economy of the dependent people is the last. The entire methodology has been framed keeping in mind these factors.

### 3.1. SAMPLING OF VEGETATION

Following steps have been followed to obtain relevant vegetation estimates across the different plot areas studied.

**3.1.1. Plot Selection:** Sample plots were selected at random covering the entire study area, which is the core area of Buxa Tiger Reserve

**3.1.2. Plot layout:** Three concentric circles with radial of 10 meters (for canopy), 3 meters (for under-storey) and 1 meter (for ground cover) were laid (Sarkar *et al*, 2009; Fig. 3.1). Tree-trunks were numerically marked for future recognition of a plot. Diameter at breast height (DBH), height, and crown cover for the trees (over 10 cm in diameter) along with the occurrence of epiphytes on trees occurring within the largest circle were recorded. In the under-storey, along with the list-count data height, collar diameter (CD) and crown diameter were also recorded for the plants with stem diameter 2.5 – 10.

For ground cover sample (smallest circle), list-count and cover for all plants with less than 2.5 cm in diameter were recorded. Details of herbs and seedlings observed in the smallest circle were also noted. Random sampling plot survey has been done in consecutive three seasons (Wertime *et al*, 1999; Chakrabarti *et al*, 2002; Biswas *et al*, 2012; Tag *et al*, 2012).

**3.1.3. Physical attributes:** A structured questionnaire used to record some important physical status parameters of each plot under study and includes altitude, aspect and slope. The method suggested by Ruhe and Walker (1968) had been followed to measure the slope.

**3.1.4. Soil sampling:** Soil samples were collected by digging a hole of at least 25 cm deep from the smallest circle to measure the soil moisture and chemical properties like organic Carbon, other organic matters, Nitrogen, Phosphorus, Potassium and Sulphur (Pennock, 2008). Samples were stored as per procedure prescribed by Sheppard and Addison (2008). Soil Phosphorus was measured following Schoenau and O'Halloran (2008). Assessment of Potassium has been done following the method of Ziadi and Tran (2008). Methodology of Maynard *et al* (2008) followed to measure soil Nitrogen. In addition, pH and moisture content of soil were also measured.



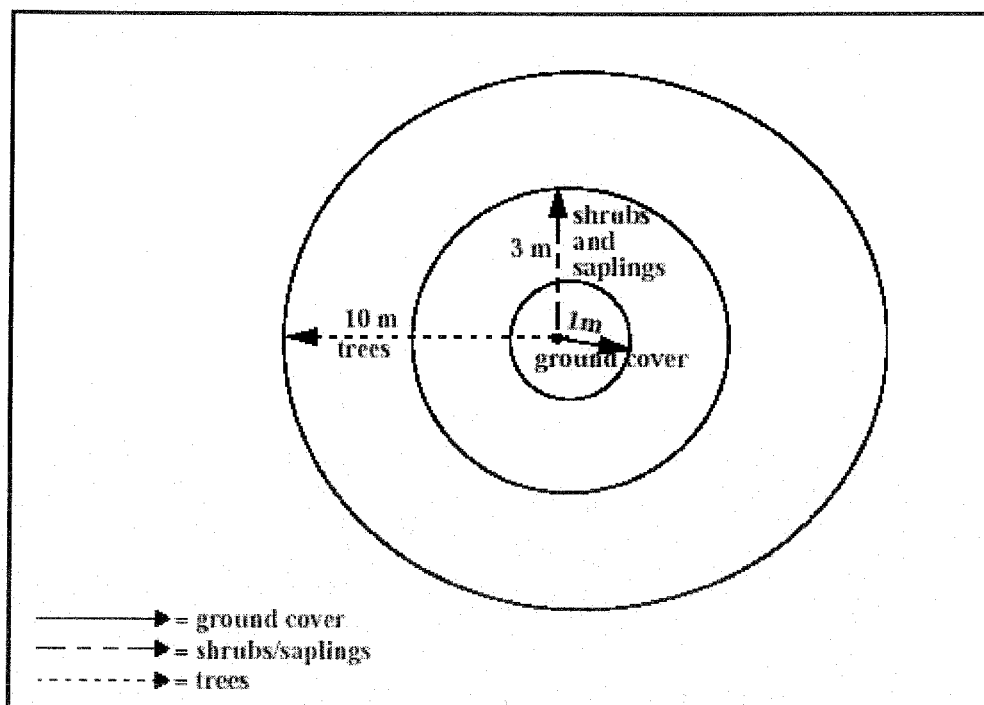


Fig. 3.1. Concentric Circles for Vegetation Study of a Forest Plot

- 3.1.5. Qualitative observation:** Careful qualitative observation on active soil erosion, plants damaged by insects, evidence of livestock intervention, tree fall, jungle trail, location of the plot (whether near a river/stream/road), presence of insects etc were also noted;
- 3.1.6. Recognition through vernacular names:** Forest department people and the local inhabitants are quite familiar with the vernacular names of the plants of their surrounding areas. These names were also recorded with a view to use those for feedback.
- 3.1.7. Processing of Specimens:** Specimens were basically processed at the field camp. After proper cleaning, pruning etc. specimens were inserted in blotters in a Herbarium Press. After drying, specimens were poisoned and mounted on standard Herbarium mounts. Labelled properly and temporarily stored in steel cabinet in the laboratory (Jain and Rao, 1977).
- 3.1.8 Identification of plants:** Most of the specimens were identified in the Taxonomy and Environmental Biology Laboratory, of the Department of Botany. Identification of mounted specimens were done by conventional techniques (Jain & Rao, 1977) with the use of local floras, monographs, etc and confirmed by matching basically at NBU and then at CAL Herbaria. After the works are over, main set of the specimens will be deposited at the NBU-Herbarium and the duplicates at the CAL.

### 3.2. SAMPLING OF SOCIO-ECONOMIC ASPECTS

A Socio-Economic survey was simultaneously carried out to collect required information from the villagers. Following steps were followed:

1. An initial discussion with the members of the local village *Panchayat* and other important individuals like a teacher, each from the nearest high school and the local primary school helped us to understand the general socio-economic features of the people residing in the area under present study.

As a second step, a complete list of the households has been prepared and following data has been collected—

- Settlement history
  - Demographic structure
  - Occupation of highest earning member
  - Annual income of the family and
  - Collection of fuel wood from the forest.
2. 40 representative households have been selected from the list using random sampling technique and a cross check have undertaken to reveal that the population parameters and sample parameters like—
    - a. Occupation status;
    - b. Annual family income and
    - c. Collection of NTFP from the forest.
  3. A structured questionnaire was canvassed among the selected households to elicit information about socio-economic status of each of them and their dependence on forest products.
  4. In addition informal discussions with villagers at local market teashops and school also carried out to gather information.

### 3.2.1. Analysis of socio-economic information

The socio-economic data helped us to document—

- History of the settlement;
- Demographic features of the population;
- Major income sources;
- Man-forest relationship with particular reference to ethnobotanical practices and
- Quantitative information about forest produces harvested.

Socio-economic information has been accumulated using IFRI techniques (Werthme *et al*, 1999). Voucher specimens of different NTFPs are collected with the help of the respondents during household survey. Local uses viz. subsistence, commercial or ethnobotanical – have been documented during survey. Methodology of Jain (1981, 1987, 1991); Rai *et al* (1998); Rai & Bhujel (1999), Rai (2006); Ghosh & Das (2011); Devi *et al* (2011); Sarkar & Das (2012) are followed for this purpose.

### 3.3. PHYTOSOCIOLOGICAL ANALYSIS

Using the list-count data recorded from the circular sample plots were used to calculate frequency, density, abundance, basal area etc to determine the Importance Value Index (IVI). IVI is the sum of the relatives of frequency, density and dominance (Phillips, 1959; Misra, 1969; Shimwell, 1971; Das & Lahiri, 1997; Kadir, 2001; Rai, 2006 and Ghosh, 2006). Calculation of IVI for shrubs and herbs were done – considering abundance – following the methodology of Samanta and Das (1996).

#### 3.3.1. Frequency

Frequency (F) and Relative Frequency (RF) of a species is determined using the formulae:

**Frequency (F%)** = (Number plots in which species occurred / Total number of plots studied) x 100.

**Relative Frequency (RF)** = (Frequency of a species /  $\sum$  of the frequencies of all species) x 100.

### 3.3.2. Density

Density (D) and Relative Density (RD) of a species is determined using the formulae:

$$\text{Density (D)} = \frac{\text{Total number of individuals of a species in all studied plots}}{\text{Total number of plots studied}}$$

$$\text{Relative density (RD)} = \frac{\text{Number of individual of a species}}{\text{Number of individual of all species}} \times 100$$

### 3.3.3. Dominance

Dominance (Dm) and Relative Dominance (RDm) of a species is determined using the formulae:

**Dominance (Dm)** = Value of individual basal cover.

$$\text{Relative Dominance (RDm)} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all the species}} \times 100$$

### 3.3.4. Importance Value Index (IVI)

IVI is calculated using the following formula –

$$\text{IVI} = \text{RF} + \text{RD} + \text{RDm}$$

### 3.3.5. Shannon – Weaver Index of Diversity (SWID) [Shannon-Weaver, 1963]

The formula for calculating the Shannon diversity index is

$$H' = - \sum p_i \ln p_i$$

Where,  $H'$  = Shannon index of diversity

$p_i$  = the proportion of important value of the  $i$ th species ( $p_i =$

$n_i / N$ ,  $n_i$  is the stem count of  $i$ th species and  $N$  is the stem count of all the species).

### 3.3.6. Simpson's Dominance Index (SDI) [Simpson, 1949]

SDI is calculated by the following way –

$$\text{SDI} = \frac{n(n-1)}{N(N-1)}$$

### 3.3.7. Species Richness [Menhinick, 1964]

Species richness of floral community has been calculated in the following way:

$$D = S^2/N$$

$S$  = Total number of species observed.

$N$  = Total number of individual observed.

CHAPTER: IV  
ENUMERATION

# ENUMERATION OF RECORDED VASCULAR PLANTS

From the sample plots in the study area in the Jainti Forest of the Buxa Tiger Reserve (BTR) during the entire survey period as much as 413 species of vascular plants from 97 families has the recorded to grow. The taxonomical enumeration of these plants is presented below in alphabetic order for families, genera under each family and species under each genus. Though for the delimitation of families Cronquist's (1988) system of classification has been followed mostly, but the modifications in APG-III system as available in the recent (2014) version of 'The Plant List' were also accepted. For nomenclature, author citation and protologue references mostly IPNI and 'The Plant List' (2014) have been used extensively.

## 4.1 Classification of Major Taxa

The arrangement of different recorded taxa in the present work in the classification of Cronquist (1988) is given below for Angiosperms and for Pteridophytes it is as per Sermolli (1977) and Ching (1978).

### Division PTERIDOPHYTA

Subdivision: Lycopytina

Class: Lycopsidea

Order: Lycopodiales

Lycopodiaceae

Order: Selaginellales

Selaginellaceae

Subdivision: Filicophytina

Class: Ophioglossopsida

Order: Ophioglossales

Ophioglossaceae

Class: Marattiopsida

Order: Marattiales

Marattiaceae

Class: Filicopsida

Order: Pteridales

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Pteridaceae  
 Order: Polypodiales  
 Polypodiaceae  
 Order: Aspidiales  
 Thelypteridaceae  
 Athyriaceae  
 Tectariaceae

**Class: MAGNOLIOPSIDA**

Subclass: Magnoliidae

Order: Magnoliales  
 Magnoliaceae  
 Order: Laurales  
 Lauraceae  
 Myristicaceae  
 Order: Piperales  
 Chloranthaceae  
 Piperaceae  
 Order: Ranunculales  
 Menispermaceae  
 Berberidaceae  
 Sabiaceae

Subclass: Hamamelidae [sic: correctly *Hamamelididae*]

Order: Urticales  
 Cannabaceae  
 Moraceae  
 Urticaceae  
 Order: Juglandales  
 Juglandaceae  
 Order: Fagales  
 Fagaceae

Subclass: Caryophyllidae

Order: Caryophyllales  
 Nyctaginaceae  
 Amaranthaceae  
 Caryophyllaceae  
 Order: Polygonales  
 Polygonaceae

Subclass: Dilleniidae

Order: Dilleniales  
 Dilleniaceae  
 Order: Theales  
 Dipterocarpaceae  
 Theaceae  
 Pentaphylaceae  
 Actinidiaceae  
 Order: Malvales

Elaeocarpaceae

Malvaceae

Order: Lecythidales

Lecythidaceae

Order: Violales

Tamaricaceae

Cucurbitaceae

Begoniaceae

Order: Salicales

Salicaceae

Order: Capparales

Capparaceae

Cleomaceae

Brassicaceae

Order: Primulales

Primulaceae

Subclass: Rosidae

Order: Rosales

Rosaceae

Order: Fabales

Fabaceae

Order: Myrtales

Lythraceae

Myrtaceae

Melastomaceae

Combretaceae

Order: Rhizophorales

Rhizophoraceae

Order: Cornales

Cornaceae

Order: Euphorbiales

Euphorbiaceae

Phyllanthaceae

Order: Rhamnales

Rhamnaceae

Vitaceae

Order: Sapindales

Sapindaceae

Burseraceae

Anacardiaceae

Simaroubaceae

Meliaceae

Tetrameliaceae

Rutaceae

Order: Geraniales

Oxalidaceae

Balsaminaceae

Order: Apiales  
 Araliaceae  
 Apiaceae

Subclass: Asteridae

Order: Gentianales  
 Loganiaceae  
 Apocynaceae

Order: Solanales  
 Solanaceae  
 Convolvulaceae

Order: Lamiales  
 Lamiaceae

Order: Plantaginales  
 Plantaginaceae

Order: Scrophulariales  
 Scrophulariaceae  
 Linderniaceae  
 Gesneriaceae  
 Acanthaceae  
 Bignoniaceae

Order: Rubiales  
 Rubiaceae

Order: Asterales  
 Asteraceae

**Class: LILIOPSIDA**

Subclass: Arecidae

Order: Arecales  
 Arecaceae

Order: Pandanales  
 Pandanaceae

Order: Arales  
 Araceae

Subclass: Commelinidae

Order Commelinales  
 Commelinaceae

Order Cyperales  
 Cyperaceae  
 Poaceae

Subclass: Zingiberidae

Order: Zingiberales  
 Musaceae  
 Zingiberaceae  
 Costaceae  
 Marantaceae

Subclass: Liliidae

Order: Liliales  
 Smilacaceae



Dioscoriaceae  
 Order: Orchidales  
 Asparagaceae  
 Amaryllidaceae  
 Hypoxidaceae  
 Orchidaceae

## 4.2 ENUMERATION

### 4.2.1 Division: PTERIDOPHYTA

For the delimitation of Pteridophyta classification of Singh and Panigrahi (2005) has been followed.

#### ATHYRIACEAE

*Diplazium esculentum* (Retzius) Swartz, *J. Bot. (Schrader) 1801(2): 312. 1803. Hemionitis esculenta* Retzius, *Observ. Bot. 6: 38 1791.*

*Exsiccatae: Animesh & AP Das 095*, dated 19. 01. 2009.

Terrestrial herbs, rhizome erect, fronds caespitose; lamina stiffly herbaceous, glabrous or hairy; costae shallowly grooved, with light brown short hairs; sori mostly linear, slightly curved, from near midribs to laminar margin.

**Local distribution:** Throughout the forests.

#### LYCOPODIACEAE

*Lycopodiella cernua* (Linnaeus) Pichi Sermolli, *Webbia 23(1): 166. 1968. Lycopodium cernuum* Linnaeus, *Sp. Pl. 2: 1103. 1753.*

*Exsiccatae: Animesh & AP Das 353*, dated 09. 02. 2010.

Plants terrestrial, prefer moist areas; dichotomously branched, glabrous; leaves of lateral branches and branchlets spirally arranged, dense, slightly bent upward, subulate to linear, base decurrent, sessile, margin entire, apex acuminate; strobili solitary, erect, terete, stalked.

**Local distribution:** Hill forest areas.

#### MARATTIACEAE

*Angiopteris crassipes* Wallich ex C. Presl, *Suppl. Tent. Pterid. 23. 1845. L.N.: Gaikhoret*

*Exsiccatae: Animesh & AP Das 051*, dated 17. 01. 2009.

Terrestrial, fronds large, stipes hirsute; laminae bipinnate; pinnae 60–80 × 20–30 cm, bases cordate, rounded, or truncate, margins usually serrate, apices acute to caudate; sori marginal.

**Local distribution:** Hill slope and core forest areas.

*Angiopteris evecta* (G. Forster) Hoffmann, *Commentat. Soc. Regiae Sci. Gott. 12: 29, t. 5. 1794. Polypodium evectum* G. Forster, *Fl. Ins. Austr. 81. 1786. L.N.: Gaikhoret*

*Exsiccatae: Animesh & AP Das 078*, dated 18. 01. 2009.

Terrestrial, fronds large, stipes smooth; laminae bipinnate; pinnae 65–70 cm, with 15–30 pairs of spreading pinnules; pinnules 7–20 × 0.9–3.5 cm, bases cordate, rounded to cuneate, margins crenulate to serrate, apices acuminate to caudate; sori marginal.

**Local distribution:** Hill slope and core forest areas.

#### OPHIOGLOSSACEAE

*Helminthostachys zeylanica* (Linnaeus) Hooker, *Gen. Fil., Pl. 47, B. 1842. Osmunda zeylanica* Linnaeus, *Sp. Pl. 2: 1063. 1753. L.N.: Muzurkhutte*

*Exsiccatae: Animesh & AP Das 513*, dated 28. 09. 2010.

Terrestrial; fronds usually single at rhizome apex; sterile lamina ternate with basal pinnae divided into 3 or 4 pinnules; pinnules lanceolate, 6–20 × 1.5–3 cm, base decurrent, margin irregularly toothed, apex acute; spikelike sporophore arising at top of common stipe.

**Local distribution:** River side forests.

### POLIPODIACEAE

*Drynaria quercifolia* (Linnaeus) J.E. Smith, *J. Bot. (Hooker)* 3: 398. 1841. *Polypodium quercifolium* Linnaeus, Sp. Pl. 2: 1087. 1753.

**Exsiccatae:** Animesh & AP Das 322, dated 07. 02. 2010.

Epiphytic herbs, rhizome shortly creeping; lamina pinnatifid, apex aborted; pinnae 5–9 pairs, spreading or slightly ascending, oblanceolate, margin subentire, apex acute or acuminate; sori in 2 rows between costa and margin.

**Local distribution:** Core forest areas.

*Microsorium punctatum* (Linnaeus) Copeland, *Univ. Calif. Publ. Bot.* 16(2): 111. 1929. *Acrostichum punctatum* Linnaeus, Sp. Pl., ed. 2, 2: 1524. 1763. L.N.: Rukh jheu

**Exsiccatae:** Animesh & AP Das 333, dated 07. 02. 2010.

Epiphytic; rhizome shortly creeping, terete, slightly compressed; lamina simple, narrowly obovate to narrowly elliptic, 10–175 × 1.5–15 cm, herbaceous to subleathery, stipe winged, auriculate, margin entire or undulate, apex acuminate to rounded; sori separate, small.

**Local distribution:** Core forest areas.

*Pyrrosia lanceolata* (Linnaeus) Farwell, *Amer. Midl. Naturalist* 12(8): 245. 1931. *Acrostichum lanceolatum* Linnaeus, Sp. Pl. 2: 1067. 1753.

**Exsiccatae:** Animesh & AP Das 347, dated 08. 02. 2010.

Epiphytic herbs, rhizome long creeping; fronds monomorphic, lamina widest at middle, 4–14 × 0.6 cm, base attenuate, long decurrent, apex obtuse; indumentum persistent, monomorphic, dense; sori sunken.

**Local distribution:** Through out the forests.

### PTERIDACEAE

*Adiantum cordatum* Maxon, *Amer. Fern J.* 21(4): 136. 1931. L.N.: Ranisinka

**Exsiccatae:** Animesh & AP Das 234, dated 14. 05. 2009.

Plants terrestrial, epilithic; rhizomes erect, short; lamina 1-pinnate, lanceolate in outline, 15–30 × 2–4 cm, base slightly narrow; white ventral side; fronds clustered; false indusia dark brown.

**Local distribution:** Stream side Hill slope.

*Adiantum lunulatum* Burman f., *Fl. Indica* 235. 1768.

**Exsiccatae:** Animesh & AP Das 257, dated 19. 09. 2009.

Plants terrestrial, epilithic; rhizomes densely covered with scales; lamina 1-pinnate, linear-lanceolate in outline, 6–23 × 2–3 cm, base subattenuate, apex acuminate; false indusia dark brown.

**Local distribution:** Stream side Hill slope.

*Pteris elongata* C.Presl, *Tent. Pterid.* 145. 1836. L.N.: Lamkane

**Exsiccatae:** Animesh & AP Das 052, dated 17. 01. 2009.

Plants terrestrial; rhizome erect or ascending; fronds clustered; lamina thinly leathery, base gradually narrowed, apex rounded or obtuse; costa slender, not prominent, veins evident; sori linear, along margin.

**Local distribution:** Hill forest areas.

### SELAGINELLACEAE

*Selaginella monospora* Spring, *Mém. Acad. Roy. Sci. Belgique* 24: 135. 1850.

**Exsiccatae:** Animesh & AP Das 370, dated 10. 02. 2010.

Terrestrial; perennial, long creeping; axillary leaves on main stems larger than those on branches, ovate or broadly ovate, base not peltate, obtuse; axillary leaves on branches asymmetrical, ovate or narrowly elliptic, margin denticulate; strobili solitary, terminal, compact.

**Local distribution:** Hill slope and core forest areas.

### TECTARIACEAE

*Tectaria gemmifera* (A.L.A. Fée) Alston, *J. Bot.* 77: 288. 1939. *Sagenia gemmifera* A.L.A. Fée, *Mém. Foug.* 313. 1850.

**Exsiccatae:** Animesh & AP Das 465, dated 26. 09. 2010.

Terrestrial; rhizome erect or ascending to creeping; lamina pinnatifid to quadripinnatifid, light green to brown when dried, deltoid, 20–40 × 20–30 cm, herbaceous to thickly papery, apex acute; indusia orbicular-reniform.

**Local distribution:** Through out the forests.

### THELYPTERIDACEAE

*Christella dentata* (Forsskal) Brownsey & Jermy, *Brit. Fern Gaz.* 10(6): 338. 1973. *Polypodium dentatum* Forsskal, *Fl. Aegypt.-Arab.* 185. 1775. L.N.: *Rukh Ningro*

**Exsiccatae:** Animesh & AP Das 419, dated 16. 05. 2010.

Plants epilithic; epiphytic; laminae herbaceous to papery, brownish green when dried, shortly hairy adaxially, densely puberulent abaxially; sori orbicular, in 1 row on either side of costa.

**Local distribution:** Core forest areas.

*Thelypteris nudata* (Roxburgh) C.V. Morton, *Contr. U.S. Natl. Herb.* 38(7): 352. 1974. *Polypodium nudatum* Roxburgh, *Calcutta J. Nat. Hist.* 4: 491. 1844.

**Exsiccatae:** Animesh & AP Das 314, dated 22. 09. 2009.

Terrestrial herbs, rhizomes long creeping; laminae herbaceous when dry, green or grayish green, abaxial surface with sparse short setae along veins; spores bilateral, reniform.

**Local distribution:** Through out the forests.

*Trigonospora caudipinna* Sledge, *Bull. Brit. Mus. (Nat. Hist.), Bot.* 8(1): 15. 1981.

**Exsiccatae:** Animesh & AP Das 367, dated 10. 02. 2010.

Terrestrial herbs, rhizomes long creeping, black; laminae dark brown when dry, papery; abaxially rachises, costae, and veins with long hairs, adaxially with dense, appressed setae along costal grooves; indusia membranous, orbicular-reniform, deciduous.

**Local distribution:** Hill forest areas.

## 4.2.2 Division: PINOPHYTA

### PINACEAE

*Pinus roxburghii* Charles Sprague Sargent, *Silva N. Amer.* 11: 9. 1897. L.N.: *Pine, Salla*

**Exsiccatae:** Animesh & AP Das 192, dated 11. 05. 2009.

Trees, winter buds brown, small; needles 3 per bundle; megasporophyll oblong, thick.

**Local distribution:** Hill slope and core forest areas.

## 4.2.3 Division: MAGNOLIOPHYTA

### 4.2.3.1 Class: Magnoliopsida

#### ACANTHACEAE

*Barleria cristata* Linnaeus, *Sp. Pl.* 636. 1753. L.N.: *Jhusephool*

**Exsiccatae:** Animesh & AP Das 088, dated 19. 01. 2009.

Subshrubs; stems terete, branched; leaf blade elliptic to oblong to ovate, apex acute to sometimes acuminate, base cuneate and decurrent onto petiole, axillary short and dense cymes, shortly pedunculate; corolla purplish blue; capsule glabrous.

**Local distribution:** Road side forest area.

*Barleria prionitis* Linnaeus, *Sp. Pl.* 636. 1753.

**Exsiccatae:** Animesh & AP Das 021, dated 17. 01. 2009.

Shrubs; stems and branches terete; leaf blade elliptic to ovate, margin entire, apex acute, base attenuate and decurrent onto petiole; flowers clustered in axils of upper leaves; corolla orange; capsule ovoid.

**Local distribution:** Stream side forest.

*Barleria strigosa* Willdenow, *Sp. Pl.* 3: 379. 1800. L.N.: *Satpatrephool / Jhusephool*

**Exsiccatae:** Animesh & AP Das 072, dated 18. 01. 2009.

Subshrubs, branched; stems subterete, strigose. leaf blade elliptic to ovate, base cuneate and decurrent onto petiole, apex acute; flowers bluish in axillary and terminal dense spikes; capsule ellipsoid, glabrous.

**Local distribution:** Marginal forest areas and stream side.

*Dicliptera bupleuroides* Nees, *Pl. Asiat. Rar.* 3: 111. 1832. L.N.: *Panakhuri*

**Exsiccatae:** Animesh & AP Das 065, dated 18. 01. 2009.

Diffuse annual; stems sulcate; leaf blade ovate, margin subentire, apex acuminate, base cuneate; flowers many in axillary and terminal shortly pedunculate cymose clusters; capsule pilose at tip.

**Local distribution:** Road side forests.

*Eranthemum griffithii* (T. Anderson) Bremekamp & Nannenga-Bremekamp, *Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2.* 45(1): 35. 1948. *Daedalacanthus griffithii* T. Anderson, *J. Linn. Soc., Bot.* 9: 486. 1867. L.N.: *Chuaphool*

**Exsiccatae:** Animesh & AP Das 105, dated 19. 01. 2009.

A large glabrous, erect, shrubs; lamina elliptic or ovate-elliptic, crenulate, acute-acuminate, base attenuate; spikes terminal and axillary; bracts leafy, ovate-elliptic to obovate; flowers bluish purple.

**Local distribution:** Road side forest area.

*Eranthemum pulchellum* Andrews, *Bot. Repos.* 2: t. 88. 1800.

**Exsiccatae:** Animesh & AP Das 079, dated 18. 01. 2009.

Shrubs, erect, less branched; stem terete, 4-angled on young stems; lamina elliptic or ovate-elliptic, entire or crenulate, acute to acuminate, basally attenuate; flowers blue in branched panicle; capsule ca. 12-15 mm.

**Local distribution:** Throughout the forests.

*Justicia adhatoda* Linnaeus, *Sp. Pl.* 15. 1753. L.N.: *Basak*

**Exsiccatae:** Animesh & AP Das 301, dated 22. 09. 2009.

Small, erect, branched, shrubs; branches thickened, lenticellate, pubescent when young but soon glabrescent; leaf blade ovate to elliptic-ovate, entire, acuminate and sometimes slightly falcate, base broadly cuneate; terminal or axillary spikes; corolla white; capsule obovoid.

**Local distribution:** Road side forest area.

*Lepidagathis incurva* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal.* 119. 1825. L.N.: *Jhuse*

**Exsiccatae:** Animesh & AP Das 045, dated 17. 01. 2009.

Annual herbs; leaves with 1-2 cm long petiole; lamina speckled with white, lanceolate-oblong to broadly lanceolate-ovate, entire, acute; spikes elongate, secund; flower white; capsule oblong.

**Local distribution:** Marginal forests and stream side areas.

*Nelsonia canescens* (Lamarck) Sprengel, *Syst. Veg.* 1: 42. 1824. *Justicia canescens* Lamarck, *Tabl. Encycl.* 1: 41. 1791.

**Exsiccatae:** Animesh & AP Das 376, dated 14. 05. 2010.

Creeping annual herbs, softly hairy; subterete; leaf blade elliptic to ovate, entire, acute, base cuneate; spikes terminal and axillary; flower bluish purple; capsule.

**Local distribution:** Road side forest area.

**Phlogacanthus thyrsoformis** (Roxburgh ex Hardwicke) Mabberley, *Bot. Hist. Hortus Malabaricus* 189. 1980. *Justicia thyrsoformis* Hardwicke, *Asiat. Res.* 6: 349. 1799. L.N.: *Chuaphool*

**Exsiccatae:** Animesh & AP Das 324, dated 07. 02. 2010.

Long, erect, weak, less branched, shrubs; leaves often crowded near branch tips; lamina ovoid to elliptic, smooth, shortly acuminate at both ends; thyrses terminal, many flowered; flowers orange-red, tubular; capsule narrowly clavate.

**Local distribution:** Road side forests and stream side areas.

**Rhinacanthus calcaratus** Nees, *Prodr.* 11: 444. 1847.

**Exsiccatae:** Animesh & AP Das 404, dated 16. 05. 2010.

Perennial, erect, branched herbs; lamina broadly ovate to oblong, entire, acute, base cuneate and decurrent onto petiole; thyrses terminal; flowers bluish purple; capsule clavate, pubescent.

**Local distribution:** Marginal forests and stream side areas.

**Rungia pectinata** (Linnaeus) Nees, *Prodr.* 11: 470. 1847. *Justicia pectinata* Linnaeus, *Amoen. Acad.* 4: 299. 1760. L.N.: *Dandis jhaar*

**Exsiccatae:** Animesh & AP Das 003, dated 17. 01. 2009.

Small, annual diffuse herbs; stem basally prostrate, rooting at nodes; leaf blade oblong-elliptic, entire, acute, base cuneate and decurrent onto petiole; spikes axillary and terminal, second; corolla pinkish; capsule ellipsoid.

**Local distribution:** River side forest areas.

#### ACTINIDIACEAE

**Saurauia roxburghii** Wallich, *Pl. Asiat. Rar.* 2: 40. 1831. L.N.: *Gagunpate*

**Exsiccatae:** Animesh & AP Das 530, dated 29. 09. 2010.

Small tree; stem densely tomentose, sparsely scaly; lamina broadly or narrowly elliptic-oblong, remotely setose-serrate, abruptly acuminate, base obtuse to rounded, symmetrical to oblique, leathery; cymose clusters axillary and from old stem; flowers translucent white; fruit berry, globose or depressed-globose, usually ribbed.

**Local distribution:** Core forest areas.

#### AMARANTHACEAE

**Achyranthes bidentata** Blume, *Bijdr.* 545. 1826.

**Exsiccatae:** Animesh & AP Das 266, dated 20. 09. 2009.

Perennial herbs; stem green or tinged with purple; leaf blade elliptic or elliptic-lanceolate, rarely oblanceolate, base cuneate or broadly cuneate, caudate; racemes densely flowered; utricles yellowish brown.

**Local distribution:** Road side forests and stream side areas.

**Alternanthera philoxeroides** (C. Martius) Grisebach, *Abh. Königl. Ges. Wiss. Göttingen* 24: 36. 1879. *Bucholzia philoxeroides* C. Martius, *Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur.* 13(1): 107. 1825.

**Exsiccatae:** Animesh & AP Das 247, dated 19. 09. 2009.

Perennial herbs, prefer moist areas; stem ascending, internode hollowed; leaf blade oblong, oblong-obovate, or ovate-lanceolate, entire, acute or obtuse, base attenuate; heads solitary, peduncled at leaf axil, globose; tepals white.

**Local distribution:** Stream side forests.

**Amaranthus viridis** Linnaeus, *Sp. Pl. ed. 2:1405.* 1763.

**Exsiccatae:** *Animesh & AP Das 278*, dated 20. 09. 2009.

Stem erect, green or somewhat tinged purple; leaf blade ovate, ovate-oblong, or ovate-elliptic, entire or slightly undulate, notched or rounded, with a pointed mucro, base broadly cuneate or subtruncate; complex terminal thyrses of erect and branched slender spikes, green; utricles green, globose, slightly compressed, very rugose, indehiscent.

**Local distribution:** Marginal forests and stream side areas.

#### ANACARDIACEAE

***Mangifera indica*** Linnaeus, *Sp. Pl. 200. 1753*. L.N.: *Aanp*

**Exsiccatae:** *Animesh & AP Das 106*, dated 19. 01. 2009.

Spreading trees; leaf blade oblong to oblong-lanceolate, entire, undulate, acute to long acuminate, base cuneate to obtuse, leathery; panicle, terminal, much branched; flowers polygamous petals light yellow; drupe oblong to subreniform.

**Local distribution:** Core forest areas.

***Mangifera sylvatica*** Roxburgh, *Fl. Ind., ed. 1820 2: 438. 1824*. L.N.: *Chuche Aanp*

**Exsiccatae:** *Animesh & AP Das 005*, dated 17. 01. 2009.

Trees; panicles, leaf blade lanceolate to oblong-lanceolate, entire, acuminate, base cuneate, thinly leathery; terminal, glabrous, with slender primary branches; petals white; drupe oblique, ovate.

**Local distribution:** River side forest areas.

***Semecarpus anacardium*** Linnaeus f., *Suppl. Pl. 182. 1782*. L.N.: *Bhalayo*

**Exsiccatae:** *Animesh & AP Das 069*, dated 18. 01. 2009.

Deciduous trees; leaves large, lamina obovate, entire, slightly revolute, truncate to retuse, base attenuate, leathery, glabrous on both surfaces; panicles terminal; male flower sessile, yellowish green; drupe subglobose, yellowish green.

**Local distribution:** Core forest areas.

***Spondias pinnata*** (Linnaeus f.) Kurz, *Prelim. Rep. Forest Pegu Appendix A: 44, Appendix B: 42. 1875*. *Mangifera pinnata* Linnaeus f., *Suppl. Pl. 156. 1782*.

**Exsiccatae:** *Animesh & AP Das 048*, dated 17. 01. 2009.

Deciduous trees; leaflet blade ovate-oblong to elliptic-oblong often oblique, serrate or entire, acuminate, base cuneate to rounded; panicles terminal with spreading branches; flowers subsessile, white; drupe ellipsoid to elliptic-ovoid.

**Local distribution:** River side forests.

***Sorindeia madagascariensis*** Thouars ex de Candolle, *Prodr. 2: 80. 1825*.

**Exsiccatae:** *Animesh & AP Das 027*, dated 17. 01. 2009.

Small shrubs to small trees; leaves imparipinnate; leaflets membranous to chartaceous, subopposite or usually alternate, entire and not thickened at the undulate margin, all rounded or obtuse to acuminate at the apex, oblong or obovate, cuneate at the base; panicles, terminal, sparsely branched; flowers very small, red; drupe bright yellow, ellipsoid, acute, apiculate.

**Local distribution:** Core forest areas.

#### ANNONACEAE

***Artabotrys caudatus*** Wallich ex Hooker f. & Thomson, *Fl. Ind. 1: 129. 1855*. L.N.: *Kali Lahara*

**Exsiccatae:** *Animesh & AP Das 517*, dated 29. 09. 2010.

Spreading lianas; lamina elliptic, oblong-lanceolate, caudate, base cuneiform; flowers many in 2 fascicles, green, maturing to yellow; fruits mericarps, elliptic.

**Local distribution:** Road side forest area.

*Desmos chinensis* Loureiro, *Fl. Cochinch.* 352. 1790. L.N.: *Janglee Baigun*

**Exsiccatae:** *Animesh & AP Das* 260, dated 19. 09. 2009.

Medium woody climbers; branches stout, sparsely hairy when young, with raised grayish white lenticels; lamina oblong to elliptic, rarely broadly ovate, abaxially glaucous and sparsely appressed hairy, acute to acuminate, base rounded to slightly oblique, membranous; 1-flowered cymes in superaxillary or leaf-opposed; flower pale yellow; monocarps ellipsoid or moniliform.

**Local distribution:** Road side forest area.

*Goniothalamus sesquipetalis* (Wallich) Hooker f. & Thomson, *Fl. Ind.* 1: 108. 1855. *Guatteria sesquipetalis* Wallich, *Pl. Asiat. Rar.* 3: t. 266. 1832. L.N.: *Janglee Aaru*

**Exsiccatae:** *Animesh & AP Das* 374, dated 10. 02. 2010.

Trees; lamina obovate, densely rust-colored hirsute, caudate or shortly acuminate, base cuneate, papery; flowers 1 or many in cymose axillary or extra-axillary fascicles; flower greenish yellow; fruiting carpels oblongelliptic.

**Local distribution:** Core forest areas.

*Polyalthia simiarum* (Buchanan-Hamilton ex Hooker f. & Thomson) Bentham ex Hooker f. & Thomson in J. D. Hooker, *Fl. Brit. India* 1: 63. 1872. *Guatteria simiarum* Buchanan-Hamilton ex J. D. Hooker & Thomson, *Fl. Ind.* 1: 142. 1855.

**Exsiccatae:** *Animesh & AP Das* 217, dated 14. 05. 2009.

Tall trees; bark grayish white; branches puberulent when young; leaves large glossy; lamina ovate-oblong, oblong, lanceolate or oblanceolate, acuminate, shortly acuminate, or obtuse, base rounded to broadly cuneate and sometimes oblique, membranous ovoid to ovoid-ellipsoid; cymose fascicles on axillary or on old or short branches; flowers numerous, yellowish green; monocarpic fruit.

**Local distribution:** Core forest areas.

*Uvaria hamiltonii* Hooker f. & Thomson, *Fl. Ind.* 1: 96. 1855.

**Exsiccatae:** *Animesh & AP Das* 133, dated 06. 02. 2009.

Climbing shrubs, scandent; aromatic leaves elliptic-oblong or obovate, entire, acute or acuminate, base round; cymes leaf-opposed, 2 flowered; flowers yellowish; berries syncarpus.

**Local distribution:** Hill forest areas.

## APIACEAE

*Centella asiatica* (Linnaeus) Urban, *Fl. Bras.* 11(1): 287. 1879. *Hydrocotyle asiatica* Linnaeus, *Sp. Pl.* 1: 234. 1753. L.N.: *Ghortapre*

**Exsiccatae:** *Animesh & AP Das* 162, dated 07. 02. 2009.

Perennial rosette herbs; runners slender, rooting at nodes; lamina orbicular or reniform, base broadly cordate, coarsely toothed; umbels 3–4-flowered; flowers subsessile, redish.

**Local distribution:** Moist areas of river valley.

## APOCYNACEAE

*Alstonia scholaris* (Linnaeus) Robert Brown, *Asclepiadeae* 75. 1810. *Echites scholaris* Linnaeus, *Mant. Pl.* 1: 53. 1767. L.N.: *Chatium*

**Exsiccatae:** *Animesh & AP Das* 115, dated 20. 01. 2009.

Robust spreading trees with of many leaves; bark gray; branchlets copiously lenticellate; leaves in whorls of 3-10; lamina narrowly obovate to very narrowly spatulate, usually rounded, base cuneate, leathery; cymes terminal, dense, pubescent; flower white; follicles distinct, linear.

**Local distribution:** Road side forest areas.

*Calotropis gigantea* (Linnaeus) Dryander, *Hortus Kew.* 2:78. 1811. *Asclepias gigantea* Linnaeus, *Sp. Pl.* 1: 214. 1753. L.N.: *Aankh*

**Exsiccatae:** Animesh & AP Das 201, dated 12. 05. 2009.

Shrubs with thickly cottony stems and leaves; lamina obovate-oblong or oblong, obtuse, base cordate, cottony tomentose when young; cymes umbellate; flowers bud cylindric, purplish; follicles obliquely elliptic to oblong-lanceolate in outline.

**Local distribution:** Road side forest areas.

**Chonemorpha fragrans** (Moon) Alston, *Ann. Roy. Bot. Gard. (Peradeniya) 11: 203. 1929. Echites fragrans* Moon, *Cat. Pl. Ceylon 20. 1824. L.N.: Jhuse Lahara*

**Exsiccatae:** Animesh & AP Das 116, dated 20. 01. 2009.

Woody, much branched liana; leaf blade suborbicular to broadly ovate, acute or rounded, cuspidate, base cordate; flowers in terminal umbellate cymes; corolla white; follicles cylindric to fusiform.

**Local distribution:** Core forest areas.

**Holarrhena pubescens** Wallich ex G. Don, *Gen. Hist. 4: 78. 1837. L.N.: Khirra*

**Exsiccatae:** Animesh & AP Das 180, dated 11. 05. 2009.

Medium trees; branches with whitish, dotlike lenticels; leaves large, broad; lamina ovate or elliptic, acute or obtuse, pubescent, base rounded, membranous; cymes in terminal branch, spreading; flower white; follicles linear.

**Local distribution:** Hill forest areas.

**Hoya parasitica** Wallich ex G.W. Traill, *Trans. Hort. Soc. London 7: 23. 1830. L.N.: Chepti*

**Exsiccatae:** Animesh & AP Das 221, dated 14. 05. 2009.

Shrubby epiphytic climber, laxly branched; lamina ovate-oblong, succulent, apex acute to acuminate, base cuneate; flowers in globose clusters, white, fragrant; follicles linear-lanceolate in outline.

**Local distribution:** Core areas of forest.

**Hoya linearis** Wallich ex D. Don, *Prodr. Fl. Nepal. 130. 1825.*

**Exsiccatae:** Animesh & AP Das 063, dated 18. 01. 2009.

Stems hanging; stems hanging, puberulent; leaves linear-terete; lamina linear, mucronate, base cuneate, leathery; pseudumbels terminal, sessile; flowers in pendulous umbel, many, white, fragrant; follicles lanceolate.

**Local distribution:** Hill forest areas.

**Ichnocarpus frutescens** (Linnaeus) W.T. Aiton, *Hortus Kew. 2: 69. 1811. Apocynum frutescens* Linnaeus, *Sp. Pl. 1: 213. 1753.*

**Exsiccatae:** Animesh & AP Das 042, dated 17. 01. 2009.

Woody liana, profusely branched, branches pubescent when young; leaves much variable; lamina pubescent or glabrous abaxially; many flowered clusters in much branched peduncle; corolla white; follicles cylindric.

**Local distribution:** Throughout the forests.

**Rauvolfia serpentina** (Linnaeus) Bentham ex Kurz, *Forest Fl. Burma 2: 171. 1877. Ophioxylon serpentinum* Linnaeus, *Sp. Pl. 2: 1043. 1753. L.N.: Nagbeli, Sarpagandha*

**Exsiccatae:** Animesh & AP Das 073, dated 18. 01. 2009.

Suffrutescent under-shrubs; stems less branched, slender, straw colored; leaves grouped near stem apex, in whorls of 3-5; lamina narrowly elliptic or obovate, acuminate or rarely obtuse, base cuneate, membranous; cymes congested, reddish; corolla white; drupes ellipsoid.

**Local distribution:** Rare common; river valley and hill forest areas.

**Tabernaemontana divaricata** (Linnaeus) R. Brown ex Roemer & Schultes, *Syst. Veg. 4: 427. 1819. Nerium divaricatum* Linnaeus, *Sp. Pl. 1: 209. 1753. L.N.: Thulo Baromasey Phool*

**Exsiccatae:** Animesh & AP Das 157, dated 07. 02. 2009.

Large shrubs, profusely branched; bark whitish; lamina elliptic or narrowly so, acuminate; flowers in spreading cymose corymb; buds with an ovoid head, flowers white; follicles obliquely and narrowly ellipsoid.



**Local distribution:** Throughout the forests.

*Tylophora indica* (Burman f.) Merrill, *Philipp. J. Sci.* 19: 373. 1921. *Cynanchum indicum* Burman f., *Fl. Indica* 70. 1768.

**Exsiccatae:** Animesh & AP Das 239, dated 19. 09. 2009.

Shrubby climber, leaves ovate-oblong to elliptic-oblong, with a narrow tip, heart-shaped at base; branches slender; cymose umbels extra-axillary; flowers yellow; follicle ovoid-lance-shaped

**Local distribution:** Road side forest areas.

*Wrightia arborea* (Dennstaedt) Mabberley, *Taxon* 26: 533. 1977. *Periploca arborea* Dennstedt, *Schlüssel Hortus Malab.* 13, 23, 25. 1818. L.N.: *Seto Khirra*

**Exsiccatae:** Animesh & AP Das 123, dated 05. 02. 2009.

Small trees; branches gray or brown, pubescent, lenticellate; lamina elliptic to broadly so or obovate, pubescent to glabrescent adaxially; cymes pubescent; flowers yellowish; follicles broad.

**Local distribution:** Marginal forests and stream side areas.

## ARALIACEAE

*Schefflera pubigera* (Brongniart ex Planchon) Frodin, *World Checklist Bibliogr. Araliaceae* 368. 2003 publ. 2004. *Paratropia pubigera* Brongniart ex Planchon, *Hort. Donat.* 11. 1858. L.N.: *Kurshimal*

**Exsiccatae:** Animesh & AP Das 130, dated 05. 02. 2009.

Shrubby evergreen epiphytes; leaves palmate, 5 - 7, narrowly obovate to narrowly elliptic, entire, acuminate, base cuneate to acute, papery to subleathery; umbels in terminal panicle; flowers whitish.

**Local distribution:** Core areas of forest.

*Trevesia palmata* (Roxburgh ex Lindley) Visiani, *Mem. Reale Accad. Sci. Torino II*, 4: 262. 1842. *Gastonia palmata* Roxburgh ex Lindley, *Bot. Reg.* 11: t. 894. 1825. L.N.: *Magare*

**Exsiccatae:** Animesh & AP Das 087, dated 19. 01. 2009.

Small evergreen trees, sparsely branched; leaves simple, large, palmately lobed, serrate, acuminate, leathery; umbels in large panicles, 25-45 flowered; flowers yellowish; fruit subglobose to compressed-globose.

**Local distribution:** Core areas of forest.

## ASTERACEAE

*Acmella uliginosa* (Swartz) Cassini, *Dict. Sci. Nat.*, ed. 2. 24: 331. 1822. *Spilanthes uliginosa* Swartz, *Prodr.* 110. 1788. L.N.: *Illame Jhaar*

**Exsiccatae:** Animesh & AP Das 004, dated 17. 01. 2009.

Annual herbs; lower stem prostrate, branches semierect, diffuse; lamina lanceolate, narrowly ovate to ovate, glabrous to sparsely pilose on both surfaces, margin sinuate to dentate, sparsely ciliate, acute to acuminate, base attenuate to cuneate; capitula terminal on main and axillary shoots; ray corolla truncate, shallowly 3 dentate; disc corolla 4 merous, yellow; achenes black.

**Local distribution:** Road side forest areas.

*Ageratum conyzoides* Linnaeus, *Sp. Pl.* 839. 1753. L.N.: *Aalu jhaar*

**Exsiccatae:** Animesh & AP Das 037, dated 17. 01. 2009.

Annual erect hispid herbs, less branched below; median leaves ovate, elliptic, or oblong; leaf margin crenate-serrate, acute, base obtuse or broadly cuneate; capitula in terminal umbels; all disc florates, corolla whitish or blue; achenes black.

**Local distribution:** Road side forest areas.

*Aster albescens* (de Candolle) Wallich ex Handel-Mazzetti, *Acta Horti Gothob.* 12: 205. 1938. *Amphirhapis albescens* de Candolle, *Prodr.* 5: 343. 1836. L.N.: *Chiaphool*

**Exsiccatae:** Animesh & AP Das 034, dated 17. 01. 2009.

Erect shrubs, unbranched, hispid; leaves reduced distally, sessile; lamina ovate, flat to revolute, acute to acuminate, base cuneate or attenuate; capitulum terminal; ray corollas white, disc corollas yellow; achenes obovoid.

**Local distribution:** Core areas of forest.

*Bidens pilosa* Linnaeus, *Sp. Pl.* 2: 832. 1753.

**Exsiccatae:** Animesh & AP Das 039, dated 17. 01. 2009.

Annual, erect, much branched; leaves palmate; serrate or entire, apices acute to attenuate, bases truncate to cuneate; capitula long peduncled, crowded upwards; discs yellow, rays white; achenes blackish, linear-fusiform.

**Local distribution:** Throughout the open forests.

*Blumea lanceolaria* (Roxburgh) Druce, *Rep. Bot. Exch. Cl. Brit. Isles* 1916, 609. 1917. *Conyza lanceolaria* Roxburgh, *Fl. Ind.*, ed. 1832, 3: 432. 1832. L.N.: *Putus phool*

**Exsiccatae:** Animesh & AP Das 024, dated 17. 01. 2009.

Perennial, erect herbs, woody at base, hollow in center; basal leaves in rosette, oblanceolate; leaf margin minutely serrate-dentate, acuminate, base attenuate into auriculate; capitula in terminal panicle; flowers yellow; achenes oblong.

**Local distribution:** Road side forest areas.

*Chromolaena odorata* (Linnaeus) R.M. King & H. Robinson, *Phytologia* 20: 204. 1970. *Eupatorium odoratum* Linnaeus, *Syst. Nat.*, ed. 10, 2: 1205. 1759.

**Exsiccatae:** Animesh & AP Das 001, dated 17. 01. 2009.

Large suffrutescent herbs, rhizomes robust; leaves opposite; lamina broadly triangular-ovate, irregularly crenate or entire, acute, base truncate or shallowly cordate, odorous; capitula densely corymbs at branch-tips; all disc florates, corolla whitish; achenes black-brown.

**Local distribution:** Road side forest areas.

*Cissampelopsis buimalia* (Buchanan-Hamilton ex D. Don) C. Jeffrey & Y.L.Chen, *Kew Bull.* 39(2): 348. 1984. *Senecio buimalia* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal.* 178. 1825.

**Exsiccatae:** Animesh & AP Das 022, dated 17. 01. 2009.

Annual, erect herbs; stems becoming woody, white tomentose; upper leaves smaller, ovate to lanceolate, basally cordate to cuneate; lamina abaxially grayish white, adaxially deep green, ovate or ovate-triangular, abaxially arachnoid, margin ± sinuate-denticulate with mucronulate teeth, acute-acuminate-apiculate base cordate, thinly papery; capitulum solitary, terminal; ray florates 5, disc florates 14 – 16, corolla yellow; achenes cylindrical.

**Local distribution:** Core areas of forest.

*Conyza leucantha* (D. Don) Ludlow & P.H. Raven, *Kew Bull.* 17: 71. 1963. *Erigeron leucanthus* D. Don, *Prodr. Fl. Nepal.* 171. 1825.

**Exsiccatae:** Animesh & AP Das 056, dated 17. 01. 2009.

Perennial, erect herbs; lamina elliptic-oblong to ovate or lanceolate, serrate to serrulate, teeth mucronulate, acuminate, base cuneate to attenuate; capitulum in terminal corymb; ray florates white, filiform, disc florates 5 toothed; achenes straw-colored to pale brown, lanceolate, compressed.

**Local distribution:** Hill slope and core forest areas.

*Cyanthillium cinereum* (Linnaeus) P.H. Robinson, *Proc. Biol. Soc. Wash.* 103: 252. 1990. *Conyza cinerea* Linnaeus, *Sp. Pl.* 862. 1753.

**Exsiccatae:** Animesh & AP Das 041, dated 17. 01. 2009.

Annual, erect herbs, less branched; lamina hombic-ovate, rhombic-oblong or ovate, remotely mucronate-serrate, or repand, acute or slightly obtuse, base cuneately attenuate into winged petiole; few capitulum in terminal corymb; capitula all disc, bluish; achenes cylindrical.

**Local distribution:** Throughout the forests.

*Elephantopus scaber* Linnaeus, *Sp. Pl.* 2: 814. 1753.

**Exsiccatae:** Animesh & AP Das 007, dated 17. 01. 2009.

Annual rosette herbs; stems erect, branched, densely white adpressed hirsute; lamina oblong-obovate, crenate-serrate, rounded or shortly acute, base gradually attenuate; flowering shoot erect, unbranched; compound capitula in dense terminal umbel; florates white; achenes oblong-linear, angled.

**Local distribution:** Throughout the forests.

*Mikania micrantha* Kunth, *Nov. Gen. Sp.* [H.B.K.] 4(15): 105. (ed. fol.). 1818; later publ. 4(15): 134 (ed. qto.). 1820. L.N.: *Mikani Larang*

**Exsiccatae:** Animesh & AP Das 002, dated 17. 01. 2009.

Profusely branched large herbaceous climber; stems yellowish or brownish, usually terete; leaves opposite; lamina ovate, margin entire to coarsely dentate, shortly acuminate, base cordate; capitula forms compound corymbs; flowers dirty-white; achenes 4-ribbed with many scattered glands.

**Local distribution:** Road side forest areas.

*Tridax procumbens* Linnaeus, *Sp. Pl.* 900. 1753.

**Exsiccatae:** Animesh & AP Das 008, dated 17. 01. 2009.

Annual, procumbent, less branched herbs; leaves few, shortly petiolate; lamina ovate to ovate-lanceolate, deeply irregularly serrate, acute or acuminate, base cuneate; capitulum solitary on long peduncle; ray corolla truncate, shallowly 3 dentate; disc corolla 4 merous, yellow; achenes brown, oblong.

**Local distribution:** Through out the forests.

#### BALSAMINACEAE

*Impatiens trilobata* Colebrooke, *Exot. Fl.* 2: t. 141. 1825.

**Exsiccatae:** Animesh & AP Das 165, dated 07. 02. 2009.

Annual, erect herbs; leaves alternate, lamina lanceolate, narrowly elliptic, or oblanceolate, deeply serrate, acuminate, base cuneate; cymes 2-flowered from leaf axils, without peduncles; flowers pink; capsule broadly fusiform.

**Local distribution:** Throughout the forests.

#### BEGONIACEAE

*Begonia picta* J.E. Smith, *Exot. Bot.* 2: 81. 1806. L.N.: *Rato Magarkanche*

**Exsiccatae:** Animesh & AP Das 407, dated 16. 05. 2010.

Annual, deciduous succulent herbs, stem short; leaves 1 or 2, basal or cauline; lamina ovate-cordate, slightly asymmetric, bidentate, acuminate, base slightly oblique, cordate to deeply cordate; inflorescences terminal; outer perianth segment broadly elliptic, pink; capsule pendulous, obovoid.

**Local distribution:** Hill forest areas.

*Begonia satrapis* C.B. Clarke, *Fl. Brit. India* 2: 638. 1879.

**Exsiccatae:** Animesh & AP Das 409, dated 16. 05. 2010.

Annual, deciduous succulent herbs, stem short; lamina ovate-cordate, slightly asymmetric, bidentate, acuminate, base slightly oblique, cordate to deeply cordate; inflorescences glabrous, peduncle elongated; outer perianth segment elliptic, flowers pink; capsule pendulous, obovoid.

**Local distribution:** Hill slope and core forest areas.

*Begonia sikkimensis* Alphonse de Candolle, *Ann. Sci. Nat., Bot.* IV, 11: 134. 1859.

**Exsiccatae:** Animesh & AP Das 049, dated 17. 01. 2009.

Annual, succulent herbs, stem unbranched; leaves basal and cauline; lamina suborbicular, slightly asymmetric, remotely and shallowly denticulate, long acuminate, base shallowly cordate; peduncle 8-12 cm; staminate flowers, outer perianth segment elliptic, pink; capsule nodding, obovoid-oblong.

**Local distribution:** Hill slope and core forest areas.

#### BERBARIDACEAE

*Mahonia napaulensis* de Candolle, Syst. Nat. 2: 21. 1821. L.N.: *Chutro*

*Exsiccatae:* Animesh & AP Das 468, dated 26. 09. 2010.

Erect, profusely branched shrubs; leaves green, elliptic to ovate; leaflets oblong, oblong-ovate, or ovate to ovate-lanceolate, oblique, with 3-10 teeth on each side, acute, acuminate, or cuspidate, base broadly cuneate, rounded, or sometimes subcordate; racemes 3 – 18, fascicled; flowers yellow; berry bluish black, pruinose, oblong.

**Local distribution:** Hill forest areas.

#### BIGNONIACEAE

*Oroxylum indicum* (Linnaeus) Kurz, *Forest Fl. Burma* 2: 237. 1877. *Bignonia indica* Linnaeus, Sp. Pl. 2: 625. 1753. L.N.: *Totala*

*Exsiccatae:* Animesh & AP Das 057, dated 17. 01. 2009.

Small trees, branching on upper part; bark gray-brown; leaves pinnately compound, borne nearly at stem apex; lamina triangular-ovate, entire, short acuminate, base subrounded or cordate; racemes long, terminal; flowers night blooming, purple-red, tube fleshy; capsule woody.

**Local distribution:** Hill forest areas.

*Stereospermum tetragonum* de Candolle, *Biblioth. Universelle Genève n.s.*, 17: 124. 1838. L.N.: *Parari*

*Exsiccatae:* Animesh & AP Das 471, dated 26. 09. 2010; 154, dated 07. 02. 2009.

Medium trees; lamina long elliptic, entire, acuminate, base cuneate; flowers many in lax terminal or axillary panicle; corolla white with purplish markings; Capsule terete, 4-angular, slightly curved.

**Local distribution:** Hill forest areas.

#### BRASSICACEAE

*Cardamine hirsuta* Linnaeus, Sp. Pl. 655. 1753. L.N.: *Simsare*

*Exsiccatae:* Animesh & AP Das 047, dated 17. 01. 2009.

Annual, semierect herbs; basal leaves rosulate; lamina lyrate-pinnatisec, terminal lobe reniform or orbicular, entire, repand, dentate; racemes erect or ascending, terminal; flowers white; pedicels erect or ascending.

**Local distribution:** Stream side hill slopes.

*Rorippa indica* (Linnaeus) Hiern, *Cat. Afr. Pl. 1: xxvi. 1896. Sisymbrium indicum* Linnaeus, Sp. Pl., ed. 2, 2: 917. 1763.

*Exsiccatae:* Animesh & AP Das 297, dated 21. 09. 2009.

Annual, erect herbs, branched; basal leaves withered by flowering lamina lyrate-pinnatipartite or undivided, obovate, oblong, or lanceolate, entire, irregularly crenate, or serrate, obtuse or subacute; terminal lobe oblong, elliptic, or oblong-lanceolate, auriculate; racemes terminal; flowers ebracteate, yellow; fruit linear, often curved upward.

**Local distribution:** River Valley.

#### BURSERACEAE

*Canarium sikkimense* King, *J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 187. 1893. L.N.: Charpate Arari*

*Exsiccatae:* Animesh & AP Das 427, dated 17. 05. 2010.

Trees; lamina lanceolate, elliptic, or ovate, entire, acuminate, base rounded or obliquely cuneate; inflorescences axillary, cymose panicles in male plants; flowers whitish; drupe ovoid.

**Local distribution:** Core areas of forest.

*Garuga floribunda* var. *gamblei* (King ex W.W. Smith) Kalkman, *Blumea* 7: 466. 1953. *Garuga gamblei* King ex Smith, *Rec. Bot. Surv. India* 4: 262. 1911. L.N.: *Dabdabe*

**Exsiccatae:** *Animesh & AP Das* 369, dated 10. 02. 2010.

Deciduous trees; lamina elliptic or oblong-lanceolate, serrate, acuminate, base rounded, oblique, membranous or papery; panicles lateral or axillary towards the end of branches; petals ovate, pale yellow; fruit nearly globose.

**Local distribution:** Core areas of forest.

*Garuga pinnata* Roxburgh, *Pl. Coromandel* 3: 5. 1811. L.N.: *Dabdabe*

**Exsiccatae:** *Animesh & AP Das* 483, dated 26. 09. 2010.

Deciduous trees; bark gray-brown, rough; leaves with 9-23 leaflets, pubescent with long hairs when young; lamina spoon-shaped or linear, sparsely serrate, usually narrowly acuminate, base rounded, sometimes obliquely cuneate; panicles lateral or axillary towards the end of branches; petals elliptic, yellow; fruit globose, yellow when ripe.

**Local distribution:** Core areas of forest.

## CANNABACEAE

*Celtis tetrandra* Roxburgh, *Fl. Ind.* 2: 63. 1824. L.N.: *Khari*

**Exsiccatae:** *Animesh & AP Das* 317, dated 07. 02. 2010.

Small, deciduous trees; bark grayish white; lamina ovate-elliptic, ovate-lanceolate, entire or obtusely serrate, teeth 0-13 on each side, acuminate to shortly caudate-acuminate, base oblique with one side  $\pm$  rounded and other cuneate; flowers fascicled, occasionally in racemes of 2 or 3-flowers; petals whitish; drupe yellow to orange when mature.

**Local distribution:** Hill slope and core areas of forest.

*Celtis timorensis* Spanoghe, *Linnaea* 15: 343. 1841.

**Exsiccatae:** *Animesh & AP Das* 509, dated 28. 09. 2010.

Small, deciduous trees; margin entire or weakly serrate above middle and with 15 low rounded teeth on each side, acuminate to caudate-acuminate; cymes branched, 8–12 flowered, monoecious; petals whitish; drupe yellow, becoming red to orange-red when mature, broadly ovoid.

**Local distribution:** Hill slope and core areas of forest.

*Trema politoria* (Planchon) Blume, *Mus. Bot.* 2: 58. 1856. *Sponia politoria* Planchon, *Ann. Sci. Nat.* 10: 326. 1848. L.N.: *Bhale Khanyo*

**Exsiccatae:** *Animesh & AP Das* 523, dated 29. 09. 2010.

Small, deciduous trees; lamina lanceolate, denticulate, acuminate to acute, base cordate and oblique, leathery and fragile, abaxially grayish white to grayish green when dry; cymes axillary; flowers unisexual or polygamous, shortly pedicellate, whitish; drupes black when mature, globose to ovoid-globose, compressed.

**Local distribution:** Hill slope and core areas of forest.

## CAPPARACEAE

*Capparis acutifolia* Sweet, *Hort. Brit. ed.* 2: 585. 1830. L.N.: *Daringpate*

**Exsiccatae:** *Animesh & AP Das* 160, dated 07. 02. 2009.

Large shrubs, braches weak; twigs pale yellowish green when dry, terete, spineless or sometimes with straight or ascending stipular spines; lamina oblong-lanceolate to ovate-lanceolate, rounded acute to acuminate, base cuneate to sometimes; racemes axillary or terminal; flower buds oblong; flowers white; fruit red, subglobose.

**Local distribution:** River side forests.

*Crateva religiosa* G. Forster, *Fl. Ins. Austr.* 35. 1786. L.N.: *Chipley*

**Exsiccatae:** *Animesh & AP Das* 193, dated 11. 05. 2009.

Small trees; twigs light greenish to yellowish green when dried, with gray elongated lenticels; lamina as long as wide, acuminate to abruptly acuminate, thin and leathery; flowers in racemes or corymbs, open as leaves emerge, white; fruit surface lenticellate.

**Local distribution:** River side forests.

*Stixis suaveolens* (Roxburgh) Pierre, *Bull. Mens. Soc. Linn. Paris* 1: 654. 1887. *Roydsia suaveolens* Roxburgh, *Pl. Coromandel* 3: 87. 1819.

**Exsiccatae:** Animesh & AP Das 366, dated 10. 02. 2010.

Woody vines, stout, terete; lamina elliptic, oblong, or oblong-lanceolate, nearly rounded, base cuneate to nearly rounded, leathery; racemes axillary, or sometimes forming panicles; flowers yellowish; fruit orange when mature, ellipsoid.

**Local distribution:** Core areas of forest.

#### CARYOPHYLLACEAE

*Drymaria cordata* subsp. *diandra* (Blume) J.A. Duke, *Ann. Missouri Bot. Gard.* 48: 253. 1961.

*Drymaria diandra* Blume, *Bijdr.* 62. 1825. L.N.: *Halmale saag*

**Exsiccatae:** Animesh & AP Das 258, dated 19. 09. 2009.

Annual diffuse herbs; stems straggling; lamina ovate-cordate, prominently 3—5-veined from base; cymes terminal; flowers white; capsule ovoid.

**Local distribution:** River valley.

*Stellaria media* (Linnaeus) Villars, *Hist. Pl. Dauphiné* 3: 615. 1789. *Alsine media* Linnaeus, *Sp. Pl.* 1: 272. 1753. L.N.: *Aalujhaar*

**Exsiccatae:** Animesh & AP Das 396, dated 15. 05. 2010.

Annual diffuse herbs; stems decumbent or ascending; basal leaves long petiolate, distal leaves sessile or shortly petiolate; lamina broadly ovate to ovate-orbicular, acuminate or acute; flowers in terminal or axillary cymes, white; capsule ovoid, slightly longer than persistent sepals.

**Local distribution:** River valley.

#### CHLORANTHACEAE

*Chloranthus elatior* Link, *Enum. Hort. Berol. Alt.* 1: 140. 1821. L.N.: *Jnuka dabai*

**Exsiccatae:** Animesh & AP Das 451, dated 25. 09. 2010.

Subshrubs; spikes terminal, dichotomously or racemosely branched; lamina broadly elliptic or obovate to long obovate or oblanceolate, serrate, gradually narrowed to caudate, base cuneate; flowers white; fruit green when young, white at maturity, obovoid.

**Local distribution:** Throughout the shaded forest floor.

#### CLEOMACEAE

*Cleome ruidosperma* de Candolle, *Prodr.* 1: 241. 1824.

**Exsiccatae:** Animesh & AP Das 510, dated 28. 09. 2010.

Annual herbs, stems branched often with decumbent branches; leaflets 3; leaflet blades oblanceolate to rhomboid-elliptic, entire or serrulate-ciliate, acute; racemes terminal, 3-6 flowered or axillary-solitary; flowers pinkish; capsule striate.

**Local distribution:** Road side areas.

#### COMBRETACEAE

*Combretum nanum* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal.* 219. 1825. L.N.: *Aiselu Lahara*

**Exsiccatae:** Animesh & AP Das 174, dated 11. 05. 2009.

Evergreen liana, profusely weak branched; lamina lanceolate, ovate-lanceolate, or narrowly elliptic, abruptly caudate, cauda with rounded or obtuse tip, base obtuse-rounded; racemes terminal or axillary; bracts leafy, petaloid, white.

**Local distribution:** River side forests.

*Terminalia bellirica* (Gaertner) Roxburgh, *Pl. Coromandel* 2: 54. 1805. *Myrobalanus bellirica* Gaertner, *Fruct. Sem. Pl.* 2: 90. 1790. L.N.: *Barra*

**Exsiccatae:** *Animesh & AP Das 534*, dated 29. 09. 2010.

Large semi-evergreen trees; bark gray, longitudinally ridged; leaves spiraled, crowded into pseudowhorls at apices of branchlets; lamina glossy, obovate, obtuse or mucronate, base obtuse-rounded or attenuate; spikes axillary, simple; flowers yellowish; fruit shortly stipitate, subglobose to broadly ellipsoid or ovoid.

**Local distribution:** Throughout the forests.

***Terminalia catappa*** Linnaeus, *Mant. Pl.* 128. 1767. L.N.: *Pakasnaj*

**Exsiccatae:** *Animesh & AP Das 416*, dated 16. 05. 2010.

Large deciduous trees; bark brownish black, longitudinally peeling. leaves alternate, crowded into pseudowhorls at apices of branchlets; lamina obovate to oblanceolate, obtuse or mucronate, base narrow, cordate or truncate; spikes axillary, simple, slender; flowers greenish white; fruit not stipitate, ellipsoid, slightly to strongly compressed.

**Local distribution:** Core areas of forest.

***Terminalia chebula*** Retzius, *Observ. Bot.* 5: 31. 1788. L.N.: *Harra*

**Exsiccatae:** *Animesh & AP Das 359*, dated 09. 02. 2010.

Large deciduous trees; bark grayish black to gray, coarsely split and thick; leaves alternate or subopposite; lamina elliptic, mucronate, base obtuse-rounded or cuneate, oblique; spikes axillary or terminal, simple; flowers yellowish; fruit ovoid or ellipsoid.

**Local distribution:** Core areas of forest.

***Terminalia myriocarpa*** Van Heurck & Müller Argoviensis, *Observ. Bot.* 215. 1871. L.N.: *Panisanj*

**Exsiccatae:** *Animesh & AP Das 293*, dated 21. 09. 2009.

Large deciduous trees; trunk with buttresses; leaves opposite; lamina oblong-elliptic or oblong-lanceolate, entire or slightly undulate, rarely conspicuously toothed, apex with short, oblique tip, base obtuse; spikes simple or compound, terminal or axillary; flowers greenish; fruit yellowish when dry.

**Local distribution:** Core areas of forest.

## CONVOLVULACEAE

***Argyrea roxburghii*** (Wallich) Arnott ex Choisy, *Mém. Soc. Phys. Genève* 6: 419. 1833. *Convolvulus roxburghii* Wallich, *Numer. List n.* 1415. 1829. L.N.: *Putus Lahara*

**Exsiccatae:** *Animesh & AP Das 081*, dated 18. 01. 2009.

Large suffrutescent climbers, stems densely appressed-pubescent; lamina broadly ovate, entire, abruptly caudate-acuminate, base shallowly cordate; flowers in axillary clusters, pink; fruits globose, yellow.

**Local distribution:** Throughout the forests.

***Evolvulus nummularius*** (Linnaeus) Linnaeus, *Sp. Pl. (ed. 2)* 1: 391. 1762. *Convolvulus nummularius* Linnaeus, *Sp. Pl.* 1: 157. 1753.

**Exsiccatae:** *Animesh & AP Das 097*, dated 19. 01. 2009.

Creeping perennial herb, rooting at nodes, prostrate; leaves distichous; lamina nearly circular, rounded or emarginate, base cordate to rounded; peduncle absent or very short; flowers leaf axils, white; capsule globose.

**Local distribution:** Road side areas.

***Ipomoea batatas*** (Linnaeus) H.J. Lam, *Tabl. Encycl.* 1: 465. 1793. *Convolvulus batatas* Linnaeus, *Sp. Pl.* 1: 154. 1753.

**Exsiccatae:** *Animesh & AP Das 085*, dated 19. 01. 2009.

Scandent or prostrate annual, stems with hairs and bristles; lamina broadly ovate to circular, entire or palmately 3-5 lobed cymes axillary; flowers purplish; capsule rarely produced, ovoid or depressed globose.

**Local distribution:** River valley.

*Ipomoea nil* (Linnaeus) Roth, *Catal. Bot. 1*: 36. 1797. *Convolvulus nil* Linnaeus, *Sp. Pl. ed. 2. 1*: 219. 1762.

**Exsiccatae:** Animesh & AP Das 440, dated 25. 09. 2010.

Herbaceous annual twiner; stem shortly hairy and with long bristles; lamina broadly ovate or nearly circular, entire, acuminate, base cordate; racemose heads axillary, corolla with blue limb and white tube; capsule straw colored, ovoid.

**Local distribution:** River valley.

*Merremia hirta* (Linnaeus) Merrill, *Philipp. J. Sci. 7*: 224. 1912. *Convolvulus hirtus* Linnaeus, *Sp. Pl. 1*: 159. 1753.

**Exsiccatae:** Animesh & AP Das 385, dated 14. 05. 2010.

Twining or prostrate herbs; stems rooting at nodes or internodes; lamina linear, oblong-lanceolate, ovate-oblong, or ovate, entire, obtuse, acute or slightly emarginate and mucronulate, base truncate, rounded; nodes rooting; stem slender, hirsute to glabrous; inflorescence axillary; flowers white; capsule broadly ovoid to globose.

**Local distribution:** River valley.

*Merremia vitifolia* (Burman f.) Hallier f., *Bot. Jahrb. Syst. 16(4-5)*: 552. 1893. *Convolvulus vitifolius* N. L. Burman, *Fl. Indica 45*. 1768.

**Exsiccatae:** Animesh & AP Das 064, dated 18. 01. 2009.

Large twiner or creeper, stem stout with yellowish hairs; lamina circular in outline, coarsely serrate or subentire, acuminate to obtuse, base cordate, palmately angled or lobed; cymes axillary, compact; corolla yellow; capsule straw colored, globose, papery.

**Local distribution:** Throughout the forests.

#### CORNACEAE

*Alangium chinense* (Loureiro) Harms, *Ber. Deutsch. Bot. Ges. 15*: 24. 1897. *Stylidium chinense* Loureiro, *Fl. Cochinch. 1*: 221. 1790. **L.N.:** Akhane

**Exsiccatae:** Animesh & AP Das 181, dated 11. 05. 2009.

Small trees, branchlets pubescent; lamina ovate or orbicular to cordate, entire or with few shallow lobes, acuminate, base usually oblique, occasionally rounded; cymes axillary, few-flowered; flowers greenish white; drupe ovoid.

**Local distribution:** Stream side hill slopes.

#### CUCURBITACEAE

*Diplocyclos palmatus* (Linnaeus) C. Jeffrey, *Kew Bull. 15*: 352. 1962. *Bryonia palmata* Linnaeus, *Sp. Pl. 2*: 1012. 1753.

**Exsiccatae:** Animesh & AP Das 330, dated 07. 02. 2010.

Annual climbing herb; stems slender; lamina ovate, acuminate or obtuse, palmately 5-lobed, membranous; root tuberous; stem slender; flowers white in axillary fascicles; fruit yellow-green to red, narrowly white striped, globose, indehiscent.

**Local distribution:** River side forests.

*Luffa cylindrica* (Linnaeus) M. Roemer, *Fam. Nat. Syn. Monogr. 2*: 63. 1846. *Momordica cylindrica* Linnaeus, *Sp. Pl. 1009*. 1753. **L.N.:** Dhundul

**Exsiccatae:** Animesh & AP Das 320, dated 07. 02. 2010.

Climber, stem glabrous; lamina triangular or suborbicular, dentate, acute or acuminate, base deeply cordate; flowers axillary cluster; petals white; fruit cylindrical, straight or slightly curved, smooth, ecostate, inside strongly fibrous when mature.

**Local distribution:** River side forests.

*Mukia maderaspatana* (Linnaeus) M. Roemer, *Fam. Nat. Syn. Monogr. 2*: 47. 1846. *Cucumis maderaspatanus* Linnaeus, *Sp. Pl. 2*: 1012. 1753. **L.N.:** Kundri



**Exsiccatae:** Animesh & AP Das 246, dated 19. 09. 2009.

Annual climbers; stems many branched, robust, sulcate; lamina somewhat rigid, ovate or ovate-cordate, irregularly denticulate, slightly obtuse, base cordate; flowers in axillary cluster; petals white; berries spherical red.

**Local distribution:** open river valley areas.

#### DILLENACEAE

**Dillenia indica** Linnaeus, *Sp. Pl.* 535. 1753. L.N.: *Chalta*

**Exsiccatae:** Animesh & AP Das 424, dated 16. 05. 2010.

Evergreen trees; bark reddish brown, exfoliating; lamina oblong or obovate-oblong, serrate, acute; flowers solitary, axillary; sepals thickly accrescent; petals white; aggregate fruit globose, indehiscent.

**Local distribution:** Core areas of forest.

**Dillenia pentagyna** Roxburgh, *Pl. Coromandel 1: 21.* 1795. L.N.: *Tartari*

**Exsiccatae:** Animesh & AP Das 302, dated 22. 09. 2009.

Large deciduous trees; bark smooth, gray, exfoliating; leaf blade oblong to obovate-oblong, margin with shallowly undulate teeth, acute, leathery; flowers 2-7 in fascicles from the top of lateral spurs, small; sepals accrescent, reddish yellow; pseudocarp indehiscent.

**Local distribution:** Core areas of forest.

#### DIPTEROCARPACEAE

**Shorea robusta** Gaertner, *Suppl. Carp.* 48. 1805. L.N.: *Sal*

**Exsiccatae:** Animesh & AP Das 225, dated 14. 05. 2009.

Large deciduous trees, crown spreading; bark gray to dark reddish brown, becoming fissured and flaky; lamina ovate to oblong, acuminate, base obtuse to cordate, thinly leathery; flowers subsessile, on spreading racemose panicles; flowers yellowish; fruit sepals unequal, spatulate.

**Local distribution:** Core areas of forest.

#### ELAEOCARPACEAE

**Elaeocarpus floribundus** Blume, *Bijdr.* 120. 1825. L.N.: *Jalpai*

**Exsiccatae:** Animesh & AP Das 522, dated 29. 09. 2010.

Large trees, crown spreading; broadly lanceolate-ovate, ovate, oblong, or elliptic, shallowly crenate, acuminate, acumen obtuse, base attenuate and decurrent; racemes axillary or terminal; flowers bisexual; petals fringed, white; drupe spindleshaped, pointed at both ends.

**Local distribution:** Core areas of forest.

**Elaeocarpus varunua** Buchanan-Hamilton *ex* Masters, *Fl. Brit. India 1: 407.* 1874. L.N.: *Bhadrase*

**Exsiccatae:** Animesh & AP Das 457, dated 25. 09. 2010.

Large trees; branchlets sparsely gray puberulent; lamina elliptic to oblong, entire or slightly crenate, acute, with obtuse acumen, base rounded or obtuse, membranous; racemes in axils of current and fallen leaves; petals fringed, white; drupe ellipsoid.

**Local distribution:** Hill forest areas.

#### EUPHORBIACEAE

**Balakata baccata** (Roxburgh) H.J. Esser, *Blumea 44: 155.* 1999. *Sapium baccatum* Roxburgh, *Fl. Ind.*, ed. 1832, 3: 694. 1832. L.N.: *Akhataru*

**Exsiccatae:** Animesh & AP Das 342, dated 08. 02. 2010.

Evergreen trees, glabrous; branchlets usually in whorls; lamina ovate or long ovate, rarely elliptic, entire, acuminate, base acute to obtuse, rarely attenuate or cordate; flowers yellowish in raceme-like terminal whorls or in leaf axils, male at upper part, female at base; fruits baccate.

**Local distribution:** Core areas of forest.

**Baliospermum solanifolium** (Burman) Suresh, *Interpret. Rheede's Hort. Malab.* 106. 1988. *Croton solanifolius* Burman, *Fl. Malab.* 6. 1769. L.N.: *Khasrey*

**Exsiccatae:** *Animesh & AP Das 101*, dated 19. 01. 2009.

Sub-shrubs; young branches green; lamina elliptic, oblong, or oblanceolate, subentire or sparsely serrulate to undulate-crenulate, obtuse or acute, base rounded to broadly cuneate; panicles axillary, male narrow, female flowers, axillary or at base of male inflorescences; flowers greenish; capsule pendulous, subglobose.

**Local distribution:** Hill forest areas.

***Cleidion javanicum*** Blume, *Bijdr. 613. 1826. L.N.: Bepari*

**Exsiccatae:** *Animesh & AP Das 090*, dated 19. 01. 2009.

Small trees; lamina elliptic to oblong-lanceolate or ovate, sinuate-toothed or subentire, acute or acuminate, base obtuse or cuneate, thinly leathery; female inflorescences frequently 1-flowered; flowers yellowish; capsule 2-lobed, smooth.

**Local distribution:** Hill forest areas.

***Croton tiglium*** Linnaeus, *Sp. Pl. 1004. 1753.*

**Exsiccatae:** *Animesh & AP Das 219*, dated 14. 05. 2009.

Trees; young branches green, sparsely stellate-hairy, glabrous at maturity; lamina ovate, ovate-elliptic, or ovate-lanceolate, serrulate or subentire, acute or acuminate, base broadly cuneate, rarely slightly cordate, with discoid glands, papery; racemes axillary or terminal; male flower buds subglobose, female flowers oblong-lanceolate, whitish; capsules ellipsoidal, oblong-ovoid, or subglobose.

**Local distribution:** Hill forest areas.

***Macaranga denticulata*** (Blume) Müller Argoviensis, *Prodr. 15(2): 1000. 1866. Mappa denticulata* Blume, *Bijdr. 625. 1826. L.N.: Joksa*

**Exsiccatae:** *Animesh & AP Das 282*, dated 21. 09. 2009.

Small trees, much branched, ferruginous or yellowish brown tomentose when young; lamina broadly ovate, repand or subentire, cuspidate-acuminate, palmately 7-9-veined, base obtuse or subtruncate, narrowly peltate, thinly leathery; panicle branches raceme-like, erect, spreading, female flowers solitary; flowers greenish; capsule 2-lobed, densely glandular-scaly.

**Local distribution:** Forest margins.

***Macaranga indica*** Wight, *Icon. Pl. Ind. Orient. 5: t. 1883. 1852. L.N.: Maledo*

**Exsiccatae:** *Animesh & AP Das 033*, dated 17. 01. 2009.

Small trees, branchlets stout, zigzag; lamina ovate-orbicular, serrulate, acuminate, base rounded and broadly peltate, with glands; male flowers many per bract, female inflorescences branched; flowers greenish; capsule globose, sparsely glandular-scaly.

**Local distribution:** Forest margins.

***Mallotus philippensis*** (H.J. Lam) Müller Argoviensis, *Linnaea 34: 196. 1865. Croton philippensis* Lamarck, *Encycl. 2: 206. 1786. L.N.: Sindure*

**Exsiccatae:** *Animesh & AP Das 083*, dated 19. 01. 2009.

Small trees; lamina ovate to lanceolate, subentire, acuminate, base cuneate or obtuse, with 2-4 basal glands; panicle branches raceme-like, erect, axillary or terminal; flowers yellow-brownish stellate-tomentose; fruits red; capsule subglobose, covered with a red glandular-scaly layer.

**Local distribution:** Throughout the forests.

***Mallotus polycarpus*** (Benth) Kulju & Welzen, *Blumea 52: 130. 2007. Trewia polycarpa* Benth, *Gen. Pl. 3: 318. 1880. L.N.: Pithali*

**Exsiccatae:** *Animesh & AP Das 150*, dated 06. 02. 2009.

Dioecious trees; leaves opposite, ovate; lamina entire, acuminate; flowers in racemes, appearing with the leaves, dioecious; berry ovoid and fleshy, depressed globose, greyish-green, outer shell thin, splitting.

**Local distribution:** River side forests.

*Tragia involucrata* Linnaeus, *Sp. Pl.* 980. 1753.

**Exsiccatae:** *Animesh & AP Das 036*, dated 17. 01. 2009.

Herbaceous vines; lamina cuneate-obovate or elliptic to broadly lanceolate, serrulate, acuminate, base obtuse or slightly cordate, papery or membranous, adaxially villous, abaxially tomentose; male racemes at axillary or branch tip; flowers greenish.

**Local distribution:** Core areas of forest.

## FABACEAE

*Abrus precatorius* Linnaeus, *Syst. Nat.*, ed. 12, 2: 472. 1767.

**Exsiccatae:** *Animesh & AP Das 143*, dated 06. 02. 2009.

Much branched shrubby climber; leaves pinnate, leaflets oblong; racemes axillary; flowers small, pink; legumes oblong, leathery.

**Local distribution:** Road side forest areas on bushes.

*Abrus pulchellus* Wallich *ex* Thwaites, *Enum. Pl. Zeyl.* 91. 1859.

**Exsiccatae:** *Animesh & AP Das 159*, dated 07. 02. 2009.

Much branched shrubby climber; leaves pinnate, leaflets oblong; racemes axillary; flowers pink; legumes ob-long, densely white hairy.

**Local distribution:** Road side forest areas on bushes.

*Acacia catechu* (Linnaeus *f.*) Willdenow, *Sp. Pl.* 4: 1079.1806. *Mimosa catechu* Linnaeus *f.*, *Suppl. Pl.* 439. 1782. L.N.: *Khair*

**Exsiccatae:** *Animesh & AP Das 103*, dated 19. 01. 2009.

Medium trees, shoots with paired stipular spines; leaflets 20-50 pairs, linear; spikes solitary, axillary; flowers yellowish; legume brown, straight, strap-shaped, nitid.

**Local distribution:** River valley.

*Acacia concinna* (Willdenow) de Candolle, *Prodr.* 2: 464.1825. *Mimosa concinna* Willdenow, *Sp. Pl.* 4: 1039. 1806. L.N.: *Sikakai*

**Exsiccatae:** *Animesh & AP Das 068*, dated 18. 01. 2009.

Woody climber, profusely branched with recurved prickles; leaflets 15-25 pairs, linear-oblong, ciliate, obtuse, membranous; heads in terminal panicles; flowers yellow; legume brown, strap-shaped, fleshy, with wrinkled surfaces.

**Local distribution:** Hill slopes and core forest areas.

*Acacia pennata* (Linnaeus) Willdenow, *Sp. Pl.* 4: 1090.1806. *Mimosa pennata* Linnaeus, *Sp. Pl.* 1: 522.1753. L.N.: *Ararekanra*

**Exsiccatae:** *Animesh & AP Das 129*, dated 05. 02. 2009.

Liana, shoots with scattered recurved prickles; leaflets 30-54 pairs, densely crowded, linear, ciliate, sharply acute, base truncate; heads in terminal panicle; flowers yellow; legume strap-shaped.

**Local distribution:** Stream side hill slopes.

*Acrocarpus fraxinifolius* Arnott, *Mag. Zool. Bot.* 2: 547.1838. L.N.: *Mandane*

**Exsiccatae:** *Animesh & AP Das 244*, dated 19. 09. 2009.

Trees; leaves at apices of branches pinnate, entire, acuminate or acute, base slightly oblique, broadly cuneate or rounded, subleathery; racemes axillary, densely flowered; flowers pink; legume purplish brown, flat, narrowly winged along ventral suture.

**Local distribution:** Hill forest areas.

*Adenanthera microsperma* Teijsmann & Binnendijk, *Natuurk. Tijdschr. Ned.-Indie* 27: 58. 1864.

**Exsiccatae:** *Animesh & AP Das 117*, dated 20. 01. 2009.

Trees, deciduous; leaflets 4-7 pairs, alternate, oblong or ovate, both ends rounded-obtuse; racemes simple, axillary or arranged in panicles at apices of branchlets; flowers white; legume narrow-oblong.

**Local distribution:** Stream side forests.

*Aganope polystachya* (Benth) Thothathri & D.N. Das, Rheedea 2(1): 63. 1992. *Derris polystachya* Benth, J. Proc. Linn. Soc., Bot. 4(Suppl.): 114. 1860. L.N.: *Hanumane Lahara*

**Exsiccatae:** *Animesh & AP Das 238*, dated 19. 09. 2009.

Liana or scandent shrubs; leaf imparipinnate, lamina oblong or obovate-oblong, obtuse or acute; pseudopanicles axillary or terminal; flowers whitish; pods glabrous, narrowed.

**Local distribution:** Core areas of forest.

*Albizia chinensis* (Osbeck) Merrill, Amer. J. Bot. 3: 575. 1916. *Mimosa chinensis* Osbeck, Dagb. Ostind. Resa, 233. 1757. L.N.: *Siris*

**Exsiccatae:** *Animesh & AP Das 425*, dated 17. 05. 2010.

Trees; branchlets yellow pubescent; leaflets 20-35 pairs, sessile, oblong-linear, falcate, margin ciliate, acuminate, base subtruncate; heads in axillary or terminal panicles; flowers yellowish white; legume indehiscent, or irregularly breaking up, plano-compressed.

**Local distribution:** Road side forests.

*Albizia lebbeck* (Linnaeus) Benth, London J. Bot. 3: 87. 1844. *Mimosa lebbeck* Linnaeus, Sp. Pl. 1: 516. 1753. L.N.: *Kalo Siris*

**Exsiccatae:** *Animesh & AP Das 360*, dated 09. 02. 2010.

Trees, bark rough, deciduous; leaflets 4-8 pairs, narrowly elliptic or slightly obliquely oblong, obtuse or retuse; heads solitary, axillary; flowers dimorphic, greenish-yellow; legume straw-colored, strap-shaped, flat, remaining on trees long after ripening.

**Local distribution:** Core areas of forest.

*Albizia lucidior* (Steudel) I.C. Nielsen ex H. Hara, Enum. Fl. Pl. Nepal 2: 104. 1979. *Inga lucidior* Steudel, Nomencl. Bot., ed. 2, 1: 810. 1840. L.N.: *Patpate Siris*

**Exsiccatae:** *Animesh & AP Das 067*, dated 18. 01. 2009.

Trees; branchlets glabrous, angulate; leaflets 1-6 pairs, elliptic, oblong, or obliquely obovate, acute, acuminate, or obtuse, base attenuate to subrounded; heads in terminal panicle; flowers yellowish; legume dehiscent, brownish, straight, ligulate.

**Local distribution:** Road side forest areas.

*Albizia procera* (Roxburgh) Benth, London J. Bot. 3: 89. 1844. *Mimosa procera* Roxburgh, Pl. Coromandel 2: 12. 1799.

**Exsiccatae:** *Animesh & AP Das 420*, dated 16. 05. 2010.

Trees; branchlets slightly pubescent or subglabrous; leaflets 6-12 pairs, ovate to subrhombic, obtuse or emarginate, base oblique, subleathery; heads in elongated terminal panicle; flowers yellowish white; legume ligulate, flat.

**Local distribution:** Core areas of forest.

*Bauhinia acuminata* Linnaeus, Sp. Pl. 1: 376. 1753. L.N.: *Tanki*

**Exsiccatae:** *Animesh & AP Das 274*, dated 20. 09. 2009.

Shrubs, young branches zigzag; leaf blade ovate-cordate to cordate, apex bifid to 1/3-2/5, lobes acuminate or slightly acute at apex or rarely rounded, base cordate, subleathery; flowers axillary, solitary, white; legume straight or slightly curved, linear-oblongate, compressed.

**Local distribution:** Rare; throughout the forests.

*Bauhinia purpurea* Linnaeus, Sp. Pl. 1: 375. 1753. L.N.: *Tanki*

**Exsiccatae:** *Animesh & AP Das 506*, dated 28. 09. 2010.

Deciduous trees; branches puberulent when young; lamina suborbicular, apex bifid to 1/3-1/2, lobes slightly acute or rarely rounded at apex, base shallowly cordate, stiffly papery; very short reduced racemes from leafless axiles and branch-tips; flower pink; legume linear, flat.

**Local distribution:** Road side forests.

*Bauhinia scandens* Linnaeus, Sp. Pl. 1: 374. 1753. L.N.: *Nagfeni lahara*

*Exsiccatae:* *Animesh & AP Das 446*, dated 25. 09. 2010.

Large woody liana; branches cylindric when young, ap-planate when old; lamina ovate to broadly ovate, entire on flowering branches, bifid to more than 1/2 in sterile or juvenile branches, lobes with obtuse or acuminate apices, base shallowly cordate to truncate, papery; racemes elongated, many flowered; petals white; legume rhombic to oblong, indehiscent or tardily dehiscent.

**Local distribution:** Core forest areas.

*Bauhinia variegata* Linnaeus, Sp. Pl. 1: 375. 1753. L.N.: *Koiralo*

*Exsiccatae:* *Animesh & AP Das 091*, dated 19. 01. 2009.

Deciduous trees; branches gray puberulent when young; lamina suborbicular or broadly ovate, bifid to 1/3, lobes rounded at apex, base shallowly to deeply cordate, subleathery; racemes small, few flowered, sometimes corymblike; petals white; legume linear, flat.

**Local distribution:** Road side forests.

*Bauhinia vahlii* Wight & Arnott, Prodr. Fl. Ind. Orient. 1: 297. 1834.

*Exsiccatae:* *Animesh & AP Das 305*, dated 22. 09. 2009.

Large liana; tendrils circinate, usually opposite the leaves; lamina orbicular, lobed at the apex, cordate at the base; many flowers corymbs; flower white; pods thickly tomentose; pod woody, dehiscent, rusty velvety.

**Local distribution:** River valley.

*Caesalpinia cucullata* Roxburgh, Fl. Ind., ed. 1832, 2: 358. 1832.

*Exsiccatae:* *Animesh & AP Das 392*, dated 15. 05. 2010; *186*, dated 11. 05. 2009.

Climbers, with recurved prickles; leaf rachis 20-40 cm; leaflets 3-6 pairs, acuminate, base broadly cuneate or obtuse-rounded, leathery; racemes long, spreading; flowers yellow; pods thin, broad.

**Local distribution:** Throughout the forests.

*Cassia fistula* Linnaeus, Sp. Pl. 1: 377. 1753. L.N.: *Sonalu, Bandarjhola*

*Exsiccatae:* *Animesh & AP Das 166*, dated 07. 02. 2009.

Small trees, deciduous; leaves in 3 or 4 pairs of leaflets; leaflets broadly ovate or ovate-oblong, acute, base broadly cuneate, leathery; racemes axillary, pendulous, many flowered; flowers golden yellow; legume pendulous, blackish brown, terete, sausage-shaped, indehiscent.

**Local distribution:** Road side forests.

*Codoriocalyx motorius* (Houttuyn) H. Ohashi, J. Jap. Bot. 40: 367. 1965. *Hedysarum motorium* Houttuyn, Nat. Hist. 10: 246. 1779. L.N.: *Mohoni jhaar*

*Exsiccatae:* *Animesh & AP Das 218*, dated 14. 05. 2009.

Shrubs; stem simple or branched; leaves 3-foliolate, often 1-foliolate by reduction of lateral leaflets; terminal leaflet blade narrowly elliptic or lanceolate, lateral ones when present narrowly elliptic or linear, very small; panicles terminal, lax, many flowered; flowers purplish red; legume falcate or straight.

**Local distribution:** River valley.

*Crotalaria alata* Buchanan-Hamilton ex D. Don, Prodr. Fl. Nepal. 241. 1825.

*Exsiccatae:* *Animesh & AP Das 308*, dated 22. 09. 2009.

Small much branched, zigzag, erect, annual herbs; leaves simple, nearly sessile; lamina elliptic to obovate-elliptic, obtuse and mucronate, base attenuate to cuneate; racemes terminal or leaf-opposed; flowers

yellow; fruits turn black on ripening; legume oblong.

**Local distribution:** Road side forest areas.

*Crotalaria pallida* Aiton, Hort. Kew. 3: 20. 1789. L.N.: *Sanai Phool*

**Exsiccatae:** *Animesh & AP Das 528*, dated 29. 09. 2010.

Tall much-branched annual or biannual herbs; leaves 3-foliolate; leaflet oblong to elliptic, obtuse to retuse, base broadly cuneate; flowers yellow in long racemes; legume oblong.

**Local distribution:** Road side areas.

*Dalbergia stipulacea* Roxburgh, Fl. Ind., ed. 1832, 3: 233.1832. L.N.: *Siris Lahara*

**Exsiccatae:** *Animesh & AP Das 183*, dated 11. 05. 2009.

Scandent shrubs or sprawling tree; branches spreading; leaflets oblong to obovate-oblong, acute, ultimately rounded or obtuse, sometimes emarginated; flowers blue in panicles; legume broadly ligulate to ovoid or elliptic.

**Local distribution:** Throughout the forests.

*Derris robusta* (Roxburgh ex de Candolle) Benth, J. Proc. Linn. Soc., Bot. 4(Suppl.): 104. 1860.

*Dalbergia robusta* Roxburgh ex de Candolle, Prodr. 2: 417. 1825.

**Exsiccatae:** *Animesh & AP Das 294*, dated 21. 09. 2009.

Trees, deciduous; leaves 13-21-foliolate; obtuse and shortly cuspidate; elongated, rachis nodes with 2 or 3 fascicled flowers; flowers white; legume linear-oblong, flat.

**Local distribution:** Core areas of forest.

*Desmodium confertum* A.P. de Candolle, Ann. Sci. Nat. (Paris) 4: 101. 1825.

**Exsiccatae:** *Animesh & AP Das 270*, dated 20. 09. 2009.

Erect shrubs, less branched; leaf trifoliolate, orbicular, obtuse or acuminate; racemes slender, axillary and terminal; flowers pink; pods stipitate.

**Local distribution:** River valley.

*Desmodium gangeticum* (Linnaeus) A.P. de Candolle, Prodr. 2: 327. 1825. *Hedysarum gangeticum* Linnaeus, Sp. Pl. 2: 746. 1753. L.N.: *Badam*

**Exsiccatae:** *Animesh & AP Das 194*, dated 12. 05. 2009.

Annual or perennial herbs; less branched; leaves 1-foliolate, variable in shape and size; lamina narrowly elliptic-ovate, sometimes ovate or lanceolate, acute, base rounded; racemes slender, terminal; flowers pink; legume linear, slightly curved.

**Local distribution:** River valley.

*Entada phaseoloides* (Linnaeus) Merrill, Philipp. J. Sci., C, 9: 86. 1914. *Lens phaseoloides* Linnaeus, Herb. Amboin. 18. 1754. L.N.: *Pangra*

**Exsiccatae:** *Animesh & AP Das 343*, dated 08. 02. 2010.

Large woody climbers; stems often spirally twisted; leaflets 1 or 2 pairs, elliptic or narrowly obovate, obtuse, emarginate, base slightly oblique, leathery; spikes terminal, spreading; flowers yellowish; legume curved, flat.

**Local distribution:** Core areas of forest.

*Leucaena leucocephala* (Lamarck) de Wit, Taxon 10: 54. 1961. *Mimosa leucocephala* Lamarck, Encycl. 1: 12. 1783.

**Exsiccatae:** *Animesh & AP Das 141*, dated 06. 02. 2009.

Trees; branchlets pubescent; leaflets linear-oblong, ciliate, acute, base cuneate; heads usually 1 or 2, axillary; flowers white; legume straight, strap-shaped, flat.

**Local distribution:** River side forest areas.

*Mimosa himalayana* Gamble, Bull. Misc. Inform. Kew 4. 1920. L.N.: *Ararekanra*

**Exsiccatae:** *Animesh & AP Das 205*, dated 12. 05. 2009.

Scrambling shrubs, profusely branched; prickles present on nodes or inter nodes, straight or hooked; leaves pinnate, lamina broad, oblong, obtuse, mucronate, glabrous above; heads in axillary and terminal clusters; flowers pink; pods occasionally with prickles on the sutures, strap-shaped.

**Local distribution:** Along forest margins and stream side.

*Mimosa pudica* Linnaeus, Sp. Pl. 1: 518. 1753. L.N.: *Lajjaboti*

**Exsiccatae:** *Animesh & AP Das 326*, dated 07. 02. 2010.

Annual or perennial subshrubby herbs; stems densely hispid, prickly; leaflets linear-lanceolate, ciliate, acute, base rounded to slightly oblique; heads terminal or axillary; flowers pink; legumes arranged in a star, flat, oblong.

**Local distribution:** Road side areas.

*Mucuna pruriens* (Linnaeus) de Candolle, Prodr. 2: 405. 1825. *Dolichos pruriens* Linnaeus, Herb. Amboin. 23. 1754.

**Exsiccatae:** *Animesh & AP Das 383*, dated 14. 05. 2010.

Annual herbaceous twiner, stems silvery pubescent first; leaflets slender, straight or slightly curved, rounded, acute, base broadly cuneate to rounded, papery; racemes axillary, pendulous; flowers dark purple; pods thickly clothed with stinging hairs.

**Local distribution:** Stream side forests.

*Phaseolus vulgaris* Linnaeus, Sp. Pl. 2: 723. 1753.

**Exsiccatae:** *Animesh & AP Das 053*, dated 17. 01. 2009.

Annual twinning herbs; leaflets broadly ovate or obovate-rhombic, entire, acuminate, base rounded or broadly cuneate; racemes shorter than leaves, several at top of peduncle; flowers white; legumes linear-oblong, turgid.

**Local distribution:** Road side areas.

*Pongamia pinnata* (Linnaeus) Merrill, Interpr. Herb. Amboin. 271. 1917. *Cytisus pinnatus* Linnaeus, Sp. Pl. 2: 741. 1753. L.N.: *Bhale Neem*

**Exsiccatae:** *Animesh & AP Das 518*, dated 29. 09. 2010.

Trees, branchlets sometimes tomentose; leaves 5- or 7-foliolate; lamina ovate, broadly elliptic, or oblong, rounded to acuminate, base rounded, broadly cuneate, or truncate, leathery; racemes axillary, many flowered; flower pink; pods short, woody; seeds flat.

**Local distribution:** Core areas of forest.

*Pueraria phaseoloides* (Roxburgh) Benth, J. Linn. Soc., Bot. 9: 125. 1865. *Dolichos phaseoloides* Roxburgh, Fl. Ind., ed. 1832, 3: 316. 1832. L.N.: *Janglee Kalodal*

**Exsiccatae:** *Animesh & AP Das 096*, dated 19. 01. 2009.

Herbaceous twiner, stems and petioles spreading brown hirsute; leaflets broadly ovate, rhomboid, or ovate-rhomboid, entire or 3-lobed, base oblique; racemes axillary, flowers crowded at tips of peduncle; flowers purplish; fruits slender, terete, black on ripening.

**Local distribution:** Road side areas.

*Pueraria sikkimensis* Prain, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 66: 419. 1897. L.N.: *Gonfle*

**Exsiccatae:** *Animesh & AP Das 464*, dated 26. 09. 2010.

woody liana, profusely branched, branches twinning; lamina broadly ovate, acute or shortly acuminate, base rounded or truncate, sparsely pubescent; racemes axillary; flowers white, wing-petals dark blue.

**Local distribution:** Throughout the forests.

*Senna siamea* (Lamarck) H.S. Irwin & Barneby, Mem. New York Bot. Gard. 35: 98. 1982. *Cassia siamea* Lamarck, Encycl. 1: 648. 1785. L.N.: *Minjiri*

**Exsiccatae:** *Animesh & AP Das 014*, dated 17. 01. 2009.

Trees, young branches ribbed; leaflets oblong or ovate-oblong, obtusely rounded, mucronate, base rounded, leathery; racemes in axils of apical leaves, often several forming a large terminal panicle on a robust peduncle; flowers yellow; legume flat-tened, purplish brown when mature.

**Local distribution:** Road side plantations.

*Sesbania sesban* (Linnaeus) Merrill, Philipp. J. Sci., C, 7: 235. 1912. *Aeschynomene sesban* Linnaeus, Sp. Pl. 2: 714. 1753.

**Exsiccatae:** Animesh & AP Das 227, dated 14. 05. 2009.

Tall annual herbs, nodes conspicuously gibbous; leaves 20-40-foliolate; lamina oblong to linear, rounded to retuse and mucronate, base obliquely rounded; racemes 4-10 flowered; flowers white; legume subterete.

**Local distribution:** River valley.

*Spatholobus parviflorus* (A.P. de Candolle) Kuntze, Revis. Gen. Pl. 1: 205. 1891. *Butea parviflora* Roxburgh ex Candolle, Prodr. 2: 415. 1825. L.N.: *Debre Lahara*

**Exsiccatae:** Animesh & AP Das 275, dated 20. 09. 2009.

Shrubby climber to robust liana; leaflets obovate or broadly elliptic, obtuse or rounded, base rounded or slightly narrowed, leathery; flowers in crowded racemose clusters, pinkish white to red flowers; legumes falcate-oblong, thick, densely brownish velutinous.

**Local distribution:** Hill forest areas.

*Tamarindus indica* Linnaeus, Sp. Pl. 1: 34. 1753. L.N.: *Tentul*

**Exsiccatae:** Animesh & AP Das 011, dated 17. 01. 2009.

Huge spreading trees; leaflets ob-long, rounded or emarginate, base obliquely rounded; flowers in few flowered racemes, yellowish tinged with purplish red stripes; fruits terete with fleshy mesocarp.

**Local distribution:** Along the forest margins.

*Tephrosia candida* de Candolle, Prodr. 2: 249. 1825. L.N.: *Paniel*

**Exsiccatae:** Animesh & AP Das 142, dated 06. 02. 2009.

Small to large shrubs, stems ridged; leaves 17-25-foliolate; lamina oblong, entire, acute or mucronate, sometimes acuminate, base round to acute; pseudoracemes terminal or lateral; flowers white; legume linear, straight.

**Local distribution:** Marginal forest and stream side areas.

## FAGACEAE

*Castanopsis indica* (Roxburgh ex Lindley) Alphonse de Candolle, J. Bot. 1: 182. 1863. *Castanea indica* Roxburgh ex Lindley in Wallich, Pl. Asiat. Rar. 2: 5. 1830. L.N.: *Dalne Kattus*

**Exsiccatae:** Animesh & AP Das 015, dated 17. 01. 2009.

Large trees; lamina broadly elliptic, serrate except basally entire, mucronate to acuminate, base cuneate to rounded and usually inaequilateral, thickly papery; spikes paniculate, densely tomentose; cupules solitary, globose, thickly prickly, usually splits into 4 segments.

**Local distribution:** Hill forest areas.

*Castanopsis tribuloides* (Smith) Alphonse de Candolle, J. Bot. 1: 182. 1863. *Quercus tribuloides* Smith in Rees, Cycl. 29: *Quercus* no. 13. 1814. L.N.: *Kattus*

**Exsiccatae:** Animesh & AP Das 035, dated 17. 01. 2009.

Medium trees; lamina elliptic to ovate, margin entire or rarely with 1 or 2 teeth, acute, base acute to rounded; spikes slender at branch tips; cupules solitary, slender, thickly prickly.

**Local distribution:** Hill slope and Core areas of forest.

*Quercus obtusata* Bonpland, Pl. Aequinoct. 2: 26. 1809. L.N.: *Thulo Kattus*

**Exsiccatae:** Animesh & AP Das 060, dated 18. 01. 2009.



Evergreen trees; ovate-elliptic, elliptic to obovate-elliptic, serrate, acuminate, base cuneate to rounded and usually inaequilateral, thickly papery; female inflorescences axillary on young shoots; cupule half globose.

**Local distribution:** Hill forest areas.

#### GESNERIACEAE

*Rhynchotechum ellipticum* (Wallich ex D.F.N. Dietrich) A.P. de Candolle, *Prodr.* 9: 285. 1845.  
*Corysanthera elliptica* Wallich ex D.F.N. Dietrich, *Syn. Pl.* 3: 582. 1842. L.N.: *Mala phool*

**Exsiccatae:** Animesh & AP Das 009, dated 17. 01. 2009.

Undershrubs, stem occasionally sparingly branched; leaves opposite; lamina oblanceolate to obovate, denticulate to serrate, acute to acuminate, base cuneate to attenuate, rarely nearly rounded; cymes sparingly fascicled; flowers pink; berry white.

**Local distribution:** Road side bushes.

#### JUGLANDACEAE

*Engelhardtia spicata* Lechen ex Blume, *Bijdr.* 528. 1826. L.N.: *Mewa*

**Exsiccatae:** Animesh & AP Das 098, dated 19. 01. 2009.

Trees, deciduous; lamina elliptic, elliptic-lanceolate, or elliptic-ovate, shortly acuminate, base broadly cuneate. spikes pendulous, males lateral and females central; flowers yellowish; nutlets globose or ovoid, 3 winged.

**Local distribution:** Hill forest areas.

#### LAMIACEAE

*Achyrospermum wallichianum* (Bentham) Bentham ex Hooker f., *Fl. Brit. India* 4: 673. 1885. *Teucrium wallichianum* Bentham, *Pl. Asiat. Rar.* 2: 19. 1830. L.N.: *Lalgeri*

**Exsiccatae:** Animesh & AP Das 058, dated 18. 01. 2009.

Suffrutescent erect herbs, stems unbranched, rooting adventitiously; lamina broadly ovate, crenate-dentate above base, acuminate, base broadly cuneate, membranous; spikes terminal, verticillasters 6- flowered; corolla white.

**Local distribution:** Throughout the forests.

*Anisomeles indica* (Linnaeus) Kuntze, *Revis. Gen. Pl.* 2: 512. 1891. *Nepeta indica* Linnaeus, *Sp. Pl.* 2: 571. 1753.

**Exsiccatae:** Animesh & AP Das 146, dated 06. 02. 2009.

Annual erect, oppositely branched herb; lamina broadly ovate, irregularly dentate, acute or short acuminate, base broadly truncate-cuneate; spikes longer than verticillasters; corolla pink; nutlets.

**Local distribution:** Road side areas.

*Callicarpa arborea* Roxburgh, *Fl. Ind.* 1: 405. 1820. L.N.: *Guenlo*

**Exsiccatae:** Animesh & AP Das 017, dated 17. 01. 2009.

Small trees; lamina broadly elliptic, entire, base cuneate to rounded, leathery; umbels compound, compact, densely tomentose; flowers violate; fruit purple-brown.

**Local distribution:** Hill slope and core areas of forest.

*Clerodendrum infortunatum* Linnaeus, *Sp. Pl.* 637. 1753. *Clerodendrum viscosum* Ventanut, *Jard. Malmaison t.* 25 1803. L.N.: *Bhnati*

**Exsiccatae:** Animesh & AP Das 211, dated 13. 05. 2009.

Suffrutescent under-shrubs; lamina rounded-ovate, coarsely serrate; panicles of cymes mostly terminal, spreading but shorter than subtending leaves, 3-12 flowered; corolla white; fruiting calyx red.

**Local distribution:** Throughout the forests.

*Gmelina arborea* Roxburgh, *Hort. Bengal.* 46. 1814. L.N.: *Gamar*

**Exsiccatae:** Animesh & AP Das 290, dated 21. 09. 2009.

Large trees; bark grayish brown lamina broadly ovate, acuminate, base broadly cuneate to subcordate, thickly papery; thyrses narrow, terminal; corolla yellow; ripe drupes yellow, ellipsoid to obovoid-ellipsoid.

**Local distribution:** River side forests.

*Gomphostemma ovatum* Wallich ex Bentham, *Pl. Asiat. Rar.* 2: 12. 1830. L.N.: *Lalgeri*

**Exsiccatae:** *Animesh & AP Das 016*, dated 17. 01. 2009.

Robust herbs; branches few; lamina ovate to obovate-elliptic, widely spaced serrulate, obtuse to acute, base obliquely cuneate, decurrent; cymes axillary, many flowered; corolla deep yellow; nutlets brown, glabrous.

**Local distribution:** Through out the forests.

*Holmskioldia sanguinea* Retzius, *Observ. Bot.* 6: 31. 1791. L.N.: *Sanaiphool*

**Exsiccatae:** *Animesh & AP Das 222*, dated 14. 05. 2009.

Evergreen, scandent shrub; lamina ovate, shallowly serrate, acuminate; cymes axillary; calyx broadly conical hat-like, red; corolla brick-red to orange.

**Local distribution:** Stream side hill slopes.

*Hyptis suaveolens* (Linnaeus) Poiteau, *Ann. Mus. Hist. Nat.* 7: 472. 1806. *Ballota suaveolens* Linnaeus, *Syst. Nat.*, ed. 10, 2: 1100. 1759.

**Exsiccatae:** *Animesh & AP Das 368*, dated 10. 02. 2010.

Tall, erect, annual herbs; stems much branched, spreading hispid; lamina ovate to broadly ovate, serrulate, subacute to obtuse, base rounded to shallow cordate, oblique; cymes in paniculate racemes, 2-5 blue flowered; nutlets dark brown.

**Local distribution:** Road side areas.

*Lantana camara* Linnaeus, *Sp. Pl.* 627. 1753. L.N.: *Putusknara*

**Exsiccatae:** *Animesh & AP Das 267*, dated 20. 09. 2009.

Densely bushy shrubs, armed with stout recurved prickles; leaf blade ovate to oblong, crenate, base rounded to subcordate, papery; heads terminal, long peduncled; flowers yellow to orange; drupes deep purple, globose.

**Local distribution:** Road side bushes.

*Pogostemon benghalensis* (Burman f.) Kuntze, *Revis. Gen. Pl.* 2: 529. 1891. *Origanum benghalense* Burman f., *Fl. Indica* 128. 1768. L.N.: *Janglee Chirato*

**Exsiccatae:** *Animesh & AP Das 394*, dated 15. 05. 2010.

Subshrubs, stems solid; lamina ovate elliptic to broadly ovate, irregularly incised, obtuse to acute, base cuneate-attenuate, papery; verticillasters regular or secund in spikes; corolla pink.

**Local distribution:** Road side forests.

*Tectona grandis* Linnaeus f., *Suppl. Pl.* 151. 1782. L.N.: *Teak, Segun*

**Exsiccatae:** *Animesh & AP Das 010*, dated 17. 01. 2009.

Trees, branchlets 4 angled; lamina ovate-elliptic to ovate, entire, acuminate to obtuse, base cuneate and de-current, papery; cymes in much branched spreading panicles; flowers fragrant; corolla white; fruit globose, minutely tomentose.

**Local distribution:** Core areas of forest; all planted.

*Vitex quinata* (Loureiro) F.N. Williams, *Bull. Herb. Boissier II*, 5: 431. 1905. *Cornutia quinata* Loureiro, *Fl. Cochinch.* 2: 387. 1790. L.N.: *Panchpate*

**Exsiccatae:** *Animesh & AP Das 245*, dated 19. 09. 2009.

Evergreen trees; leaves 3-5-foliolate; leaflets obovate-elliptic, entire, acuminate, acute, or obtuse, base cuneate, thickly papery; panicles terminal, lax; flowers yellowish; fruit black, obovoid to globose.

**Local distribution:** River side forests.

## LAURACEAE

*Actinodaphne obovata* (Nees) Blume, *Mus. Bot. 1*: 342. 1851. *Tetradenia obovata* Nees in Wallich, *Pl. Asiat. Rar. 2*: 64. 1831. L.N.: *Runche*

**Exsiccatae:** *Animesh & AP Das 521*, dated 29. 09. 2010.

Small trees; leaves large, obovate, white bloomy below; lamina obovate, acuminate or acute, tip obtuse, base cuneate or rotund; racemes of 5 flowered umbels; flowers whitish; fruit oblong or ellipsoid.

**Local distribution:** Throughout the forests.

*Cinnamomum glaucescens* (Nees) Handel-Mazzetti, *Oesterr. Bot. Z. 85*: 214. 1936. *Laurus glaucescens* Buchanan-Hamilton ex Nees, *Pl. Asiat. Rar. 2*: 70. 1831. L.N.: *Malagiri*

**Exsiccatae:** *Animesh & AP Das 364*, dated 10. 02. 2010.

Evergreen trees; lamina green and shiny adaxially, ovate or ovate-lanceolate, entire, acuminate, base acute, leathery or subleathery, glabrous on both surfaces; flowers small, yellowish in axillary or terminal panicle.

**Local distribution:** Core areas of forest.

*Cinnamomum tamala* (Buchanan-Hamilton) T. Nees & Eberman, *Handb. Med.-Pharm. Bot. 2*: 426. 1831. *Laurus tamala* Buchanan-Hamilton, *Trans. Linn. Soc. London 13*: 555. 1822. L.N.: *Tezpat*

**Exsiccatae:** *Animesh & AP Das 242*, dated 19. 09. 2009.

Evergreen trees; scented bark; leaves alternate or those on young branchlets sometimes subopposite; lamina ovate, oblong, or lanceolate, entire, long acuminate, base acute or broadly cuneate, thinly leathery; panicle axillary or terminal; flowered many, whitish-green to yellowish; fruit obovoid or ellipsoid.

**Local distribution:** River side forests.

*Cryptocarya amygdalina* T. Nees, *Pl. Asiat. Rar. 2*: 69. 1831. L.N.: *Hallure*

**Exsiccatae:** *Animesh & AP Das 295*, dated 21. 09. 2009.

Trees, branchlets terete; leaves alternate; lamina elliptic or oblong, shortly acuminate, base acute or obtuse; umbels axillary; flowers yellow; fruit green, ellipsoid or narrowly ellipsoid.

**Local distribution:** Hill forest areas.

*Litsea cubeba* (Loureiro) Persoon, *Syn. Pl. 2*: 4. 1806. *Laurus cubeba* Loureiro, *Fl. Cochinch. 1*: 252. 1790. L.N.: *Dhaunli*

**Exsiccatae:** *Animesh & AP Das 519*, dated 29. 09. 2010.

Deciduous trees; leaves alternate; lamina lanceolate, oblong, or elliptic, acuminate or acute, base cuneate; umbels solitary or clustered, 4-6 flowered; flowers whitish; fruit subglobose.

**Local distribution:** Through out the forests.

*Litsea glutinosa* (Loureiro) Charles Robinson, *Philipp. J. Sci., C 6*: 321. 1911. *Sebifera glutinosa* Loureiro, *Fl. Cochinch. 2*: 638. 1790. L.N.: *Dudh Seola*

**Exsiccatae:** *Animesh & AP Das 463*, dated 25. 09. 2010.

Deciduous trees; leaves alternate; lamina obovate-oblong, or elliptic-lanceolate, obtuse or rounded, base cuneate, obtuse, or rotund; umbels solitary, few flowered; flowers yellowish; fruit globose.

**Local distribution:** Throughout the forests.

*Litsea laeta* (Wallich ex T. Nees) Hooker f., *Fl. Brit. India 5*: 169. 1886. *Tetranthera laeta* Wallich ex T. Nees, *Pl. Asiat. Rar. 2*: 67. 1831. L.N.: *Jhakre Seola*

**Exsiccatae:** *Animesh & AP Das 152*, dated 07. 02. 2009.

Trees, evergreen; lamina elliptic or oblanceolate-elliptic, entire, apex and base acute; flowers in umbellate cymes or panicles; flowers yellowish; fruits ellipsoid, green.

**Local distribution:** Hill forest areas.

*Litsea monopetala* (Roxburgh) Persoon, *Syn. Pl. 2*: 4. 1806. *Tetranthera monopetala* Roxburgh, *Pl. Coromandel 2*: 26. 1798. L.N.: *Kutmero*

**Exsiccatae:** *Animesh & AP Das 430*, dated 17. 05. 2010.

Evergreen trees; leaves alternate; lamina broadly ovate or obovate to ovate-oblong, obtuse or rounded, rarely acute, base rounded or acute; umbels clustered on shortest branchlets, 4-6 yellow-white flowered; fruit long ovoid, seated on shallowly discoid perianth tube.

**Local distribution:** Road side and stream side vegetation.

***Litsea pungens*** Hemsley, J. Linn. Soc., Bot. 26: 384. 1891.

**Exsiccatae:** *Animesh & AP Das 099*, dated 19. 01. 2009.

Deciduous trees; leaves alternate, often clustered at apex of branchlet; lamina lanceolate or obovate-lanceolate, shortly acute, base cuneate; umbel axillary, 8-12-flowered; flowers yellow; fruit globose, blue-black at maturity.

**Local distribution:** Marginal forest areas and stream side vegetation.

***Litsea salicifolia*** (Roxburgh ex Nees) Hooker f., *Fl. Brit. India 5*: 167. 1886. *Tetranthera salicifolia* Roxburgh ex Nees in Wallich, *Pl. Asiat. Rar. 2*: 66. 1831. L.N.: *Kainjale*

**Exsiccatae:** *Animesh & AP Das 372*, dated 10. 02. 2010.

Evergreen trees; leaves alternate; lamina long elliptic, acuminate or acute, base acute; umbels axillary, males 4-6 flowered; flowers yellowish; fruit oblong.

**Local distribution:** Core areas of forest.

***Machilus gamblei*** King ex Hooker f., *Fl. Brit. India 5(13)*: 138. 1886. L.N.: *Kawlo*

**Exsiccatae:** *Animesh & AP Das 415*, dated 16. 05. 2010.

Trees; branchlets slender, terete; lamina oblong, obovate, or oblanceolate, thinly leathery; umbels axillary; flowers white or yellowish; fruit globose, blackish when ripe.

**Local distribution:** Hill forest areas.

***Machilus glaucescens*** (T. Nees) Wight, *Icon. Pl. Ind. Orient. 5(2)*: 12. 1852. *Ocotea glaucescens* Nees in Wallich, *Pl. Asiat. Rar. 2*: 71. 1831. L.N.: *Kawlo*

**Exsiccatae:** *Animesh & AP Das 214*, dated 13. 05. 2009.

Large trees, branchlets blackish brown, longitudinally striate; lamina broadly elliptic-lanceolate, leathery; cymose panicles subterminal; flowers yellowish; fruit globose.

**Local distribution:** Core areas of forest.

***Neocinnamomum caudatum*** (T. Nees) Merrill, *Contr. Arnold Arbor. 8*: 64. 1934. *Cinnamomum caudatum* T. Nees in Wallich, *Pl. Asiat. Rar. 2*: 76. 1831.

**Exsiccatae:** *Animesh & AP Das 112*, dated 20. 01. 2009.

Trees, branchlets terete; leaves alternate; ovate or ovate-oblong, acuminate, base cuneate, broadly cuneate, or subrounded, papery; flowers small in umbels, yellowish-green; fruit narrowly ellipsoid, red when ripe.

**Local distribution:** Hill forest areas.

## LECYTHIDACEAE

***Careya arborea*** Roxburgh, *Pl. Coromandel 3*: 14. 1819. L.N.: *Kumbhi*

**Exsiccatae:** *Animesh & AP Das 137*, dated 06. 02. 2009.

Trees; lamina large, broadly round, entire, obtuse or bluntly acute; flowers solitary, axillary or branch sub terminal; petals white; fruits globose, yellowish green.

**Local distribution:** Marginal forest areas and stream sides.

## LINDERNIACEAE

***Lindernia ciliata*** (Colsmann) Pennell, *Brittonia 2*: 182. 1936. *Gratiola ciliata* Colsmann, *Prodr. Descr. Gratiol.* 14. 1793.

**Exsiccatae:** *Animesh & AP Das 023*, dated 17. 01. 2009.

Annual, much branched, erect or diffuse; lamina oblong to lanceolate-oblong, densely aristate-serrate, acute, base amplexicaul, glabrous; racemes terminal; flowers white; capsules cylindrical.

**Local distribution:** River valley.

*Lindernia crustacea* (Linnaeus) F. Mueller, *Syst. Census Austral. Pl.* 97. 1882. *Capraria crustacea* Linnaeus, *Mant. Pl.* 1: 87. 1767. L.N.: *Domrusaag*

**Exsiccatae:** *Animesh & AP Das 131*, dated 05. 02. 2009.

Annual herbs, much branched; lamina triangular-ovate to broadly ovate, shallowly crenate to serrate, obtuse to subacute, base broadly cuneate to rounded, pilose to subglabrous; flowers axillary-solitary or in short apical racemes; flowers bluish pink; capsules broadly ellipsoid.

**Local distribution:** River valley.

*Lindernia parviflora* (Roxburgh) Haines, *Bot. Bihar Orissa* 635. 1922. *Gratiola parviflora* Roxburgh, *Pl. Coromandel* 3: 3. 1811. L.N.: *Aalujhaar*

**Exsiccatae:** *Animesh & AP Das 241*, dated 19. 09. 2009.

Erect, much branched, glabrous herbs; lamina ovate to broadly ovate, shallowly crenate to serrate, subacute, base broadly cuneate, subglabrous; flowers axillary, solitary, pink; capsules ellipsoid.

**Local distribution:** River valley.

*Torenia cordifolia* Roxburgh, *Pl. Coromandel* 2: 52, pl. 161. 1798. L.N.: *Kyamuna*

**Exsiccatae:** *Animesh & AP Das 075*, dated 18. 01. 2009.

Annuals, erect with prostrate branches from base; lamina ovate to cordate, coarsely triangular-serrate, acute, base cuneate and decurrent, sparsely villous; flowers in axillary fascicles, blue-purple; capsules oblong.

**Local distribution:** River side open forest areas.

## LOGANIACEAE

*Strychnos nux-vomica* Linnaeus, *Sp. Pl.* 189. 1753. L.N.: *Kak Bhalayo*

**Exsiccatae:** *Animesh & AP Das 202*, dated 12. 05. 2009.

Trees; lamina suborbicular or elliptic-ovate, entire, short acuminate to acute, base rounded to cordate, glabrous and shiny above; flowers 5-merous, white; berry orange when ripe, globose.

**Local distribution:** Hill forest areas.

## LYTHRACEAE

*Duabanga grandiflora* (A.P. de Candolle) Walpers, *Repert. Bot. Syst.* 2: 114. 1843. *Lagerstroemia grandiflora* Roxburgh ex Candolle, *Mém. Soc. Hist. Nat. Genève* 32: 84. 1826. L.N.: *Lampate*

**Exsiccatae:** *Animesh & AP Das 189*, dated 11. 05. 2009.

Trees; lamina broadly ovate to oblong, entire, shortly acuminate, base cordate; corymbs broad, drooping at branch ends; flowers white; capsules subglobose, 6–9-valved.

**Local distribution:** River side forest areas.

*Lagerstroemia hypoleuca* Kurz, *Rep. Veg. Andaman Isl. App. viii:* 2. 1870.

**Exsiccatae:** *Animesh & AP Das 163*, dated 07. 02. 2009.

Trees; inflorescence terminal racemes; lamina elliptic or oblong-elliptic, entire, shortly acuminate, base acute to attenuate, thinly leathery; flowers purple; capsules oblong.

**Local distribution:** Core forest areas.

*Lagerstroemia parviflora* Roxburgh, *Pl. Coromandel* 1: 48. 1796. L.N.: *Sidha*

**Exsiccatae:** *Animesh & AP Das 332*, dated 07. 02. 2010.

Trees, bark gray; lamina ovate elliptic, entire, acute, base attenuate; flowers numerous in terminal racemes, small, white, hypanthium tomentose; capsules oblong.

**Local distribution:** Core forest areas.

*Lagerstroemia speciosa* (Linnaeus) Persoon, *Syn. Pl.* 2: 72. 1806. *Munchausia speciosa* Linnaeus, *Hausvater* 5: 257. 1770. L.N.: *Jarul*

**Exsiccatae:** Animesh & AP Das 439, dated 25. 09. 2010.

Trees; lamina oblong-elliptic, entire, shortly acuminate, base acute, thinly leathery; flowers many in terminal broad panicle; flowers purple; capsules oblong, 6 valved.

**Local distribution:** Core forest areas.

**Woodfordia fruticosa** (Linnaeus) Kurz, *J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist.* 40(2): 56. 1871.

*Lythrum fruticosum* Linnaeus, *Syst. Nat.*, ed. 10, 2: 1045. 1759. L.N.: Dhnoero

**Exsiccatae:** Animesh & AP Das 494, dated 27. 09. 2010.

Shrubs, branches flexuous; lamina lanceolate to ovate-lanceolate, entire, acuminate, base rounded to subcordate, leathery, orange to black glandular punctate; flowers axillary, crowded, red-orange; capsules elongate, elliptic.

**Local distribution:** Hill forest areas.

## MAGNOLIACEAE

**Magnolia champaca** (Linnaeus) Baillon ex Pierre, *Fl. Forest. Cochinch. t. 3.* 1880. *Michelia champaca*

Linnaeus, *Sp. Pl.* 536. 1753. L.N.: Chanp

**Exsiccatae:** Animesh & AP Das 371, dated 10. 02. 2010.

Trees; lamina elliptic or ovate, entire, long acuminate to subcaudate, base broadly cuneate or rounded; flowers terminal, fragrant, yellow; mature carpels obovoid-ellipsoid, tuberculate.

**Local distribution:** Road side forest areas.

**Magnolia pterocarpa** Roxburgh, *Pl. Coromandel 3:* 62. 1820. L.N.: Patpate

**Exsiccatae:** Animesh & AP Das 533, dated 29. 09. 2010.

Trees; lamina elliptic or ovate - elliptic, entire, long acuminate, base broadly cuneate; flowers terminal, solitary, fragrant, yellow; mature carpels obovoid.

**Local distribution:** Core areas of forest.

## MALVACEAE

**Bombax ceiba** Linnaeus, *Sp. Pl.* 511. 1753. L.N.: Shimal

**Exsiccatae:** Animesh & AP Das 276, dated 20. 09. 2009.

Trees, branches spreading; leaflets 5–7, blades oblong to oblong-lanceolate, entire, acuminate, base broad or tapering, glabrous; flowers solitary and terminal, orange-red; capsule ellipsoid.

**Local distribution:** Core area forests.

**Firmiana colorata** (Roxburgh) Robert Brown, *Pterocymbium 235.* 1844. *Sterculia colorata* Roxburgh, *Pl. Coromandel 1:* 26. 1795. L.N.: Phirphire

**Exsiccatae:** Animesh & AP Das 119, dated 20. 01. 2009.

Deciduous trees; lamina broadly cordate, 3–5-lobed, lobes entire, obtuse, base deeply cordate, thinly leathery; cymose-paniculate, densely orange-red stellate puberulent; flowers orange red; follicle stalked, remain open exposing seeds, reddish when mature.

**Local distribution:** Core area forests.

**Grewia sclerophylla** Roxburgh ex G. Don, *Gen. Hist. 1:* 550. 1831.

**Exsiccatae:** Animesh & AP Das 529, dated 29. 09. 2010.

Small trees; lamina ovate to ovate-oblong, densely serrulate, acute, base rounded, leathery, stellate; cymes axillary, 1–3 flowered; flowers bisexual, yellowish; drupes 4-lobed.

**Local distribution:** Hill area forests.

**Grewia serrulata** de Candolle, *Prodr. 1:* 510. 1824. L.N.: Chipley

**Exsiccatae:** Animesh & AP Das 318, dated 07. 02. 2010.

Small trees; lamina oblong-lanceolate, serrulate, long acuminate, base cuneate or broadly cuneate, papery; cymes axillary, 3–7 flowered; flowers yellowish; drupes 4-lobed, glabrous.

**Local distribution:** Core areas of forest.

*Kydia calycina* Roxburgh, Pl. Coromandel 3: 11. 1811 ["1819"].

*Exsiccatae:* Animesh & AP Das 164, dated 07. 02. 2009.

Small trees; lamina nearly rounded, usually palmately 3–5-lobed, sparsely denticulate, acute or obtuse, base rounded or nearly cordate; cymes axillary; flowers reddish; capsules globose with winged persistent epicalyx.

**Local distribution:** Marginal forest areas and stream side.

*Pterospermum acerifolium* (Linnaeus) Willdenow, Sp. Pl. 3: 729. 1800. *Pentapetes acerifolia* Linnaeus, Sp. Pl. 698. 1753. L.N.: Hatipaile

*Exsiccatae:* Animesh & AP Das 184, dated 11. 05. 2009.

Large trees, bark smooth; lamina nearly orbicular or oblong, lobed, entire or crenate, truncate, rounded or pointed, base cordate, leathery; juvenile leaves palmately lobed, peltate; flowers solitary, axillary, fragrant, white; capsules woody, cylindrical.

**Local distribution:** Core area forests.

*Pterygota alata* (Roxburgh) Robert Brown, *Pterocymbium* 234. 1844. *Sterculia alata* Roxburgh, Pl. Coromandel 3: 84. 1811 ["1819"]. L.N.: Narikeli

*Exsiccatae:* Animesh & AP Das 390, dated 14. 05. 2010.

Huge trees, crown at upper part of stem; lamina cordate or broadly ovate, nearly entire, acute, base truncate, cordate or rounded; flowers solitary, red; follicles woody, compressed globose.

**Local distribution:** Core area forests.

*Sida acuta* Burman f., Fl. Indica 147. 1768. L.N.: Ballu Jhaar

*Exsiccatae:* Animesh & AP Das 139, dated 06. 02. 2009.

Erect annual herbs, much branched; lamina ovate-oblong or linear-lanceolate, dentate, sometimes partly entire toward its base, acute or acuminate, base obtuse; pair of stipule dissimilar; flowers solitary or paired, axillary, sometimes congested at stem apex; petals light yellow; schizocarp nearly globose.

**Local distribution:** Road side forest area.

*Sida rhombifolia* Linnaeus, Sp. Pl. 684. 1753. L.N.: Ballu Jhaar

*Exsiccatae:* Animesh & AP Das 500, dated 28. 09. 2010.

Erect, profusely branched under-shrubs; lamina rhombic to oblong-lanceolate or obovate, rarely linear-lanceolate, dentate, obtuse to acute, base broadly cuneate; flowers solitary, axillary; petals yellow; fruits semiglobose.

**Local distribution:** Throughout the forests.

*Sterculia villosa* Roxburgh, Fl. Ind., ed. 1832 3: 153–154. 1832. L.N.: Odal

*Exsiccatae:* Animesh & AP Das 253, dated 19. 09. 2009.

Deciduous trees, branchlets robust; leaves simple; lamina palmately 3–7 lobed, central lobe broadly ovate, lobes entire, caudate, base broadly cordate; panicles appear on leafless branchlets; flowers yellow; follicles narrowly ellipsoid.

**Local distribution:** Stream side forests.

*Triumfetta rhomboidea* Jacquin, Enum. Syst. Pl. 22. 1760. L.N.: Dollekuro

*Exsiccatae:* Animesh & AP Das 185, dated 11. 05. 2009.

Subshrubs; lamina broadly ovate-orbicular to rhomboid, or broadly ovate, 3-lobed, irregularly bluntly serrate, acute, base broadly cuneate; cymes axillary, 3–5 flowered; flower buds cylindric; corolla yellow; capsules globose, spiny.

**Local distribution:** Throughout the forests.

## MELASTOMATACEAE

*Osbeckia chinensis* Linnaeus, Sp. Pl. 1: 345–346. 1753. L.N.: Dantrangi

*Exsiccatae:* Animesh & AP Das 020, dated 17. 01. 2009.

Erect under-shrubs, strigose; stems 4-sided, appressed strigose; lamina linear, linear-lanceolate, oblong-ovate, elliptic-ovate, or sometimes ovate-lanceolate, entire, acute, base obtuse, subrounded, rounded, or subcordate, stiffly papery; flowers terminal, capitate, 2–8-flowered, white; capsule purplish red, ovoid-globose.

**Local distribution:** Riverside forest areas.

## MELIACEAE

*Aglaia lawii* (Wight) C. J. Saldanha ex Ramamoorthy in C. J. Saldanha & Nicolson, Fl. Hassan Dist. 392. 1976. *Nimmonia lawii* Wight, Calcutta J. Nat. Hist. 7: 13. 1847.

**Exsiccatae:** Animesh & AP Das 196, dated 12. 05. 2009.

Small trees; branches grayish, pale to yellowish lepidote; leaves alternate; lamina elliptic, oblong, ovate-lanceolate, or lanceolate, acuminate to obtuse, base rounded or  $\pm$  oblique and conspicuously decurrent on one side and rounded on other, papery to leathery; thyrses axillary; flowers unisexual, greenish white; fruit dehiscent, ellipsoid, globose, or pyriform with base gradually constricted.

**Local distribution:** Core areas of forest.

*Aglaia perviridis* Hiern, Fl. Brit. India 1: 556. 1875. L.N.: Charpate

**Exsiccatae:** Animesh & AP Das 477, dated 26. 09. 2010.

Small trees; branchlets dark gray, with scattered small yellowish lenticels; leaflets alternate to subopposite; lamina oblong-elliptic or ovate, acuminate, base cuneate to subrotund, subleathery; thyrses axillary; flowers white; fruit indehiscent, oblong and curved.

**Local distribution:** Core areas of forest.

*Aglaia spectabilis* (Miquel) S.S. Jain & S. Bennet, Indian J. Forest. 9: 271. 1986 publ. 1987. *Amoora spectabilis* Miquel, Ann. Mus. Bot. Lugduno-Batavi 4: 37. 1868. L.N.: Khopote Lali

**Exsiccatae:** Animesh & AP Das 044, dated 17. 01. 2009.

Small trees; leaves alternate; leaflets opposite; petiolules 1-1.5 cm, thick, adaxially sulcate and stellately lepidote; lamina oblong-elliptic, reflexed, acuminate, base truncate to rounded; thyrses axillary; flower buds ovoid; petals white; fruit dehiscent, obovoid to pyriform.

**Local distribution:** Hill slope and core forest areas.

*Amoora rohituka* (Roxburgh) Wight & Arnott, Cat. Ind. Pl. 24. 1833. *Andersonia rohituka* Roxburgh, Fl. Ind. 2: 213. 1824. L.N.: Lali

**Exsiccatae:** Animesh & AP Das 220, dated 14. 05. 2009.

Large trees; lamina oblong-elliptic, elliptic, or ovate, entire, caudate-acuminate to obtuse, base oblique and cuneate to broadly cuneate or sometimes one side rounded; thyrses axillary; flowers with 3 bracteoles, creamy; capsule spherical-pyriform to nearly ovoid.

**Local distribution:** Core areas of forest.

*Aphanamixis polystachya* (Wallich) R. Parker, Indian For. 57: 486. 1931. *Aglaia polystachya* Wallich in Roxburgh, Fl. Ind. 2: 429. 1824. L.N.: Lahsune Lali

**Exsiccatae:** Animesh & AP Das 062, dated 18. 01. 2009.

Trees; leaves odd- or even- pinnate; leaflets opposite; lamina oblong-elliptic, elliptic, or ovate, entire, caudate-acuminate to obtuse, base oblique and cuneate to broadly cuneate or sometimes one side rounded, subleathery to leathery when mature; corymbs axillary; flowers with 3 bracteoles; capsule spherical-pyriform to nearly ovoid.

**Local distribution:** Core areas of forest.

*Chisocheton cumingianus* (Casimir de Candolle) Harms, Nat. Pflanzenfam. 3(4): 296. 1896.

*Dasycoleum cumingianum* Casimir de Candolle, Monogr. Phan. 1: 541. 1878. L.N.: Bandare Lali

**Exsiccatae:** Animesh & AP Das 175, dated 11. 05. 2009.

Trees; lamina oblong to oblong-lanceolate, entire, acuminate, base broadly oblique with one side cuneate and other side cuneate to rounded, papery to leathery; thyrses axillary, usually as long as or longer than



leaves; flowers pale pink; capsule salmon-colored when mature, pyriform-globose.

**Local distribution:** Core areas of forest.

*Chukrasia tabularis* A. Jussieu, *Mém. Mus. Hist. Nat.* 19: 251. 1830. L.N.: *Chikrasi*

**Exsiccatae:** *Animesh & AP Das* 259, dated 19. 09. 2009.

Trees; bark of old branches exfoliating; lamina ovate to oblong-lanceolate, entire, acute to acuminate, base oblique, papery; thyrses axillary; flowers creamy, fragrant; capsule yellowish gray to brown, subglobose to oblong.

**Local distribution:** Core areas of forest.

*Cipadessa baccifera* (Roth) Miquel, *Ann. Mus. Bot. Lugduno-Batavi* 4: 6. 1868. *Melia baccifera* Roth, *Nov. Pl. Sp.* 215. 1821.

**Exsiccatae:** *Animesh & AP Das* 200, dated 12. 05. 2009.

Trees; bark coarse; young branches grayish brown, ribbed; leaflets opposite; lamina ovate to ovoid-oblong, entire or apical half serrate, acute, acuminate, or mucronate, base oblique and rounded, cuneate, or broadly cuneate, papery; thyrses corymbose; flowers yellow; fruit purple to black when mature, globose.

**Local distribution:** Core areas of forest.

*Dysoxylum gotadhora* (Buchanan-Hamilton) Mabblerley, *Fl. China* 11: 127. 2008. *Guarea gotadhora* Buchanan-Hamilton, *Mem. Wern. Nat. Hist. Soc.* 6: 307. 1 Jan 1832. L.N.: *Lahsune*

**Exsiccatae:** *Animesh & AP Das* 460, dated 25. 09. 2010.

Trees; leaflets alternate; lamina oblong, oblong-elliptic, or lanceolate, acuminate, base oblique and cuneate to  $\pm$  rounded, thickly papery; thyrses axillary, much shorter than leaves; flowers yellow; capsule obovoid, pyriform, or subglobose.

**Local distribution:** Road side forest and stream side areas.

*Dysoxylum mollissimum* Blume, *Bijdr.* 175. 1825.

**Exsiccatae:** *Animesh & AP Das* 191, dated 11. 05. 2009.

Small trees; leaflets opposite to subopposite; lamina oblong to oblong-lanceolate, acuminate, base oblique, membranous; thyrses axillary; flowers yellow; capsule yellow when dry, globose.

**Local distribution:** Marginal forest and stream side areas.

*Sphaerosacme decandra* (Wallich) T.D. Pennington, *Blumea* 22: 489. 1975. *Synonymous with Sphaerosacme decandra* Wallich [Publication reference not available]; *Aglaia decandra* Roxburgh, *Fl. Ind.* 2:427. 1824.

**Exsiccatae:** *Animesh & AP Das* 215, dated 13. 05. 2009.

Small trees; lamina oblong to oblong-lanceolate, entire, acuminate, base broadly oblique with one side cuneate; thyrses axillary; flowers yellow.

**Local distribution:** Hill area forests.

*Swietenia macrophylla* King, *Hooker's Icon. Pl.* 16: t. 1550. 1886.

**Exsiccatae:** *Animesh & AP Das* 187, dated 11. 05. 2009.

Large trees; lamina ovate to lanceolate, entire or with 1 or 2 serrations, long acuminate, base oblique, leathery; thyrses axillary with new leaves; flowers small, greenish white; Capsule brown, ovoid.

**Local distribution:** Core areas of forest.

*Toona ciliata* M. Roemer, *Fam. Nat. Syn. Monogr.* 1: 139. 1846. L.N.: *Tuni*

**Exsiccatae:** *Animesh & AP Das* 418, dated 16. 05. 2010.

Medium trees; trunk with or without buttresses, strong smell of cedar when cut; lamina lanceolate to ovate-lanceolate, entire, acute to acuminate, base usually asymmetric; inflorescence branches corymbose; flowers small white, sweetly scented; capsule.

**Local distribution:** Road side areas.

*Walsura robusta* Roxburgh, Fl. Ind., ed. 1832, 2: 386. 1832.

**Exsiccatae:** Animesh & AP Das 197, dated 12. 05. 2009.

Trees; leaflets opposite; lamina oblong, elliptic, or lanceolate, acuminate, base cuneate, thinly leathery; thyrses sparsely pubescent; flowers white; berry globose to ovoid, densely covered with yellowish gray trichomes.

**Local distribution:** Core areas of forest.

## MENISPERMACEAE

*Cissampelos pareira* Linnaeus, Sp. Pl. 1031. 1753.

**Exsiccatae:** Animesh & AP Das 040, dated 17. 01. 2009.

Slender perennial twiner; lamina cordate-rotund or rotund, entire, often emarginate, with a mucronate acumen, base often cordate, sometimes subtruncate, rarely slightly rounded, papery; cymes corymbose on old wood; flowers greenish; drupes pubescent; endocarp broadly obovate.

**Local distribution:** Throughout the forests.

*Parabaena sagittata* Miers, Ann. Mag. Nat. Hist., ser. 2 7: 39. 1851. L.N.: Pad Larang

**Exsiccatae:** Animesh & AP Das 134, dated 06. 02. 2009.

Perennial twiner; stems and branches striate; lamina broadly ovate or oblong-ovate, sparsely serrate to dentate, rarely entire, acuminate, palmately 5-7-veined, abaxially densely pannose-tomentose, adaxially sparsely puberulent or sometimes subglabrous, base sagittate, lobes mucronate or rounded, papery or membranous when dry; inflorescence dichotomously branched axillary cymes; flowers creamy; drupes subglobose and slightly flattened.

**Local distribution:** Throughout the forests.

*Stephania glabra* (Roxburgh) Miers, Ann. Mag. Nat. Hist., ser. 3, 18: 14. 1866. *Cissampelos glabra* Roxburgh, Fl. Ind., ed. 1832, 3: 840. 1832.

**Exsiccatae:** Animesh & AP Das 012, dated 17. 01. 2009.

Perennial twiners with tuberous rootstock; stems striate, hollow; lamina narrowly peltate, broadly ovate or rotund, apical margin horned, palmately veined, base rounded, papery or membranous; flowers in axillary pedunculate umbels; petals greenish; drupes obovate, flattened.

**Local distribution:** Throughout the forests.

*Stephania hernandiifolia* (Willdenow) Walpers, Repert. Bot. Syst. 1: 96. 1842. *Cissampelos hernandiifolia* Willdenow, Sp. Pl. 4: 861. 1806.

**Exsiccatae:** Animesh & AP Das 084, dated 19. 01. 2009.

Slender twiner; lamina conspicuously peltate, usually triangular-rotund or broadly triangular-ovate to rotund, entire, with a finely mucronate acumen, base usually broadly rounded; small white flowers in axillary clusters, glabrous; drupes red, obovate to subglobose.

**Local distribution:** Throughout the forests.

*Stephania japonica* (Thunberg) Miers, Ann. Mag. Nat. Hist., ser. 3 18: 14. 1866. *Menispermum japonicum* Thunberg in Murray, Syst. Veg., ed. 14, 892. 1784.

**Exsiccatae:** Animesh & AP Das 074, dated 18. 01. 2009.

Perennial twiners with tuberous rootstock; stems slender, slightly woody; lamina conspicuously peltate, usually triangular-rotund or broadly triangular-ovate to rotund, apex with a finely mucronate acumen, base usually broadly rounded, thinly leathery; umbels often borne on mature leafless branches; flowers greenish in axillary clusters, pubescens; drupes red, obovate to subglobose.

**Local distribution:** Core areas of forest.

*Tinospora crispa* (Linnaeus) Hooker f. & Thomson, Fl. Ind. 1: 183. 1855. *Menispermum crispum* Linnaeus, Sp. Pl., ed. 2, 2: 1468. 1763.

**Exsiccatae:** *Animesh & AP Das 118*, dated 20. 01. 2009.

Large twiner; old stems fleshy, with very prominent blunt tubercles; lamina broadly ovate to orbicular, lobes rounded, entire, acuminate, base deeply to shallowly cordate, thinly papery when dried; male flowers in few flowered clusters, single female flower borne in axis; flowers white; drupes orange, subglobose.

**Local distribution:** Road side forest area.

*Tinospora sinensis* (Loureiro) Merrill, *Sunyatsenia* 1: 193. 1934. *Campylus sinensis* Loureiro, *Fl. Cochinch.* 1: 113. 1790.

**Exsiccatae:** *Animesh & AP Das 171*, dated 07. 02. 2009.

Large twiner; stems slightly fleshy, green when young, striate; lamina broadly ovate to subrotund, rarely broadly ovate, margin entire, acutely acuminate, base deeply to slightly cordate, papery; male flowers in few flowered clusters, single female flower borne along axis; flowers whitish; drupes red, subglobose.

**Local distribution:** Stream side forests.

## MORACEAE

*Artocarpus chama* Buchanan-Hamilton, *Mem. Wern. Nat. Hist. Soc.* 5: 331. 1826. L.N.: *Lator*

**Exsiccatae:** *Animesh & AP Das 077*, dated 18. 01. 2009.

Erect deciduous tree, shoot brownish hispid, branchlets furrowed when dry; lamina elliptic, oblong, or ovate, entire or  $\pm$  crenate, acute to shortly acuminate, base broadly cuneate to rounded; flower-heads ellipsoid; drupes ellipsoid.

**Local distribution:** River side forest areas.

*Ficus hederacea* Roxburgh, *Fl. Ind.* 3: 538. 1832.

**Exsiccatae:** *Animesh & AP Das 135*, dated 06. 02. 2009.

Climbing shrubs, profusely branched; stems and branchlets with aerial roots at nodes; lamina elliptic to ovate-elliptic, entire, obtuse to occasionally rounded, base broadly cuneate to obtuse, both sides with papillate cystoliths; figs axillary on leafy or on leafless branchlets, solitary or paired, subglobose, green; achenes ellipsoid.

**Local distribution:** Stream side hill slope (prefer moist areas).

*Ficus hispida* Linnaeus f., *Suppl. Pl.* 442. 1782. L.N.: *Ramgua*

**Exsiccatae:** *Animesh & AP Das 329*, dated 07. 02. 2010.

Small dioecious tree; leaves opposite; lamina ovate, oblong, or obovate-oblong, entire or bluntly toothed, acute to mucronate, base rounded to  $\pm$  cuneate, thickly papery; figs solitary or several, axillary or in short raceme, globose, greenish.

**Local distribution:** Throughout the forests.

*Ficus neriifolia* Smith, *Cycl.* 14: 21. 1810. L.N.: *Latka, Kusum*

**Exsiccatae:** *Animesh & AP Das 019*, dated 17. 01. 2009.

Tree, branches glabrous, leaf traces and stipular scars conspicuous; lamina elliptic, ovate, ovate-elliptic, or ovate-lanceolate, entire, acuminate to caudate, base cuneate to rounded, leathery; figs smooth when mature, yellowish green; achenes smooth.

**Local distribution:** River valley.

*Ficus racemosa* Linnaeus, *Sp. Pl.* 1060. 1753. L.N.: *Dumri*

**Exsiccatae:** *Animesh & AP Das 310*, dated 22. 09. 2009.

Trees upto 3-10m, monoecious; leaves alternate; lamina elliptic-obovate, elliptic, or narrowly elliptic, entire, acuminate to obtuse, base cuneate to obtuse; subglobose figs born on long slender lateral leafless shoots, rarely axillary.

**Local distribution:** Hill slope and core forest areas.

*Ficus religiosa* Linnaeus, *Sp. Pl.* 1059. 1753. L.N.: *Pipal*

*Exsiccatae*: Animesh & AP Das 387, dated 14. 05. 2010.

Tree to 20 m, often epiphytic; leaf blade triangular-ovate, entire or undulate, acute to caudate with a 2-5 cm cauda, base broadly cuneate to cordate, leathery; figs small, reddish when ripe.

**Local distribution**: Stream side hill slope.

*Ficus sarmentosa* Buchanan-Hamilton ex Smith in Rees, *Cycl.* 14: *Ficus* no. 45. 1810. L.N.: *Labar Larang*

*Exsiccatae*: Animesh & AP Das 228, dated 14. 05. 2009.

Lianas; leaves distichous; lamina ovate, ovate-elliptic, elliptic-lanceolate, lanceolate, or oblong, entire, acute to acuminate, base rounded to broadly cuneate, leathery; figs axillary on leafy or on leafless branchlets, solitary or occasionally paired, blackish purple when mature; achenes ovoid-ellipsoid.

**Local distribution**: River side areas.

*Ficus semicordata* Buchanan-Hamilton ex Smith, *Cycl.* 14: 71. 1810. L.N.: *Khanyo*

*Exsiccatae*: Animesh & AP Das 252, dated 19. 09. 2009.

Large tree; leaves distichous; lamina oblong-lanceolate, strongly asymmetric, with small teeth or entire, acuminate, base obliquely cordate on one side and auriculate on other side, papery; globose figs born on axils of fallen leaves, yellowish; achenes broadly ovoid, apically slightly concave on one side.

**Local distribution**: Hill area forests.

*Streblus asper* Loureiro, *Fl. Cochinch.* 1: 615. 1790. L.N.: *Seuri*

*Exsiccatae*: Animesh & AP Das 054, dated 17. 01. 2009.

Small trees, scabrous; leaves shortly petiolate or sessile; lamina elliptic-obovate to elliptic, entire or irregularly crenate, blunt to shortly acuminate, base obtuse to cordate, leathery; male flowers in small heads like clusters; females solitary, axillary, pedunculate; drupes yellow, globose, indehiscent.

**Local distribution**: In semi-open and open forest areas.

#### MYRISTICACEAE

*Myristica longifolia* Hooker f. & Thomson, *Fl. Ind.* 1: 156. 1855. L.N.: *Ramgua*

*Exsiccatae*: Animesh & AP Das 395, dated 15. 05. 2010.

Evergreen trees; lamina obovate-lanceolate, entire, acuminate or long acuminate, base rounded; pedicellate flowers urceolate or bell-shaped, rarely tubular; fruit nearly sessile, ellipsoid or ovoid.

**Local distribution**: Core areas of forest.

#### MYRTACEAE

*Psidium guajava* Linnaeus, *Sp. Pl.* 470. 1753. L.N.: *Pyara*

*Exsiccatae*: Animesh & AP Das 315, dated 07. 02. 2010.

Small trees, bark gray, smooth; lamina oblong to elliptic, acute to obtuse, base rounded, leathery; flowers solitary or 2 to 3 in cymes; petals white; berry globose, ovoid, or pyriform, with persistent calyx lobes at apex.

**Local distribution**: River valley.

*Syzygium cumini* (Linnaeus) Skeels, *Bull. Bur. Pl. Industr. U.S.D.A.* 248: 25. 1912. *Myrtus cumini* Linnaeus, *Sp. Pl.* 1: 471. 1753. L.N.: *Jamun*

*Exsiccatae*: Animesh & AP Das 169, dated 07. 02. 2009.

Trees, branchlets grayish white when dry; leaf blade broadly elliptic to narrowly elliptic, rounded to obtuse and with a short cusp leathery, base broadly cuneate to rarely rounded; inflorescences axillary on flowering branches, paniculate cymes; flowers white; fruit red to black, ellipsoid to pot-shaped.

**Local distribution**: Road side forest area.

*Syzygium formosum* (Wallich) Masamune, *Enum. Phan. Born.* 528. 1942. *Eugenia formosa* Wallich, *Pl. Asiat. Rar.* 2: 6. 1830. L.N.: Amboke

**Exsiccatae:** Animesh & AP Das 149, dated 06. 02. 2009.

Trees, branchlets 4-angled; lamina elliptic, obovate-elliptic or oblong, entire, obtuse, abruptly mucronate or slightly acute, base cuneate, leathery; panicles axillary and terminal on branches; flowers white; fruits dark red, rounded.

**Local distribution:** Throughout the forests.

*Syzygium nervosum* A.Cunningham ex de Candolle, *Prodr.* 3: 260. 1828.

**Exsiccatae:** Animesh & AP Das 206, dated 13. 05. 2009.

Trees, much-branched; lamina oblong to elliptic, entire, acute to acuminate, base broadly cuneate to slightly rounded, thinly leathery; panicles lateral on leafless branches; flowers white; fruits violet to black when mature, broadly ovoid.

**Local distribution:** On forest margin and stream side areas.

*Syzygium praecox* (Roxburgh) Rathakrishnan & N.C. Nair, *J. Econ. Taxon. Bot.* 4: 288. 1983. *Eugenia praecox* Roxburgh, *Fl. Ind. ed.* 1832 2: 488. 1832. L.N.: Falame

**Exsiccatae:** Animesh & AP Das 132, dated 05. 02. 2009.

Small trees; lamina narrowly elliptic to elliptic, acute, base cuneate, leathery; panicle of cymes terminal; flowers redish; fruits ellipsoid.

**Local distribution:** Core areas of forest.

#### NYCTAGINACEAE

*Boerhavia diffusa* Linnaeus, *Sp. Pl.* 1: 3. 1753. L.N.: Lore saag

**Exsiccatae:** Animesh & AP Das 248, dated 19. 09. 2009.

Perennial herbs, stems ascending; lamina ovate, repund, obtuse or acute, base rounded or cuneate, succulent; inflorescences terminal and subterminal, in 2–8 flowered clusters; flowers pink; fruits with sticky hairs.

**Local distribution:** River side forests.

#### OXALIDACEAE

*Biophytum sensitivum* (Linnaeus) de Candolle, *Prodr.* 1: 690. 1824. *Oxalis sensitiva* Linnaeus, *Sp. Pl.* 1: 434. 1753.

**Exsiccatae:** Animesh & AP Das 013, dated 17. 01. 2009.

Small annuals, stem simple; leaves uni-pinnate; lamina oblong to obovate-oblong, entire, base almost symmetric, glabrous; flowers several, in umbels, yellow; capsules ellipsoid-obovoid.

**Local distribution:** River side forests.

*Oxalis corniculata* Linnaeus, *Sp. Pl.* 435. 1753. L.N.: Abijal

**Exsiccatae:** Animesh & AP Das 018, dated 17. 01. 2009.

Small creeping herbs with runners; lamina obcordate, deeply emarginated; flower in umbellate clusters, yellow; capsule long cylindrical.

**Local distribution:** Throughout the forests.

#### PENTAPHYLACEAE

*Eurya acuminata* de Candolle, *Prodr.* 1: 525. 1824. L.N.: Jhingane

**Exsiccatae:** Animesh & AP Das 377, dated 14. 05. 2010.

Small trees, branchlets reddish brown; lamina lanceolate, oblong-lanceolate or rarely ovate-oblong, serrulate, caudate-acuminate with an obtuse tip, base cuneate, obtuse, or rounded, papery to thinly leathery; flowers axillary, solitary or to 3 in a cluster; petals greenish; fruits globose.

**Local distribution:** Core areas of forest.

*Eurya cerasifolia* (D. Don) Kobuski, *Ann. Missouri Bot. Gard.* 25: 3226. 1938 publ. 1937. *Diospyros cerasifolia* D. Don, *Prodr. Fl. Nepal.* 144. 1825. L.N.: Kalikath

**Exsiccatae:** *Animesh & AP Das* 108, dated 19. 01. 2009.

Trees, densely yellowish brown; lamina oblong to oblong-oblongeolate, basal ½ entire and upper ½ serrulate, acuminate to caudate-acuminate, base broadly cuneate to obtuse, leathery to thinly leathery; flowers in axillary cymes; males leathery, females slightly smaller.

**Local distribution:** Throughout the forests.

### PHYLLANTHACEAE

*Antidesma acidum* Retzius, *Observ. Bot.* 5: 30. 1788. L.N.: Bhotey Archal

**Exsiccatae:** *Animesh & AP Das* 080, dated 18. 01. 2009; 151, dated 06. 02. 2009.

Shrubs; lamina obovate to elliptic-oblong, rounded to acute or acuminate, sometimes mucronate, base acute to obtuse, rarely attenuate, papery; spikes terminal to axillary, simple to branched twice at base; flowers white; drupes ellipsoid, nearly terete to laterally compressed.

**Local distribution:** River side forests.

*Antidesma bunius* (Linnaeus) Sprengel, *Syst. Veg.* 1: 826. 1824. *Stilago bunius* Linnaeus, *Mant. Pl.* 1: 122. 1767. L.N.: Archal

**Exsiccatae:** *Animesh & AP Das* 271, dated 20. 09. 2009.

Small trees; lamina oblong, elliptic to obovate, acute to rounded, base acute to rounded, leathery or thickly papery; racemes axillary or terminal, robust; flowers white, males sessile; drupes ellipsoid, laterally compressed, red to black when ripe.

**Local distribution:** Stream side hill slopes.

*Aporosa octandra* (Buchanan-Hamilton ex D. Don) Vickery, *Enum. Fl. Pl. Nepal* 3: 193. 1982. *Myrica octandra* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal.* 56. 1825. L.N.: Barkumble

**Exsiccatae:** *Animesh & AP Das* 120, dated 20. 01. 2009.

Small trees; lamina elliptic, narrowly ovate, oblong-elliptic, entire or sparsely shallowly dentate, rounded to acute, base rounded or cuneate, leathery; spikes axillary, females longer; flowers greenish; capsules ellipsoid.

**Local distribution:** Core areas of forest.

*Bridelia sikkimensis* Gehrmann, *Bot. Jahrb. Syst.* 41(95): 34. 1908. L.N.: Gayo Lahara

**Exsiccatae:** *Animesh & AP Das* 029, dated 17. 01. 2009.

Small trees; lamina obovate, sometimes elliptic, entire, rounded or truncate, rarely acute, sometimes with short acumen, base obtuse, rounded, or shallowly cordate, papery or thinly leathery; flowers in axillary monoecious clusters, yellowish-green.

**Local distribution:** River side forests.

*Bridelia stipularis* (Linnaeus) Blume, *Bijdr.* 597. 1826. *Clusia stipularis* Linnaeus, *Mant. Pl.* 1: 127. 1767. L.N.: Gayo Lahara

**Exsiccatae:** *Animesh & AP Das* 188, dated 11. 05. 2009.

Woody climbers; lamina elliptic, obovate or rounded, entire, acute or obtuse, base obtuse to rounded, subleathery; 2–6 flowered clusters axillary; flowers yellowish; drupes ovoid.

**Local distribution:** Hill area forests.

*Glochidion thomsonii* (Müller Argoviensis) Hooker f., *Fl. Brit. India* 5: 318. 1887. *Phyllanthus thomsonii* Müller Argoviensis, *Flora* 48: 375. 1865. L.N.: Latikath

**Exsiccatae:** *Animesh & AP Das* 179, dated 11. 05. 2009.

Shrubs; lamina oblong or elliptic, acuminate to obtuse, base obtuse, leathery; inflorescence axillary clusters; flowers greenish; capsules depressed globose.

**Local distribution:** Hill forest areas.

*Flueggea virosa* (Roxburgh ex Willdenow) Royle, *Ill. Bot. Himal. Mts.* 328. 1836. *Phyllanthus virosus* Roxburgh ex Willdenow, *Sp. Pl.* 4: 578. 1805.

**Exsiccatae:** *Animesh & AP Das 216*, dated 14. 05. 2009.

Small shrubs, branches erect; lamina elliptic, oblong to obovate, entire, slightly revolute when dry, rounded to acute, mucronulate, base obtuse to cuneate; flowers in axillary clusters, yellowish; berry subglobose to obovate, bright white when ripe.

**Local distribution:** Stream side forests.

*Phyllanthus acidus* (Linnaeus) Skeels, *Bull. Bur. Pl. Industr. U.S.D.A.* 148: 17. 1909. *Averrhoa acida* Linnaeus, *Sp. Pl.* 428. 1753.

**Exsiccatae:** *Animesh & AP Das 502*, dated 28. 09. 2010.

Deciduous trees, monoecious; lamina elliptic or oblong, acute, apiculate, base obtuse to rounded, membranous, slightly glaucous abaxially; flowers axillary, solitary or in cymose fascicles; reddish; berries globose.

**Local distribution:** River valley.

*Phyllanthus emblica* Linnaeus, *Sp. Pl.* 982. 1753. **L.N.:** *Anmla*

**Exsiccatae:** *Animesh & AP Das 025*, dated 17. 01. 2009.

Deciduous monoecious trees; lamina oblong or linear-oblong, narrowly revolute, truncate, rounded or obtuse, mucronate or retuse at tip, base shallowly cordate and slightly oblique, papery to leathery; fascicles with male flowers and sometimes 1 - 2 larger female flowers; flowers yellowish; drupes globose.

**Local distribution:** River valley.

*Phyllanthus fraternus* G.L. Webster, *Contr. Gray Herb.* 176: 53. 1955. **L.N.:** *Kanchi saag*

**Exsiccatae:** *Animesh & AP Das 223*, dated 14. 05. 2009.

Erect annual herbs; lamina oblong or elliptic-oblong, obtuse or rounded and often apiculate, base rounded, membranous or thinly papery; flower in fascicles, males in lower axils, middle ones with 1 female and 1 male, yellowish white; capsules smooth.

**Local distribution:** Throughout the forests.

*Sauropus compressus* Müller Argoviensis, *Prodr.* 15(2): 243. 1866.

**Exsiccatae:** *Animesh & AP Das 358*, dated 09. 02. 2010.

Erect shrubs, branchlets compressed in upper portion; lamina ovate, elliptic, or rounded, rounded or obtuse, mucronate, base rounded or obtuse, membranous or thinly papery; cymes axillary, 1-2 flowered; flowers whitish; capsules ovoid.

**Local distribution:** Stream side hill slopes.

## PIPERACEAE

*Piper attenuatum* Buchanan-Hamilton ex Miquel, *Syst. Piperac.* 306. 1843.

**Exsiccatae:** *Animesh & AP Das 082*, dated 18. 01. 2009.

Root-climbers; stems ridged and furrowed when dry; lamina ovate-orbicular or ovate, cuspidate or mucronate, base rounded to subcordate, usually truncate, membranous; spikes leaf-opposed, green; drupe drying black, ovoid to globose.

**Local distribution:** Throughout the forests.

*Piper betloides* Chaveer & Tanomtung, *Acta Phytotax. Geobot.* 58: 33. 2007. **L.N.:** *Gachpaan*

**Exsiccatae:** *Animesh & AP Das 026*, dated 17. 01. 2009.

Climbers, dioecious, stems rooted at nodes; lamina ovate to ovate-oblong, at apex of stem sometimes elliptic, papery to leathery, acuminate, base cordate, sometimes rounded; male spikes nearly as long as leaf blades at anthesis; drupes fused to form terete, fleshy.

**Local distribution:** Through out the forests.

*Piper chuyva* Miquel, *Syst. Piperac.* 267. 1843.

*Exsiccatae: Animesh & AP Das 470*, dated 26. 09. 2010.

Root-climbers; stems ridged and furrowed when dry; lamina toward base of stem elliptic to narrowly elliptic, oblong to oblong-lanceolate or ovate, acute to long acuminate, base oblique, 1 side rounded, other side tapered and acute, papery to thinly papery; male spikes slender, females erect.

**Local distribution:** Throughout the forests.

*Piper khasianum* Casimir de Candolle, *Prodr. 16(1): 349. 1869.*

*Exsiccatae: Animesh & AP Das 501*, dated 28. 09. 2010.

Root-climbers; stoloniferous; lamina ovate-orbicular or ovate, cuspidate or mucronate, base rounded to subcordate, usually truncate, membranous; dioecious, spikes leaf-opposed, green; drupes ovoid to globose.

**Local distribution:** Roadside forest areas.

*Piper longum* Linnaeus, *Sp. Pl. 29. 1753. L.N.: Pipla*

*Exsiccatae: Animesh & AP Das 455*, dated 25. 09. 2010.

Root-climbers; lamina of basal leaves ovate to reniform, those of upper leaves ovate to ovate-oblong, densely glandular, acute to acuminate, base cordate, papery; dioecious; spikes leaf-opposed, recurved; drupes globose.

**Local distribution:** River valley.

*Piper mullesua* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal. 20. 1825. L.N.: Chabuk*

*Exsiccatae: Animesh & AP Das 287*, dated 21. 09. 2009.

Woody root-climbers; lamina elliptic or narrowly elliptic or ovate-lanceolate, without glands, caudate-acuminate, base cuneate, symmetric or slightly oblique, papery to thinly leathery; spikes leaf-opposed; drupes obovoid.

**Local distribution:** Throughout the forests.

*Piper peepuloides* Roxburgh, *Fl. Ind. 1: 159. 1820. L.N.: Gach Pipla*

*Exsiccatae: Animesh & AP Das 475*, dated 26. 09. 2010.

Herbaceous root-climbers; lamina ovate to ovate-oblong, for upper leaves sometimes elliptic, acuminate, base cordate, sometimes rounded, papery to leathery; dioecious; spikes leaf-opposed, whitish.

**Local distribution:** Streamside hill slopes.

*Piper pedicellatum* Casimir de Candolle, *J. Bot. 4: 164. 1866. L.N.: Choi Larang*

*Exsiccatae: Animesh & AP Das 535*, dated 29. 09. 2010.

Root-climbers; stem glabrous; lamina ovate or narrowly ovate to elliptic, finely glandular, acute to acuminate, base oblique, sometimes higher side rounded, papery; spikes leaf-opposed; drupes obovoid, 4-angled.

**Local distribution:** Roadside forest areas.

*Piper sylvaticum* Roxburgh, *Fl. Ind. 1: 158–159. 1820.*

*Exsiccatae: Animesh & AP Das 410*, dated 16. 05. 2010.

Herbaceous root-climbers; lamina usually ovate, those of upper leaves ovate-lanceolate, densely glandular, acuminate, base cordate, symmetric, papery; dioecious; spikes leaf-opposed, male spikes slender, female spikes erect, whitish; drupes globose.

**Local distribution:** Core areas of forest.

*Peperomia pellucida* (Linnaeus) Kunth, *Nov. Gen. Sp. (quarto ed.) 1: 64. 1816.*

*Exsiccatae: Animesh & AP Das 213*, dated 13. 05. 2009.

Annual herbs, fleshy, translucent, diffuse; lamina broadly ovate or ovate-triangular, length equal to width, both surfaces glabrous, translucent, acute or obtuse, base cordate, fleshy, membranous on drying; spikes terminal or leaf-opposed; flowers bisexual, lax; nutlets globose.

**Local distribution:** Throughout the forests.

## PLANTAGINACEAE



*Scoparia dulcis* Linnaeus, *Sp. Pl.* 116. 1753.

**Exsiccatae:** Animesh & AP Das 346, dated 08. 02. 2010.

suffrutescent, erect, perennial; leaves in whorl; lamina rhomboid-ovate to rhomboid-lanceolate, toothed above middle, serrate, or subentire, obtuse, base cuneate, glabrous, glandular punctate; flowers usually axillary, white; capsules globose with persistent style.

**Local distribution:** Roadside forests.

### POLYGONACEAE

*Persicaria capitata* (Buchanan-Hamilton ex D. Don) H. Gross, *Bot. Jahrb. Syst.* 49: 277. 1913.

*Polygonum capitatum* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal.* 73. 1825. L.N.: Amilo saag

**Exsiccatae:** Animesh & AP Das 263, dated 20. 09. 2009.

Perennial herbs, stems creeping; lamina with large blackish spot adaxially, ovate or elliptic, entire and glandular hairy, acute, base cuneate; heads terminal; flowers pink; achenes black-brown, trigonous.

**Local distribution:** Riverside forests.

*Persicaria chinensis* (Linnaeus) H. Gross, *Bot. Jahrb. Syst.* 49(2): 269. in obs. 1913. *Polygonum*

*chinense* Linnaeus, *Sp. Pl.* 1: 363. 1753. L.N.: Amilo jhaar

**Exsiccatae:** Animesh & AP Das 231, dated 14. 05. 2009.

Perennial under-shrubs, stems erect, slender, weak; lamina ovate, elliptic, or lanceolate, entire, shortly acuminate, base truncate or broadly cordate; heads terminal or axillary, capitates; flowers pinkish; achenes black, broadly ovoid, trigonous.

**Local distribution:** River valley.

*Persicaria hydropiper* (Linnaeus) Delarbre, *Fl. Auvergne ed. 2:* 518. 1800. *Polygonum hydropiper* Linnaeus, *Sp. Pl.* 361. 1753. L.N.: Amilo jhaar

**Exsiccatae:** Animesh & AP Das 273, dated 20. 09. 2009.

Erect, annual, much-branched herbs; stem glabrous; lamina lanceolate or elliptic-lanceolate, acuminate, base cuneate, both surfaces glabrous, margins ciliate; spikes terminal or axillary, partially pendulous; flowers reddish; achenes black-brown, ovoid, biconvex or trigonous.

**Local distribution:** River valley.

### PRIMULACEAE

*Ardisia solanacea* Roxburgh, *Pl. Coromandel 1:* 27. 1795. L.N.: Kancho Ragat

**Exsiccatae:** Animesh & AP Das 328, dated 07. 02. 2010.

Shrubs, branches soft; lamina elliptic or oblanceolate, subrevolute, entire, acute, base cuneate or narrowly decurrent on petiole, veins elevated below; racemes from bases of new shoots, corymbose-paniculate; flowers pinkish; fruits purplish red or blackish, oblate.

**Local distribution:** Throughout the forests.

*Maesa chisia* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal.* 148. 1825. L.N.: Dudh Seola

**Exsiccatae:** Animesh & AP Das 423, dated 16. 05. 2010.

Shrubs, branchlets angular; lamina oblong, elliptic-lanceolate to oblanceolate, serrate, caudate-acuminate, base cuneate, glabrous, papery; spikes compound; flowers white; fruits globose.

**Local distribution:** Core areas of forest.

*Maesa indica* (Roxburgh) Alphonse de Candolle, *Trans. Linn. Soc. London* 17(1): 134. 1834.

*Baeobotrys indica* Roxburgh, *Fl. Ind.* 2: 230. 1824.

**Exsiccatae:** Animesh & AP Das 210, dated 13. 05. 2009.

Shrubs; branches slightly scandent; lamina broadly ovate to oblong, serrate-dentate or -denticulate, teeth not callose, acute or acuminate, base obtuse or subrounded, papery; spikes compound; flowers white; fruits globose.

**Local distribution:** Throughout the forests.

*Maesa macrophylla* Wallich, *Fl. Ind.* 2: 234. 1824. L.N.: Bhogote

*Exsiccatae*: Animesh & AP Das 127, dated 05. 02. 2009.

Small trees, profusely branched; lamina broadly ovate, serrate-dentate or -denticulate, acute, base obtuse or subrounded, papery; spikes small, forming compound umbles; flowers yellowish white; fruits globose or subglobose.

**Local distribution**: Core areas of forest.

#### RHAMNACEAE

*Ventilago denticulata* Willdenow, *Neue Schriften Ges. Naturf. Freunde Berlin* 3: 417. 1801. L.N.: Sialphusre

*Exsiccatae*: Animesh & AP Das 113, dated 20. 01. 2009.

Small trees; lamina ovate-oblong to ovate-elliptic, obtusely dentate, long acuminate, base subrounded, symmetric or asymmetric, papery or subleathery; flowers small in axillary clusters, bisexual; drupes densely pubescent, wing oblong.

**Local distribution**: Hill forest areas.

*Berchemia floribunda* (Wallich) Brongniart, *Ann. Sci. Nat. (Paris)* 10: 357. 1827. *Ziziphus floribunda* Wallich, *Fl. Ind.*, 2: 368–369. 1824.

*Exsiccatae*: Animesh & AP Das 235, dated 19. 09. 2009.

Climbing shrubs; lamina ovate or ovate-elliptic to elliptic, entire, obtuse to rounded or acute to acuminate base rounded to cordate, papery; flowers in fascicles, terminal cymose panicles or axillary cymose racemes; flowers yellowish; drupes red, bluish black at maturity, cylindric-elliptic to ovoid-oblong.

**Local distribution**: Throughout the forests.

*Gouania leptostachya* de Candolle, *Prodr.* 2: 40. 1825.

*Exsiccatae*: Animesh & AP Das 277, dated 20. 09. 2009.

Climbing shrubs with tendrils; lamina ovate or ovate-oblong, crenate-serrate, acuminate, base cordate, papery; flowers solitary or in fascicles of pedunculate cymes, polygamous, whitish; capsules 3-winged.

**Local distribution**: Throughout the forests.

*Ziziphus jujuba* Miller, *Gard. Dict. ed. 8:1.* 1768. L.N.: Sanu Baer

*Exsiccatae*: Animesh & AP Das 111, dated 20. 01. 2009.

Trees, semi-deciduous to deciduous; lamina ovate to elliptic-oblong, crenate-serrate, obtuse or rounded, rarely acute, mucronulate base slightly asymmetric, subrounded, glabrous, adaxially, 3-veined from base, papery; solitary or 2–8 crowded in axillary cymes; flowers bisexual, yellow-green; drupes turning red-purple at maturity, oblong or narrowly ovoid.

**Local distribution**: Riverside forest areas.

*Ziziphus oenopolia* (Linnaeus) Miller, *Gard. Dict. (ed. 8) no. 3.* 1768. *Rhammus oenopolia* L., *Sp. Pl.* 1: 194. 1753.

*Exsiccatae*: Animesh & AP Das 203, dated 12. 05. 2009.

Shrubs, scandent; lamina ovate-oblong or ovate-lanceolate, crenate, acute or acuminate, base usually asymmetric, subrounded, 3-veined at base, papery; pedunculate cymes axillary; flowers greenish yellow; drupe black, shiny, globose or obovoid-globose.

**Local distribution**: River valley.

*Ziziphus rugosa* H.J. Lam, *Encycl.* 3(1): 319. 1789. L.N.: Baer

*Exsiccatae*: Animesh & AP Das 031, dated 17. 01. 2009.

Shrubs, evergreen; lamina broadly ovate or broadly elliptic, serrulate, rounded, base subcordate or rounded, oblique, 3–5-veined from base, subleathery; flowers green, terminal or axillary cymose panicles or cymose racemes; flowers greenish; drupe orange, turning black at maturity, obovoid-globose or subglobose.

**Local distribution**: River valley.

#### RHIZOPHORACEAE

*Carallia brachiata* (Loureiro) Merrill, *Philipp. J. Sci.* 15: 249. 1919. *Diatoma brachiata* Loureiro, *Fl. Cochinch.* 296. 1790. L.N.: Phalamekath

**Exsiccatae:** Animesh & AP Das 178, dated 11. 05. 2009.

Trees; lamina oblong-elliptic, entire, base cuneate, coreaceous; flowers shortly pedicellate or sessile, bracteates, white; fruits pink to red, globose.

**Local distribution:** Throughout the forests.

## ROSACEAE

*Eriobotrya bengalensis* (Roxburgh) Hooker f., *Fl. Brit. India (Rosaceae)*; 371. 1878. *Mespilus bengalensis* Roxburgh, *Fl. Ind.* 510. 1832. L.N.: Maya

**Exsiccatae:** Animesh & AP Das 153, dated 07. 02. 2009.

Trees, deciduous; lamina lanceolate, oblong, or elliptic, both surfaces glabrous, remotely shortly incised-serrate, entire near base, acuminate, base cuneate; panicle spreading, densely flowered; flowers brownish; pome ovoid-globose.

**Local distribution:** Hill forest areas.

## RUBIACEAE

*Benkara fasciculata* (Roxburgh) Ridsdale, *Reinwardtia* 12: 298. 2008. *Posoqueria fasciculata* Roxburgh, *Fl. Ind.* 2: 568. 1824. *Fagerlindia fasciculata* (Roxburgh) Tirvengadam, *Nordic. J. Bot.* 3: 458. 1983.

**Exsiccatae:** Animesh & AP Das 145, dated 06. 02. 2009.

Small trees, climbing tendency, usually armed with paired spines; lamina ovate-orbicular to lanceolate or ovate-lanceolate, acute to caudateacuminate, base rounded to obtuse or broadly cuneate; cymes terminal on lateral branches; flowers redish; berry globose.

**Local distribution:** Riverside forest areas.

*Catunaregam longispina* (Link) Tirvengadam, *Edinburgh J. Bot.* 53: 95. 1996. *Posoqueria longispina* Link, *Enum. Pl.* 1: 225. 1821. L.N.: Amra

**Exsiccatae:** Animesh & AP Das 229, dated 14. 05. 2009.

Small trees; lamina obovate or oblong-obovate, strigose, entire or often shortly ciliate, acute, base cuneate and sometimes decurrent; cymes terminal on lateral short shoots; flowers yellow.

**Local distribution:** Core areas of forest.

*Cephalanthus tetrandra* (Roxburgh) Ridsdale & Bakhuizen van den Brink, *Blumea* 23: 182. 1976. *Nauclea tetrandra* Roxburgh, *Fl. Ind.* 2: 125. 1824. L.N.: Kalikath

**Exsiccatae:** Animesh & AP Das 307, dated 22. 09. 2009.

Deciduous, small trees; lamina ovate-lanceolate, elliptic or elliptic-oblong, usually glabrous, acute to acuminate, base obtuse, rounded, or subcordate; inflorescence densely tomentulose or pilosulous, 1 – 10 flowering heads; flowers yellowish.

**Local distribution:** Core areas of forest.

*Haldina cordifolia* (Roxburgh) Ridsdale, *Blumea* 24: 361. 1978. *Nauclea cordifolia* Roxburgh, *Pl. Coromandel* 1: 49. 1796. L.N.: Karam

**Exsiccatae:** Animesh & AP Das 155, dated 07. 02. 2009.

Trees, deciduous; lamina broadly ovate, entire, acute to acuminate, base cordate; flowers in small heads, yellow.

**Local distribution:** Core areas of forest.

*Ixora athroantha* Bremekamp, *Indian Forester* 85: 372. 1959.

**Exsiccatae:** Animesh & AP Das 304, dated 22. 09. 2009.

Shrubs, sparsely branched; lamina ovate oblong to oblong elliptic, entire, shortly acuminate, base cuneate, coreaceous; cymose umbels terminal; flowers pedicellate or sessile, bisexual, yellow.

**Local distribution:** Throughout the forests.

*Ixora nigricans* Robert Brown ex Wight & Arnott, *Prodr. Fl. Ind. 1: 428. 1834. L.N.: Tilke*

**Exsiccatae:** Animesh & AP Das 442, dated 25. 09. 2010.

Shrubs; lamina ovate to ovate elliptic, entire, acute to shortly acuminate, base cuneate, coreaceous; cymose umbels terminal; flowers pedicellate or sessile, bisexual, redish.

**Local distribution:** Core areas of forest.

*Ixora undulata* Roxburgh, *Fl. Ind. 1: 385. 1820.*

**Exsiccatae:** Animesh & AP Das 299, dated 22. 09. 2009.

Shrubs; lamina elliptic-oblong, elliptic or oblanceolate, glabrous on both surfaces, rounded, obtuse, or bluntly acute base cuneate, rounded, or subcordate, papery to subleathery; umble head terminal; flowers pedicellate or sessile, bisexual, red.

**Local distribution:** Through out the forests.

*Meyna spinosa* Roxburgh ex Link, *Jahrb. Gewächsk. 1(3): 32. 1820. L.N.: Katamoli, Sanu Mayna*

**Exsiccatae:** Animesh & AP Das 284, dated 21. 09. 2009.

Large shrubs to small trees; lamina obovate or oblong-obovate or rarely ovate to spatulate, entire or often shortly ciliate, acute, base cuneate and sometimes, coreaceous or subleathery; 1–3-flowered clusters terminal on young lateral short shoots; flowers yellow; berry globose.

**Local distribution:** Riverside forest areas.

*Morinda angustifolia* Roxburgh, *Pl. Coromandel 3: 32. 1815.*

**Exsiccatae:** Animesh & AP Das 378, dated 14. 05. 2010.

Erect shrubs, branches few; lamina elliptic-oblong, elliptic, oblong-lanceolate, or oblanceolate, acute to acuminate, base acute to attenuate, leathery; heads solitary and leaf-opposed; flowers white; drupes obovoid to subglobose.

**Local distribution:** Throughout the forests.

*Mussaenda roxburghii* Hooker f., *Fl. Brit. India 3: 87. 1880. L.N.: Hardipate*

**Exsiccatae:** Animesh & AP Das 204, dated 12. 05. 2009.

Shrubs; lamina broadly elliptic, elliptic-oblong, ovate, or oblanceolate, acute to caudate-acuminate, base acute, obtuse, or rounded, thinly leathery; head terminal; petaloid sepal white, corolla yellow; berry ovoid or ellipsoid.

**Local distribution:** Throughout the forests.

*Neonauclea griffithii* (Hooker f.) Merrill, *J. Wash. Acad. Sci. 5: 540. 1915. Adina griffithii* J.D. Hooker, *Fl. Brit. India 3: 24. 1880. L.N.: Santalu*

**Exsiccatae:** Animesh & AP Das 413, dated 16. 05. 2010.

Evergreen trees; lamina obovate to elliptic, rounded then abruptly cuspidate or acute, base acute to cuneate and frequently decurrent, both surfaces glabrous; flowering heads solitary, terminal; flowers whitish; capsules obconic.

**Local distribution:** Core areas of forest.

*Neolamarckia cadamba* (Roxburgh) Bosser, *Bull. Mus. Natl. Hist. Nat., B, Adansonia 6: 247. 1984.*

*Nauclea cadamba* Roxburgh, *Fl. Ind. 2: 121. 1824. L.N.: Kadam*

**Exsiccatae:** Animesh & AP Das 059, dated 18. 01. 2009.

Deciduous trees; lamina elliptic or oblong-elliptic, entire, acute, base shallowly cordate on juvenile growth, rounded or truncate on adult growth, thinly leathery; flowers in globose terminal heads; infructescence obovoid.

**Local distribution:** Riverside forest areas.

*Paederia foetida* Linnaeus, *Mant. Pl. 1: 52. 1767.*

**Exsiccatae:** Animesh & AP Das 359, dated 18. 01. 2009.

Perennial shrubby climber, rooting at nodes touching soil; lamina ovate, ovate-oblong, lanceolate elliptic or elliptic, acute or acuminate, base cuneate, rounded, truncate, or sometimes cordulate to cordate, subleathery; flowers small in cymose clusters, terminal or from axils; whitish with purple markings; capsule globose.

**Local distribution:** Common along the forest margins.

**Psilanthus bengalensis** (Roxburgh ex Schultes) J.-F. Leroy, *Bull. Mus. Natl. Hist. Nat., B, Adansonia* 3: 252. 1981. *Coffea bengalensis* Roxburgh, *Fl. Ind. ed. 2, 1: 540.1832.*

**Exsiccatae:** Animesh & AP Das 659, dated 18. 01. 2009.

Oppositely branched small shrubs; lamina elliptic, elliptic-oblong, or occasionally ovate-oblong, glabrous on both surfaces, occasionally crisped-undulate, acuminate, base cuneate to obtuse; flowered in axillary clusters; flowers sessile or shortly pedicellate, bisexual, white; drupes green, subglobose, black on ripening.

**Local distribution:** Throughout the forests.

**Rubia manjith** Roxburgh ex Fleming, *Asiat. Res. 11: 177. 1810. L.N.: Majeto*

**Exsiccatae:** Animesh & AP Das 411, dated 16. 05. 2010.

Herbaceous scrambler; normal leaf and leafy stipule similar; lamina oblong-lanceolate, ovate-lanceolate, thinly revolute, long acuminate or caudate, base rounded to cordate, herbaceous, scabrid below; thyrses paniculate, terminal and axillary, many flowered; flowers brick-red.

**Local distribution:** Hill forest areas.

**Spermacoe alata** Aublet, *Hist. Pl. Guiane* 60. 1775. L.N.: *Pirey*

**Exsiccatae:** Animesh & AP Das 488, dated 27. 09. 2010.

Annual herbs, erect or suberect or prostrate; lamina elliptic or ovate-oblong, entire, acute or obtuse, base cuneate to obtuse then long decurrent, herbaceous; verticillastre axillary and infrequently also terminal, several flowered; corolla white; capsules ellipsoid to subglobose.

**Local distribution:** Throughout the forests.

**Spermacoe ocymoides** Burman f., *Fl. Indica* 34. 1768.

**Exsiccatae:** Animesh & AP Das 536, dated 29. 09. 2010.

Annual, prostrate to procumbent herbs; stem winged; lamina ovate or elliptic-oblong, entire, acute to obtuse, base obtuse to cuneate, herbaceous; verticillastre axillary; corolla white, minute.

**Local distribution:** Through out the forests.

**Wendlandia coriacea** (Wallich) de Candolle, *Prodr. 4: 412. 1830. Rondeletia coriacea* Wallich, *Fl. Ind. 2: 142. 1824.*

**Exsiccatae:** Animesh & AP Das 283, dated 21. 09. 2009.

Shrubs to small trees; lamina elliptic, elliptic-oblong, or obovate-oblong, acute or shortly acuminate, base cuneate or acute, leathery or coreaceous; thyrses paniculate, terminal and axillary, cymes many flowered; flowers white.

**Local distribution:** Riverside forest areas.

## RUTACEAE

**Aegle marmelos** (Linnaeus) Corrêa, *Trans. Linn. Soc. London* 5: 223. 1800. *Crateva marmelos* Linnaeus, *Sp. Pl.* 444. 1753. L.N.: *Bel*

**Exsiccatae:** Animesh & AP Das 126, dated 05. 02. 2009; 046, dated 17. 01. 2009.

Medium trees; lamina ovate to elliptic, crenate-serrate, acuminate or sometimes acute, base rounded to narrowly cuneate; flowers in few flowered racemose loose fascicles, terminal and axillary, whitish; fruits greenish yellow.

**Local distribution:** Riverside forest areas.

*Atalantia missionis* (Wight) Oliver, *J. Proc. Linn. Soc., Bot.* 5(Suppl. 2): 25. 1861.

**Exsiccatae:** Animesh & AP Das 107, dated 19. 01. 2009.

Trees; lamina lanceolate, entire, acuminate, base narrowly cuneate; panicle of racemes in fascicles, terminal and axillary; flowers bisexual white; fruits globose.

**Local distribution:** Core forest areas.

*Citrus limon* (Linnaeus) Osbeck, *Reise Ostindien* 250. 1765. *Citrus medica* var. *limon* Linnaeus, *Sp. Pl.* 782. 1753. L.N.: Janglee Limbu

**Exsiccatae:** Animesh & AP Das 156, dated 07. 02. 2009.

Shrubs, branches spiny; lamina ovate to elliptic, conspicuously crenulate, usually mucronate; axillary and terminal cymes; flowers bisexual, white; ripe fruits yellow, ellipsoid to ovoid, narrowed at both ends, sarcocarp in 8–11 segments, pale yellow.

**Local distribution:** Hill slope and core areas of forests.

*Citrus medica* Linnaeus, *Sp. Pl.* 782 1753. L.N.: Bhimira, Janglee Limbu

**Exsiccatae:** Animesh & AP Das 226, dated 14. 05. 2009.

Shrubs, branches spiny; lamina elliptic to ovate-elliptic, serrate, rounded, obtuse, or rarely mucronate, base cuneate; axillary and terminal cymes; flowers bisexual or male, white; fruits pale yellow when ripe, elliptic to subglobose, sarcocarp with 10–15 segments, colorless.

**Local distribution:** Commonly in stream side forests.

*Clausena excavata* Burman f., *Fl. Indica* 89. 1768. L.N.: Currypatta

**Exsiccatae:** Animesh & AP Das 281, dated 21. 09. 2009.

Under-shrubs; lamina ovate, lanceolate or rhomboid, asymmetric, repand, acute or obtuse, base oblique; flowers in terminal compound umbel, white or creamy white; fruits ellipsoid.

**Local distribution:** Throughout the forests.

*Glycosmis pentaphylla* (Retzius) de Candolle, *Prodr.* 1: 538. 1824. *Limonia pentaphylla* Retzius, *Observ. Bot.* 5: 24. 1788. L.N.: Dandisko

**Exsiccatae:** Animesh & AP Das 345, dated 08. 02. 2010.

Shrubs; lamina oblong, serrate, mucronate, base cuneate, chartaceous; flowers in umbel, white; fruits reddish, subglobose.

**Local distribution:** Throughout the open forests.

*Micromelum integerrimum* (Buchanan-Hamilton ex de Candolle) Wight & Arnott ex M. Roemer, *Fam. Nat. Syn. Monogr.* 1: 47. 1846. *Bergera integerrima* Buchanan-Hamilton ex de Candolle, *Prodr.* 1: 537. 1824.

**Exsiccatae:** Animesh & AP Das 168, dated 07. 02. 2009.

Small trees; lamina alternate to subopposite, elliptic, lanceolate or ovate, inequilateral, entire, acuminate, base cuneate; umbels compound; buds pale green, oblong, flowers pale yellow; fruits ellipsoid to obovoid.

**Local distribution:** Roadside forest area.

*Murraya koenigii* (Linnaeus) Sprengel, *Syst. Veg.* 2: 315. 1817. *Bergera koenigii* Linnaeus, *Mant. Pl.* 2: 555, 563. 1771. *Bergera koenigii* Linnaeus, *Mant. Pl.* 565. 1767.

**Exsiccatae:** Animesh & AP Das 089, dated 19. 01. 2009; 061, dated 18. 01. 2009.

Shrubs; lamina ovate, entire or crenulate, base obtuse to rounded and oblique; panicle terminal, many flowered; flowers white; fruit bluish black, ovoid to oblong.

**Local distribution:** Road side forest area.

*Murraya paniculata* (Linnaeus) Jack, *Malayan Misc.* 1(5): 31. 1820. *Chalcas paniculata* Linnaeus, *Mant. Pl.* 1: 68. 1767. L.N.: Bajrathenga

**Exsiccatae:** Animesh & AP Das 100, dated 19. 01. 2009.

Shrubs; lamina suborbicular to ovate to elliptic, entire or crenulate, rounded to acuminate; fascicles terminal and axillary; flowers white, fragrant; fruit orange to vermilion, narrowly ellipsoid or rarely ovoid.

**Local distribution:** Roadside forest areas.

*Toddalia asiatica* (Linnaeus) Lamarck, Tabl. Encycl. 2: 116. 1797. *Paullinia asiatica* Linnaeus, Sp. Pl. 1: 365. 1753.

**Exsiccatae:** Animesh & AP Das 487, dated 19. 01. 2009.

Shrubs, much prickly on stems and leaves; lamina elliptic or narrowly elliptic to obovate to oblanceolate, acuminate or rarely acute to obtuse or rounded, base narrowly cuneate to attenuate; flowers in racemes, creamy-white; fruits globose.

**Local distribution:** Riverside forest areas.

*Zanthoxylum budrunga* de Candolle, Prodr. 1: 728. 1824. L.N.: Timboor

**Exsiccatae:** Animesh & AP Das 337, dated 08. 02. 2010.

Trees with large wide prickles on trunks; lamina alternate or opposite, lanceolate or rarely ovate, serrulate, acuminate, base cuneate, oil glands numerous; cymose-corymbs terminal, to 30-flowered; flowers whitish.

**Local distribution:** Hill forest areas.

*Zanthoxylum nitidum* (Roxburgh) de Candolle, Prodr. 1: 727. 1824. *Fagara nitida* Roxburgh, Fl. Ind. 1: 439. 1820. L.N.: Lahare Timboor

**Exsiccatae:** Animesh & AP Das 071, dated 18. 01. 2009.

Woody climbers, trunk with tumor like prickles; leaves opposite; lamina, broadly ovate, subcordate, elliptic, narrowly elliptic, crenate at least toward apex or entire, acuminate to caudate, leathery; corymbs terminal; flowers pale yellowish; follicles reddish brown.

**Local distribution:** Core forest areas.

## SABIACEAE

*Sabia lanceolata* Colebrooke, Trans. Linn. Soc. London 12: 355, pl. 14, 1819.

**Exsiccatae:** Animesh & AP Das 182, dated 11. 05. 2009.

Woody climbers; lamina elliptic-oblong to lanceolate, both surfaces glabrous, acute or acuminate, base cuneate or cordate, papery to leathery; cymes 10 – 30 flowered, solitary, axillary or arranged in axillary panicles; flowers yellowish; schizocarp blueish when fresh, distinctly obovoid to oblong-obovoid or pyriform.

**Local distribution:** Core areas of forest.

## SALICACEAE

*Casearia graveolens* Dalzell, Hooker's J. Bot. Kew Gard. Misc. 4: 107. 1852. L.N.: Asare

**Exsiccatae:** Animesh & AP Das 232, dated 14. 05. 2009.

Small tree, branched on upper part; lamina broadly elliptic to elliptic-oblong, shallowly serrate, crenate, broadly acute, obtuse or rounded, base rounded or broadly obtuse, papery; axillary cymes; flowers yellow-green; capsule orange-yellow when ripe, dark reddish.

**Local distribution:** Throughout the forests.

*Flacourtia jangomas* (Loureiro) Raeuschel, Nomencl. Bot. ed. 3: 290. 1797. *Stigmarota jangomas* Loureiro, Fl. Cochinch. 2: 634. 1790. L.N.: Latka

**Exsiccatae:** Animesh & AP Das 279, dated 21. 09. 2009.

Small tree, trunk covered with compound spines; lamina narrowly ovate, ovate-elliptic or ovate-oblong, entire or serrate to crenate, obtuse or gradually tapering to narrowly acuminate, base acute, obtuse or rounded, thinly leathery to papery; cymose; flowers small, white; fruits brownish red or purple, finally blackish, subglobose, fleshy.

**Local distribution:** River valley.

## SAPINDACEAE

*Sapindus mukorossi* Gaertner, Fruct. Sem. Pl. 1: 342, pl. 70, f. 3. 1788. L.N.: *Ritha*

**Exsiccatae:** *Animesh & AP Das 323*, dated 07. 02. 2010.

Deciduous trees; lamina of leaflets oblong or ovate-lanceolate, base obtuse, acute or sometimes nearly acuminate, thinly coreaceous; racemes terminal, erect, tower-shaped; flowers yellowish; fertile schizocarps dark red or orange-red, globose.

**Local distribution:** Core areas of forest.

### SCROPHULARIACEAE

*Buddleja asiatica* Loureiro, *Fl. Cochinch.* 72. 1790. L.N.: *Bhimsinge*

**Exsiccatae:** *Animesh & AP Das 352*, dated 09. 02. 2010.

Large shrubs, less branched; lamina lanceolate to narrowly elliptic, serrate, acuminate, base cuneate; panicles mostly terminal, also axillary; flowers white, fragrant.

**Local distribution:** Riverside forest areas.

### SIMAROUBACEAE

*Ailanthus integrifolia* subsp. *calycina* (Pierre) Nooteboom, *Fl. Males.* 6: 218. 1962. *Ailanthus calycina* Pierre, *Fl. Forest. Cochinch.* t. 294. 1893. L.N.: *Gokul*

**Exsiccatae:** *Animesh & AP Das 476*, dated 26. 09. 2010.

Tall trees, evergreen; lamina ovate-lanceolate to ovate elliptic, acuminate, base cuneate; flowers unisexual or polygamous, 1-3 fasciculate; petals yellowish; fruits winged.

**Local distribution:** Core forest areas.

### SOLANACEAE

*Solanum aculeatissimum* Jacquin, *Icon. Pl. Rar.* 1: 5, pl. 41. 1781. L.N.: *Janglee Baigon*

**Exsiccatae:** *Animesh & AP Das 516*, dated 28. 09. 2010.

Annual herbs, much prickly, branched; lamina broadly ovate, 5-7-lobed or -parted, with angular or dentate sharp lobes, acute or obtuse, base truncate to subhastate; cymes axillary; flowers white; berry pale yellow, globose.

**Local distribution:** Throughout the forests.

### TAMARICACEAE

*Tamarix indica* Willdenow, *Ges. Naturf. Freunde Berlin Neue Schriften* 4: 214. 1803. L.N.: *Jhau*

**Exsiccatae:** *Animesh & AP Das 537*, dated 29. 09. 2010.

Shrubs, much branched; lamina lanceolate to ovate-lanceolate or ovate-orbicular, acuminate, base decurrent; flowers in spikes or panicles on terminal and lateral branches; flowers reddish.

**Local distribution:** River valley.

### TETRAMELIACEAE

*Tetrameles nudiflora* Robert Brown, *Pl. Jav. Rar.* 79, pl. 17. 1838. L.N.: *Maina*

**Exsiccatae:** *Animesh & AP Das 466*, dated 26. 09. 2010.

Large trees; lamina cordate-ovate or suborbicular, serrate, slightly 2- or 3-lobed when young, acute or acuminate; terminal spikes; flowers yellowish; capsule brown yellow at maturity, globose-urceolate.

**Local distribution:** On river bed.

### THEACEAE

*Schima wallichii* Choisy, *Syst. Verz.* 144. 1854. L.N.: *Chilaune*

**Exsiccatae:** *Animesh & AP Das 449*, dated 25. 09. 2010.

Large trees; lamina elliptic to broadly elliptic, entire, bluntly acute, base broadly cuneate, leathery; flowers axillary, solitary or to 3 in a cluster, white, fragrant; capsules brown, subglobose.

**Local distribution:** Core areas of forest.

### URTICACEAE



*Boehmeria cylindrica* (Linnaeus) Swartz, *Prodr. Veg. Ind. Occ.* 34. 1788. *Urtica cylindrica* Linnaeus, *Sp. Pl.* 984. 1753. L.N.: Malakhasrey

**Exsiccatae:** Animesh & AP Das 076, dated 18. 01. 2009.

Erect shrubs; lamina ovate, elliptic, oblong or subelliptic, denticulate, acuminate or caudate-acuminate, base broadly cuneate, rounded, slightly rough, chartaceous; spike-like congested, long; flowers whitish.

**Local distribution:** Hill area forests.

*Boehmeria penduliflora* Weddell ex D.G. Long, *Notes Roy. Bot. Gard. Edinburgh* 40: 130. 1982.

**Exsiccatae:** Animesh & AP Das 240, dated 19. 09. 2009.

Erect shrubs, much branched; lamina lanceolate or linear-lanceolate, minutely serrulate, teeth revolute, long acuminate or caudate, base obtuse, rounded or subcordate, rugose, thickly chartaceous; male spikes often in pairs, in proximal axils, shorter than females; female spikes unbranched; flowers yellowish.

**Local distribution:** Throughout the forests.

*Dendrocnide sinuata* (Blume) Chew, *Gard. Bull. Singapore* 21: 206. 1965. *Urtica sinuata*

Blume, *Bijdr. Fl. Ned. Ind.* 505. 1826.

**Exsiccatae:** Animesh & AP Das 147, dated 06. 02. 2009.

Large bushy shrubs, branchlets spreading, covered with stinging hairs; lamina elliptic, oblong- or obovate-lanceolate, entire, sinuate to irregularly denticulate, acute to long acuminate base cuneate, rounded or deeply cordate, leathery; male inflorescences long paniculate; female flowers fleshy, white; achene asymmetrically pyramidal.

**Local distribution:** Throughout the forests.

*Urtica dioica* Linnaeus, *Sp. Pl.* 984. 1753. L.N.: Sishnu

**Exsiccatae:** Animesh & AP Das 122, dated 05. 02. 2009.

Much bushy shrubs, sometimes suffrutescent, dioecious; lamina ovate, sometimes lanceolate, coarsely serrate or dentate, teeth often incurved-tipped, apex acuminate or long acuminate, base cordate to cuneate; racemes paniculate; flowers whitish; fruits subglobose.

**Local distribution:** Roadside forests and stream side; prefer open areas.

## VITACEAE

*Ampelocissus sikkimensis* (M.A. Lawson) Planchon, *Vigne Amer. Vitic. Eur.* 8: 375. 1884. *Vitis sikkimensis* M.A. Lawson, *Fl. Brit. India* 1(3): 650. 1875.

**Exsiccatae:** Animesh & AP Das 429, dated 17. 05. 2010.

Shrubby climber; lamina broadly ovate, base cordate, finely toothed, mucronate; dichasium compound, leaf-opposed, base with a bifurcate tendril; flowers yellowish white; berry red, globose.

**Local distribution:** Forest margins and stream side areas.

*Cayratia geniculata* (Blume) Gagnepain, *Notul. Syst. (Paris)* 1: 345. 1911. *Cissus geniculata*

Blume, *Bijdr.* 184. 1825.

**Exsiccatae:** Animesh & AP Das 340, dated 08. 02. 2010.

Woody lianas, tendrils bifurcate; leaves 3-foliolate, broadly ovate, sparse fine toothed, caudate or acuminate, base cuneate; dichasium compound, axillary; flowers whitish; berry nearly globose.

**Local distribution:** Throughout the forests.

*Cissus elongata* Roxburgh, *Fl. Ind.* 1: 411. 1820.

**Exsiccatae:** Animesh & AP Das 397, dated 15. 05. 2010.

Woody lianas, tendrils unbranched; leaves palmately 5-foliolate, lamina obovate-lanceolate or obovate-elliptic, 7-9 fine teeth on each side, cuspidate, base cuneate; compound dichasium pseudo-terminal or leaf-opposed; flowers whitish; berry purple-black at maturity.

**Local distribution:** Hill area forests.

*Cissus repanda* (Wight & Arnott) Vahl, *Symb. Bot.* 3: 18. 1794. No Basionym exist. L.N.: *Pani Lahara*

**Exsiccatae:** Animesh & AP Das 316, dated 07. 02. 2010.

Woody lianas, tendrils racemosely 5-7-branched; leaves simple, lamina ovate or bicular, irregularly toothed or undulate, acuminate, mucronate or acute, base cordate; compound umbels terminal or leaf-opposed; flowers whitish; berry globose.

**Local distribution:** Core areas of forest.

*Cissus repens* H.J. Lam, *Encycl.* 1: 31. 1783. L.N.: *Kali Lahara*

**Exsiccatae:** Animesh & AP Das 496, dated 27. 09. 2010.

Vines, herbaceous, tendrils bifurcate; leaves simple, lamina cordate oval, 9 – 12 sharp teeth on each side, acute or acuminate, base cordate, membranous; umbels terminal or leaf-opposed; flowers whitish.

**Local distribution:** Throughout the forests.

*Cyphostemma adenanthum* (Fresenius) Descoings, *Naturalia Monspel., Sér. Bot.* 18: 218. 1967.

*Cissus adenantha* Fresenius, *Mus. Senckenberg.* 2: 283. 1837. L.N.: *Charchare*

**Exsiccatae:** Animesh & AP Das 388, dated 14. 05. 2010.

Woody lianas, tendrils unbranched; lamina broadly ovate to ovate elliptic, sharp teeth on each side, acute or acuminate, base cordate, membranous; dichasium compound or an umbel, leaf-opposed; flowers whitish.

**Local distribution:** Core areas of forest.

*Leea aequata* Linnaeus, *Syst. Nat. (ed. 12)* 2: 627. 1767.

**Exsiccatae:** Animesh & AP Das 458, dated 25. 09. 2010.

Large shrub; lamina elliptic-lanceolate or ovate-lanceolate, irregularly toothed, acuminate or caudate acuminate, base cuneate or rounded; leaf-opposed compound dichasia; flowers greenish; berry oblate.

**Local distribution:** Throughout the forests.

*Leea asiatica* (Linnaeus) Ridsdale, *Bot. Hist. Hort. Malab.* 189. 1980. *Phytolacca asiatica* Linnaeus, *Sp. Pl.* 1: 441. 1753.

**Exsiccatae:** Animesh & AP Das 484, dated 27. 09. 2010.

Erect shrubs; leaves pinnate or 3-foliolate, lamina oblong, ovate-elliptic or long ovate, with rounded and obtuse teeth, acuminate or caudate, base rounded or slightly cordate; compound dichasia leaf-opposed, usually branched at base; flowers greenish; berry oblate.

**Local distribution:** Throughout the forests.

*Leea guineense* G. Don, *Gen. Hist.* 1: 712. 1831. L.N.: *Galeni*

**Exsiccatae:** Animesh & AP Das 362, dated 10. 02. 2010.

Small trees; Leaves 2 or 3-pinnate, lamina oval elliptic to long and roundly lanceolate, acute toothed, acuminate, base broadly cuneate, glabrous; dichasia leaf-opposed, densely ferruginous pubescent; flowers yellowish; berry subglobose.

**Local distribution:** Core areas of forest.

*Parthenocissus semicordata* (Wallich) Planchon, *Monogr. Phan.* 5: 451. 1887. *Vitis semicordata* Wallich, *Fl. Ind., ed. 1820* 2: 481. 1824. L.N.: *Charchara, Choi Larang*

**Exsiccatae:** Animesh & AP Das 380, dated 14. 05. 2010.

Woody lianas, tendrils with 4 – 6 branches; leaves 3-foliolate; lamina obovate-elliptic or obovate, 6–11-toothed, cuspidate, base asymmetric, nearly rounded or cuneate; polychasium with inconspicuous main axis; flowers whitish; berry globose.

**Local distribution:** Forest margins and stream side areas.

*Tetrastigma bracteolatum* (Wallich) Planchon, *Monogr. Phan.* [A. DC. & C. DC.] 5(2): 428. 1887. *Vitis bracteolata* Wallich, *Fl. Ind., ed. 1820* 2: 483. 1824. L.N.: *Jhuse Lahara*

**Exsiccatae:** Animesh & AP Das 524, dated 29. 09. 2010.

Lianas; stem slender, tendrils biforked or sometimes unbranched; leaves palmately compound, lamina elliptic-lanceolate to ovate-lanceolate, distantly teeth, acuminate or acute base cuneate, glabrous; inflorescence umbelliform, axillary; flowers whitish; berry globose.

**Local distribution:** Throughout the forests.

*Tetrastigma planicaule* (Hooker f.) Gagnepain, *Notul. Syst. (Paris) 1: 319. 1910. Vitis planicaulis* Hooker f., *Bot. Mag. 94: 5685 1868.*

**Exsiccatae:** Animesh & AP Das 441, dated 25. 09. 2010.

Woody lianas, stem plank-like flat; tendrils unbranched; leaves palmately 5-foliolate, lamina elliptic-lanceolate, lanceolate to ovate-lanceolate, 5–9-toothed on each side, teeth inconspicuous or fine, rarely large, acuminate or acute base cuneate, glabrous; axillary umbel; flowers yellowish; berry globose.

**Local distribution:** Throughout the forests.

*Tetrastigma serrulatum* (Roxburgh) Planchon, *Monogr. Phan. 5: 432. 1887. Cissus serrulata* Roxburgh, *Fl. Ind. 1: 432. 1820.*

**Exsiccatae:** Animesh & AP Das 481, dated 26. 09. 2010.

Shrubby climber; stem slender; leaves pedately 5-foliolate, lamina ovate-lanceolate, base rounded or cuneate, undulate with 5–8 fine teeth on each side, caudate, acuminate or acute, base of lateral leaflets asymmetric; axillary umbel; flowers whitish; berry purple-black at maturity, spheroid.

**Local distribution:** Throughout the forests.

*Tetrastigma thomsonianum* Planchon, *Monogr. Phan. 5: 439. 1887.*

**Exsiccatae:** Animesh & AP Das 306, dated 22. 09. 2009.

Woody lianas, tendrils biforked or sometimes unbranched; leaves 3 or 5-foliolate, lamina ovate-lanceolate, base rounded, fine teeth on each side, acute, base of lateral leaflets asymmetric; axillary umbel; flowers whitish.

**Local distribution:** Forest margins and stream side areas.

### 4.2.3 Class: Liliopsida

#### AMARYLLIDACEAE

*Crinum amoenum* Ker Gawler ex Roxburgh, *J. Sci. Arts (London) 3:106. 1817.*

**Exsiccatae:** Animesh & AP Das 050, dated 17. 01. 2009.

Perennial herbs with large globose underground bulb; lamina linear-lanceolate, undulate, acuminate, sharply pointed; umbel 10–24 flowered; flowers fragrant, white; capsule subglobose.

**Local distribution:** Common along forest margins and in open forests.

#### ARACEAE

*Alocasia macrorrhizos* (Linnaeus) G. Don, *Hort. Brit. ed. 3: 631. 1839. Arum macrorrhizon* Linnaeus, *Sp. Pl. 2: 965. 1753. L.N.: Kachu*

**Exsiccatae:** Animesh & AP Das 032, dated 17. 01. 2009.

Pachycaul herbs, massive; lamina ovate-sagittate, bluntly triangular, entire, weakly peltate in juveniles; spadix paired among leaf bases, subtended by membranous cataphylls; flowers yellowish; fruiting spathe green, oblong-ellipsoid; fruit ripening scarlet, ellipsoid.

**Local distribution:** Stream side hill slopes.

*Amorphophallus bulbifer* (Roxburgh) Blume, *Rumphia 1: 148. 1837. Arum bulbiferum* Roxburgh, *Fl. Ind. ed. 1832 3: 510. 1832. L.N.: Gurbe*

**Exsiccatae:** Animesh & AP Das 128, dated 05. 02. 2009.

Terrestrial herbs; leaf solitary; lamina elliptic-lanceolate, bifurcated many times, lobes acuminate. glabrous; spadix 1, epigeal, solitary; flowers brownish; berries orange-red when mature, ovoid.

**Local distribution:** Throughout the forests.

*Typhonium trilobatum* (Linnaeus) Schott, *Wiener Z. Kunst* 3: 72. 1829. *Arum trilobatum* Linnaeus, *Sp. Pl.* 2: 965. 1753. L.N.: *Karengi saag*

*Exsiccatae*: Animesh & AP Das 104, dated 19. 01. 2009.

Underground part a short, tuberous rhizome; lamina cordate-ovate, usually deeply 3-lobed, rarely 5-lobed; central lobe ovate, acuminate, sometimes mucronate; spadix appearing after leaves; flowers reddish; fruiting zone with spathe remaining; berries at first green with purple spots, white when mature, ellipsoid.

**Local distribution**: River valley.

*Xanthosoma brasiliense* (Desfontaines) Engler, *Pflanzenr.* IV, 23E: 58. 1920. *Caladium brasiliense* Desfontaines, *Tabl. École Bot. ed. 3*: 7, 386. 1829.

*Exsiccatae*: Animesh & AP Das 148, dated 06. 02. 2009.

Pachycaul herbs, massive; lamina ovate-sagittate to ovate-triangular, entire; spadix subtended by membranous cataphylls; flowers yellowish.

**Local distribution**: Throughout the forests.

## AREACACEAE

*Calamus erectus* Roxburgh, *Fl. Ind.* 3: 774. 1832. L.N.: *Gauribet*

*Exsiccatae*: Animesh & AP Das 006, dated 17. 01. 2009.

Stems clustered, non-climbing; leaf sheaths dark green with dark brown hairs, with short rows of brown, flattened spines, rachis to 3 m with up to 40 lanceolate pinnae per side, these regularly arranged; spikes pendulous; flowers greenish; fruits greenish- or reddish brown, ellipsoid.

**Local distribution**: Hill area forests.

*Calamus viminalis* Willdenow, *Sp. Pl.* 2: 203. 1799. L.N.: *Bet*

*Exsiccatae*: Animesh & AP Das 177, dated 11. 05. 2009.

Stems clustered, climbing; leaf-sheaths green with densely covered grayish or brownish hairs, rachis to 1.3 m with 32–55 gray-green lanceolate pinnae per side, distinctly clustered and spreading in different planes; spikes pendulous; flowers brownish green; fruits whitish or yellowish, globose.

**Local distribution**: Hill area forests.

*Caryota urens* Linnaeus, *Sp. Pl.* 2: 1189. 1753. L.N.: *Kharate Jharoo*

*Exsiccatae*: Animesh & AP Das 207, dated 13. 05. 2009.

Monopodial tree; leaves in terminal crown, pendulous, primary pinnae to 27 per side of rachis, secondary pinnae 12 – 27 per side of secondary rachis, with deeply jagged margins; spikes borne among leaves; flowers yellowish; fruits dull reddish or orange, globose.

**Local distribution**: Hill area forests.

*Phoenix sylvestris* (Linnaeus) Roxburgh, *Fl. Ind.* 3: 787. 1832. *Elate sylvestris* Linnaeus, *Sp. Pl.* 1189. 1753. L.N.: *Khejur*

*Exsiccatae*: Animesh & AP Das 161, dated 07. 02. 2009.

Monopodial tree; leaves in terminal crown; leaves to 2 m, pinnae 40–130 per side of rachis, linear, irregularly arranged; male inflorescences erect, with many rachillae, female inflorescences erect, becoming pendulous; flowers yellowish; fruits orange-brown or purple-brown, obovoid.

**Local distribution**: Hill forest areas.

## ASPARAGACEAE

*Asparagus filicinus* Buchanan-Hamilton ex D. Don, *Prodr. Fl. Nepal.* 49. 1825. L.N.: *Satamuli*

*Exsiccatae*: Animesh & AP Das 093, dated 19. 01. 2009.

Suffrutescent, stems erect, sparsely branched; cladodes in fascicles, linear, leaf spur spinescent, spine straight or subrecurved; inflorescences developing after cladodes, axillary, many flowered raceme; flowers white; fruits globose.

**Local distribution:** Riverside forest areas.

*Asparagus racemosus* Willdenow, *Sp. Pl.* 2: 152. 1799. L.N.: Satamuli, Kurilo, Nagbel

*Exsiccatae:* Animesh & AP Das 030, dated 17. 01. 2009.

Suffrutescent, stems climbing, branched; cladodes in fascicles, linear, spine straight; racemes developing after cladodes, axillary, many flowered raceme; flowers white; fruits globose.

**Local distribution:** Riverside forest areas.

#### COMMELINACEAE

*Commelina diffusa* Burman f., *Fl. Indica* 18. 1768. L.N.: Kane ghas

*Exsiccatae:* Animesh & AP Das 319, dated 07. 02. 2010.

Perennial herbs, stems creeping, rooting at nodes, branched; lamina lanceolate or proximal ones oblong, acuminate, base cordate or rounded, glabrous or hispid; cincinni dichotomously branched from base; flowers bluish; capsule oblong, trigonous.

**Local distribution:** River valley.

*Cyanotis vaga* (Loureiro) Schultes & Schultes f., *Syst. Veg.* 7: 1153. 1830. *Tradescantia vaga* Loureiro, *Fl. Cochinch.* 1: 193. 1790.

*Exsiccatae:* Animesh & AP Das 144, dated 06. 02. 2009.

Perennial herbs, bulbs globose, stems amply branched; leaves all cauline, lamina linear to lanceolate, acuminate, base cordate or rounded, abaxially glabrous or sparsely pub-escens; cincinni solitary; flowers blue; capsule obovoid, trigonous.

**Local distribution:** Roadside open vegetation.

*Floscopa scandens* Loureiro, *Fl. Cochinch.* 193. 1790. L.N.: Chillopai

*Exsiccatae:* Animesh & AP Das 224, dated 14. 05. 2009.

Perennial herbs, prostrate; leaves usually sessile or with short winged petiole, lamina elliptic to lanceolate, acuminate, base cordate or rounded; profusely terminal and axillary broomlike panicle inflorescences; flowers blue; capsule ovoid, compressed.

**Local distribution:** River Valley.

#### COSTACEAE

*Cheilocostus speciosus* (J. Koenig) C.D. Specht, *Taxon* 55: 159. 2006. *Banksea speciosa* J. Koenig, *Observ. Bot.* 3: 75. 1783.

*Exsiccatae:* Animesh & AP Das 269, dated 20. 09. 2009.

Rhizomatous geophyte; stem erect, tall, leafy; lamina oblong or lanceolate, acuminate or caudate-acuminate, base subrounded; spikes terminal; flowers white; capsule red, globose.

**Local distribution:** Throughout the forests.

#### CYPERACEAE

*Cyperus laxus* H.J. Lam, *Tabl. Encycl.* 1: 146. 1791. L.N.: Mothe

*Exsiccatae:* Animesh & AP Das 344, dated 08. 02. 2010.

Perennial herbs, culms erect, 3-angled; leaves equaling or shorter than culm; sheath pale green and eventually reddish brown; lamina wide, flat, scabrous; decomposed anthela terminal; nutlet dark brown, ellipsoid.

**Local distribution:** River valley.

*Eleocharis palustris* (Linnaeus) Roemer & Schultes, *Syst. Veg.* 2: 151. 1817. *Scirpus palustris* Linnaeus, *Sp. Pl.* 1: 47. 1753.

*Exsiccatae:* Animesh & AP Das 086, dated 19. 01. 2009.

Perennials, rhizomes creeping; leaf sheaths 1 or 2, basally red purple, tubular, lamina linear; spikelet oblong, many flowered; nutlet at first yellowish then becoming brownish, obovoid.

**Local distribution:** Stream side hill slopes.

*Eriophorum comosum* Nees in wight, Contrib. 110. 1834. L.N.: Baboi Khar

**Exsiccatae:** Animesh & AP Das 414, dated 16. 05. 2010.

Rhizomes short, culms densely tufted, 3-angled; leaves many, overtopping inflorescence; lamina linear, involute and scabrous, gradually tapering and setaceous toward apex; spikelets many; nutlet narrowly oblong.

**Local distribution:** River valley.

*Kyllinga brevifolia* Rottboell, Descr. Icon. Rar. Pl. 13. 1773. L.N.: Mothe

**Exsiccatae:** Animesh & AP Das 209, dated 13. 05. 2009.

Perennials, rhizomes slender, long creeping, culms compressed 3-angled; leaves shorter to slightly longer than culm; sheaths brown, mouth obliquely truncate, apex acuminate; lamina linear, flaccid, flat, midvein and apical margin spinulose; spike 1-3, globose; nutlet obovoid-oblong.

**Local distribution:** River valley.

*Scleria terrestris* (Linnaeus) Fassett, Rhodora 26: 159. 1924. *Zizania terrestris* Linnaeus, Sp. Pl. 2: 991. 1753.

**Exsiccatae:** Animesh & AP Das 280, dated 21. 09. 2009.

Perennial, stoloniferous, rhizomes woody; leaf sheaths papery; lamina linear, slightly scabrous, papery, glabrous; panicle with 1-3 distant branches; nutlets white or pale brown, spherical to ovoid.

**Local distribution:** Streamside vegetation.

## DIOSCOREACEAE

*Dioscorea belophylla* (Prain) Voigt ex Haines, Forest Fl. Chota Nagpur 530. 1910. *Dioscorea nummularia* var. *belophylla* Prain, Bengal Pl. 2: 1065. 1903. L.N.: Janglee alu

**Exsiccatae:** Animesh & AP Das 124, dated 05. 02. 2009.

Twining herbs, rootstock rhizomatous; leaves alternate, simple; lamina broadly ovate, entire, acuminate, base cordate to subtruncate; flowers arranged spirally in axillary, spikes, greenish; capsules globose or oblong-obovoid.

**Local distribution:** Hill area forests.

*Dioscorea deltoidea* Wallich ex Grisebach, Fl. Bras. 3(1): 43. 1842.

**Exsiccatae:** Animesh & AP Das 114, dated 20. 01. 2009.

Rhizome horizontal, ginger-shaped, stem twining to left; leaves alternate, simple; lamina triangular or triangular-ovate, entire, acuminate, base shallowly cordate to subtruncate; male flowers solitary or paired; flowers whitish; capsule reflexed, brown at maturity, globose or oblong-obovoid.

**Local distribution:** Hill area forests.

*Dioscorea esculenta* (Loureiro) Burkill, Gard. Bull. Straits Settlem. 1: 396. 1917. *Oncus esculentus* Loureiro, Fl. Cochinch. 1: 194. 1790.

**Exsiccatae:** Animesh & AP Das 438, dated 25. 09. 2010.

Twining herbs, stem twining to left; leaves alternate, simple; lamina broadly cordate, entire, acute, base cordate; spikes solitary, pendent; flowers whitish; capsule very seldom maturing, base truncate, apex slightly emarginated.

**Local distribution:** Road side bushes.

*Dioscorea hamiltonii* Hooker f., Fl. Brit. India 6: 294. 1892. L.N.: Jat tarul

**Exsiccatae:** Animesh & AP Das 339, dated 08. 02. 2010.

Twining herbs, rootstock rhizomatous; leaves simple; lamina broadly cordate or broadly ovate, entire, acuminate, base cordate; spikes long; flowers whitish; fruits oblong.

**Local distribution:** Core area of forests.

*Dioscorea prazeri* Prain & Burkill, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 73(Suppl.): 2. 1904. L.N.: Gittha

**Exsiccatae:** *Animesh & AP Das 198*, dated 12. 05. 2009.

Twining herbs, rootstock rhizomatous; leaves alternate, simple; lamina broadly cordate, entire, shortly acuminate, base cordate; spikes or racemes elongated; flowers yellowish; capsules ovoid, truncate, apex slightly emarginate.

**Local distribution:** Throughout the forests.

***Dioscorea pubera*** Blume, *Enum. Pl. Javae 1: 21. 1827.*

**Exsiccatae:** *Animesh & AP Das 321*, dated 07. 02. 2010.

Twining herbs, rootstock rhizomatous; leaves opposite, simple; lamina broadly cordate, shortly acuminate, base cordate; spikes axillary; flowers whitish.

**Local distribution:** Road side bushes.

## HYPOXIDACEAE

***Curculigo orchioides*** Gaertner, *Fruct. Sem. Pl. 1: 63. 1788.*

**Exsiccatae:** *Animesh & AP Das 158*, dated 07. 02. 2009.

Rhizomes erect, subcylindric; lamina lanceolate to linear, narrowly acuminate; umbel-like racemes, 4 - 6 yellow flowered; flowers white; berry subfusiform.

**Local distribution:** Core area of forests.

***Molineria capitulata*** (Loureiro) Herbert, *Amaryllidaceae 84. 1837. Leucojum capitulatum* Loureiro, *Fl. Cochinch. 199. 1790. L.N.: Sarah*

**Exsiccatae:** *Animesh & AP Das 038*, dated 17. 01. 2009.

Perennial herbs, rhizome stout; lamina oblong-lanceolate, acuminate; raceme deflexed capitates; flowers yellow in globose bracteates basal heads; berry white.

**Local distribution:** Forest margins and stream side areas.

## MARANTACEAE

***Phrynium pubinerve*** Blume, *Enum. Pl. Javae 38. 1827.*

**Exsiccatae:** *Animesh & AP Das 102*, dated 19. 01. 2009.

Herbs, rhizomes cylindric, fleshy, starchy; lamina oblong - elliptic, shortly cuspidate, base rounded to truncate; inflorescences 2 or 3 per leafy shoot; flowers white with blue veined; capsule trigonous, oblong ovoid, dehiscent.

**Local distribution:** River Valley.

## MUSACEAE

***Musa paradisiaca*** Linnaeus, *Sp. Pl. 1043. 1753. L.N.: Kera*

**Exsiccatae:** *Animesh & AP Das 110*, dated 19. 01. 2009.

Pseudostems clumped, yellow-green; lamina oblong, entire, petiole spongy, base asymmetric. spadix pendulous; flowers redish; berries yellow when ripe, oblong, slightly curve.

**Local distribution:** Hill forest areas.

## ORCHIDACEAE

***Aerides multiflora*** Roxburgh, *Pl. Coromandel 3: 68. 1820.*

**Exsiccatae:** *Animesh & AP Das 195*, dated 12. 05. 2009.

Epiphytic herbs, stems ascending, enclosed by leaf sheaths; leaves distichous, linear-oblong, tip bilobed, base jointed and sheathing, leathery, slightly fleshy; racemes densely many flowered; flowers pinkish.

**Local distribution:** Core area of forests.

***Aerides odorata*** Loureiro, *Fl. Cochinch. 525. 1790.*

**Exsiccatae:** *Animesh & AP Das 121*, dated 05. 02. 2009.

Stems branched; lamina broadly lorate, obtuse and unequally bilobed, base jointed, thickly leathery; inflorescence nodding, racemose, dense; flowers purple.

**Local distribution:** Core forest areas.

***Arundina graminifolia*** (D. Don) Hochreutiner, *Bull. New York Bot. Gard. 6: 270. 1910. Bletia graminifolia* D. Don, *Prodr. Fl. Nepal. 29. 1825. L.N.: Ghumring*

**Exsiccatae:** Animesh & AP Das 251, dated 19. 09. 2009.

Terrestrial, stems tall, rigid, enclosed by leaf sheaths; leaves numerous, acuminate, leathery or papery; inflorescence raceme or panicle; flowers pink.

**Local distribution:** Stream side hill slopes.

**Bulbophyllum careyanum** (Hooker) Sprengel, *Syst. Veg.* 3: 732. 1826. *Anisopetalon careyanum* Hooker, *Exot. Fl.* 2: t. 149. 1825. L.N.: Sunakheri

**Exsiccatae:** Animesh & AP Das 109, dated 19. 01. 2009.

Epiphytic herbs, rhizome creeping, bearing a series of pseudobulbs; leaves 1 or rarely 2, arising from apex of pseudobulbs, lamina usually leathery; flowers usually racemose or umbellate, yellow.

**Local distribution:** Core area of forests.

**Bulbophyllum cornu-cervi** King, *J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist.* 64(2): 332. 1895. L.N.: Jibanti, Sunakheri

**Exsiccatae:** Animesh & AP Das 485, dated 27. 09. 2010.

Epiphytic herbs, rhizome creeping, bearing a series of pseudobulbs; lamina elliptic to ovate, obtuse to acute; flowers usually racemose, yellow.

**Local distribution:** Hill slopes and core forest areas.

**Dendrobium aphyllum** (Roxburgh) C.E.C. Fischer, *Fl. Madras* 1416. 1928. *Limodorum aphyllum* Roxburgh, *Pl. Coromandel* 1: 34. 1795. L.N.: Musakane

**Exsiccatae:** Animesh & AP Das 172, dated 07. 02. 2009.

Epiphytic herbs, stems erect and many noded; lamina oblong-lanceolate, acute, base not decurrent into clasping sheath, leathery; racemes many flowered; flowers pink.

**Local distribution:** River valley.

**Dendrobium fugax** Reichenbach f., *Gard. Chron.* 1871: 1257. 1871.

**Exsiccatae:** Animesh & AP Das 237, dated 19. 09. 2009.

Epiphytic herbs, stems erect and many noded; leaves alternate, oblanceolate, acute, base not decurrent into clasping sheaths, leathery; racemes many flowered; flowers white.

**Local distribution:** Hill area forests.

**Dendrobium jenkinsii** Wallich ex Lindley, *Edwards's Bot. Reg.* 25: t. 37. 1839.

**Exsiccatae:** Animesh & AP Das 313, dated 22. 09. 2009.

Pseudobulbs aggregated, ovoid; leaves apical, oblanceolate, acute; 1-3 inflorescence arises from pseudobulbs; flowers yellow-orange.

**Local distribution:** Hill area forests.

**Eria lasiopetala** (Willdenow) Ormerod, *Opera Bot.* 124: 22. 1995. *Aerides lasiopetala* Willdenow, *Sp. Pl.* 4(1): 130. 1805.

**Exsiccatae:** Animesh & AP Das 335, dated 08. 02. 2010.

Epiphytic herbs, rhizome creeping, stems pseudobulbous; leaves convolute in bud, elliptic to narrowly elliptic, tapering at base, articulate, leathery; inflorescence axillary; flowers yellowish.

**Local distribution:** Riverside forests.

**Nephelephyllum pulchrum** Blume, *Bijdr.* 373. 1825.

**Exsiccatae:** Animesh & AP Das 170, dated 07. 02. 2009.

Terrestrial herbs, rhizomes creeping; leaves sessile, ovatecordate, acute, base subcordate, slightly fleshy; flowers terminal, white.

**Local distribution:** Hill area forests.

**Papilionanthe teres** (Roxburgh) Schlechter, *Orchis* 9: 78. 1915. *Dendrobium teres* Roxburgh, *Fl. Ind.*, ed. 1832, 3: 485. 1832.



*Exsiccatae: Animesh & AP Das 375*, dated 14. 05. 2010.

Stems rambling, branched; leaves well spaced, terete, obtuse, fleshy; racemes slightly longer than leaf; flowers pinkish white.

**Local distribution:** Throughout the forests.

*Oberonia ensiformis* (Smith) Lindley, *Fol. Orchid.* 8: 4. 1859. *Malaxis ensiformis* Smith in Rees, *Cycl.* 22: Malaxis no. 14. 1812.

*Exsiccatae: Animesh & AP Das 525*, dated 29. 09. 2010.

Plants rather large, short stem; leaves subbasal, laterally compressed, ensiform, slightly falcate, acuminate or long acuminate, base articulate, thick; many flowered spikes; flowers green.

**Local distribution:** Hill slope and core forest areas.

## PANDANACEAE

*Pandanus unguifer* Hooker f., *Bot. Mag.* 104: t. 6347. 1878. L.N.: *Janglee Anaras*

*Exsiccatae: Animesh & AP Das 167*, dated 07. 02. 2009.

Trees, stems erect, many branched; leaves simple, terminal, sessile, densely arranged in corkscrew spirals, linear, spinose-serrate; male inflorescence pedunculate; flowers whitish.

**Local distribution:** Hill area forests.

## POACEAE

*Bambusa tulda* Roxburgh, *Fl. Ind. ed.* 1832 2: 193. 1832. L.N.: *Filling Bnaas*

*Exsiccatae: Animesh & AP Das 296*, dated 21. 09. 2009.

Perennial, culms apically slightly drooping, culm sheaths deciduous; lamina broadly linear or linear-lanceolate, abaxially pale gray, densely villous, adaxially deep green, glabrous; spikes long.

**Local distribution:** Hill forest areas.

*Bambusa vulgaris* Schrader, *Coll. Pl.* 2: 26. 1808.

*Exsiccatae: Animesh & AP Das 094*, dated 19. 01. 2009.

Clumps rather open, ribbed-striate when dry; lamina narrowly lanceolate, both surfaces glabrous; pseudospikelets several, clustered at nodes.

**Local distribution:** Riverside forest areas.

*Capillipedium assimile* (Steudel) A. Camus, *Fl. Indo-Chine* 7: 314. 1922. *Andropogon assimilis* Steudel, *Syn. Pl. Glumac.* 1: 397. 1854. L.N.: *Kharugi / Mihi khar*

*Exsiccatae: Animesh & AP Das 261*, dated 20. 09. 2009.

Perennial, culms decumbent, rooting at base; lamina linear-lanceolate, setaceously acuminate, base tapering, glabrous or hispidulous; panicle pyramidal.

**Local distribution:** Streamside vegetation.

*Centotheca lappacea* (Linnaeus) Desvaux, *Nouv. Bull. Sci. Soc. Philom. Paris* 2: 189. 1810. *Cenchrus lappaceus* Linnaeus, *Sp. Pl.*, ed. 2, 2: 1488. 1763.

*Exsiccatae: Animesh & AP Das 212*, dated 13. 05. 2009.

Perennial, culms solitary or loosely tufted, erect; leaf sheaths smooth or ciliate along one margin, lamina broadly lanceolate, apex long-attenuate; spikelets clustered around them.

**Local distribution:** Riverside forest areas.

*Cynodon dactylon* (Linnaeus) Persoon, *Syn. Pl.* 1: 85. 1805. *Panicum dactylon* Linnaeus, *Sp. Pl.* 1: 58. 1753. L.N.: *Dubo*

*Exsiccatae: Animesh & AP Das 199*, dated 12. 05. 2009.

Perennial, runners long, slender; leaf sheaths bearded at mouth, otherwise glabrous or thinly pilose, lamina linear, short and narrow, subacute, usually glabrous; racemes digitate.

**Local distribution:** Throughout the forests.

*Eragrostis amabilis* (Linnaeus) Wight & Arnott, *Cat. Indian Pl.* 2: 105. 1834. *Poa amabilis* Linnaeus, *Sp. Pl.* 68. 1753. L.N.: *Bhnui Ghas*

**Exsiccatae:** Animesh & AP Das 138, dated 06. 02. 2009.

Annual, culms slender; leaf sheaths pilose at summit, compressed, margin submembranous; lamina flat or involute; panicle solitary or clustered, 4–10 flowered.

**Local distribution:** River valley.

*Panicum notatum* Retzius, *Observ. Bot.* 4: 18. 1786. L.N.: *Banso*

**Exsiccatae:** Animesh & AP Das 262, dated 20. 09. 2009.

Perennial, culms rambling; leaf sheaths striate, puberulous to subglabrous, ciliolate on margins toward throat; lamina lanceolate, scabrid, finely pointed to acuminate, base cordate, subglabrous to pubescent; panicle broadly ovate in outline, spikelets elliptic.

**Local distribution:** River valley.

*Oplismenus compositus* (Linnaeus) Palisot de Beauvois, *Ess. Agrostogr.* 54. 1812. *Panicum compositum* Linnaeus, *Sp. Pl.* 1: 57. 1753.

**Exsiccatae:** Animesh & AP Das 028, dated 17. 01. 2009.

Perennial, culms stoloniferous; leaf sheaths glabrous, pilose or tuberculate-hairy; lamina lanceolate to ovate-lanceolate, base usually oblique, subglabrous to tuberculate hairy; inflorescence ascending to erect.

**Local distribution:** Throughout the forests.

*Saccharum longisetosum* (Andersson) V. Narayanaswami ex Bor, *Fl. Assam 5(App. 1):* 461. 1940. *Erianthus longisetosus* Andersson, *Öfvers. Kongl. Vetensk.-Akad. Förh.* 12: 163. 1855.

**Exsiccatae:** Animesh & AP Das 173, dated 07. 02. 2009.

Perennial, with long rhizomes, culms erect; leaf sheaths longer than internodes, mouth bearded; lamina linear-elliptic, acuminate, tapering to base, glabrous; spikes with lower glume papery and dark brown below middle at maturity.

**Local distribution:** River valley.

*Saccharum spontaneum* Linnaeus, *Mant. Pl.* 2: 183. 1771. L.N.: *Kasphool*

**Exsiccatae:** Animesh & AP Das 092, dated 19. 01. 2009.

Perennial, with long rhizomes; culms erect; leaf sheaths pilose at mouth and margin, sometimes tuberculate-pilose throughout; lamina linear elliptic, serrate, long attenuate, tapering to midrib at base, glaucous, glabrous; callus hairs 3–4 times length of spikelet.

**Local distribution:** River valley.

*Setaria palmifolia* (J.Koenig) Stapf, *J. Linn. Soc., Bot.* 42: 186. 1914. *Panicum palmifolium* J.Koenig, *Naturforscher (Halle)* 23: 208. 1788.

**Exsiccatae:** Animesh & AP Das 140, dated 06. 02. 2009.

Perennial from a short woody, knotted rhizome, culms erect; leaf sheaths usually sparsely hispid, margins tuberculate-ciliate near ligule, otherwise glabrous; lamina fusiform-lanceolate, plicate, acuminate, narrowed toward base; spikelets broadly lanceolate.

**Local distribution:** River valley.

*Thysanolaena latifolia* (Roxburgh ex Hornemann) Honda, *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.* 3: 312. 1930. *Melica latifolia* Roxburgh ex Hornemann, *Suppl. Hort. Bot. Hafn.* 117. 1819. L.N.: *Kucho, Amlisho*

**Exsiccatae:** Animesh & AP Das 070, dated 18. 01. 2009.

Culms hard, unbranched; leaf sheaths smooth; lamina broadly lanceolate-oblong, leathery; ligule truncate; panicle up to 60 cm, open or contracted.

**Local distribution:** Hill area forests.

## SMILACACEAE

*Smilax ovalifolia* Roxburgh ex D. Don, *Prodr. Fl. Nepal.* 49. 1825.

*Exsiccatae*: Animesh & AP Das 492, dated 27. 09. 2010.

Large liana, less branched; lamina ovate-elliptic, entire, acute, base cuneate; umbels in compound inflorescence, axillary; flowers greenish; berry globose.

**Local distribution**: Core area of forests.

#### ZINGIBERACEAE

*Alpinia calcarata* (Haworth) Roscoe, *Trans. Linn. Soc. London* 8: 347. 1807. *Renealmia calcarata* Haworth, *Bot. Repos.* 6: t. 421. 1805. L.N.: Purundi

*Exsiccatae*: Animesh & AP Das 043, dated 17. 01. 2009.

Terrestrial and marshy area; pseudostems large; lamina linear-lanceolate, acuminate and caudate-mucronate, base attenuate, glabrous; inflorescence panicle, proximal branches 3- or 4 flowered; flowers pink with yellow spots; capsule red, globose.

**Local distribution**: River valley.

*Alpinia nigra* (Gaertner) Burt, *Notes Roy. Bot. Gard. Edinburgh* 35: 213. 1977. *Zingiber nigrum* Gaertner, *Fruct. Sem. Pl.* 1: 35. 1788.

*Exsiccatae*: Animesh & AP Das 125, dated 05. 02. 2009.

Pseudostems large; lamina lanceolate or elliptic-lanceolate, acute, base acute, glabrous; panicles erect, usually lax with remote cincinni; flowers pink, capsule black when dry, globose.

**Local distribution**: Riverside forest areas.

*Globba marantina* Linnaeus, *Mant. Pl.* 2: 170. 1771. L.N.: Janglee Hardi

*Exsiccatae*: Animesh & AP Das 136, dated 06. 02. 2009.

Pseudostem base expanded, branched; lamina oblong-elliptic to ovate-lanceolate, caudate, base acute; flowers in thyrsi, yellow, with orange, glandular spots; capsules ellipsoid.

**Local distribution**: Throughout the forests.

*Globba racemosa* Smith, *Exot. Bot.* 2: 115. 1806.

*Exsiccatae*: Animesh & AP Das 176, dated 11. 05. 2009.

Pseudostem base expanded; leaf sheath ciliate; lamina oblong or ovate-lanceolate, caudate, base acute; flowers in thyrses, solitary, yellow, with orange spots; capsules ellipsoid.

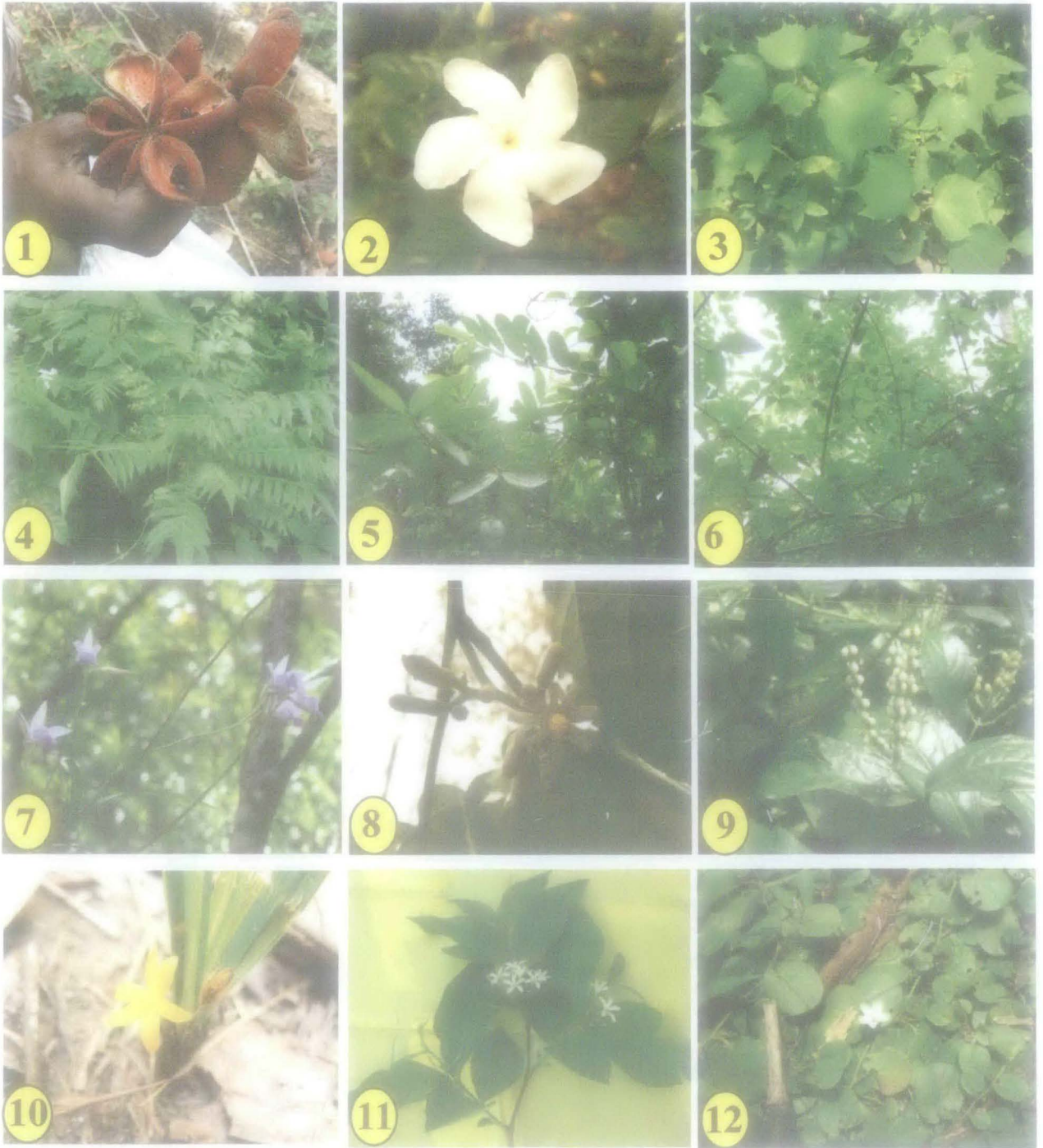
**Local distribution**: Throughout the forests.

*Hedychium thyrsiforme* J. E. Smith, *Cycl.* 17: 4. 1811. L.N.: Mala Khasrey

*Exsiccatae*: Animesh & AP Das 055, dated 17. 01. 2009.

Pseudostems large; lamina oblong-lanceolate or lanceolate, long acuminate, base acute; spikes compact, many flowered; flowers white, fragrant.

**Local distribution**: Core area of forests.



**Plate I (Flora of Jainti):**

1. Fruits of *Sterculia villosa* Roxburgh; 2. *Tabernaemontana divaricata* (Linnaeus) R. Brown ex Roemer & Schultes; 3. *Triumfetta rhomboidea* Jacquin; 4. *Clausena excavata* Burman f.; 5. *Psidium guajava* Linnaeus; 6. *Meyna spinosa* Roxburgh ex Link; 7. *Arundina graminifolia* (D. Don) Hochreutiner; 8. *Alangium chinense* (Loureiro) Harms; 9. *Chloranthus elatior* Link; 10. *Curculigo orchiioides* Gaertner; 11. *Holarrhena pubescens* Wallich ex G. Don; 12. *Evolvulus nummularius* (Linnaeus) Linnaeus



**Plate II (Flora of Jainti):**

13. *Rauvolfia serpentina* (Linnaeus) Bentham *ex* Kurz; 14. *Tetrastigma bracteolatum* (Wallich) Planchon; 15. *Helminthostachys zeylanica* (Linnaeus) Hooker; 16. *Papilionanthe teres* (Roxburgh) Schlechter; 17. *Polyalthia simiarum* (Buchanan-Hamilton *ex* Hooker *f.* & Thomson) Bentham *ex* Hooker *f.* & Thomson; 18. *Ardisia solanacea* Roxburgh; 19. *Globba racemosa* Smith; 20. *Ixora athroantha* Bremekamp; 21. *Angiopteris evecta* (G. Forster) Hoffmann; 22. *Morinda angustifolia* Roxburgh; 23. *Eranthemum pulchellum* Andrews; 24. *Lindernia ciliata* (Colsmann) Pennell; 25. *Lantana camara* Linnaeus; 26. *Cyanotis vaga* (Loureiro) Schultes & Schultes *f.*

CHAPTER: V  
RESULTS

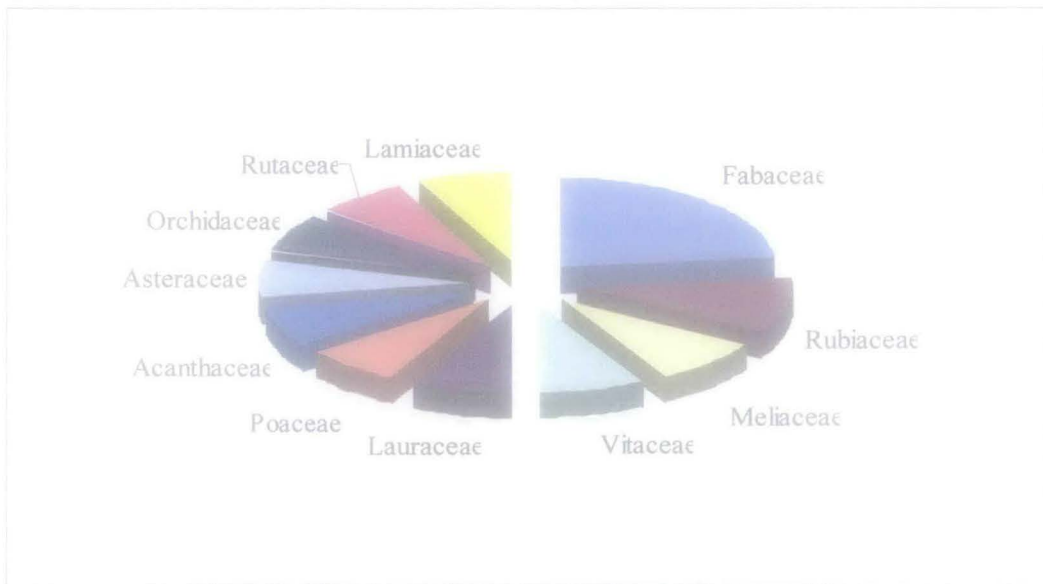
## CHAPTER: V

# RESULTS

Jainti Forest Range is administering the core area of BTR. Present study concentrates only in this area. This area is harbouring three types of forest – riverine, moist deciduous and evergreen. Existence of riverine forest is scanty. However, the other two types are well represented. Study has been done in plains and hilly areas close to the Indo-Bhutan border. Hilly area is quite inaccessible and this natural barrier helping this Protected Area to maintain its natural flora nicely.

### 5.1. FLORA

Jainti is the repository of at least 413 species of vascular plants of which 396 are angiospermic, 16 pteridophytic and only one gymnosperm species. These plants are distributed in 95 families.



**Fig 5.1. Number of species in dominated families**

It is observed that Fabaceae is represented by highest number of 40 species and is followed by Rubiaceae, Meliaceae, Vitaceae, Lauraceae, Poaceae, Acanthaceae, Asteraceae, Orchidaceae, Rutaceae, and Lamiaceae (Fig 5.1).

#### 5.1.1. Habit Groups

Habit-wise distribution of plants is given in Table 5.1.

**Table 5.1. Habit group classification of recorded plants**

HABIT	No. of species
Herb	139
Tree	150
Liana	18
Herabceous Climber	44
Shrubs and Shrubby climbers	62
<b>Total</b>	<b>413</b>

### 5.1.1. A. Trees

As much as 150 species of trees and 18 species of woody climbers or liana (total 168 species) are recorded in this forest stand from the sample plots. Of these, highest stem count has been recorded for *Shorea robusta* (99) and is followed by *Polyalthia simiarum* (75), *Duabanga grandiflora* (58), *Aglaia spectabilis* (45), *Tectona grandis* (37) and *Schima wallichii* (32) (Table 5.2). The mean DBH of trees in the forest is 26.02 cm with a mean height of 5.2 m. The total stem count is 893, giving a figure of 17.9 stems per plot with a projected stem of 595/ ha.

**Table 5.2. Phytosociological assesment of dominant tree species**

Scientific Name	Stem Count	D	RD	F	RF	Dm	RDm	IVI
<i>Shorea robusta</i>	99	0.0063	11.09	36	3.73	1380.97	12.26	27.08
<i>Aglaia spectabilis</i>	45	0.0029	5.04	52	5.39	512.41	4.55	14.98
<i>Polyalthia simiarum</i>	75	0.0048	8.40	48	4.98	20.47	0.18	13.56
<i>Duabanga grandiflora</i>	58	0.0037	6.49	64	6.64	16.85	0.15	13.28
<i>Tetrameles nudiflora</i>	4	0.0003	0.45	8	0.83	1209.00	10.73	12.01
<i>Wendlandia coriacea</i>	22	0.0014	2.46	14	1.45	519.10	4.61	8.52
<i>Aphanamixis polystachya</i>	16	0.0010	1.79	28	2.90	308.08	2.73	7.43
<i>Magnolia pterocarpa</i>	31	0.0020	3.47	30	3.11	22.49	0.20	6.78
<i>Schima wallichii</i>	32	0.0020	3.58	26	2.70	50.77	0.45	6.73
<i>Tectona grandis</i>	37	0.0024	4.14	14	1.45	32.09	0.28	5.88

### 5.1.1. B. Shrubs

The mean collar diameter (CD) of the woody species in the under-storey is 4.78 cm while the total stem count is found to be 153. The mean height is 2.89 m. There are about 3.06 stems per plot and the projected stem count/ ha is 1082.80. There are a total of 62 shrub species (one species *Bambusa tulda* is morphologically herb, however, methodologically considered as shrub) in the forest plots with a Simpson Diversity Index of 0.2164 and a Shannon Richness Index of 0.4388. *Tabernaemontana divaricata* (42), *Mussaenda roxburghii* (38), *Bambusa tulda* (23), *Meyna spinosa* (18) are the most dominant species (Table 5.3) in this tier.

**Table 5.3. Phytosociological assesment of dominant shrub species**

Scientific Name	Stem count	D	RD	F	RF	Dm	RDm	IVI
<i>Atalantia missionis</i>	2	0.003	1.31	2	2.22	0.099	61.14	64.67
<i>Mussaenda roxburghii</i>	38	0.001	24.84	30	33.33	0.006	3.47	61.64
<i>Tabernaemontana divaricata</i>	42	0.027	27.45	26	28.89	0.006	3.47	59.81
<i>Meyna spinosa</i>	18	0.030	11.76	10	11.11	0.006	3.47	26.34
<i>Bambusa tulda</i>	23	0.013	15.03	6	6.67	0.006	3.47	25.17
<i>Clerodendrum infortunatum</i>	4	0.016	2.61	6	6.67	0.006	3.47	12.75
<i>Citrus limon</i>	4	0.003	2.61	4	4.44	0.006	3.47	10.53
<i>Eranthemum griffithii</i>	3	0.002	1.96	4	4.44	0.006	3.47	9.87
<i>Buddleja asiatica</i>	2	0.001	1.31	4	4.44	0.006	3.47	9.22
<i>Artabotrys caudatus</i>	1	0.001	0.65	2	2.22	0.007	4.19	7.07

### 5.1.1. C. Herbs

Number of individuals in the studied plots is 3131, thus the individuals per plot is 62.62 and the projected number of individual count/ha is 199426.8. A total of 183 (Herb: 139 and Herbaceous climber: 44) species of herbs are recorded. *Panicum notatum* (989) followed by *Globba marantina* (504), *Alternanthera philoxeroides* (264), *Spermacoce alata* (228) are the most commonly occurring species (Table 5.4).



**Table 5.4. Phytosociological assesment of dominant herbs**

Scientific Name	Stem count	D	RD	F	RF	Dm	RDm	IVI
<i>Panicum notatum</i>	989	6.30	31.59	6	0.40	329.67	12.99	44.98
<i>Globba marantina</i>	504	3.21	16.10	54	3.56	18.67	0.74	20.39
<i>Alternanthera philoxeroides</i>	264	1.68	8.43	4	0.13	264.00	10.41	18.97
<i>Spermacoce alata</i>	228	1.45	7.28	2	0.13	228.00	8.99	16.40
<i>Lindernia parviflora</i>	168	1.07	5.37	14	0.13	168.00	6.62	12.12
<i>Barleria prionitis</i>	159	1.01	5.08	4	0.13	159.00	6.27	11.48
<i>Cynodon dactylon</i>	196	1.25	6.26	2	0.26	98.00	3.86	10.39
<i>Eragrostis amabilis</i>	239	1.52	7.63	16	0.92	34.14	1.35	9.90
<i>Piper mullesua</i>	135	0.86	4.31	14	0.26	67.50	2.66	7.24
<i>Bulbophyllum careyanum</i>	168	1.07	5.37	8	0.92	24.00	0.95	7.23

### 5.1.1. D. Seedlings

Total number of seedlings of trees and shrubs recorded from the studied plots is 974. Thus seedlings per plot are 19 and the projected seedling count/ ha are 61847. Highest number of seedlings counted in *Stereospermum tetragonum* (67) followed by *Croton tiglium* (59), *Magnolia champaca* (44), *Ziziphus rugosa* (27), *Sesbania sesban* (25) are the most commonly occurring species (Table 5.5).

**Table 5.5. Phytosociological assesment of dominant seedlings**

Name of the Plant	Stem count	D	RD	F	RF	Dm	RDm	IVI
<i>Stereospermum tetragonum</i>	67	0.426	6.879	4	0.621	0.013	1.378	8.878
<i>Syzygium cumini</i>	22	0.140	2.259	24	3.727	0.014	1.378	7.364
<i>Croton tiglium</i>	59	0.375	6.057	4	0.621	0.003	0.344	7.023
<i>Sesbania sesban</i>	25	0.159	2.567	12	1.863	0.014	1.378	5.808
<i>Pterygota alata</i>	1	0.006	0.103	18	2.795	0.027	2.756	5.654
<i>Chukrasia tabularis</i>	16	0.101	1.643	12	1.863	0.021	2.067	5.573
<i>Erythropsis colorata</i>	6	0.038	0.616	18	2.795	0.021	2.067	5.478
<i>Ziziphus rugosa</i>	27	0.171	2.772	10	1.553	0.007	0.689	5.014
<i>Magnolia champaca</i>	44	0.280	4.517	2	0.311	0.002	0.172	5.000
<i>Bauhinia purpurea</i>	6	0.038	0.616	18	2.795	0.010	1.034	4.445

### 5.1.1. E. Saplings

The mean basal area of the saplings is 5.15 cm and the mean height is 4.44 m. The total stem count of the plots in thus stems per plot are 6.8 and the projected stem count/ha is 2406. Saplings of 69 species of trees and shrubs have been recorded. Highest number of saplings was found for *Magnolia pterocarpa* (15) and *Ficus neriifolia* (15) and was followed by *Actinodaphne obovata* (13), *Aglaia spectabilis* (11) and *Polyalthia simiarum* (10) (Table 5.6).

## 5.2. NON TIMBER FOREST PRODUCES [NTFP]

There are 112 plant species in BTR those are recorded to be collected by the locals of which 59 plants are purely for their own subsistence and the remaining 53 are for commercial purpose only. Among the commercial species 35 are widely sold in the market and the rest are rarely sold.

### 5.2.1. Species used for subsistence

Local people use 17 trees, 7 woody climbers (Liana), 11 shrubs, 17 herbs and 7 herbaceous climbers in their daily life for their own survival. Of these people use three as broom, eighteen edible in raw, fourteen medicinal, four rope making, ten vegetables, three religious, one each as gun powder, fencing, housing, packing butter, storing drinking water and as pigs fodder. Parts of plant used by them are fruit of nineteen species, leaf of sixteen species, stem of twelve species, whole plant of four species, root of three species, bark of two species, seed, petiole and tender tip of one species each (Annexure IV).

**Table 5.6. Phytosociological assesment of dominant saplings**

Name of the Plant	Stem count	D	RD	F	RF	Dm	RDm	IVI
<i>Magnolia pterocarpa</i>	15	0.011	4.412	24	5.854	0.475	38.353	48.618
<i>Ficus neriifolia</i>	15	0.011	4.412	16	3.902	0.409	33.038	41.352
<i>Ailanthus grandis</i>	7	0.005	2.059	14	3.415	0.021	1.727	7.201
<i>Casearia graveolens</i>	9	0.006	2.647	12	2.927	0.019	1.509	7.083
<i>Streblus asper</i>	5	0.004	1.471	14	3.415	0.022	1.746	6.631
<i>Aglaia spectabilis</i>	11	0.008	3.235	12	2.927	0.001	0.118	6.280
<i>Actinodaphne obovata</i>	13	0.009	3.824	8	1.951	0.004	0.327	6.102
<i>Polyalthia simiarum</i>	10	0.007	2.941	10	2.439	0.009	0.700	6.080
<i>Litsea cubeba</i>	6	0.004	1.765	12	2.927	0.016	1.282	5.973
<i>Aporosa dioica</i>	8	0.006	2.353	10	2.439	0.006	0.468	5.260

### 5.2.2. Major commercial species

Jainti villagers harvest 18 trees, 2 liana, 6 shrubs, 7 herbs, and 2 herbacious climbers for sell off in the market only. These form one important source of earning to sustain their families. They sell their collected NTFPs to the local traders, mostly in their village. However, a few of them sell it to the nearby town at Alipurduar. Harvested NTFPs include, nineteen medicinal, fourteen decorative and one each as dry flower/broom, insance, handicraft (Annexure V). *Bombax ceiba*, *Oroxylum indicum*, *Thysanolaena latifolia*, *Luffa aegyptica*, *Rubia manjith* and *Parthenocissus himalayana* has multiple uses. Local people regularly harvest stem, leaf, inflorescence, fruit, floss, gum etc. of the noted NTFP species from this forest to sustain their life. Harvesters sell their harvested products to the local trader, who, in turn, supplies the materials to a trader in the nearby city-market at Coochbehar.

### 5.2.3. Minor commercial species

Jainti people also collect 18 floral species those are with less commercial importance (Annexure VI). Eight of these are trees, two shrubs, four herbs and four are herbaceous climbers. They use these species for subsistence as well as for commercial purpose. Parts used are edible fruits (5), fruit cover (3), stem (2), leaf (2), and one each of leaf vein, root, bark seed and whole plant. Ethno-botanically six of these species are used as medicine, two as adulterant, one for sowing in the forest to grow elephant fodder, five as decorative, and one each as edible, rope making, ply wood and for religious purpose.

### 5.2.4. Threatened and Endangered NTFPs

*Angiopteris evecta* is a medicinally useful plant and enlisted by IUCN as an endangered species (Srivastava, 2008). Botanical Survey of India's list ([www.bsi.gov.in](http://www.bsi.gov.in) downloaded on 10.12.2013) of threatened plants included two of the recorded species, namely *Rauwolfia serpentina* and *Dioscorea deltoidea*. Particularly, the medicinally important plants have become threatened due to over exploitation from their wild habitat. *Alstonia scholaris* is listed as thretend by IUCN ([www.iucnredlist.org/search](http://www.iucnredlist.org/search)) however, it is a common tree in study area.

### 5.2.5. Altitudinal variation and the availability of NTFPs

The altitude of the study area varies from 85 to 480 m and NTFP producing species are also growing along this entire range. However, larger number of NTFPs is collected from the low altitude areas. The most interesting fact revealed is that 50 % of the commercially harvested species as well as species use for subsistence are generally growing upto 150 m altitude.

## 5.3. IMPACT OF DIFFERENT ATTRIBUTES ON VEGETATION

### 5.3.1. Elevation

The topography of Jainti forest area is a mixture of plain land and hilly terrains. For the present study sample plots are located between 85 to 480 m altitudes. Altitudinal variation creates a space for wide range of species. Higher number of the species is recoded in alluvium plains region within 85 – 149 m (Table 5.7)

Table 5.7. Distributional range of NTFP species

Altitudinal range (Meter)	No of Species	Percent of species
Alluvium plain (AP) [85-149 m]	49	45
Foot hills (FH) [150-250 m]	6	6
Hills (H) [> 250 m]	15	5
AP to FH	17	15
FH to H	2	1
AP to H	23	22

### 5.3.2. Slope

Slope or gradient of the habitat plays substantial role in regeneration, survival, growth and maturation of a plant. Major part of the study area is alluvium plain (0°) and the heighest slope (65°) noted in one plot (Table 5.8 and Annexure VII).

Table 5.8. Slope-wise distribution of studied plots

Range of slope in Degree	0°	1-10°	11-20°	21-30°	31-40°	41-50°	51-60°	61-70°	71-80°
Number of plots	26	10	1	3	8	1	0	1	0

### 5.3.3. Plot aspect

Duration of sunlight available to a plant depends on the aspect of a slope where it is growing. Flora of a place varies greatly depending on the availability of sunlight to the concerned vegetation. Vegetation on alluvium plain has ben represented the highest number of floristic elements and one can understand that vegetation on plains can receive light from all directions (Table 5.9).

Table 5.9. Aspect-wise distributional ratio of plants

Plants occurred	Alluvium Plain	East	South-East	South	South-West	West	North-West	North	North-East
Percent	60	3	9	7	7	5	5	4	1

### 5.3.4. Soil nutrients

Jainti forest has plain and hilly areas. Major soil nutrients (Nitrogen, Phosphorus and Pottasium and Sulpher) have been estimated from the soil in three topographical areas. Soil moisture, pH, soil Carbon (%) and other organic matter (%) also have been estimated (Table 5.10).

**Table 5.10.** Major soil components across the study area

Season	Topography	pH	Moisture (gm.)	Org C%	Org matter %	N %	P (ppm)	K (ppm)	S (ppm)
Pre-Monsoon	Alluvium plain	5.20	2.13	1.29	0.9594	0.068	87.01	103.14	12.22
	Foot hill	5.96	2.38	1.12	0.7995	0.053	79.02	95.32	19.32
	Hill	4.75	0.96	1.17	0.7011	0.046	73.35	109.27	11.18
Post-Monsoon	Alluvium plain	6.26	1.00	2.13	0.5904	0.032	65.18	97.01	23.39
	Foot hill	5.69	1.73	1.38	0.7626	0.051	69.17	108.65	18.41
	Hill	5.73	1.63	0.52	0.6273	0.034	61.65	101.19	19.91
Winter	Alluvium plain	4.40	1.33	0.98	1.0209	0.071	92.78	89.39	47.01
	Foot hill	4.86	0.68	1.13	1.0701	0.076	89.69	76.48	35.65
	Hill	4.77	1.63	1.24	1.0332	0.072	83.34	73.39	38.98

Soil pH is higher in alluvium plain in post-monsoon. Foot hills soil maintain highest soil pH during pre- and post-monsoon period (Table 5.10). Similarly, soil moisture of foot hills area is higher in two seasons (pre-monsoon and post-monsoon) and is quite low in winter. Organic carbon (%) is also high in foot hill areas during post-monsoon and winter. The interesting trend observed that, soil carbon content is gradually decreasing from winter – pre-monsoon – post-monsoon seasons (Table 5.11). Other organic matters, Nitrogen (N), Phosphorus (P) and Pottasium (K) also showed the similar trend like soil carbon in foot hill areas. However, Hill areas registered highest K in soil. Sulpher (S) is showed an opposite trend and highest amount is present in alluvium plains during post-monsoon and in winter (Table 5.10).

#### 5.4. ANALYSIS OF ASSOCIATION AMONG THE DOMINANT SPECIES

##### 5.4.1. Association among the dominant trees

*Shorea robusta* is the most dominant species in this forest with highest association percentage (88.89 %) in the studied plots compared to other dominant species (Table 5.11). *Polyalthia simiarum* and *Schima wallichii* also have association tendencies (77.78 %) with the dominant species followed by *Duabanga grandiflora* and *Aglaia spectabilis* (66.67 %) and *Wendlandia coriacea*. On the other hand, *Magnolia pterocarpa* (55.56 %) and *Tectona grandis* (33.33 %) showed quite low affinity and the lowest affinity with the dominant species has been determined for *Tetrameles nudiflora* (11.11 %).

**Table 5.11.** Association of dominant trees

Association of dominant tree species (present/plot)										
Name of trees	<i>Shorea Robusta</i>	<i>Aglaia Spectabilis</i>	<i>Polyalthia simiarum</i>	<i>Duanabanga grdiflora</i>	<i>Tetrameles Nudiflora</i>	<i>Wendlandia coriacea</i>	<i>Aphanamixis polystachia</i>	<i>Magnolia pterocarpa</i>	<i>Schima wallichii</i>	<i>Tectona grandis</i>
<i>Shorea robusta</i>	18	9	7	7	4	0	3	4	1	1
<i>Aglaia spectabilis</i>	9	26	2	2	2	0	1	1	1	0
<i>Polyalthia simiarum</i>	7	2	24	1	0	0	3	0	1	0
<i>Duanabanga grdiflora</i>	7	2	1	32	4	1	0	15	0	1
<i>Tetrameles nudiflora</i>	4	2	0	4	4	0	1	3	0	0
<i>Wendlandia coriacea</i>	0	0	0	1	0	7	0	1	0	0
<i>Aphanamixis polystachia</i>	3	1	3	0	1	0	14	0	0	0
<i>Magnolia pterocarpa</i>	4	1	0	15	3	1	0	15	0	0
<i>Schima wallichii</i>	1	1	1	0	0	0	0	0	13	1
<i>Tectona grandis</i>	1	0	0	1	0	0	0	0	1	7

### 5.4.2. Association among the dominant shrubs

*Atalantia missionis* has the highest (85.71 %) association affinity with the dominant shrub species followed by *Tabernaemontana divaricata* (42.86 %) and *Mussaenda roxburghii*, *Bambusa tulda*, *Meyna spinosa* and *Clerodendrum infortunatum* (28.57 %). *Citrus limon*, *Eranthemum griffithii*, *Buddleja asiatica* and *Arbotrys caudatus* have grown rarely with any other dominant shrub species (Table 5.12).

**Table 5.12.** Association of dominant shrubs

Association of dominant shrubs (Presence/plot)										
Name of Shrubs	<i>Atalantia Missionis</i>	<i>Mussaenda roxburghii</i>	<i>Tabernaemontana divaricata</i>	<i>Meyna Spinosa</i>	<i>Bambusa tulda</i>	<i>Clerodendrum infortunatum</i>	<i>Citrus limon</i>	<i>Eranthemum griffithii</i>	<i>Buddleja asiatica</i>	<i>Arbotrys caudatus</i>
<i>Atalantia missionis</i>	1	1	1	1	0	1	0	1	0	1
<i>Mussaenda roxburghii</i>	1	5	3	0	0	0	0	0	1	1
<i>Tabernaemontana divaricata</i>	1	3	3	3	1	0	1	0	0	1
<i>Meyna spinosa</i>	1	0	3	5	1	2	0	0	0	0
<i>Bambusa tulda</i>	0	0	1	1	3	0	0	0	0	0
<i>Clerodendrum infortunatum</i>	1	0	0	2	0	3	0	1	1	0
<i>Citrus limon</i>	0	0	1	0	0	0	2	0	0	0
<i>Eranthemum griffithii</i>	1	0	0	0	0	1	0	3	0	0
<i>Buddleja asiatica</i>	0	1	0	0	0	1	0	0	2	0
<i>Arbotrys caudatus</i>	1	1	1	0	0	0	0	0	0	1

### 5.4.3. Association among the dominant herbs

*Panicum notatum* is the most widely associated (88.89 %) herbaceous species of the study area followed by *Globba marantina* (77.78 %), *Eragrostis amabilis*, *Alternanthera philoxeroides*, *Lindernia parviflora*, *Bulbophyllum careyanum* (66.67%), *Barleria prionitis* (55.56%) and *Piper mullesua* (44.44%). Least affinity towards other dominant species is found for *Cynodon dactylon* (11.11%) (Table 5.13).

**Table 5.13.** Association of dominant herbs

Association of dominant herbs & seedlings (presence/plot)										
Name of Herbs	<i>Panicum Notatum</i>	<i>Globba bulbifera</i>	<i>Alternanthera philoxeroides</i>	<i>Spermacoce alata</i>	<i>Lindernia parviflora</i>	<i>Barleria prionitis</i>	<i>Cynodon Dactylon</i>	<i>Eragrostis amabilis</i>	<i>Piper mullesua</i>	<i>Bulbophyllum careyanum</i>
<i>Panicum notatum</i>	3	1	2	1	1	0	1	0	1	0
<i>Globba bulbifera</i>	1	27	2	4	1	0	0	0	1	1
<i>Alternanthera philoxeroides</i>	2	2	3	3	0	0	0	1	0	1
<i>Spermacoce alata</i>	1	1	1	1	0	1	0	0	1	1
<i>Lindernia parviflora</i>	1	1	0	0	1	1	0	1	1	1
<i>Barleria prionitis</i>	0	0	0	1	1	1	0	1	1	1
<i>Cynodon dactylon</i>	1	0	0	0	0	0	2	0	0	0
<i>Eragrostis amabilis</i>	0	0	1	0	1	1	0	7	0	2
<i>Piper mullesua</i>	1	1	0	1	1	1	0	0	2	1
<i>Bulbophyllum careyanum</i>	0	1	1	1	1	1	0	2	1	7

#### 5.4.4. Association of NTFPs with dominant trees

The associatedness among the recorded NTFP species and ten dominant tree species has given in Annexure VIII. It is observed that 19 species has no affinity to grow with dominant 10 tree species. But, one NTFP species has 100 % associatedness with the dominant species followed by 90 % (four species), 80 % (seven species), 70 % (twelve species), 60 % (eight species), 50 % (nine species), 40 % (fifteen species), 30 % (seventeen species), 20 % (thirteen species) and 10 % (six species).

#### 5.4.5. Crown cover

Crown cover plays an important role to allow sunlight for the plants in the lower strata. Sunlight has to penetrate three layers of crown cover before touching the ground – canopy, under-storey & sground cover. In the study all the three layers have been considered together as single layer for further analysis. Average canopy crown percentage of studied plots showing the natural rule where post-monsoon stood the highest (58.14 %) followed by pre-monsoon (52.28 %) and winter (49.3 %) (Fig 5.2). No crown cover is noted in two plots each in post-monsoon and pre-monsoon. Whether, the result of without crown cover during winter is in three plots. Highest crown cover is observed in one plot (95 %) during post-monsoon (Table 5.14 and Annexure VII).

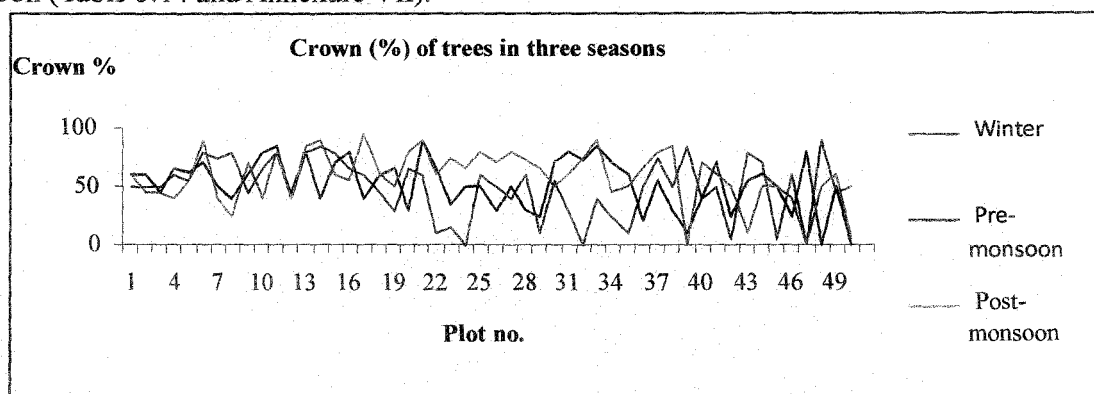


Fig 5.2. Variation in crown cover across the seasons

Table 5.14. Seasonal distribution of plots considering crown cover

Range of Crown cover (%)	Crown cover percent of studied plots in three seasons		
	Winter	Pre-monsoon	Post-monsoon
0	3	2	2
1-10	5	1	2
11-20	1	1	0
21-30	3	7	1
31-40	3	6	5
41-50	12	7	10
51-60	8	8	9
61-70	4	9	6
71-80	8	6	8
81-90	3	3	6
>90	0	0	1

### 5.4.6. Ground cover

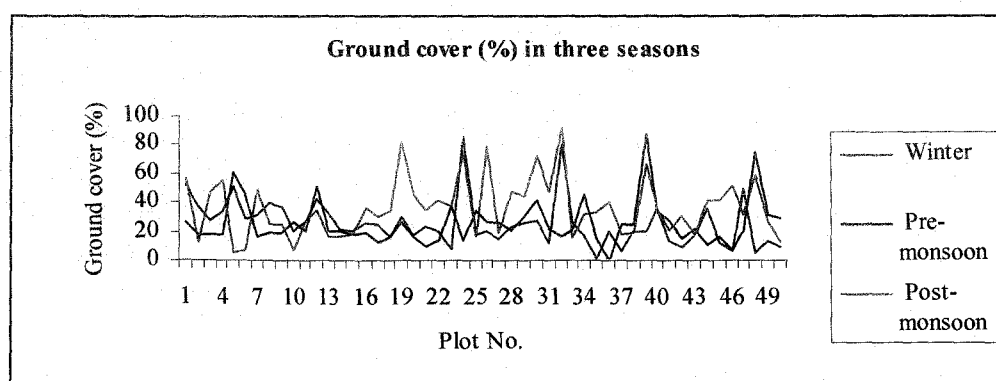
Average ground cover (herbs and seedlings) percent is highest during post-monsoon (36.75 %) followed by winter (26.40 %) and pre-monsoon (25.96 %). Highest ground cover recorded during post-monsoon (91.5%) in plot no. 32 is followed by pre-monsoon (87%) in plot no. 39 and for winter (86%) in plot no. 24 (Table 5.15; Fig 5.3; Annexure VII). Number of studied plots fallen under different range of ground cover has been given in Table 5.16. No ground cover is recorded in one plot during pre-monsoon.

**Table 5.15.** Relationship of crown cover with ground cover in their extremes

Attributes	Winter	Pre-monsoon	Post-monsoon
Plot No	24	39	32
Crown cover (%)	0	10	75
Ground cover (%)	86	87	91.5

**Table 5.16.** Ground cover percent in different plots in three seasons

Range of Ground Cover (%)	Ground Cover Percent of Studied Plots in Three Seasons		
	Winter	Pre-monsoon	Post-monsoon
0	0	1	0
1-10	7	2	3
11-20	10	18	11
21-30	18	18	6
31-40	9	4	10
41-50	2	3	10
51-60	2	1	4
61-70	0	1	1
71-80	0	1	3
81-90	2	1	2
>90	0	0	0



**Fig 5.3.** Variation in ground cover (%) in three seasons

### 5.4.7. Epiphytes

Presence of epiphytes in the vegetation is an indicator regarding the status of a forest and the moisture content in the ambient environment. During the present survey, epiphytes were recorded from 43 plots (i.e. 84 %; average presence in three seasons) (Table 5.17). Post-monsoon season scored the highest for absence as well as the occurrence of abundant epiphytes.

**Table 5.17.** Seasonal variation in epiphytes

Abundance	Presence of epiphytes: number of plots		
	Winter	Pre-monsoon	Post-monsoon
Absent	7	4	11
Few	24	26	9
Abundant	19	20	30

### 5.5. SURVIVAL RATE OF EXISTING SPECIES

Survival rate of 187 species, covering 150 trees, 18 lianas and 19 shrubs also have been noted during study when seedlings and saplings were spotted and calculated (Annexure IX). 100 % of survival is recorded for nineteen plants, followed by 86 % for one, 75 % for three, 67 % for seven, 63 % and 58 % for one each, 50 % for eight and less than 50 % for 34 plants have been determined. Survival rate between 1 to 100 is found only for 47.10 % of plants. However, 52.90 % of total species exists are not following any expected natural ratio between germination and survival. Of which, 49 (31.21 %) species are with either more seedlings than adults or just the opposite. While the seedlings of 14.60 % species of trees were not found, the trees for 7.0 % recorded seedlings were absent in the plots (Table 5.18).

**Table 5.18.** Survival ratio of woody plants

	Range (%)								Unnatural ratio	Seedling absent	Tree absent
	100	86	75	67	63	58	50	<50			
No. of sp.	19	1	3	7	1	1	8	34	49	23	11
Sp. Ratio	12.1	0.64	1.91	4.46	0.64	0.64	5.1	21.66	31.21	14.6	7.0

### 5.6. HUMAN INTERVENTION

As much as 78%, 88 % and 74 % of the studied plots lay during winter, pre-monsoon and post-monsoon, respectively, were located in the areas of natural forest vegetation (Table 5.19) and with no human intervention. Rest of the plots (22 % in winter, 12 % in pre-monsoon and 26 % in post-monsoon) were mostly situated in plantations are suffering with anthropogenic disturbances. It was observed that the human intervention was highest during pre-monsoon period.

**Table 5.19.** Observation of seasonal human intervention

Type	Percentage of human intervention in studied plots		
	Winter	Pr-monsoon	Post-monsoon
Natural	78	88	74
Human intervention	22	12	26

### 5.7. SOCIAL ATTRIBUTES

Socio-economic studies were conducted in three settlements, namely Jainti, Bhutia Basti Bengal Line and at Nurpur. Aspects of study were mainly demography, occupation and their dependence of forests,



specially related to the collection of NTFP.

### 5.7.1. Bhutia Basty Bengal Line settlement (BBBL)

This settlement, which is a village on leased land to Bengal Lime Co. Ltd, located in the core area of Buxa Tiger Reserve. The western side of the settlement is bounded by the Jainti River while the northern and southern sides are surrounded by forests of the Tiger Reserve. Administratively, it is controlled by the Raja Bhatkhawa gram panchayat under the Kalchini block of Alipurduar sub-division, Jalpaiguri district.

The inhabitants of the settlements are Jharkhandis, Biharis and Nepalis, who came here long back to work as labourer for the Bengal Lime Co. There are 79 individuals of which 38 (47.75 %) are males and 41 (52.25 %) are females. The age and gender specific distribution of population is given in (Table 5.20).

**Table 5.20.** Gender and age-wise distribution of Population in Bhutia Basty Bengal Line

Attributes	Represented by
Household	15
Population	79
Adult Male	26 (33.16 %)
Adult Female	28 (35.54 %)
Child Male	12 (14.59 %)
Child Female	13 (16.71 %)

Most of the residents keep livestock and sell out the milk they produce. One person has opened a lodge for tourists and providing food and accommodation to the visitors. Large number of villagers also works as daily-wage labourers to collect boulders from the adjacent Jainti River and for the Forest Department, while a few of them collect and sale NTFPs.

They do not own any agricultural land, as they are living on land leased out to a company. However, they cultivate on the available land around their houses. One of the most glaring problems is large-scale crop depredation by elephants, deer, wild boar and peacocks. This problem has compelled them to reduce their agricultural activities and some land is left as fallow.

### 5.7.2. Jainti settlement

This settlement is a 'Fixed Demand Holding Village' and is located in the core area of the Buxa Tiger reserve. It is under the same administrative set-up as for the Bengal-Line settlement. The area around the settlement is flat and situated on the north bank of the river Jainti with the Jainti hills to the southeast. The western side of the settlement is bound on by the Bala River while the northern and southern sides are surrounded by forests of the Tiger Reserve and the Eastern side is bounded on by the river Jainti. There are 1041 individuals in the village with 551 (52.93 %) males and 492 (47.26 %) females. The age and gender groups of the population are given in Table 5.21.

**Table 5.21.** Gender and Age-wise distribution of population in Jainti village

Attributes	Represented by
Household	215
Population	1041
Adult Male	379 (36.41 %)
Adult Female	346 (33.24 %)
Child Male	172 (16.52 %)
Child Female	146 (14.02 %)

After the declaration of BTR, residents derive most of their basic resource through the harvest of NTFPs from the forest, as most of them are unemployed and landless. They collect over 35 species of

NTFPs in different seasons of the year for sale and around 112 species for their subsistence. Some of the users own cattle and sale milk. All their cattle graze in forest during day time. Few people in the settlement also find customers for firewood within the locality, as its demand has increased with the opening of home stay facilities for tourists. Some of them have constructed separate accommodation facility for the tourists and supply food as well. The most common occupations observed here are wage-labourer and collection and sale of NTFPs. An average of 20 truck load of boulder from the adjacent Jainti river is taking out every day. A group of 5 - 6 individuals is earning Rs. 1200/- (Rs.700/- as wage and Rs. 500/- as tips) from each truck to load 300 cft (cubic foot) boulders. Everyday each group loads at least two trucks.

Since it is a Fixed Demand Holding Village none of them have legal rights on the land and due to crop depredation they stopped cultivation since 2006. Most of the residents are without any full time job and is dependent on the meager amounts earned by the sale of firewood and other NTFPs and by boulder loading. At the same time, there are some households who have members working in different Government departments are with a steady or regular income. On the other hand some are involved in petty trade like grocery-shop, tea-stall etc. are also with regular income. Out of the 215 households of Jainti settlement, 68 are having one member each who works outside the settlement on full time jobs.

### 5.7.3. Nurpur settlement

Nurpur is a revenue village under Majherdabri Gram Panchayet in Kumargram Block of Alipurduar sub-division, Jalpaiguri. Residents are mostly migrants from the then East Pakistan (now Bangladesh) in 1947 during the partition of British India and later from Bangladesh during 1971 freedom fight. A few Rajbangshis and Jharkhandis also settled here. There are 166 individuals in the village, of them 95 (57.23 %) is male and 71 (42.77 %) is female. The age and gender specific distribution of population is given in Table 5.22.

**Table 5.22.** Gender and Age-wise distribution of population in Nurpur village

Attributes	Represented by
Household	39
Population	166
Adult Male	65 (39.16 %)
Adult Female	51 (30.72 %)
Child Male	30 (18.07 %)
Child Female	20 (12.05 %)

People of Nurpur are engaged in agriculture. However, the crop is much affected by wildlife. Presently they get sporadic work from the local Panchayat under NREGS (National Rural Employment Gurantee Scheme). So, most of the villagers depend on agriculture and NTFP collection. Many of them have own livestock and sale milk. However, some of them work as wage-labourer in their own village and also in other areas. Petty business, collect and sell of NTFPs and timber are the good sources of income to these families. They collect NTFPs from nearby Jainti forest for subsistence and for marketing. They are also selling fire woods in their own locality. Average monthly family income from selling NTFPs is Rs. 1500/-.

### 5.7.4. Socio-ecological relationship

The survey recorded a total of 1041 individuals, 859 (82.52 %) of Jainti, 79 of Bhutia Basti Bengal Line and 166 of Nurpur, depend on Jainti forest for commercial activities of harvesting and selling of NTFPs. The fire wood they collect is primarily used as their domestic energy source for cooking. They collect a good share of their subsistence from NTFPs which is ecologically tolerable than the logging activities.

### 5.7.5. Ethnobotany

Ethnobotany is the study of inter-relationship between local habitants with their surrounding vegetation. People of Jainti, BBBL and Nurpur have developed a suitable relationship with their habitat, which mostly forested vegetation. This relationship has been developed from the urge for their survival in that remote and

inhospitable surrounding. However, this socio-ecological linkage is very weak with Nurpur villagers compared to other two groups (Jainti and BBBL). The plants and their mode of use by them is discussed below.

***Mangifera indica***: Ripe fruit eaten raw and unripe fruits used to make *chatnys* and pickles and taken along with the main meals.

**Preparation**: Cleaned in fresh water, peel off its outer coat and cut into pieces. Wash again in water and lightly fry in oil and then boil in water. Add sugar or molasses and spices to makes it tasty. Cool the preparation and serve on the plate.

***Ageratum conyzoides***: Leaf extract is used to stop bleeding or for curing sores.

***Catunaregam longispina***: Ripe fruits eaten raw and unripe fruits used to make *chatny* and taken along with the main meals.

**Preparation**: Cleaned in fresh water, peel off its outer coat, wash and boil in water. Add sugar or molasses and spices to make it tasty. Cool the preparation and serve on the plate.

***Acacia pennata***: Stem dust is used as ingredient for preparing gun powder by the locals.

***Sida acuta***: Dried plant, except leaf and root, use as broom to clean *kachcha* houses, place of domestic animals and surrounding areas of the house.

***Cheilocostus speciosus***: Stem used as rope to tie firewood or fencing.

***Quercus obtusata***: Nut is eaten by the locals.

**Preparation**: Burn the outer spiny coat of *fruits* and then break it to take out the edible seeds. Toasted nut is quite tasty and rich in fat.

***Citrus medica* and *Citrus limon***: Fruits eaten raw with their meal or mix the juice in water and then add sugar and salt to prepare a refreshing drink called *Sarbat*.

***Cynodon dactylon***: Leaf used in different rituals of the locals; extract of whole plant is used as haemostat on minor injuries.

***Antidesma acidum***: Ripe fruit eaten raw; young twigs made into *chatneys*.

***Boerhavia diffusa***: Whole plant is served to anemia patient for swift cure.

**Preparation**: Half cup-full of boiled leaf is served twice daily; add salt for taste.

***Dillenia indica***: Green and ripe fruits used as vegetable and for making pickles.

**Preparation**: Chopped acresent calyx is boiled in water, cook for sometime, mix sugar or molasses and crushed mustard powder, stir, cool and serve on plate.

***Alpinia nigra***: Rhizome used as vegetable.

**Preparation**: Rhizome is washed and cut into pieces, deep fried in mustard oil with cumin, onion, garlic, green chilli and serve it hot.

***Clausena excavata***: Leaf used as ingredient in vegetable preparations.

**Preparation**: Properly washed leaves are added to different vegetable curries to increase its taste. Sometimes people mix fried leaf in fried *chura* (compressed rice).

***Glycosmis pentaphylla***: Leaf juice used in liver problem.

**Preparation**: One tea-spoon of leaf extract, twice daily after food is given regularly to the liver patient.

***Stephania japonica***: Root tuber is used to prepare local brew.

**Preparation**: A cake is prepared using powdered stem, mixing with water. Necessary quantity of cake is put in rice grain for fermentation.

**Molineria capitulata:** Leaf is used to pack butter and Jharkhandi's use it in death ceremonies to put different items.

**Maesa chisia:** Keep leaf inside milk to delay fermentation.

**Bambusa tulda:** Stem used in fencing.

**Angiopteris evecta:** Extract of petiole used to cure hoof disease of cow.

**Preparation:** Wash the hoof in clean water and put the extract twice daily.

**Centella asiatica:** Leaf used as vegetable and leaf extract in children's diarrhea.

**Preparation:** (i) Boil leaves with adequate salt and serve with meal. (ii) One tea-spoonful of leaf extract is given twice daily after food to the diarrhea affected children.

**Dioscorea prazeri:** Root-tuber is used as vegetable.

**Preparation:** Root-tuber is washed and cut into small pieces; put in hot oil, stir, put salt, turmeric powder, spices and chili, cover it for proper cooking. Add some ghee and cardamom powder, stir and serve on plate.

**Calamus erectus:** Stem used as rope to tie fencing or loads of fire-wood.

**Amorphophallus bulbifer:** Leaf and stem used as vegetable.

**Preparation:**

1. **Leaf:** Put cumin and green chili in hot mustard oil, stir till it turns to brownish. Put washed and cut leaves in it, add salt and turmeric powder. Stir the stuff till it properly fried.
2. **Stem:** Boiled the pieces in water, squeeze and drained off the water. Rinse in clean water again. Put cumin and green chili in hot mustard oil, stir till it turn to brownish. Put the boiled stuff in it, add salt and turmeric powder. Cook it till it dried. A few people add garlic and onion to acheive their favourable taste.

**Tinospora sinensis:** Stem extract used against fracture in livestock and against raised blood-sugar in human.

**Preparation:**

1. **Livestock:** One cupful of stem juice, thrice daily is given orally
2. **Human:** Three – four pieces of stem is kept in a cup of water overnight and drink the water in morning in empty stomach.

**Hoya linearis:** Paste of stem is use on broken body parts to cure.

**Diplocyclos palmatus:** Fruits used as vegetable.

**Preparation:** (i) Fried fruits are taken with major meal; (ii) boiled half-fried fruits mixed with other vegetables and served. Appropriate amount of spices, salt and turmeric powder need to be added in both the preparations. Some times favourable quantity of sugar and other vegetables are also added during cooking.

**Syzygium cumini:** Ripe fruits eaten raw.

**Solanum aculeatissimum:** Fruits used as vegetable; tastes little pungent.

**Preparation:** Pieces of washed fruits fried and taken with meal. It could be cooked with other vegetables too. Appropriate amount of spices, salt and turmeric powder need to be added during the preparation.

**Wendlandia coriacea:** Ripe fruits eaten raw.

**Chloranthus elatior:** Leaf extract is used to remove leech and to cure wounds caused by leech bite.

**Typhonium trilobatum:** Leaves taken as vegetable.

**Preparation:** Put cumin and pieces of green chilies in hot mustard oil; stir till it turns to brownish. Put washed and cut leaves in it, added salt and turmeric powder; stir the stuff till it is properly fried.

**Barleria prionitis:** Whole plant (except root and leaf) used as broom to clean house and its surroundings.

**Smilax ovalifolia:** Tender leaves used as vegetable and ripe fruits eaten raw.

**Preparation:** Put cumin, green chili, garlic paste and shredded onion in hot mustard oil, stir till it turns brownish; put washed and cut leaves in it, added salt and turmeric powder; stir the stuff till it is properly fried.

**Ficus sarmentosa:** People use the stem to climb on tall trees. One stem can be used for an week.

**Polyalthia simiarum:** Bark is used to tie fence, basket and load.

**Ficus neriifolia:** Ripe fruits eaten raw.

**Benkara fasciculata:** Ripe fruits eaten raw.

**Bambusa vulgaris:** Stem is used to construct fencing of *kachcha* houses.

**Macaranga indica:** Leaves used as plate in death ceremonies by local Nepalis to keep several items.

**Codoriocalyx motorius:** Locals used its leaves to attract girls.

**Preparation:** Mixture of leaf extracts with vermilion powder and mustard oil is put on girls body.

**Helminthostachys zeylanica:** New sprouts are used as vegetable.

**Preparation:** Put cumin, green chili, garlic paste and onion in hot mustard oil, stir till it turn brownish; put washed and cut sprouts in it, added salt and turmeric powder and then stir the stuff till it is properly fried.

**Paederia foetida:** Make soup with other vegetables; add cumin paste or powder, chili, salt and turmeric powder to improve taste.

**Cissus repanda:** People cut its stem and drink the stored fluid in it.

**Derris robusta:** Pods are very tasty and eaten raw.

**Scoparia dulcis:** Root extract is used in stomach pain and in pneumonia.

**Preparation:** Root past is mixed in water and strained through a clean cloth and taken one tea-spoonful twice daily.

**Psidium guajava:** Ripe fruits eaten raw.

**Ficus hispida:** Fruit is very tasty and eaten raw.

**Castanopsis indica:** Nut is eaten by the locals.

**Preparation:** Burn the outer spiny coat of *fruits* and then break it to take out the edible seeds. Toasted nut is quite tasty and rich in fat.

**Duabanga grandiflora:** Bark is used to prepare *Raxi* – a local brew.

**Preparation:** Cake is prepared using crushed bark and then added to boiled rice grains for fermentation.

**Piper peepuloides:** Fruits used in cough and cold and in throat irritation.

**Preparation:** Washed fruits chewed or keep in side the mouth; one fruit, four times daily.

**Ziziphus jujuba:** Ripe fruits eaten raw.

**Streblus asper:** Leaf is very good fodder for pigs.

**Stephania glabra:** Freshly collected tuberous root washed and eaten raw.

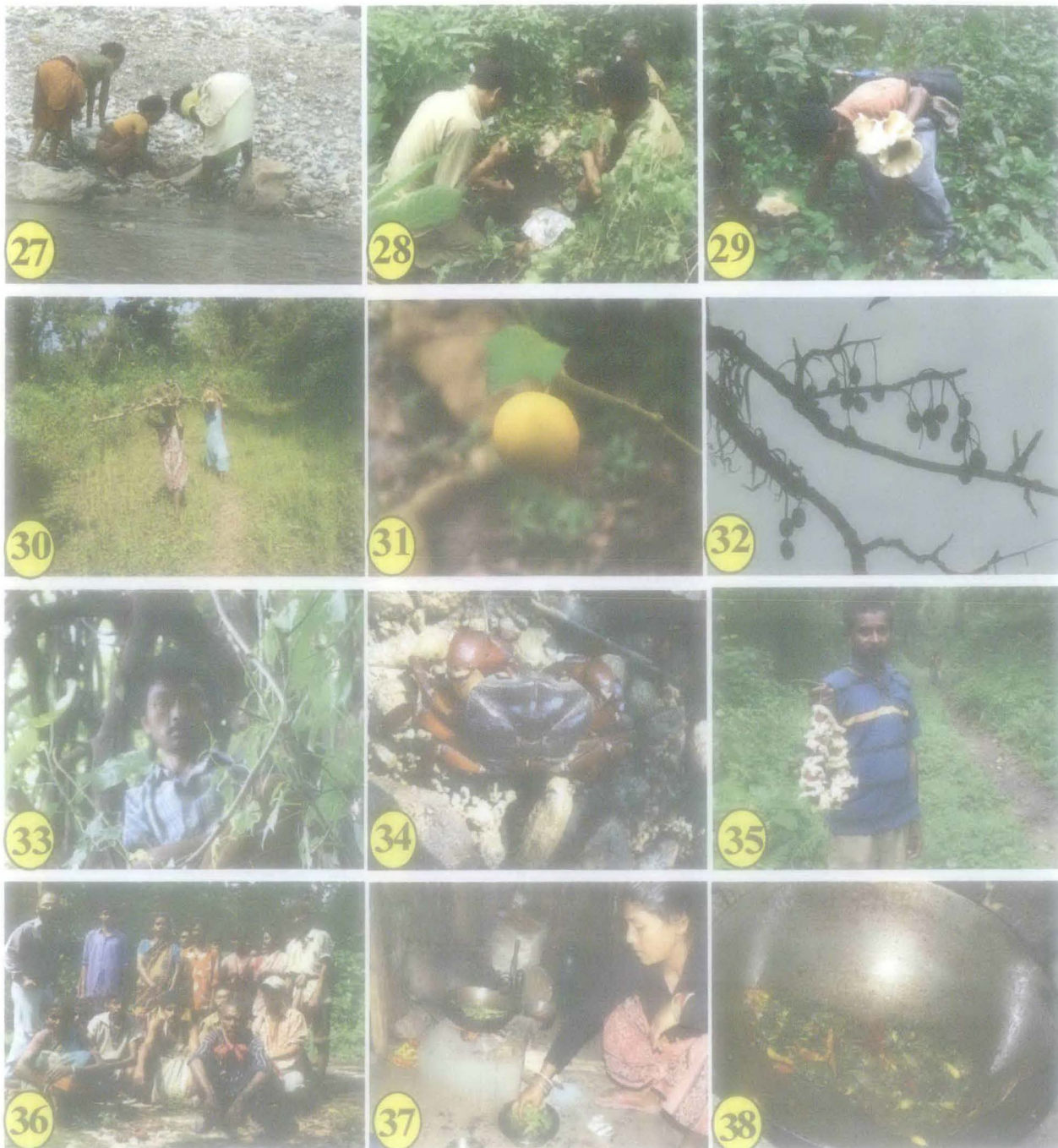
**Caryota urens:** Leaves used as broom.

*Piper pedicellatum*: Leaves used in *Laxmi puja*.

*Christella dentata*: Stem is used as rope to tie fences and baskets.

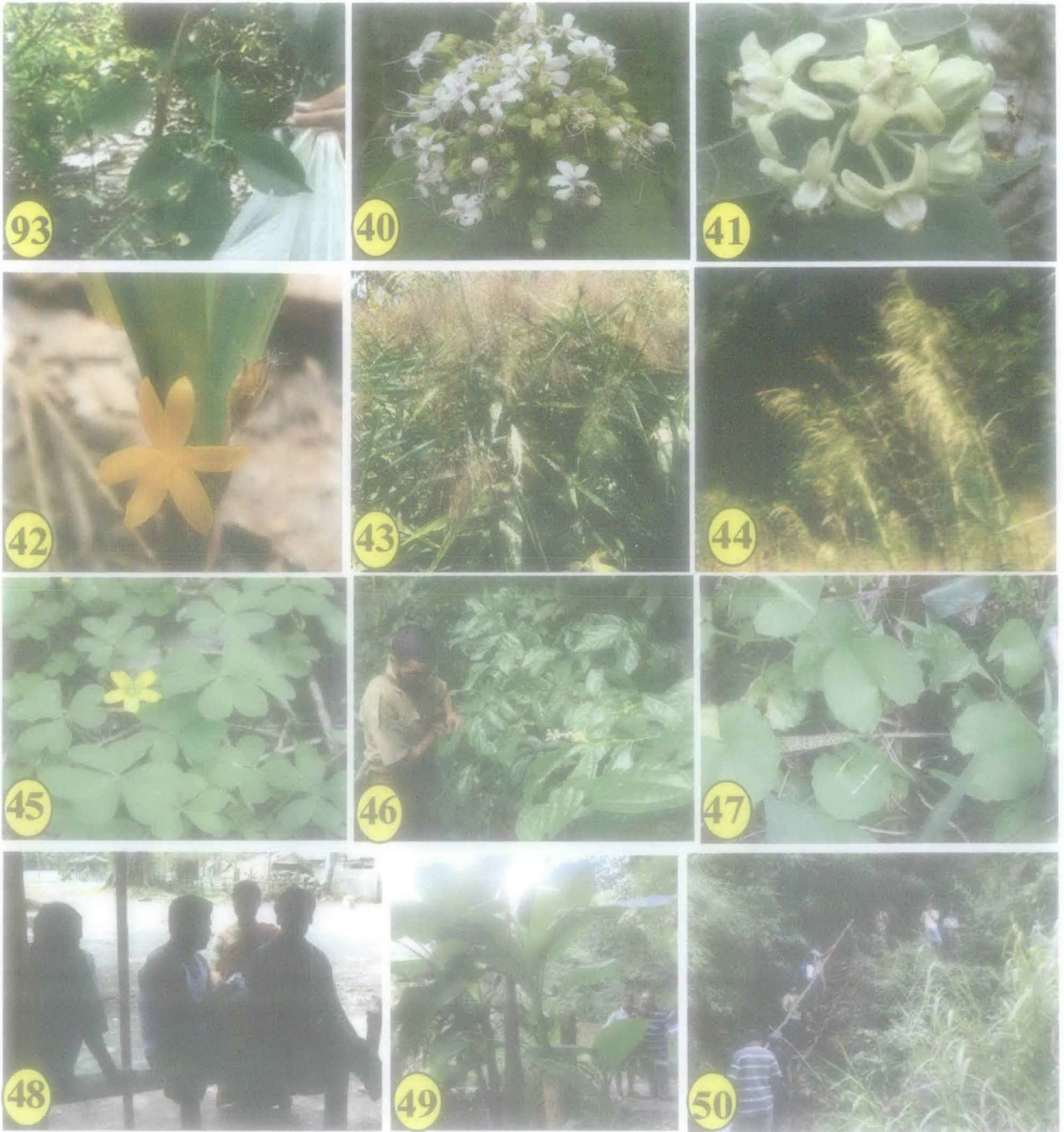
### **5.8. LOCAL INSTITUTIONS AND THEIR ROLES IN FOREST MANAGEMENT**

Studied area is the designated core zone of Buxa Tiger Reserve. Legal right to look after this area lies with the Department of Forest (FD). However, to tackle the huge problem and shortage of FD staff Joint Forest Management (JFM) programme was initiated by the national Government in last decade of 20<sup>th</sup> century. As a part of JFM, Jainti Eco-Development Committee (JEDC), Bhutia Basti EDC (BBEDC) and Nurpur Forest Protection Committee (FPC) were formed. But, these committees didn't work properly to achieve their target and lying almost defunct. So, no cooperative relationship has been developed between the FD and the newly developed institutions regarding joint forest management in this area. Recently, the Bhutia Basti has been shifted to a locality outside the forest and the committee has been dissolved.



**Plate III (NTFP):**

27. Fishing in river Jainti; 28. Collecting *Dioscorea* tuber; 29. Mushroom collection; 30. Fuel-wood collection; 31. Baigon (*Solanum aculeatissimum* Jacquin) fruit; 32. Amra [*Spondias pinnata* (Linnaeus f.) Kurz] fruit; 33. Harvest of Nagfeni Lahara (*Bauhinia scandens* Linnaeus); 34. Crab (*Potamon* sp.) on river bed; 35. Collection of Totala [*Oroxylum indicum* (Linnaeus) Kurz] flower; 36. NTFP harvesters from Nurpur village; 37. Local woman preparing stem of Gurbe [*Amorphophallus bulbifer* (Roxburgh) Blume]; 38. Gurbe stem preparation is ready to serve.



**Plate IV (Vegetation and Social Survey):**

39. *Tetrastigma bracteolatum* (Wallich) Planchon; 40. *Clerodendrum infortunatum* Linnaeus; 41. *Calotropis gigantea* (Linnaeus) Dryander; 42. *Curculigo orchioides* Gaertner; 43. *Thysanolaena latifolia* (Roxburgh ex Hornemann) Honda; 44. *Saccharum longisetosum* (Andersson) V. Narayanaswami ex Bor and *Saccharum spontaneum* Linnaeus association; 45. *Oxalis corniculata* Linnaeus; 46. Harvesting of fruit sample; 47. *Centella asiatica* (Linnaeus) Urban; 48. Discussion with villagers for collecting social information; 49. *Musa paradisiaca* Linnaeus; 50. Tourists are on the way to Mahakal Temple.



CHAPTER: VI  
**DISCUSSION**

## CHAPTER: VI

# DISCUSSION

“Biological resources provide the basis of life” (Rai, 2006). However, we are overdrawing and exploiting these resources beyond the regeneration capacity (McNeely *et al*, 1990). Pattern of our natural resource use is environmentally destructive and contribute to human insecurity (Meadows *et al*, 1972; Cronin and Pandya, 2009). Population explosion and hunger for development has led to conversion of a substantial amount of forest land into vast non-regenerating areas (Sarkar and Chakrabarti, 2012). This pressure is changing the structural characteristics of forested vegetation quite rapidly (Sarkar *et al*, 2009). In the recent past, Joint Forest Management (JFM) programme in India has impacted positively in several parts. In West Bengal, this programme helped to initiate institution building in and around forest areas. This involvement of ‘forest underclass’ (Banerjee *et al*, 2010) in forest management enhanced the forest cover (Basu, 2013). In the northern part of West Bengal, Buxa Tiger Reserve (BTR) was also benefited from this programme. However, the return for protection of forest resources is negligible compared to their livelihood demand gradually vanished their interest in forest management and as a result most of these institutions have become defunct.

BTR is divided into 13 Forest Ranges and 47 Forest Beats (Das, 2000). Jainti, at the core area of BTR, is fallen under Jainti range, consisting of 4 Beats with 22 compartments. The study revealed the presence of three types of forest, namely riverine, sal forest and mixed forest without sal. However, two forest types are matching with the classification of Champion & Seth (1968) are: Riverine forests- Northern Dry Deciduous Seral Sal, Khair, Sisoo, Simul association [5b/1S<sub>2</sub>]- and Sal forest- Eastern Bhabar and Terai Sal [3C/C<sub>1b</sub> and 3C/C<sub>1c</sub>].

Jainti forest is contiguous with the adjacent Phipsu Wildlife Sanctuary of Bhutan throughout its northern border ([www.projecttiger.nic.in/buxa](http://www.projecttiger.nic.in/buxa)). Some areas of Jainti Range along with Phipsu Wild Life Sanctuary are in hilly areas. So, there is ample space for free flow of floristic elements between plains and hills. Vegetation and socio-ecological analysis has been done to understand the overall scenario and to tackle the challenges for conservation.

### 6.1. FLORA

No detailed floristic account of BTR is available. The present survey through 50 3-tiered sample plots in the study area recorded the existence of at least 95 families of vascular plants. Of which it is observed that Fabaceae is represented by highest percentage (9.69 %) of species and is followed by Rubiaceae (4.36 %), Meliaceae (3.39 %), Vitaceae (3.39 %), Lauraceae (3.15 %), Poaceae (3.15 %), Acanthaceae (2.91 %), Asteraceae (2.91 %), Orchidaceae (2.91 %), Rutaceae (2.91 %), and Lamiaceae (2.91 %) (Table 6.1).

Among the tree species enlisted during study period *Shorea robusta* is stood top of all other tree species with IVI score of 27.08, followed by *Dysoxylum mollissimum* (IVI: 14.98), *Polyalthia simiarum* (IVI: 13.56), *Duabanga grandiflora* (IVI: 13.28), and *Tetramemes nudiflora* (IVI: 12.01) (Annexure I). Highest IVI for shrubby plants in the under-storey vegetation is registered by *Atalantia missionis* (IVI: 64.67) followed by *Mussaenda roxburghii* (IVI: 61.64), *Tabernaemontana divaricata* (IVI: 59.81), *Meyna spinosa* (IVI: 26.34), and *Bambusa tulda* (IVI: 25.17) (Annexure II). In herbs, *Panicum notatum* topped with the IVI score of 44.98 followed by *Globba bulbifera* (IVI: 20.39), *Alternanthera*

*philoxeroides* (IVI: 18.97), *Borreria alata* (IVI: 16.40), and *Lindernia parviflora* (IVI: 12.12) (Annexure III). Other important variables viz. Simpson's Dominance Index (SDI), Shannon-Weaver Index of Diversity (SWID) and Menhinick's Index of Species Richness are also considered to measure the Phytosociological affinities of plants.

**Table 6.1.** Dominant families and number of species

Family	Genera	Species
Fabaceae	26	40
Rubiaceae	15	18
Meliaceae	11	14
Vitaceae	7	14
Lauraceae	6	13
Poaceae	10	13
Acanthaceae	9	12
Asteraceae	12	12
Orchidaceae	8	12
Rutaceae	9	12
Lamiaceae	12	12

Among the tree species enlisted during study period *Shorea robusta* is stood top of all other tree species with IVI score of 28.08, followed by *Dysoxylum mollissimum* (IVI: 14.98), *Polyalthia simiarum* (IVI: 13.56), *Duabanga grandiflora* (IVI: 13.28), and *Tetramemles nudiflora* (IVI: 12.01) (Annexure I). Highest IVI for shrubby plants in the under-storey vegetation is registered by *Atalantia missionis* (IVI: 64.67) followed by *Mussaenda roxburghii* (IVI: 61.64), *Tabernaemontana divaricata* (IVI: 59.81), *Meyna spinosa* (IVI: 26.34), and *Bambusa tulda* (IVI: 25.17) (Annexure II). In herbs, *Panicum notatum* topped with the IVI score of 44.98 followed by *Globba bulbifera* (IVI: 20.39), *Alternanthera philoxeroides* (IVI: 18.97), *Borreria alata* (IVI: 16.40), and *Lindernia parviflora* (IVI: 12.12) (Annexure III). Other important variables viz. Simpson's Dominance Index (SDI), Shannon-Weaver Index of Diversity (SWID) and Menhinick's Index of Species Richness are also considered to measure the Phytosociological affinities of plants.

## 6.2. EFFECT OF ALTITUDE ON FLORA AND VEGETATION

### 6.2.1. Altitude and Vegetation

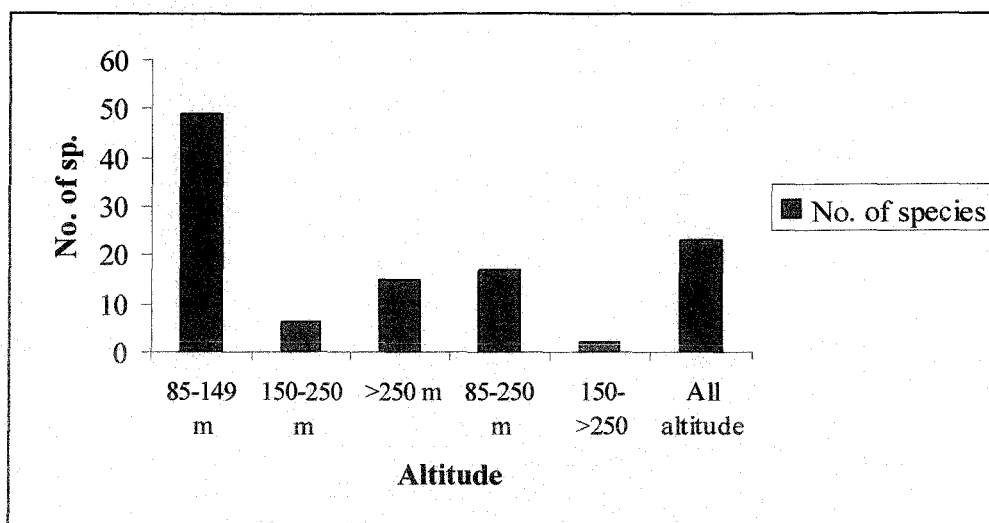
Altitude creates some difference in occurrence of different species of plants. The important major factors those vary with altitude are temperature, light, precipitation, evaporation and length of season, which influence the growth of vegetation (Shaw, 1909). In the present study area variation in the occurrence of trees and liana, shrubs tree saplings and seedlings and herbs have been observed and found majority of the species are located in alluvium plains part of the study area (tree & liana: 22.16 %; shrub & sapling: 43.55 % and herb & seedling: 32.31 %) (Table 6.2).

### 6.2.2. Altitude and NTFPs

High value NTFP – shrubs are growing in higher altitude and low value NTFP trees are growing in lower altitude (Sah and Dutta, 1996). Jainti is the habitat for 112 NTFP species and these species are found in different altitude (Fig 6.1). Alluvium plain is representing 45 % of NTFPs followed by alluvium plain to foot hills (15 %). 22 % are growing throughout the study area. As much as 51 % of harvested NTFPs are found in plains and foot hills (85 – 250 m).

**Table 6.2.** Species distribution on altitudinal variation

Range of Altitude (m.)	Tree & Liana	Shrub & Sapling	Herb & Seedling
85-149	37 (22.16 %)	27 (43.55 %)	74 (32.31 %)
150-250	32 (19.16 %)	7 (11.29 %)	38 (16.59 %)
>250	28 (16.77 %)	4 (6.45 %)	8 (3.49 %)
All altd. Studied	70 (41.92 %)	24 (38.71 %)	109 (47.60 %)
<b>Total</b>	167	62	229

**Fig 6.1.** Distribution of NTFPs across the altitude

### 6.2.3. Altitude and volume of plants

Volume of tree and liana is highest (58.97 %) in the alluvium plain areas (85 – 149 m) of Jainti forest and lowest (04.07 %) in areas located over 250 m altitude. Similarly, volume of shrubs and saplings is highest (61.84 %) in the alluvium plains and lowest (03.59 %) in high (above 250 m) (Table 6.3).

**Table 6.3.** Variation in volume across different altitudinal ranges

Altitude (m.) Range	Volume M <sup>3</sup>	
	Tree & Liana	Shrub & Sapling
85 – 149	3112.66 (58.97%)	7.45 (61.84%)
150 – 250	610.52 (11.57%)	1.32 (10.99%)
> 250	214.95 (04.07%)	0.43 (03.59%)
All altitude	1339.95 (25.39%)	2.84 (23.58%)
<b>Total Volume</b>	5278.09	12.05

### 6.2.4. Effect of altitude on crown and ground-cover

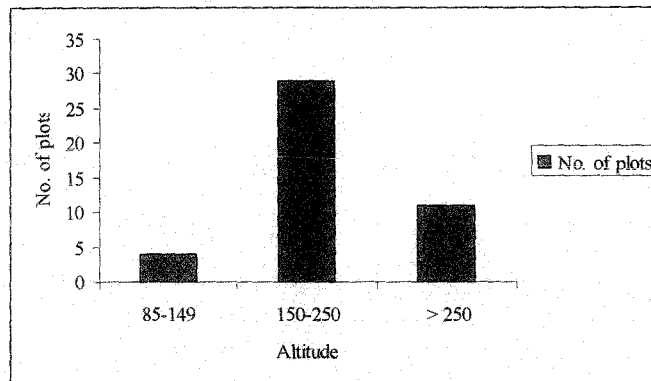
Altitudinal variations also determine the crown and ground cover percentage in the study area. In Jainti, crown and ground percentage is gradually decreasing with the increase of altitude during winter and pre-monsoon. However, during post-monsoon lowest crown percent observed between 85-149 m altitude and ground cover is lower 150-250 m than >250 m. altitude. This is happening due to foliage type of species occupying the particular ares (Table 6.4).

**Table 6.4.** Effect of altitude on crown and ground-cover [C&G = Crown & Ground]

Altitudinal Range (m)	Winter (%)		Pre-monsoon (%)		Post-monsoon (%)	
	Tree	Herb	Tree	Herb	Tree	Herb
85 – 149	53.75	41.55	62.50	19.05	25.00	48.00
150 – 250	53.10	29.38	54.89	24.79	59.07	35.44
> 250	50.00	20.45	53.71	29.00	56.85	39.775

### 6.2.5. Altitude and Epiphyte

Prevalence of epiphyte is an indicator of forest condition. Good forest with old trees harbouring ample epiphytes. Survival of epiphytes depends on moisture content of the ambient atmosphere. The result of survey in Jainti forest is showing that the occurrence of epiphyte is inversely proportionate with the altitude. Highest average has been recorded in altitude between 85 – 149 m and lowest in areas over 250 m (Fig 6.2).

**Fig 6.2.** Effect of altitude on the occurrence of epiphytes

## 6.3. EFFECT OF SLOPE ON FLORA AND VEGETATION

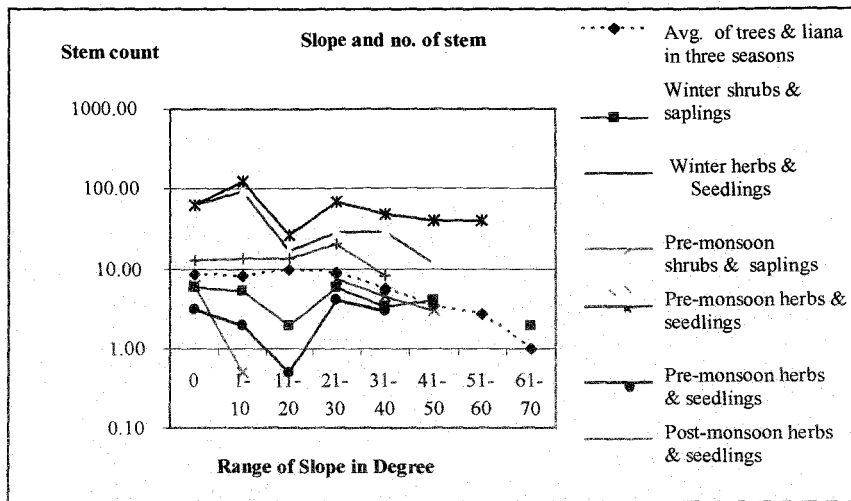
### 6.3.1. Slope and stem count

Direct effect of slope on the growth of floral species in Jainti forest is not prominent. However, stem count of trees and shrubs varies (Table 6.5).

**Table 6.5.** Impact of stem counts on plot slope

Range of slope	Avg. of three seasons	Winter		Pre-Monsoon		Post-Monsoon	
		Shrub & sapling	Herb & seedling	Shrub & sapling	Herb & seedling	Shrub & sapling	Herb & seedling
0°	8.44	5.92	64.77	6.08	63.58	3.07	13.11
1–10°	7.97	5.50	98.00	0.50	25.5	1.94	13.39
11-20°	9.67	2.00	17.00	0.00	27.00	0.50	13.67
21-30°	8.78	6.00	29.33	7.50	70.50	4.00	20.00
31-40°	5.52	3.44	28.75	4.50	48.75	3.00	8.00
41-50°	3.33	4.00	12.00	3.00	41.00	0.00	0.00
51-60°	2.67	0.00	0.00	0.00	40.00	0.00	0.00
61-70°	1.00	2.00	18.00	0.00	0.00	0.00	0.00

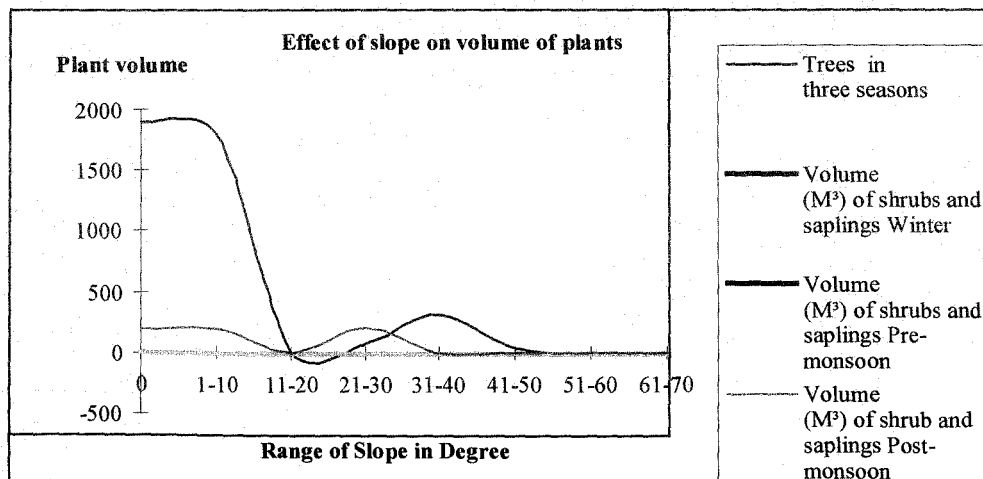
Average tree and liana stem count is highest (9.67) in slope between 11° – 20° followed by 21° – 30° (8.78), 0° (8.44), 1° – 10° (7.97). Highest stem count for shrubs and saplings in three seasons – winter, pre-monsoon and post-monsoon is in slope between 21° – 30°. Similarly highest stem of herbs and seedlings in three respective seasons is also recorded in slope between 1° – 10° during winter and recorded data showed highest stem (20) during post-monsoon recorded between 21° – 30°. So, general analysis finds 21° – 30° slope is the most suitable for floral growth (Table 6.5; Fig 6.3).



**Fig 6.3.** Variation in stem count in plots on different slopes

**6.3.2. Slope on vegetation volume**

Volume of trees and liana measured highest (1894.98 M<sup>3</sup>) in areas with no slope or is on alluvium plain. Shrubs and sapling studied during winter and pre-monsoon noted for the highest volume (6.53 M<sup>3</sup> and 10.08 M<sup>3</sup>) in alluvium plain. However, during post-monsoon highest volume of shrub and sapling is found in slope between 1° – 10° (198.27 M<sup>3</sup>). Overall observation revealed that volume of plant is better in areas without slope and it decreases with the increase of slope angle. The most unsuitable slope for volume concern is between 51° – 60° for the present study area. It is also observed that, shrub and sapling volume is measurably low during winter and pre-monsoon (Table 6.6 and Fig 6.4).



**Fig 6.4.** Effect of slope on floral volume

**Table 6.6.** Effect of slope on floral volume

Range of slope in Degree	Tree & Liana in three Seasons	Volume (M <sup>3</sup> ) of Shrub and Saplings		
		Winter	Pre-monsoon	Post-monsoon
0°	1894.98	6.53	10.08	193.57
1-10°	1795.22	2.33	0.001	198.27
11-20°	16.95	0.02	0.00	3.09
21-30°	77.06	0.35	0.62	211.50
31-40°	307.66	2.47	0.18	0.00
41-50°	33.81	0.25	0.00	0.00
51-60°	0.00	0.00	0.07	0.00
61-70°	1.49	0.089456	0.00	0.00

## 6.4. EFFECT OF ASPECT ON FLORA AND VEGETATION

### 6.4.1. Aspect and vegetation

Aspect of a plot is generally ignored. However, present study has given importance to this and data showed its impact on the number of stems. East aspect denoted the highest stem count per plot for trees and liana. In terms of shrubs and saplings, number of highest stem has been found in alluvium plain in all the three seasons. But, the number of herbs and seedlings varies season to season (Table 6.7).

**Table 6.7.** Impact of stem count on plot aspect

Aspect	Tree & liana	Avg. of three seasons					
		Winter		Pre-monsoon		Post-monsoon	
		Shrub & Sapling	Herb & Seedling	Shrub & Sapling	Herb & Seedling	Shrub & Sapling	Herb & Seedling
Alluvium plain	10.69	5.73	64.77	6.08	67.39	3.07	13.11
North	6.25	5	39.25	15	19.5	0	0
Northeast	12.00	0.5	24	0	0	0	0
East	13.00	5	122	0	41	6	14.5
Southeast	10.14	4.71	83.43	1.33	37.67	0.25	15
South	8.00	5	61.5	2	33	1	13.75
Southwest	0.00	0	0	2.33	102	2.83	11.5
West	6.50	5.5	55.5	0	0	1.25	18.25
Northwest	7.75	4.25	26	3.5	149	2	3.5

### 6.4.2. Aspect and vegetation volume

Like the stem count, aspect is also affecting on plant volume. Highest volume, 1132.96 M<sup>3</sup> of trees and liana is found in Northwest aspect. But, highest volume of shrubs and saplings is collected in different aspects in different seasons (Table 6.8).

### 6.4.3. Major soil nutrients and other components

Soil is like a mothers womb sheltered innumerable numbers of living beings. Most of the flora grows on the soil and nourished by the components present there. A few of those are moisture, pH, organic carbon (OC), Nitrogen (N), Phosphorus (P), Potassium (K) and Sulphur (S). Growth of a plant, its flowering and fruiting depends greatly on the availability of nutrients in soil (Burkley and Irwin, 2009).

Soil moisture is a medium of solution where different nutrients retain. Plants absorb water as a solution to get necessary nutrients. pH is expressing the value of acidity or alkalinity of a solution and it determines the concentration of Hydrogen ion in it. Salinity inhibits the normal growth of a plant (Lauchli and Grattan, 2007; Jaleel *et al*, 2008). Soil in study area has a tendency towards neutrality. Soil Carbon provides the structural growth of floras (Ellert *et al*, 2008). Higher production of plants is observed by CO<sub>2</sub> fertilization (Conte, 2009). On the other hand, combination of organic matter and mineral provides the ideal environment for plants' growth (Eid *et al*, 2006). Organic matter helps soil to retain water.

According to Lovblad (2000), atmospheric deposition of nitrogen provides a significant nutrient input to both terrestrial and marine ecosystems. It is biologically combined with Carbon, Hydrogen, Oxygen, and Sulphur to create amino acids – the building blocks of proteins (Uchida, 2000; Persson, 2000). Soil Nitrogen availability has strong positive effect on reproduction of different plants (Munoz *et al*, 2005). Supply of Nitrogen regulates the interactions between different trophic levels (Hogberg *et al*, 2000). Like Nitrogen, Sulphur is also an essential nutrient to plant. It's deficiency decreases the yield of vegetation (Awad *et al*, 2011). Necessary amount of Potassium required for branching and days required for emergence of flower bud (Pal and Ghosh, 2010). This also increases Nitrogen, Phosphorus and chlorophyll content in leaves. Phosphorus helps plants to increase fine litter production and take important role in nucleotide production. Nitrogen, Phosphorus and Potassium provide good structural and functional growth to a plant (Wright *et al*, 2011; Awad *et al*, 2011; Eni *et al*, 2012).

Vegetation and soil are interrelated and provide reciprocal effects on each other (Eni *et al*, 2012; Gairola *et al*, 2012). N<sub>2</sub> is bonded in the soil by biotic components. P and K are produced from the degradation of rock. In Jainti, P and K are readily available due its geological advantage. According to Marx *et al* (1999), presence of < 10 ppm Nitrogen, >10 ppm of Phosphorus, > 150 ppm of Potassium and > 2 ppm Sulphur are considered as low for better plant health. According from this standard, overall observation of soil in studied area indicates low quantity of Nitrogen and Potassium and very high quantity of Phosphorus and Sulphur is present. However, apparently, variation of soil nutrients in different seasons at varied topography do not disturb floral growth and their existence in studied plots (Oliveira-Filho *et al*, 1994) as there is no information available to compare those.

**Table 6.8.** Impact of plot aspect on vegetation volume

Plot Aspect	Average Tree & Liana Volume (M <sup>3</sup> )	Volume (M <sup>3</sup> ) of Shrub and Sapling		
		Winter	Pre-monsoon	Post-monsoon
Alluvium plain	190.94	0.00	361.98	193.57
North	197.62	0.00	16.44	0.00
Northeast	69.14	0.01	0.00	0.00
East	112.45	0.15	0.00	193.57
Southeast	223.90	0.00	211.50	16.44
South	16.52	0.00	3.09	166.47
Southwest	0.00	0.00	11.40	214.60
West	3.66	0.00	0.00	12.97
Northwest	1132.96	1.16	0.07	1.95

## 6.5. PHYTOSOCIOLOGY

Phytosociology has been calculated between 10 dominant tree and liana species and 10 herb species. This may be due to the affection between trees and lianas or herbs or between trees and lianas and herbs and seedlings.



All the 9 dominant tree species, except *Tetrameles nudiflora* are comfortable to grow in association with *Shorea robusta*. *Shorea robusta* and *Tectona grandis* has weak relationship. *Schima wallichii* has strong association with *Shorea robusta* and comparatively weak relationship with remaining species. It has no relation with *Tetrameles nudiflora* and *Aphanamixis polystachia*. *Duabanga grandiflora* is well associated with *Aphanamixis polystachia* and has no relation with *Dysoxylum mollissimum*, *Tetrameles nudiflora* and *Magnolia pterocarpa*. *Polyalthia simiarum* formed good association with *Magnolia pterocarpa*, *Shorea robusta* and *Dysoxylum mollissimum* and do not grow with *Tetrameles nudiflora* and *Tectona grandis*. *Tetrameles nudiflora* is growing only in association with *Magnolia pterocarpa*. *Wendlandia coriacea* has no association with these dominant species. *Magnolia pterocarpa* is growing in association with most of the species excluding *Duabanga grandiflora*, *Tetrameles nudiflora* and *Tectona grandis*. *Tectona grandis* is somehow associated with *Shorea robusta*, *Schima wallichii* and *Polyalthia simiarum*, but, it prefers to grow alone.

Dominant shrub, *Atalantia missionis* is forming a strong association with *Mussaenda roxburghii* and *Meyna spinosa*. However, a few other species like *Bambusa tulda*, *Tabernaemontana divaricata*, *Clerodendrum infortunatum* and *Eranthemum grifithii* has weak association. *Mussaenda roxburghii* has formed an association with *Atalantia missionis* and *Eranthemum grifithii*. *Meyna spinosa* is socializing strongly with *Atalantia missionis* and a weak association with *Citrus limon*. *Citrus limon* is growing with *Atalantia missionis* and *Mussaenda roxburghii*. *Eranthemum grifithii* is growing with *Tabernaemontana divaricata*, *Mussaenda roxburghii* and *Atalantia grifithii*. *Arbotrys caudatus* is only associated with *Atalantia missionis*. *Bambusa tulda* and *Buddleja asiatica* have no associated species.

*Panicum notatum* is forming an association with *Globba bulbifera*, *Borreria alata*, *Alternanthera philoxeroides*, *Lindernia parviflora*, *Cynodon dactylon* and *Eragrostis tenella* and has no association with *Barleria prionitis* and *Bulbophyllum careyanum*. *Globba bulbifera* is associated with *Panicum notatum*, *Alternanthera philoxeroides* and *Borreria alata*. *Borreria alata* has good association with all species except *Cynodon dactylon* and *Eragrostis tenella*. *Lindernia parviflora* has no association with *Cynodon dactylon*. *Barleria prionitis* is socializing with *Borreria alata*, *Lindernia parviflora*, *Eragrostis tenella*, *Piper mullesua* and *Bulbophyllum careyanum*. *Cynodon dactylon* has a weak association only with *Panicum notatum*. *Eragrostis tenella* is associated to *Alternanthera philoxeroides*, *Lindernia parviflora* and *Barleria prionitis*. *Piper mullesua* is associated with most of the species except *Alternanthera philoxeroides*, *Cynodon dactylon* and *Eragrostis tenella*. *Bulbophyllum careyanum* has strong association with *Borreria alata*, *Lindernia parviflora*, *Barleria prionitis* and *Eragrostis tenella*. It has weak association with other dominant species and no association with *Cynodon dactylon* and *Panicum notatum* (Table 6.9).

### 6.5.1. Phytosociology of NTFPs

Eighteen species of NTFPs (*Mangifera indica*, *Sorindeia madagascariensis*, *Litsea cubeba*, *Caryota ochlandra*, *Psidium guajava*, *Calamus acanthospathus*, *Thysanolaena latifolia*, *Acacia catechu*, *Musa paradisiaca*, *Bauhinia scandens*, *Piper sylvaticum*, *Piper pedicellatum*, *Lindernia crustacea*, *Wendlandia coriacea*, *Aegle marmelos*, *Ficus cunia*, *Alpinia calcarata* and *Ipomoea batatas*) has no association with any one of the 10 dominant tree species.

*Wendlandia coriacea* (except few plots), *Syzygium praecox*, *Aegle marmelos*, *Macaranga indica*, *Lagerstroemia hypoleuca*, *Pterospermum acerifolium*, *Careya arborea*, *Eugenia formosa*, *Mangifera indica*, *Callicarpa arborea*, *Phyllanthus fraternus*, *Engelhardtia spicata*, *Bauhinia acuminata*, *Tetrameles nudiflora* etc are less dominant plants and are forming an association. However, shrub and herb species have no such special social affection within their own habit groups.

During analysis of togetherness of NTFP plants, it is expected that at least in five plots they should be phytosociologically strongly affiliated and less than 5 would be taken as phytosociologically weak. In terms of these criteria *Shorea robusta* have strong sociology with 7 NTFP species (*Sida acuta*, *Clausena excavata*, *Tinospora crispa*, *Dioscorea prazeri*, *Polyalthia simiarum*, *Duabanga grandiflora* and *Piper betloides*). *Dysoxylum mollissimum* has strong phytosociology with 2 species, *Shorea robusta* and *Dioscorea prazeri*. *Polyalthia simiarum* is phytosociologically associated with *Clausena excavata* and *Shorea robusta*. Similarly strong phytosociology was determined between *Duabanga grandiflora* with 12 species (*Quercus spicata*, *Clausena excavata*, *Tinospora crispa*, *Smilax ovalifolia*, *Piper pedicellatum*, *Dysoxylum mollissimum*, *Shorea robusta*, *Piper mullesua*, *Amoora spectabilis*, *Magnolia pterocarpa*, *Piper betloides* and *Neocinnamomum caudatum*); *Tetrameles nudiflora* with 9 species (*Quercus spicata*, *Clausena excavata*, *Tinospora crispa*, *Smilax ovalifolia*, *Polyalthia simiarum*, *Piper pedicellatum*, *Dysoxylum mollissimum*, *Piper mullesua*, *Piper betloides* and *Magnolia pterocarpa*) and *Wendlandia coriacea* with 15 species (*Cheilocostus speciosus*, *Quercus spicata*, *Stephania japonica*, *Curculigo orchoides*, *Bambusa tulda*, *Polyalthia simiarum*, *Fagerlindia fasciculata*, *Stephania glabra*, *Calamus viminalis*, *Schima wallichii*, *Luffa aegyptiaca*, *Shorea robusta*, *Piper mullesia*, *Morus laevigata* and *Piper betloides*); and *Aphanamixis polystachya* is with 9 species (*Quercus spicata*, *Clausena excavata*, *Smilax ovalifolia*, *Polyalthia simiarum*, *Piper pedicellatum*, *Shorea robusta*, *Piper mullesua*, *Amoora spectabilis*, and *Piper betloides*). *Magnolia pterocarpa*, *Schima wallichii* and *Tectona grandis* has not found any phytosociologically strong associate.

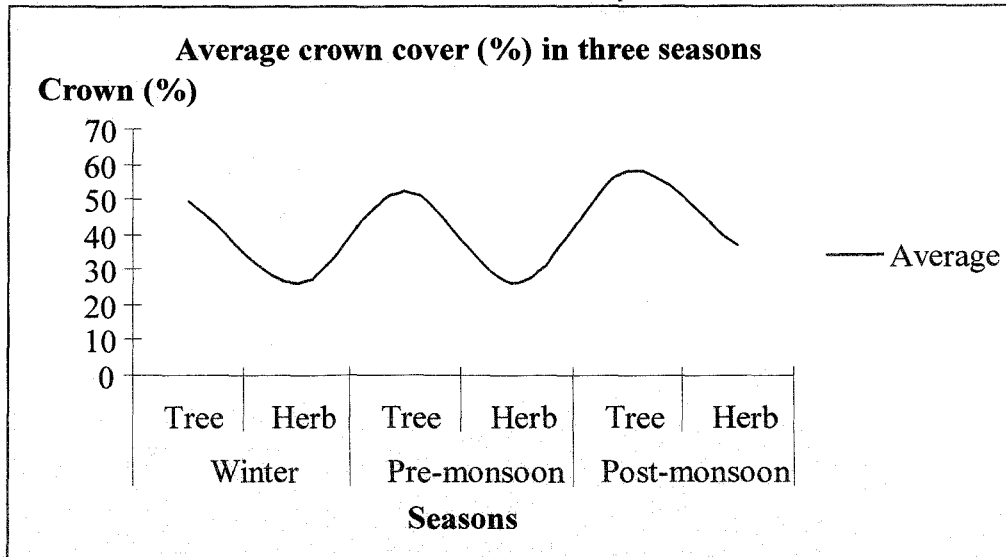
**Table 6.9.** Phytosociology between dominant trees and herbs (Present/Plot)

Name of Plants	<i>Shorea robusta</i>	<i>Dysoxylum mollissimum</i>	<i>Polyalthia simiarum</i>	<i>Duabanga grandiflora</i>	<i>Tetrameles nudiflora.</i>	<i>Wendlandia coriacea</i>	<i>Aphanamixis polystachya</i>	<i>Magnolia pterocarpa</i>	<i>Schima wallichii</i>	<i>Tectona grandis</i>
<i>Shorea robusta</i>	2	2	5	3	14	3	1	3	2	4
<i>Dysoxylum mollissimum</i>	1	2	4	2	9	0	0	1	1	5
<i>Polyalthia simiarum</i>	0	1	4	2	10	1	1	0	4	3
<i>Duabanga grandiflora</i>	0	1	2	2	12	7	1	10	5	5
<i>Tetrameles nudiflora.</i>	0	3	3	4	16	7	1	7	6	7
<i>Wendlandia coriacea</i>	0	0	1	0	0	0	0	1	0	0
<i>Aphanamixis polystachya</i>	0	0	1	0	2	0	0	0	1	0
<i>Magnolia pterocarpa</i>	0	0	1	0	8	5	0	8	2	2
<i>Schima wallichii</i>	0	1	0	1	3	0	0	0	2	1
<i>Tectona grandis</i>	0	0	1	0	4	0	0	0	3	0

### 6.5.2. Effect of crown-cover on ground-cover

Jainti forest is not truly dominated by any forest type. This is a mixture of types prevailing in the entire area. Crown or ground cover percent does maintain around 50 % in the sample plots. Post-monsoon study recorded highest crown and ground cover due to much favorable moisture content in the habitat. During winter crown cover is less due to leaf shedding of deciduous plants. Ground cover starts to dry up and this rate is slower than shedding off of tree-leaves. New leaves on trees appear early in pre-monsoon period. However, ground vegetation takes little more time for new leaves to appear (Table 6.10; Fig 6.5). This is due to the deep-seated roots of trees can draw water from deeper layers of soil and herbs draw water only from the upper much drier surface-layer, which remain almost dry during pre-monsoon.

Crown cover and ground cover is inversely proportional. However, this may vary in slopes. In this study highest ground cover (91.5 %) has been noted in plot no. 32 during post-monsoon where crown cover percent is also high (75 %). Slope of the plot is 16° and this is allowing sunlight to the ground avoiding the crown hindrance (Fig 6.6).

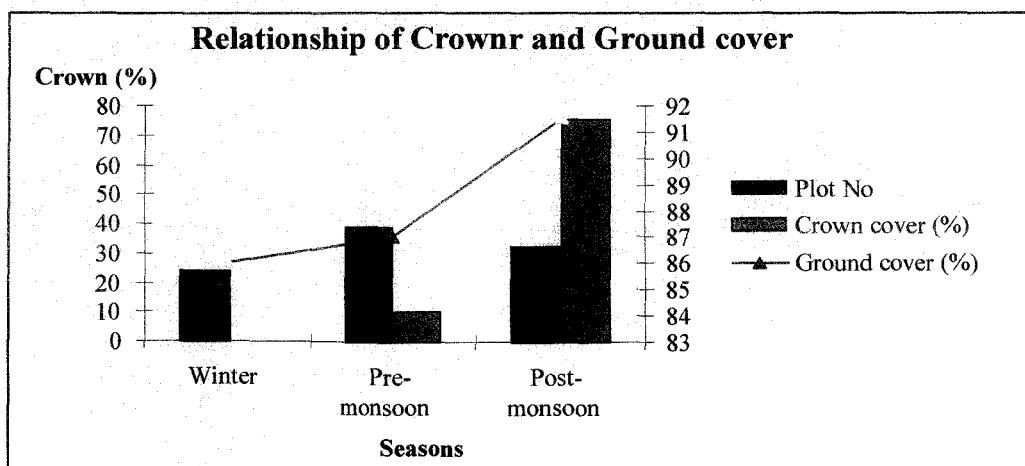


**Fig 6.5.** Average crown & ground cover across the seasons

**Table 6.10.** Average crown cover and ground cover across the seasons

Crown (%)	Winter		Pre-monsoon		Post-monsoon	
	Tree	Herb	Tree	Herb	Tree	Herb
<b>Average</b>	49.3	26.40	52.28	25.96	58.14	36.75

In addition to that, face of the plot plays a role for growth of ground cover. Normal scenario of crown and ground cover proportion in plot no. 32 is overruled and face might have an active role with slope. South-west face has exposed the plot maximum time to the sun light and influencing the growth of ground cover. Percent of light allowed by the crown cover is the source of light for the ground vegetation. During winter and pre-monsoon around 50 % light is obstructed by the crown cover and 25 % of remaining light is absorbed by the ground covering vegetation. Rest of light is warming up the ground soil. However, during post-monsoon around 41 % light is penetrating through crown of which 36 % of light is used by the ground vegetation and remaining 5 % is touching the ground. This creates a favourable condition for seed germination of a large number of floral species.



**Fig 6.6.** Comparabale chart of seasonal crown vs. ground cover in studied plots

### 6.5.3 Simpson's dominance Index (SDI)

The determined SDI of herb species is 0.94548870. Highest SDI has been recorded against *Panicum notatum* (0.9682947) followed by *Globba bulbifera* (0.9917742), *Alternanthera philoxeroides*. (0.9977471), *Eragrostis tenella* (0.9981543), *Borreria alata* (0.9983207), etc. (Table 6.11; Annexure III).

**Table 6.11.** Simpson's index of ten dominant herbs

Family	Scientific Name	SDI
Poaceae	<i>Panicum notatum</i>	0.9682947
Zingiberaceae	<i>Globba bulbifera</i>	0.9917742
Amaranthaceae	<i>Alternanthera philoxeroides</i>	0.9977471
Poaceae	<i>Eragrostis tenella</i>	0.9981543
Rubiaceae	<i>Borreria alata</i>	0.9983207
Poaceae	<i>Cynodon dactylon</i>	0.9987599
Linderniaceae	<i>Lindernia parviflora</i>	0.9990897
Orchidaceae	<i>Bulbophyllum careyanum</i>	0.9990897
Acanthaceae	<i>Barleria prionitis</i>	0.9991849
Piperaceae	<i>Piper mullesua</i>	0.9994130

**Table 6.12.** Simpson's index of ten dominant shrubs

Family	Scientific Name	SDI
Apocynaceae	<i>Tabernaemontana divaricata</i>	0.9062
Rubiaceae	<i>Mussaenda roxburghii</i>	0.9234
Poaceae	<i>Bambusa tulda</i>	0.9724
Rubiaceae	<i>Meyna spinosa</i>	0.9833
Verbenaceae	<i>Clerodendrum viscosum</i>	0.9993
Rutaceae	<i>Citrus limon</i>	0.9993
Acanthaceae	<i>Eranthemum griffithii</i>	0.9996
Rutaceae	<i>Atalantia missionis</i>	0.9998
Scrophulariaceae	<i>Buddleja asiatica</i>	0.9998
Annonaceae	<i>Artabotrys caudatus</i>	1.0000

**Table 6.13.** Simpson's index of ten dominant trees

Family	Scientific Name	SDI
Dipterocarpaceae	<i>Shorea robusta</i>	0.98782
Euphorbiaceae	<i>Polyalthia simiarum</i>	0.993033
Meliaceae	<i>Dysoxylum mollissimum</i>	0.997514
Theaceae	<i>Schima wallichii</i>	0.998755
Magnoliaceae	<i>Magnolia pterocarpa</i>	0.998832
Apocynaceae	<i>Wrightia arborea</i>	0.999473
Euphorbiaceae	<i>Trewia nudiflora</i>	0.999616
Myrtaceae	<i>Syzygium praecox</i>	0.999699
Meliaceae	<i>Chisocheton cumingianus</i>	0.999772
Fabaceae	<i>Dalbergia stipulacea</i>	0.999834

Similarly, the determined SDI of shrubs is 0.7871. Highest SDI recorded against *Tabernaemontana divaricata* (0.90621) followed by *Mussaenda roxburghii* (0.92342), *Bambusa tulda* (0.97244), *Meyna spinosa* (0.98333), etc. (Table 6.12; Annexure II).

For trees, the determined SDI is 0.9646. Highest SDI is recorded against *Shorea robusta* (0.98782) followed by *Polyalthia simiarum* (0.993033), *Dysoxylum mollissimum* (0.997514), *Schima wallichii* (0.998755), etc. (Table 6.13; Annexure I).

#### 6.5.4 Shannon - Weaver Index of Diversity (SWID)

The determined SWID for herbs is 3.771. Highest SWID is registered by *Panicum notatum* (0.0590) and is followed by *Globba bulbifera* (0.0418), *Alternanthera philoxeroides* (0.0278), *Eragrostis tenella* (0.0260), *Borreria alata* (0.0252), etc. Highest SWID ranked ten herbs has been given in Table 6.14 and the details in Annexure III.

**Table 6.14.** Shannon-Weaver index of dominant ten herb species

Family	Scientific Name	SWID
Poaceae	<i>Panicum notatum</i>	0.0590
Zingiberaceae	<i>Globba bulbifera</i>	0.0418
Amaranthaceae	<i>Alternanthera philoxeroides</i>	0.0278
Poaceae	<i>Eragrostis tenella</i>	0.0260
Rubiaceae	<i>Borreria alata</i>	0.0252
Poaceae	<i>Cynodon dactylon</i>	0.0227
Linderniaceae	<i>Lindernia parviflora</i>	0.0203
Orchidaceae	<i>Bulbophyllum careyanum</i>	0.0203
Acanthaceae	<i>Barleria prionitis</i>	0.0195
Piperaceae	<i>Piper mullesua</i>	0.0173

SWID for shrubs is 1.794. Highest SWID is observed in *Tabernaemontana divaricata* (0.08792) followed by *Mussaenda roxburghii* (0.08632), *Bambusa tulda* (0.07282), *Meyna spinosa* (0.06485), etc. SWID of top ten shrubs is presented in Table 6.15 and details in Annexure II.

**Table 6.15.** Shannon-Weaver index of dominant ten shrub species

Family	Scientific Name	SWID
Apocynaceae	<i>Tabernaemontana divaricata</i>	0.08792
Rubiaceae	<i>Mussaenda roxburghii</i>	0.08632
Poaceae	<i>Bambusa tulda</i>	0.07282
Rubiaceae	<i>Meyna spinosa</i>	0.06485
Verbenaceae	<i>Clerodendrum viscosum</i>	0.02513
Rutaceae	<i>Citrus limon</i>	0.02513
Acanthaceae	<i>Eranthemum griffithii</i>	0.02038
Rutaceae	<i>Atalantia missionis</i>	0.01503
Scrophulariaceae	<i>Buddleja asiatica</i>	0.01503
Annonaceae	<i>Artabotrys caudatus</i>	0.00875

The calculated SWID for trees is 4.095. SWID for trees is dominated by *Shorea robusta* (0.047588), *Polyalthia simiarum* (0.040602), *Duabanga grandiflora* (0.034657), *Dysoxylum mollissimum* (0.029385) and *Tectona grandis* (0.025744). However, the interesting thing observed that *Wrightia arborea* (0.017211) and *Trewia nudiflora* (0.015358) with low IVI score is positioned into the list of top ten SWID scores (Table 6.16). Details SWID for trees is given in Annexure I.

**Table 6.16.** Shannon-Weaver index of dominant ten trees

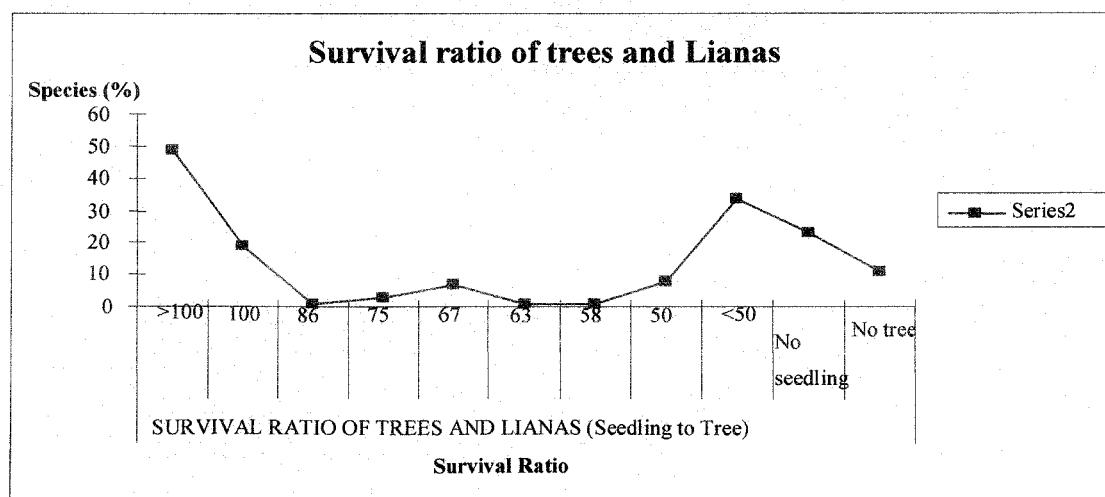
Family	Scientific Name	SWID
Dipterocarpaceae	<i>Shorea robusta</i>	0.047588
Euphorbiaceae	<i>Polyalthia simiarum</i>	0.040602
Lythraceae	<i>Duabanga grandiflora</i>	0.034657
Meliaceae	<i>Dysoxylum mollissimum</i>	0.029385
Lamiaceae	<i>Tectona grandis</i>	0.025744
Theaceae	<i>Schima wallichii</i>	0.02328
Magnoliaceae	<i>Magnolia pterocarpa</i>	0.022768
Rubiaceae	<i>Wendlandia coriacea</i>	0.017807
Apocynaceae	<i>Wrightia arborea</i>	0.017211
Euphorbiaceae	<i>Trewia nudiflora</i>	0.015358

### 6.5.5 Menhinick index of Species Richness

Species Richness of trees is highest (5.254) followed by herbs (2.457) and shrubs (1.018). Richness of saplings is 3.742 and seedlings is 4.902. Species Richness of seedlings and saplings reveals that the seeds of some plants are germinating but fail to survive till maturity due to different habitat factors.

### 6.6. MORTALITY AND ITS IMPACT

Among the recorded 176 species of vascular plants, number of species of seedling and tree is equal i.e. 19 or 12.1 %, seedling has not found in 14.6% (23) species and tree is absent in 7% (11) species. Absence of seedling stage of a species in the vegetation indicates its vulnerability. Species absent in both seedling and sapling stages indicates that the species is under threat. On the other hand, absence matured stage of a tree species indicates its new arrival in the area. So, this study shows 7 % of species arrived or introduced newly in Jainti forest. 14.6 % species are threatened and 12.1 % are vulnerable. Details are given in Annexure IX and Graph 6.7.

**Fig 6.7.** Survival ratio of tree, lianas & 8 shrub species

### 6.7. THREATENED AND ENDANGERED SPECIES

CITES list of species, shows that, two species in Jainti forest area are under category II ([www.bsi.gov.in](http://www.bsi.gov.in)), and are *Rauvolfia serpentina* and *Dioscorea deltoidea*. But, both the species are commercially important

to the locals. In addition, some other plants like *Angiopteris evecta*, *Rubia manjith*, *Wendlandia coriacea* and *Entada phaseoloides* are extremely rare in the vegetation and are locally endangered.

## 6.8. SOCIO-ECOLOGICAL RELATIONSHIP

People of Jainti are extracting 35 species of commercial importance to maintain their livelihood except for their dependent species for fuel wood and fodder. Quantitatively, Broom stick, Bet leaf, Tanki fruit, Dhundul chhobra (fibrous mesocarp) and Narikeli fruits are harvested in more than one lakh pieces and more than one lakh kilograms harvested products are Ritha, Bet fruit, Phirphire fruit, Sikakai fruit and Lali fruit. However, in terms of cost, Chilauni fruit and leaf of Basak are recorded the highest price of Rupees 200 per kg (Annexure X).

### 6.8.1. Impact of NTFP on local economy

Gross annual income of NTFP harvesters is around Rs.5768870.00 (Rupees Fifty seven lakh sixty eight thousand eight hundred seventy only). Monthly average income is recorded as Rs.2716.00 per family. Per capita daily income among the NTFP harvesters from this resource is Rs.18.40. As per state average most of the NTFP harvesting families are enjoying better life taking into consideration Rs.350.17 as the demarcation of Below Poverty Line (BPL).

Recently, since 2006, Forest Department slowly allowed collecting boulders from the Jainti River and in February 2008 the scarcity of labourer has been noted. Recently, income in most of the families increased many folds (Rs. 500/- per day) compared to as in 2000 (Sarkar and Das, 2012). A few ecotourism resorts are also providing employment to the Jainti residents. In addition, 11 self-help groups were also formed. So, the dependence of Jainti villagers on NTFPs is decreasing gradually. However, the harvesters from Nurpur area are not sparing the forest even today. They are increasing their harvest and the loss of the forest is also increasing in parallel.

## 6.9. ROLE OF LOCAL MANAGERMENTS: COMMUNITY INSTITUTIONS

There are three user groups (people of Jainti, BBBL and Nurpur) using Jainti forest. These user groups were the part of three protection committees. However, these protection committees are now almost defunct. So, there is no effective community institution to manage the forest resources.

## 6.10. FUTURE CHALLENGE

The challenge is one, the conservation. Conservation of forest resources has to be achieved for the nature and for mankind. It is essential to find out the basic problem(s) and to find out ways to manage it. Presently, Nurpur user group is the primary threat against conservation. To resist these people the JEDC may be re-energized. At the time of renewal of boulder lifting licence FD may link the clause of protection. Getting licence, every licence holder has to pay for a number of people. Payment procedure could be furnished through consultation with FD and local institutions.

Human Resource Management (HRM) is a tough task for the Range Officers. FD may consider appointing a HRM at Jainti range to handle and strengthen the basic goal of conservation. NTFPs are harvested regularly. FD in consultation with local user groups may organize training to produce finish products and for that small facilities might be created locally. Handful products shall have to choose to initiate the process. This will reduce the quantity of harvest and will reduce pressure on resources in one hand but will increase the income of the involved people.

## 6.11. CONCLUSION

Phytosociology and phytogeography influences on the growth of NTFP species. Small variables like crown cover, altitude, face of the area and even slope have effect on the growth and existence of NTFP species. NTFPs are the life saving resource to the dwellers of Jainti. Market within 30 km bestwood these people to sale some commercially demanded species and to earn a handsome!! However, over exploitation of *Acacia catechu*, *Rubia manjith*, *Rauwolfia serpentina*, *Firmiana colorata*, *Asparagus racemosus* and *Acacia concinna* have become rare in this forest.

### 6.11.1. Locational disadvantage and ethnobotanical knowledge

Locational disadvantage taught these people to use local resources. These isolated people maintain their own economy and science (Rai *et al.*, 1998). They are using a handful plant species as life saving medicine. Jharkhandis and Nepalese are mostly using these medicines. Biharies and Bengalies mostly avoid as they don't have such ethnobotanical knowledge.

### 6.11.2. Alternate livelihood option(s) and forest dependance

Boulder lifting has been allowed since 2006 which has reduced the dependence on NTFPs. However, Nurpur people took it as an advantage to harvest more NTFPs from the forest. To tackle this situation a special team of FD may be created for Jainti. This group, with the help of Jainti villagers, can frame suitable strategies to tackle this problem. Appointing a Human Resource Manager is a necessity to form a pro-conservation group and to move forward. Existing resource sharing formula between FD and JEDC was a part of National Programme. However, to motivate these people, a new resource sharing mechanism needs to be framed.

### 6.11.3. Value addition of NTFPs to reduce exploitation

Harvested species with enough commercial demand are going directly to the nearest markets. Value addition to some selected products will reduce the harvested quantity as well as will help to raise their income. So, FD or other agency could arrange annual training programme on this purpose and will establish some small cottage-level manufacturing units for the utilization and manufacture of different finished marketable products. This will promote the local economy, and will help to reduce the gap between locals and FD staffs.

### 6.11.4. Soil management for nutritional rejuvenation

Overall observation of soil in studied area indicates low amount of Nitrogen and Potassium. Presence of Phosphorus and Sulphur is very high. So, a proper management system may be adopted to reclaim the amount of Nitrogen and Potassium in the forest area.

### 6.11.5. Management(s) in forest conservation

Lack of trust between villagers and FD is also affecting the issue of conservation. Building trust with the people is the responsibility of the FD and they have to show their willingness and trustworthiness. Institutions formed under JFM programme has to be rejuvenated to speed up the conservation goal in BTR. National and State Governments have to be worked out the legality to give the right to use certain portion of land to the local dwellers. Present set of National Forestry laws does not allow self-governance initiative by the local communities (Chakrabarti *et al.*, 2004). So, the right on the property to be defined accordingly and that should be legally valid. Accordingly, appropriate legislation need to be framed by both National and State Governments in this regard.

### 6.11.6. Transboundary National Park to conserve BTR

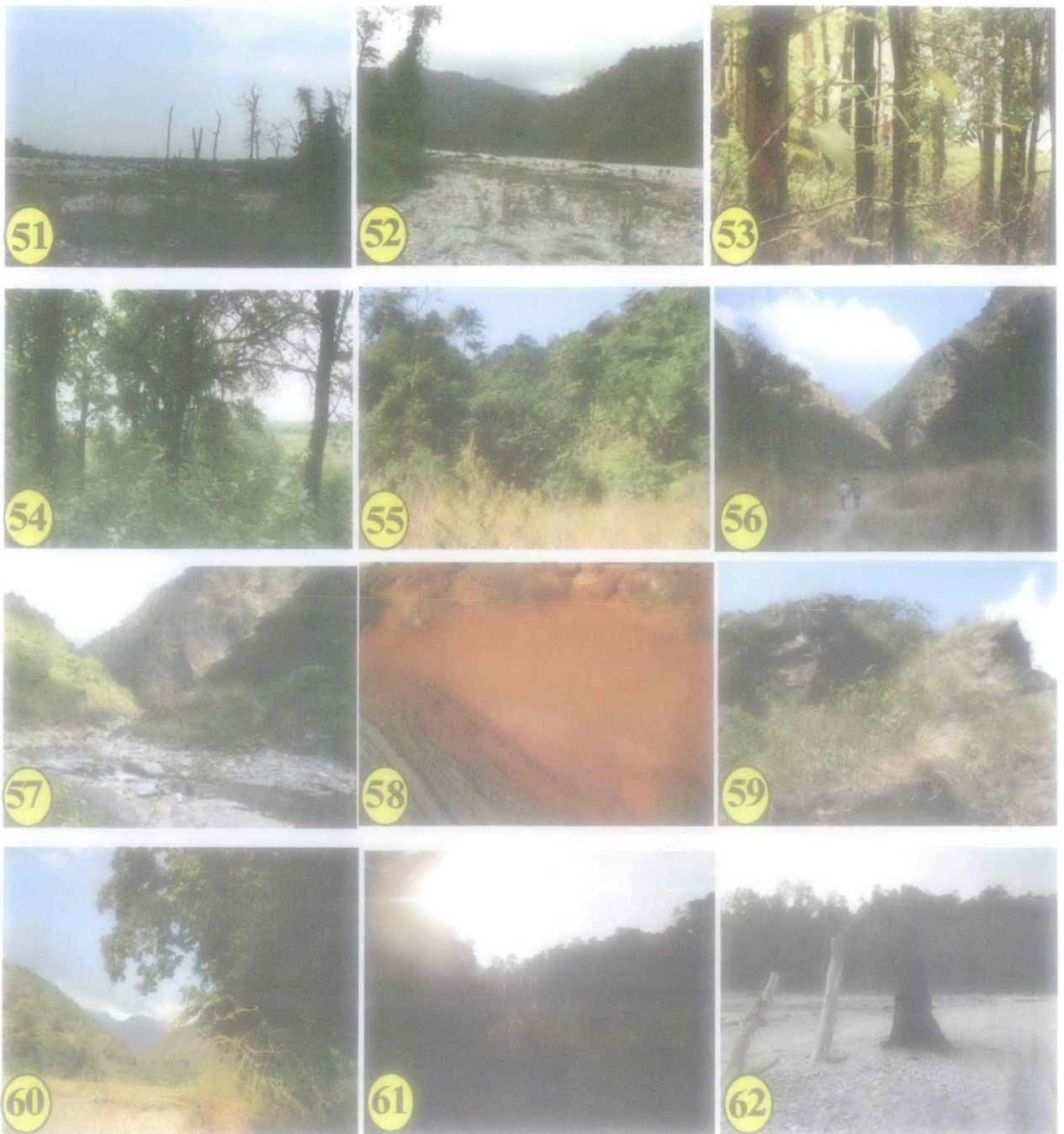
Mining in adjoining Bhutan territory has raised question regarding the stability of this reserve. Creating a transboundary National Park with adjoining Phipsu Wildlife Sanctuary, Bhutan will be benefited both sides to manage the precious diversity in BTR. This move could be helpful to curb rampant blast for mining



within Bhutan's territory to stop ecological disaster in BTR. International funds for conservation can be asked to facilitate the programme.

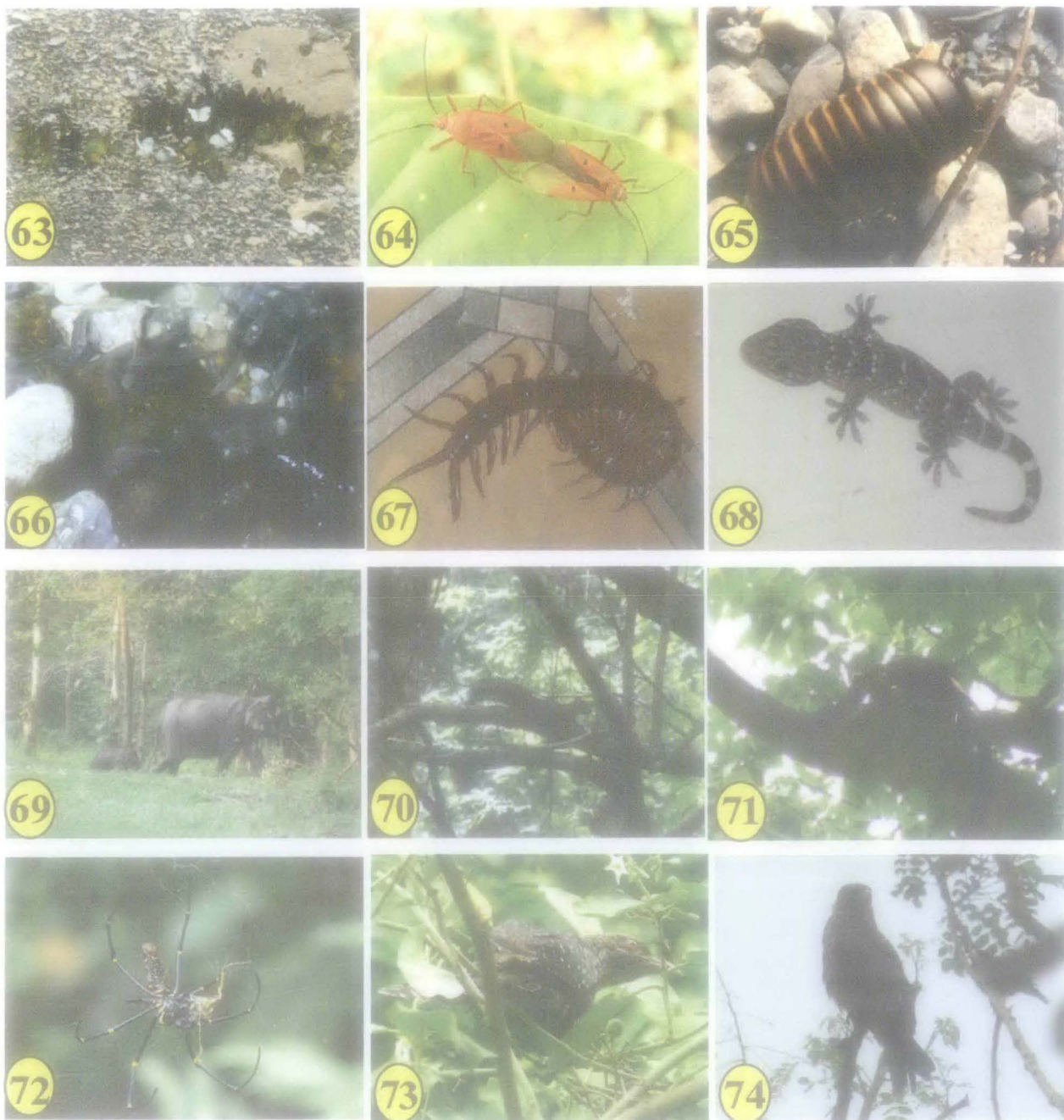
#### **6.11.7. Further research to conserve ethnic knowledge**

Over mlliennia, many rural communities depend on indigenous and traditional plants as main source of food (Hoeven *et al*, 2013) and medicine. So, proper research programs need to be under taken to record and to test the effectivity of these plants with medicinal value as well as other values in Jainti.



**Plate V (Landscape):**

51. River bed of Jainti is spreading; 52. River bed of Jainti and adjacent forest; 53. Plantation inside the core area of BTR; 54. Vegetation on the edge of a hill top; 55. Dense canopy cover ends to a grass land; 56. Grass land in valley; 57. Travellers taking rest on the bank of river Jainti; 58. Sedimentation of minerals on the bank of Jainti river; 59. Succession of vegetation on bare rock; 60. Beautiful valley leading to a hilly terrain; 61. Amazing view of shade and shine; 62. Jainti river is above the forest floor and encroaching vegetation area.



**Plate VI (Fauna of Jainti):**

63. Butterflies on the moist sand of Jainti river; 64. Mating of Red Bug insect (*Melamphaus rubrocinctu*); 65. Millipede (*Glomeris malmivaga*); 66. Fishes in Jainti river; 67. Centipede (*Scolopendra gigantea*) on the floor of Forest Department dormitory; 68. Tokke-Gecko (*Gekko gekko*); 69. Elephant (*Elephas maximus bengalensis*)family heading towards dense forest; 70. Himalayan Squirrel (*Callosciurus pygerythus*) taking rest on a tree branch; 71. Malabar giant squirrel (*Ratufa indica*) looking down for prey; 72. Golden Orb weaver spider (*Nephila clavipes*)waiting to catch food; 73. Indian Cuckoo (*Cuculus micropterus*) is waiting for male partner; 74. Jungle Hawk (*Peregrine falcons*) looking food.

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# SUMMARY

# SUMMARY

Forests ecosystem plays prominent role in controlling environmental well being and similarly growth of forest depends on the combination of environmental factors such as climate, soils, slope and aspect, and elevation. These factors determine vegetation type, how fast they'll grow and their form at maturity, as well as determine the micro-climate of a site. Linking environmental variation to population dynamics is necessary to understand and predict how the environment influences species selection, abundances, distributions and other ecological factors in a forest system.

Socio-ecological relationship in a forest system provides positive as well as negative effects. NTFP provides subsistence and commercial income to the people in and around the forests. Millions of household depends heavily on NTFP products for income worldwide. In India only the real value of NTFP is many fold greater (US\$ 43.8 billion) compared to forestry's share (US\$ 2.9 billion). It plays an important role for ecological conservation, building socio-ecological relationship and economical development of a region. However, over harvesting of produces negatively affects and made the socio-ecological relationship unsustainable. Forests also clean the atmosphere by Carbon sequestration, facilitates soil formation and check soil erosion.

Geographically BTR is lying between the latitudes of 26° 30' and 26° 55' N and the longitudes of 89° 20' and 89° 55' E and is primarily situated in Bhabar and Terai areas consisting of slightly undulating land. The overall topography of the area is an amalgamation of plains and hills. The elevation ranges from 60 to 1750 m. Hilly areas are steep and precipitous. The mountainous tract is an extension of the outer spurs of the Eastern Himalaya. Also, this is the only tiger reserve located in the northern part of West Bengal. This Protected Area is sharing its boundary with the international border with Bhutan on the North and the eastern boundary touches the Indian state of Assam. Western and Southern boundaries are demarcated by several Tea Estates (T.E.) within the Indian territory.

Four distinct climatic seasons (summer, monsoon, autumn and winter) are observed in BTR. South-West monsoon is the primary source of rainfall. June to September is the main period of precipitation. December is the driest season with minimum or no rainfall. The average annual rainfall in the reserve is 4100 mm and average minimum and maximum temperature varies between 32° C to 12° C. Maximum and minimum relative humidity varies between 80 % and 95 % and never observed below 75 %. The reserve generally does not face any devastating cyclonic storm.

BTR spreads over 760.87 sq km area with a core zone of 314.5 sq km of which 117.17 sq km is designated as National Park. The study area is Jainti – the core area of Buxa Tiger Reserve consists mainly of natural vegetation with patches of old plantations.

BTR was constituted in 1983. It includes forest area under Buxa Tiger Division and some area from Coochbehar Forest Division. 314.52 sq km area of BTR had been declared as Buxa Wildlife Sanctuary

(BWLS). The core area of BWLS (117.10 sq km) was declared as National Park in 1992. Final notification regarding the constitution of National Park came out in 1997.

It is located in the confluence of three major Bio-geographic zones (Das, 2000):

- Lower Gangetic plains;
- Central Himalayas; and
- Brahmaputra Valley.

Study area of BTR consists of mainly two types of forest:

1. Northern dry deciduous seral Sal, Khair, Sissoo, Simul association (5B/1S<sub>2</sub>); and
2. Eastern Bhabar & Terai Sal (3C/C<sub>1b</sub> & 3C/C<sub>1c</sub>).

Keeping in mind the existing inter-linkage between social and ecological systems the study has been divided into two components:

1. Vegetation study; and
2. Socio-economic study including ethno-medicinal practices.

The present survey revealed that Jainti is the repository of at least 413 species of vascular plants of which 396 are angiospermic, 16 pteridophytic and only one species of gymnosperm. These plants are distributed in 95 families. In terms faunal diversity, the reserve provides habitat to 67 species of mammals, 230 species of birds, 28 species of fishes, 35 species of reptiles and 4 species of amphibians. It is observed that Fabaceae (s.l.) is represented by highest number of 40 species.

As much as 150 species of trees and 18 species of woody climbers or liana (total 168 species) are recorded in this forest stand from the sample plots. The mean DBH of trees in the forest is 26.02 cm with a mean height of 5.2 m. The total stem count is 893, giving a figure of 17.9 stems per plot with a projected number of 595 stems/ha. The mean collar diameter (CD) of the woody species in the under-storey is 4.78 cm while the total stem count is found to be 153. The mean height is 2.89 m. There are about 3.06 stems per plot and the projected stem count/ ha is 1082.80. There are a total of 62 shrub species. Number of individuals in the studied plots is 3131, thus the individuals per plot is 62.62 and the projected number of individual count/ha is 199426.8. A total of 183 species of herbs are recorded.

Among the enlisted tree species, *Shorea robusta* is stood at top of all other tree species with IVI 27.08. Highest IVI in shrubby plants registered by *Atlantia missionis* (64.67) and in herbs by *Panicum notatum* (44.98). Simpson's Dominance Index of herb, shrub and tree species are respectively 0.94548870, 11.78355 and 167.972597. Shannon-Weavers Diversity Index of herb, shrub and tree species are respectively 0.7234, 0.4389 and 0.7992. Species Richness of trees is highest (5.254) followed by herbs (2.457) and shrubs (1.018).

*Shorea robusta* is the most dominant species in this forest and has highest percentage (88.89 %) of presence compared to other dominant species. *Croton tiglium* and *Schima wallichii* have phytosociological relationship (77.78 %) with dominant species followed by *Duabanga grandiflora* and *Aglaia spectabilis* (66.67 %), *Wendlandia coriacea* and *Magnolia pterocarpa* (55.56 %), *Tectona grandis* (33.33 %) and lowest affinity with the dominant species found in *Tetrameles nudiflora* (11.11 %). *Atlantia missionis* has the highest (85.71 %) phytosociological affinity with the dominant shrub species followed by *Tabernamontaena divaricata* (42.86 %) and *Mussaenda roxburghii*, *Bambusa tulda*, *Meyna spinosa* and *Clerodendrum infortunatum* (28.57 %). *Citrus limon*, *Eranthemum griffithii*, *Buddleja asiatica* and *Artabotrys caudatus* have grown rarely with any other dominant shrub species. *Panicum notatum* is the widely associated (88.89 %) species followed by *Globba racemosa* (77.78 %),



*Eragrostis tenella*, *Alternanthera philoxeroides*, *Lindernia parviflora*, *Bulbophyllum careyanum* (66.67 %), *Barleria prionitis* (55.56 %) and *Piper mulesua* (44.44 %). Least affinity towards other dominant species is found in *Cynadon dactylon* (11.11 %).

100 % of survival is recorded in 12.10 % followed by 86 % (0.64 %), 75 % (1.91 %), 67 % (4.4.46 %), 63 % (0.64 %), 50 % (5.10 %) and <50 % (21.66 %). Study shows that, 7 % of species arrived or introduced newly in Jainti forest. 14.6 % species are threatened and 12.1 % are vulnerable.

Jainti forest is inhabited by two human settlements – Jainti village and Bhutia Busty Bengal Line village. People of these villages are completely depending on the resources from Jainti forest. Excluding these two settlements, people from Nurpur village also depends on this forest for commercial as well as subsistence purposes. National Highway No. 31C roughly runs along its southern boundary. Nearest railway station is Rajabhatkhwa. It is 15 Km. away.

There are 112 plant species in use by the locals of which 59 plants are for purely subsistence purpose and 53 for commercial purpose. Among the commercial species 35 are widely sold in the market and the rest are rarely sold. Phytosociological relationship between NTFP species and 10 dominant tree species is observed that 19 species has no affinity to grow with dominant 10 tree species and only one species has 100 % phytosociological association with these species. *Angiopteris evecta* (G. Forster) Hoffmann, is an endangered species. *Rauwolfia serpentina* (Linnaeus) Bentham ex Kurz and *Dioscorea deltoidea* Wallich ex Grisebach are designated as threatened species. All three are medicinally important to the locals. Occurrence of NTFP depends on altitude, slope and face. Soil is acidic and Nitrogen deficient.

Commercially sold NTFPs are collected from this forest for the following purposes. Decoratives 14 species; Medicinal 19 species; Insence 1 species; Broom 1 species; Handicraft 1 species. *Bombax ceiba*, *Oroxylum indicum*, *Thysanolaena maxima*, *Luffa aegyptica*, *Rubia manjith*, *Parthenocissus himalayana* has multiple uses. Stem, leaf, inflorescence, fruit, floss, gum of noted NTFP species are regularly harvested from this forest and sustain the lives of village people. Harvesters sell their harvested products to the local trader, who, in turn, supplies it to a trader in the nearby town Coochbehar.

Monthly average income is recorded as Rs.2716/- per family. Per capita daily income among the NTFP harvesters from this resource is Rs.18.40/-. As per state average most of the NTFP harvesting families are enjoying better life taking into consideration Rs.350.17/- as the demarcation of Below Poverty Line (BPL).

There is no functional community organization to manage issues related to socio-ecological system. Only forest department and some times political parties convene meeting with the local residents.

## CONCLUSION

1. Locational disadvantage taught these people to use local resources.
2. Boulder lifting allowed since 2006 has reduced dependence on NTFPs. However, Nurpur people take it as an advantage to harvest more NTFPs from the forest.
3. Formation of a special FD team and appointing an HRM is a necessity to form a pro-conservation group and to move forward.
4. To motivate locals, a new resource sharing mechanism has to be framed.
5. Harvested species with enough commercial demand are going directly to the nearest markets. Value addition to some selected products will reduce the harvested quantity as well as will help to raise their income.

6. Overall observation of soil in studied area indicates low amount of Nitrogen and Potassium. Presence of Phosphorus and Sulphur is very high. So, a proper management system may be adopted to reclaim the amount of Nitrogen and Potassium in the forest area.
7. Lack of trust between villagers and FD is also affecting the issue of conservation.
8. Mining in adjoining Bhutan territory has raised question regarding the stability of this reserve. Creating a trans-boundary National Park with adjoining Phipsu Wildlife Sanctuary in Bhutan will benefit both sides to manage the precious diversity in BTR.
9. Over the mlliennia, many rural communities sustained on indigenous plants traditionally recognized as main sources of food (Hoeven *et al*, 2013) and medicine. So, proper research programs need to be under taken to record and to test the efficacy of these plants with medicinal value as well as other values in Jainti.

# **ANNEXURES**

# ANNEXURE - I

## Phytosociological assesment of dominant tree species

Scientific Name	Stem count	Dm	RDm	D	RD	F	RF	IVI	SDI	SWDI
<i>Shorea robusta</i>	99	1380.97	12.26	0.00631	11.086	36	3.7344398	27.08	0.9878201	0.0476
<i>Dysoxylum mollissimum</i>	45	512.41	4.55	0.00287	5.039	52	5.3941909	14.98	0.9975143	0.0294
<i>Polyalthia simiarum</i>	75	20.47	0.18	0.00478	8.399	48	4.9792531	13.56	0.9930325	0.0406
<i>Duabanga grandiflora</i>	58	16.85	0.15	0.00369	6.495	64	6.6390041	13.28	0.9999912	0.0347
<i>Tetrameles nudiflora</i>	4	1209.00	10.73	0.00025	0.448	8	0.8298755	12.01	0.99999	0.0047
<i>Wendlandia coriacea</i>	22	519.10	4.61	0.00140	2.464	14	1.4522822	8.52	0.9999874	0.0178
<i>Aphanamixis polystachya</i>	16	308.08	2.73	0.00102	1.792	28	2.9045643	7.43	0.9999912	0.0141
<i>Magnolia pterocarpa</i>	31	22.49	0.20	0.00197	3.471	30	3.1120332	6.78	0.9988325	0.0228
<i>Schima wallichii</i>	32	50.77	0.45	0.00204	3.583	26	2.6970954	6.73	0.9987546	0.0233
<i>Tectona grandis</i>	37	32.09	0.28	0.00236	4.143	14	1.4522822	5.88	0.9999887	0.0257
<i>Syzygium praecox</i>	16	271.48	2.41	0.00102	1.792	14	1.4522822	5.65	0.9996987	0.0141
<i>Litsea monopetala</i>	7	417.38	3.70	0.00045	0.784	10	1.0373444	5.53	0.9999473	0.0074
<i>Garuga floribunda</i> var. <i>gamblei</i>	1	538.00	4.78	0.00006	0.112	2	0.2074689	5.09	1	0.0015
<i>Wrightia arborea</i>	21	22.92	0.20	0.00134	2.352	24	2.4896266	5.04	0.9994727	0.0172
<i>Spatholobus parviflorus</i>	12	235.20	2.09	0.00076	1.344	14	1.4522822	4.88	0.9999912	0.0113
<i>Quercus obtusata</i>	11	91.92	0.82	0.00070	1.232	20	2.0746888	4.12	0.9998619	0.0106
<i>Mallotus polycarpus</i>	18	19.77	0.18	0.00115	2.016	18	1.8672199	4.06	0.9996158	0.0154
<i>Chisocheton cumingianus</i>	14	36.51	0.32	0.00089	1.568	20	2.0746888	3.97	0.9997715	0.0127
<i>Dalbergia stipulacea</i>	12	131.44	1.17	0.00076	1.344	14	1.4522822	3.96	0.9998343	0.0113
<i>Syzygium cumini</i>	8	169.64	1.51	0.00051	0.896	12	1.2448133	3.65	0.9999297	0.0082
<i>Eriobotrya bengalensis</i>	1	328.77	2.92	0.00006	0.112	2	0.2074689	3.24	1	0.0015
<i>Stereospermum tetragonum</i>	9	40.63	0.36	0.00057	1.008	16	1.659751	3.03	0.9999096	0.0090
<i>Castanopsis indica</i>	1	278.00	2.47	0.00006	0.112	2	0.2074689	2.79	1	0.0015
<i>Pinus roxburghii</i>	9	172.66	1.53	0.00057	1.008	2	0.2074689	2.75	0.9999096	0.0090
<i>Carallia brachiata</i>	1	271.48	2.41	0.00006	0.112	2	0.2074689	2.73	0.9999874	0.0015
<i>Castanopsis tribuloides</i>	1	266.07	2.36	0.00006	0.112	2	0.2074689	2.68	1	0.0015
<i>Terminalia bellirica</i>	8	53.35	0.47	0.00051	0.896	10	1.0373444	2.41	0.9999297	0.0082
<i>Litsea cubeba</i>	8	25.78	0.23	0.00051	0.896	12	1.2448133	2.37	0.9999297	0.0082
<i>Actinodaphne obovata</i>	7	78.93	0.70	0.00045	0.784	8	0.8298755	2.31	0.99999	0.0074
<i>Cissus repanda</i>	8	16.71	0.15	0.00051	0.896	12	1.2448133	2.29	0.9999297	0.0082
<i>Phyllanthus acidus</i>	10	10.57	0.09	0.00064	1.120	10	1.0373444	2.25	0.999887	0.0098
<i>Lagerstroemia parviflora</i>	8	12.41	0.11	0.00051	0.896	12	1.2448133	2.25	0.9999297	0.0082
<i>Sterculia villosa</i>	6	65.99	0.59	0.00038	0.672	8	0.8298755	2.09	0.9999623	0.0066
<i>Careya arborea</i>	8	35.07	0.31	0.00051	0.896	8	0.8298755	2.04	0.99999	0.0082

Scientific Name	Stem count	Dm	RDm	D	RD	F	RF	IVI	SDI	SWDI
<i>Pterospermum acerifolium</i>	7	52.20	0.46	0.00045	0.784	6	0.6224066	1.87	0.9999473	0.0074
<i>Amoora rohituka</i>	8	8.59	0.08	0.00051	0.896	8	0.8298755	1.80	0.99999	0.0082
<i>Syzygium nervosum</i>	7	87.95	0.78	0.00045	0.784	2	0.2074689	1.77	0.9999473	0.0074
<i>Dillenia pentagyna</i>	4	77.34	0.69	0.00025	0.448	6	0.6224066	1.76	0.9999849	0.0047
<i>Lagerstroemia speciosa</i>	8	23.23	0.21	0.00051	0.896	6	0.6224066	1.72	0.9999297	0.0082
<i>Trevesia palmata</i>	3	79.89	0.71	0.00019	0.336	6	0.6224066	1.67	0.9999925	0.0037
<i>Canarium sikkimense</i>	3	98.35	0.87	0.00019	0.336	4	0.4149378	1.62	0.9999925	0.0037
<i>Mallotus philippensis</i>	5	46.15	0.41	0.00032	0.560	6	0.6224066	1.59	0.9999749	0.0057
<i>Alstonia scholaris</i>	4	77.02	0.68	0.00025	0.448	4	0.4149378	1.55	0.9999849	0.0047
<i>Albizia lucidior</i>	6	25.89	0.23	0.00038	0.672	6	0.6224066	1.52	0.9999623	0.0066
<i>Terminalia catappa</i>	7	28.33	0.25	0.00045	0.784	4	0.4149378	1.45	0.9999887	0.0074
<i>Aganope polystachya</i>	1	127.23	1.13	0.00006	0.112	2	0.2074689	1.45	1	0.0015
<i>Casearia graveolens</i>	6	16.17	0.14	0.00038	0.672	6	0.6224066	1.44	0.9999623	0.0066
<i>Adenanthera microsperma</i>	1	125.40	1.11	0.00006	0.112	2	0.2074689	1.43	1	0.0015
<i>Leucaena leucocephala</i>	4	36.92	0.33	0.00025	0.448	6	0.6224066	1.40	0.9999849	0.0047
<i>Boehmeria penduliflora</i>	2	79.89	0.71	0.00013	0.224	4	0.4149378	1.35	0.9999975	0.0027
<i>Callicarpa arborea</i>	4	28.96	0.26	0.00025	0.448	6	0.6224066	1.33	0.9999849	0.0047
<i>Macaranga indica</i>	3	64.80	0.58	0.00019	0.336	4	0.4149378	1.33	0.9999887	0.0037
<i>Magnolia champaca</i>	3	39.78	0.35	0.00019	0.336	6	0.6224066	1.31	0.9999925	0.0037
<i>Garuga pinnata</i>	5	35.65	0.32	0.00032	0.560	4	0.4149378	1.29	0.9999749	0.0057
<i>Aglaiia spectabilis</i>	5	11.46	0.10	0.00032	0.560	6	0.6224066	1.28	0.9999749	0.0057
<i>Stixis suaveolens</i>	2	68.11	0.60	0.00013	0.224	4	0.4149378	1.24	0.9999975	0.0027
<i>Litsea salicifolia</i>	4	18.78	0.17	0.00025	0.448	6	0.6224066	1.24	0.9999849	0.0047
<i>Firmiana colorata</i>	6	14.48	0.13	0.00038	0.672	4	0.4149378	1.22	0.9999912	0.0066
<i>Acacia catechu</i>	4	15.52	0.14	0.00025	0.448	6	0.6224066	1.21	0.9999849	0.0047
<i>Ailanthus integrifolia</i>	3	50.92	0.45	0.00019	0.336	4	0.4149378	1.20	0.9999925	0.0037
<i>Gmelina arborea</i>	2	62.06	0.55	0.00013	0.224	4	0.4149378	1.19	0.99999	0.0027
<i>Toona ciliata</i>	3	24.40	0.22	0.00019	0.336	6	0.6224066	1.17	0.9999925	0.0037
<i>Phyllanthus emblica</i>	3	47.42	0.42	0.00019	0.336	4	0.4149378	1.17	0.9999925	0.0037
<i>Cephalanthus tetrandra</i>	4	10.61	0.09	0.00025	0.448	6	0.6224066	1.16	0.9999925	0.0047
<i>Streblus asper</i>	4	9.55	0.08	0.00025	0.448	6	0.6224066	1.16	0.9999849	0.0047
<i>Elaeocarpus floribundus</i>	3	39.15	0.35	0.00019	0.336	4	0.4149378	1.10	0.9999887	0.0037
<i>Bridelia sikkimensis</i>	3	10.93	0.10	0.00019	0.336	6	0.6224066	1.06	0.9999925	0.0037
<i>Acrocarpus fraxinifolius</i>	1	79.89	0.71	0.00006	0.112	2	0.2074689	1.03	1	0.0015
<i>Dysoxylum gotadhora</i>	3	31.19	0.28	0.00019	0.336	4	0.4149378	1.03	0.9999925	0.0037
<i>Catunaregam longispina</i>	2	43.28	0.38	0.00013	0.224	4	0.4149378	1.02	0.9999975	0.0027
<i>Zanihoxylum budrunga</i>	1	78.61	0.70	0.00006	0.112	2	0.2074689	1.02	1	0.0015
<i>Artocarpus chama</i>	1	77.98	0.69	0.00006	0.112	2	0.2074689	1.01	1	0.0015
<i>Macaranga denticulata</i>	3	28.33	0.25	0.00019	0.336	4	0.4149378	1.00	0.9999887	0.0037

Scientific Name	Stem count	Dm	RDm	D	RD	F	RF	IVI	SDI	SWDI
<i>Bombax ceiba</i>	2	40.90	0.36	0.00013	0.224	4	0.4149378	1.00	0.9999975	0.0027
<i>Cryptocarya amygdalina</i>	2	40.42	0.36	0.00013	0.224	4	0.4149378	1.00	0.9999975	0.0027
<i>Albizia procera</i>	2	38.67	0.34	0.00013	0.224	4	0.4149378	0.98	0.9999887	0.0027
<i>Vitex quinata</i>	3	22.92	0.20	0.00019	0.336	4	0.4149378	0.95	0.9999925	0.0037
<i>Aegle marmelos</i>	2	58.88	0.52	0.00013	0.224	2	0.2074689	0.95	0.9999975	0.0027
<i>Lagerstroemia hypoleuca</i>	2	35.49	0.31	0.00013	0.224	4	0.4149378	0.95	0.9999975	0.0027
<i>Pandanus unguifer</i>	1	70.29	0.62	0.00006	0.112	2	0.2074689	0.94	1	0.0015
<i>Aglaia perviridis</i>	2	34.21	0.30	0.00013	0.224	4	0.4149378	0.94	0.9999975	0.0027
<i>Engelhardtia spicata</i>	3	18.46	0.16	0.00019	0.336	4	0.4149378	0.91	0.9999925	0.0037
<i>Machilus glaucescens</i>	1	65.25	0.58	0.00006	0.112	2	0.2074689	0.90	0.9999912	0.0015
<i>Bauhinia acuminata</i>	2	27.37	0.24	0.00013	0.224	4	0.4149378	0.88	0.9999975	0.0027
<i>Cleidion javanicum</i>	2	25.34	0.22	0.00013	0.224	4	0.4149378	0.86	0.9999975	0.0027
<i>Oroxylum indicum</i>	3	11.94	0.11	0.00019	0.336	4	0.4149378	0.86	0.9999925	0.0037
<i>Benkara fasciculata</i>	0	0.00	0.00	0.00000	0.000	0	0	0.00	1	#NUM!
<i>Antidesma acidum</i>	2	24.51	0.22	0.00013	0.224	4	0.4149378	0.86	0.9999975	0.0027
<i>Dillenia indica</i>	2	44.45	0.39	0.00013	0.224	2	0.2074689	0.83	0.9999975	0.0027
<i>Leea guineense</i>	2	19.41	0.17	0.00013	0.224	4	0.4149378	0.81	0.9999975	0.0027
<i>Goniothalamus sesquipedalis</i>	3	6.68	0.06	0.00019	0.336	4	0.4149378	0.81	0.9999925	0.0037
<i>Ficus semicordata</i>	4	16.95	0.15	0.00025	0.448	2	0.2074689	0.81	0.99999	0.0047
<i>Cinnamomum glaucescens</i>	2	17.82	0.16	0.00013	0.224	4	0.4149378	0.80	0.9999975	0.0027
<i>Strychnos nux-vomica</i>	2	15.91	0.14	0.00013	0.224	4	0.4149378	0.78	0.9999975	0.0027
<i>Ventilago denticulata</i>	1	50.29	0.45	0.00006	0.112	2	0.2074689	0.77	1	0.0015
<i>Abrus precatorius</i>	2	12.56	0.11	0.00013	0.224	4	0.4149378	0.75	0.9999975	0.0027
<i>Acacia pennata</i>	2	11.14	0.10	0.00013	0.224	4	0.4149378	0.74	0.9999975	0.0027
<i>Machilus gamblei</i>	2	7.96	0.07	0.00013	0.224	4	0.4149378	0.71	0.9999975	0.0027
<i>Bauhinia variegata</i>	2	6.68	0.06	0.00013	0.224	4	0.4149378	0.70	0.9999975	0.0027
<i>Ficus racemosa</i>	1	41.37	0.37	0.00006	0.112	2	0.2074689	0.69	1	0.0015
<i>Syzygium formosum</i>	2	28.64	0.25	0.00013	0.224	2	0.2074689	0.69	0.9999975	0.0027
<i>Spondias pinnata</i>	1	38.99	0.35	0.00006	0.112	2	0.2074689	0.67	1	0.0015
<i>Cissus adenantha</i>	3	13.21	0.12	0.00019	0.336	2	0.2074689	0.66	0.9999912	0.0037
<i>Aporosa octandra</i>	3	10.37	0.09	0.00019	0.336	2	0.2074689	0.64	0.9999925	0.0037
<i>Celtis tetrandra</i>	1	35.33	0.31	0.00006	0.112	2	0.2074689	0.63	1	0.0015
<i>Chukrasia tabularis</i>	1	32.78	0.29	0.00006	0.112	2	0.2074689	0.61	0.9999912	0.0015
<i>Elaeocarpus varunua</i>	1	32.17	0.29	0.00006	0.112	2	0.2074689	0.60	1	0.0015
<i>Neolamarckia cadamba</i>	1	31.83	0.28	0.00006	0.112	2	0.2074689	0.60	1	0.0015
<i>Ficus hispida</i>	1	31.51	0.28	0.00006	0.112	2	0.2074689	0.60	0.99999	0.0015
<i>Grewia sclerophylla</i>	1	29.04	0.26	0.00006	0.112	2	0.2074689	0.58	1	0.0015
<i>Mangifera indica</i>	1	28.64	0.25	0.00006	0.112	2	0.2074689	0.57	1	0.0015
<i>Litsea pungens</i>	1	28.64	0.25	0.00006	0.112	2	0.2074689	0.57	1	0.0015

Scientific Name	Stem count	Dm	RDm	D	RD	F	RF	IVI	SDI	SWDI
<i>Chonemorpha fragrans</i>	2	15.60	0.14	0.00013	0.224	2	0.2074689	0.57	0.9999975	0.0027
<i>Derris robusta</i>	1	28.00	0.25	0.00006	0.112	2	0.2074689	0.57	1	0.0015
<i>Bauhinia scandens</i>	1	27.69	0.25	0.00006	0.112	2	0.2074689	0.57	0.9999874	0.0015
<i>Sorindeia madagascariensis</i>	1	25.46	0.23	0.00006	0.112	2	0.2074689	0.55	0.9999887	0.0015
<i>Terminalia chebula</i>	2	10.50	0.09	0.00013	0.224	2	0.2074689	0.52	0.9999975	0.0027
<i>Aglaiia lawii</i>	2	9.39	0.08	0.00013	0.224	2	0.2074689	0.51	0.99999	0.0027
<i>Ficus religiosa</i>	1	21.32	0.19	0.00006	0.112	2	0.2074689	0.51	1	0.0015
<i>Bridelia stipularis</i>	2	8.59	0.08	0.00013	0.224	2	0.2074689	0.51	0.9999975	0.0027
<i>Grewia serrulata</i>	1	21.11	0.19	0.00006	0.112	2	0.2074689	0.51	0.99999	0.0015
<i>Albizia lebbek</i>	1	19.89	0.18	0.00006	0.112	2	0.2074689	0.50	0.9999887	0.0015
<i>Pongamia pinnata</i>	1	19.74	0.18	0.00006	0.112	2	0.2074689	0.49	1	0.0015
<i>Balakata baccata</i>	1	19.10	0.17	0.00006	0.112	2	0.2074689	0.49	1	0.0015
<i>Alangium chinense</i>	1	17.51	0.16	0.00006	0.112	2	0.2074689	0.47	1	0.0015
<i>Cassia fistula</i>	1	17.19	0.15	0.00006	0.112	2	0.2074689	0.47	1	0.0015
<i>Trema politoria</i>	1	16.95	0.15	0.00006	0.112	2	0.2074689	0.47	1	0.0015
<i>Senna siamea</i>	1	15.91	0.14	0.00006	0.112	2	0.2074689	0.46	1	0.0015
<i>Ficus neriifolia</i>	1	15.28	0.14	0.00006	0.112	2	0.2074689	0.46	1	0.0015
<i>Albizia chinensis</i>	1	14.85	0.13	0.00006	0.112	2	0.2074689	0.45	1	0.0015
<i>Walsura robusta</i>	1	14.32	0.13	0.00006	0.112	2	0.2074689	0.45	1	0.0015
<i>Psidium guajava</i>	1	14.32	0.13	0.00006	0.112	2	0.2074689	0.45	1	0.0015
<i>Swietenia macrophylla</i>	1	14.32	0.13	0.00006	0.112	2	0.2074689	0.45	1	0.0015
<i>Sapindus mukorossi</i>	1	14.20	0.13	0.00006	0.112	2	0.2074689	0.45	1	0.0015
<i>Kydia calycina</i>	1	13.05	0.12	0.00006	0.112	2	0.2074689	0.44	1	0.0015
<i>Litsea glutinosa</i>	1	12.73	0.11	0.00006	0.112	2	0.2074689	0.43	1	0.0015
<i>Saurauia roxburghii</i>	1	12.41	0.11	0.00006	0.112	2	0.2074689	0.43	1	0.0015
<i>Terminalia myriocarpa</i>	1	12.09	0.11	0.00006	0.112	2	0.2074689	0.43	0.9999887	0.0015
<i>Cinnamomum tamala</i>	1	11.98	0.11	0.00006	0.112	2	0.2074689	0.43	1	0.0015
<i>Bauhinia vahlii</i>	1	11.83	0.11	0.00006	0.112	2	0.2074689	0.42	1	0.0015
<i>Tamarindus indica</i>	1	11.46	0.10	0.00006	0.112	2	0.2074689	0.42	1	0.0015
<i>Combretum nanum</i>	1	11.14	0.10	0.00006	0.112	2	0.2074689	0.42	1	0.0015
<i>Semecarpus anacardium</i>	1	10.82	0.10	0.00006	0.112	2	0.2074689	0.42	1	0.0015
<i>Myristica longifolia</i>	1	10.82	0.10	0.00006	0.112	2	0.2074689	0.42	1	0.0015
<i>Crateva religiosa</i>	1	10.32	0.09	0.00006	0.112	2	0.2074689	0.41	1	0.0015
<i>Maesa chisia</i>	1	10.32	0.09	0.00006	0.112	2	0.2074689	0.41	0.99999	0.0015
<i>Acacia concinna</i>	1	10.22	0.09	0.00006	0.112	2	0.2074689	0.41	0.99999	0.0015
<i>Phoenix sylvestris</i>	1	10.12	0.09	0.00006	0.112	2	0.2074689	0.41	1	0.0015
<i>Ziziphus rugosa</i>	1	10.01	0.09	0.00006	0.112	2	0.2074689	0.41	1	0.0015
<i>Litsea laeta</i>	1	9.55	0.08	0.00006	0.112	2	0.2074689	0.40	1	0.0015
<i>Antidesma bunius</i>	1	9.55	0.08	0.00006	0.112	2	0.2074689	0.40	1	0.0015







Scientific Name	Stem count	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Antidesma bunius</i>	0	0	0	0	0	0	0	0	0	0
<i>Woodfordia fruticosa</i>	0	0	0	0	0	0	0	0	0	0
<i>Barleria strigosa</i>	0	0	0	0	0	0	0	0	0	0
<i>Calamus erectus</i>	0	0	0	0	0	0	0	0	0	0
<i>Ixora nigricans</i>	0	0	0	0	0	0	0	0	0	0
<i>Calotropis gigantea</i>	0	0	0	0	0	0	0	0	0	0

## ANNEXURE: IIa

### Phytosociological assesment of dominant saplings

Name of the Plant	Stem count	Occurance	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Magnolia pterocarpa</i>	15	12	0.0106	4.412	24	5.854	0.475	38.353	48.618	0.998	0.032
<i>Ficus neriifolia</i>	15	8	0.0106	4.412	16	3.902	0.409	33.038	41.352	0.998	0.032
<i>Ailanthus grandis</i>	7	7	0.0050	2.059	14	3.415	0.021	1.727	7.201	1.000	0.019
<i>Casearia graveolens</i>	9	6	0.0064	2.647	12	2.927	0.019	1.509	7.083	0.999	0.023
<i>Streblus asper</i>	5	7	0.0035	1.471	14	3.415	0.022	1.746	6.631	1.000	0.015
<i>Aglaia spectabilis</i>	11	6	0.0078	3.235	12	2.927	0.001	0.118	6.280	0.999	0.026
<i>Actinodaphne obovata</i>	13	4	0.0092	3.824	8	1.951	0.004	0.327	6.102	0.999	0.029
<i>Polyalthia simiarum</i>	10	5	0.0071	2.941	10	2.439	0.009	0.700	6.080	0.999	0.024
<i>Litsea cubeba</i>	6	6	0.0042	1.765	12	2.927	0.016	1.282	5.973	1.000	0.017
<i>Aporosa dioica</i>	8	5	0.0057	2.353	10	2.439	0.006	0.468	5.260	1.000	0.021
<i>Leea guineense</i>	7	4	0.0050	2.059	8	1.951	0.012	0.950	4.960	1.000	0.019
<i>Litsea glutinosa</i>	7	4	0.0050	2.059	8	1.951	0.009	0.704	4.714	1.000	0.019
<i>Dalbergia stipulacea</i>	10	3	0.0071	2.941	6	1.463	0.003	0.218	4.623	0.999	0.024
<i>Duabanga grandiflora</i>	8	3	0.0057	2.353	6	1.463	0.007	0.571	4.388	1.000	0.021
<i>Syzygium operculatum</i>	7	3	0.0050	2.059	6	1.463	0.008	0.682	4.204	1.000	0.019
<i>Chisocheton cumingianus</i>	5	5	0.0035	1.471	10	2.439	0.004	0.291	4.201	1.000	0.015
<i>Machilus gamblei</i>	5	5	0.0035	1.471	10	2.439	0.003	0.206	4.115	1.000	0.015
<i>Mallotus philippensis</i>	5	5	0.0035	1.471	10	2.439	0.003	0.206	4.115	1.000	0.015
<i>Careya arborea</i>	3	4	0.0021	0.882	8	1.951	0.011	0.909	3.743	1.000	0.010
<i>Catunaregam longispina</i>	3	4	0.0021	0.882	8	1.951	0.011	0.882	3.715	1.000	0.010
<i>Syzygium praecox</i>	8	2	0.0057	2.353	4	0.976	0.004	0.336	3.665	1.000	0.021
<i>Albizia lucidior</i>	5	4	0.0035	1.471	8	1.951	0.003	0.223	3.645	1.000	0.015
<i>Fagerlindia fasciculata</i>	2	3	0.0014	0.588	6	1.463	0.019	1.573	3.625	1.000	0.007
<i>Ziziphus rugosa</i>	5	4	0.0035	1.471	8	1.951	0.002	0.174	3.596	1.000	0.015
<i>Stixis suaveolens</i>	5	4	0.0035	1.471	8	1.951	0.002	0.137	3.559	1.000	0.015
<i>Litsea salicifolia</i>	6	3	0.0042	1.765	6	1.463	0.002	0.183	3.411	1.000	0.017
<i>Bauhinia acuminata</i>	4	3	0.0028	1.176	6	1.463	0.009	0.746	3.385	1.000	0.012
<i>Boehmeria penduliflora</i>	5	3	0.0035	1.471	6	1.463	0.005	0.400	3.334	1.000	0.015
<i>Garuga pinnata</i>	2	1	0.0014	0.588	2	0.488	0.027	2.191	3.267	1.000	0.007
<i>Butea parviflora</i>	5	3	0.0035	1.471	6	1.463	0.003	0.240	3.174	1.000	0.015
<i>Trevesia palmata</i>	5	3	0.0035	1.471	6	1.463	0.002	0.154	3.088	1.000	0.015

Name of the Plant	Stem count	Occurrence	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Neocinnamomum caudatum</i>	6	2	0.0042	1.765	4	0.976	0.003	0.231	2.972	1.000	0.017
<i>Firmiana colorata</i>	6	2	0.0042	1.765	4	0.976	0.002	0.182	2.922	1.000	0.017
<i>Pterygota alata</i>	6	2	0.0042	1.765	4	0.976	0.002	0.150	2.891	1.000	0.017
<i>Bridelia stipularis</i>	4	3	0.0028	1.176	6	1.463	0.003	0.243	2.883	1.000	0.012
<i>Dysoxylum mollissimum</i>	4	3	0.0028	1.176	6	1.463	0.003	0.227	2.867	1.000	0.012
<i>Stereospermum tetragonum</i>	5	2	0.0035	1.471	4	0.976	0.003	0.271	2.718	1.000	0.015
<i>Crateva religiosa</i>	2	4	0.0014	0.588	8	1.951	0.002	0.127	2.667	1.000	0.007
<i>Amoora rohituka</i>	4	2	0.0028	1.176	4	0.976	0.006	0.464	2.616	1.000	0.012
<i>Albizia gamblei</i>	3	3	0.0021	0.882	6	1.463	0.002	0.177	2.523	1.000	0.010
<i>Ficus hispida</i>	3	3	0.0021	0.882	6	1.463	0.002	0.137	2.483	1.000	0.010
<i>Aphanamixis polystachya</i>	4	2	0.0028	1.176	4	0.976	0.004	0.318	2.470	1.000	0.012
<i>Lagerstroemia parviflora</i>	3	3	0.0021	0.882	6	1.463	0.001	0.100	2.446	1.000	0.010
<i>Macaranga indica</i>	6	1	0.0042	1.765	2	0.488	0.002	0.145	2.398	1.000	0.017
<i>Litsea pungens</i>	6	1	0.0042	1.765	2	0.488	0.002	0.145	2.398	1.000	0.017
<i>Albizia lucida</i>	5	1	0.0035	1.471	2	0.488	0.004	0.326	2.284	1.000	0.015
<i>Cissus repanda</i>	5	1	0.0035	1.471	2	0.488	0.004	0.317	2.275	1.000	0.015
<i>Maesa chisia</i>	2	2	0.0014	0.588	4	0.976	0.008	0.627	2.191	1.000	0.007
<i>Trewia nudiflora</i>	5	1	0.0035	1.471	2	0.488	0.002	0.182	2.140	1.000	0.015
<i>Semecarpus anacardium</i>	2	2	0.0014	0.588	4	0.976	0.007	0.527	2.091	1.000	0.007
<i>Kydia calycina</i>	3	2	0.0021	0.882	4	0.976	0.003	0.217	2.075	1.000	0.010
<i>Bridelia sikkimensis</i>	5	1	0.0035	1.471	2	0.488	0.001	0.091	2.049	1.000	0.015
<i>Psidium guajava</i>	3	2	0.0021	0.882	4	0.976	0.002	0.183	2.041	1.000	0.010
<i>Aegle marmelos</i>	3	2	0.0021	0.882	4	0.976	0.002	0.123	1.981	1.000	0.010
<i>Terminalia bellirica</i>	2	2	0.0014	0.588	4	0.976	0.004	0.314	1.878	1.000	0.007
<i>Cinnamomum tamala</i>	2	2	0.0014	0.588	4	0.976	0.002	0.200	1.764	1.000	0.007
<i>Magnolia champaca</i>	2	2	0.0014	0.588	4	0.976	0.002	0.173	1.737	1.000	0.007
<i>Mangifera indica</i>	2	1	0.0014	0.588	2	0.488	0.008	0.655	1.731	1.000	0.007
<i>Trema politoria</i>	2	2	0.0014	0.588	4	0.976	0.001	0.111	1.675	1.000	0.007
<i>Pterospermum acerifolium</i>	3	1	0.0021	0.882	2	0.488	0.003	0.271	1.642	1.000	0.010
<i>Schima wallichii</i>	3	1	0.0021	0.882	2	0.488	0.002	0.191	1.562	1.000	0.010
<i>Acacia pennata</i>	3	1	0.0021	0.882	2	0.488	0.002	0.123	1.493	1.000	0.010
<i>Castanopsis indica</i>	3	1	0.0021	0.882	2	0.488	0.001	0.091	1.461	1.000	0.010
<i>Wrightia arborea</i>	2	1	0.0014	0.588	2	0.488	0.004	0.343	1.419	1.000	0.007
<i>Cassia fistula</i>	2	1	0.0014	0.588	2	0.488	0.003	0.282	1.358	1.000	0.007
<i>Antidesma acidum</i>	2	1	0.0014	0.588	2	0.488	0.002	0.145	1.222	1.000	0.007
<i>Ixora nigricans</i>	2	1	0.0014	0.588	2	0.488	0.002	0.127	1.203	1.000	0.007
<i>Sterculia villosa</i>	2	1	0.0014	0.588	2	0.488	0.002	0.127	1.203	1.000	0.007
<i>Antidesma diandrum</i>	2	1	0.0014	0.588	2	0.488	0.001	0.091	1.167	1.000	0.007

## ANNEXURE: III

Phytosociological assesment of dominant herbs

Scientific Name	No of stem	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Panicum notatum</i>	989	6.299	31.587	6	0.395	329.667	12.994	44.977	0.9683	0.0590
<i>Globba marantina</i>	504	3.210	16.097	54	3.557	18.667	0.736	20.390	0.9918	0.0418
<i>Alternanthera philoxeroides</i>	264	1.682	8.432	4	0.132	264.000	10.406	18.970	0.9977	0.0278
<i>Spermacoce alata</i>	228	1.452	7.282	2	0.132	228.000	8.987	16.401	0.9983	0.0252
<i>Lindernia parviflora</i>	168	1.070	5.366	14	0.132	168.000	6.622	12.119	0.9991	0.0203
<i>Barleria prionitis</i>	159	1.013	5.078	4	0.132	159.000	6.267	11.477	0.9992	0.0195
<i>Cynodon dactylon</i>	196	1.248	6.260	2	0.264	98.000	3.863	10.386	0.9988	0.0227
<i>Eragrostis amabilis</i>	239	1.522	7.633	16	0.922	34.143	1.346	9.901	0.9982	0.0260
<i>Piper mullesua</i>	135	0.860	4.312	14	0.264	67.500	2.661	7.236	0.9994	0.0173
<i>Bulbophyllum careyanum</i>	168	1.070	5.366	8	0.922	24.000	0.946	7.234	0.9991	0.0203
<i>Mikania micrantha</i>	116	0.739	3.705	2	0.264	58.000	2.286	6.255	0.9996	0.0155
<i>Achyrospermum wallichianum</i>	134	0.854	4.280	20	1.318	13.400	0.528	6.125	0.9994	0.0173
<i>Evolvulus nummularius</i>	131	0.834	4.184	12	0.791	21.833	0.861	5.835	0.9994	0.0170
<i>Piper betloides</i>	77	0.490	2.459	2	0.132	77.000	3.035	5.626	0.9998	0.0114
<i>Peperomia pellucida</i>	115	0.732	3.673	18	1.186	12.778	0.504	5.362	0.9996	0.0154
<i>Alocasia macrorrhizos</i>	107	0.682	3.417	4	1.318	10.700	0.422	5.157	0.9996	0.0146
<i>Centella asiatica</i>	60	0.382	1.916	4	0.132	60.000	2.365	4.413	0.9999	0.0094
<i>Cardamine hirsuta</i>	80	0.510	2.555	20	0.264	40.000	1.577	4.395	0.9998	0.0117
<i>Lindernia crustacea</i>	78	0.497	2.491	2	1.318	7.800	0.307	4.116	0.9998	0.0115
<i>Eriophorum comosum</i>	53	0.338	1.693	2	0.132	53.000	2.089	3.914	0.9999	0.0085
<i>Papilionanthe teres</i>	16	0.102	0.511	4	3.162	0.667	0.026	3.699	1.0000	0.0032
<i>Aster albescens</i>	66	0.420	2.108	48	1.186	7.333	0.289	3.583	0.9999	0.0101
<i>Diplazium esculentum</i>	46	0.293	1.469	20	0.132	46.000	1.813	3.414	0.9999	0.0076
<i>Phyllanthus fraternus</i>	46	0.293	1.469	4	0.132	46.000	1.813	3.414	0.9999	0.0076
<i>Piper longum</i>	61	0.389	1.948	18	0.264	30.500	1.202	3.414	0.9999	0.0095
<i>Piper peepuloides</i>	48	0.306	1.533	20	1.581	4.000	0.158	3.272	0.9999	0.0079
<i>Acmella uliginosa</i>	61	0.389	1.948	24	0.527	15.250	0.601	3.076	0.9999	0.0095
<i>Lepidagathis incurva</i>	41	0.261	1.309	34	0.132	41.000	1.616	3.057	0.9999	0.0070
<i>Drymaria cordata subsp. diandra</i>	14	0.089	0.447	30	2.240	0.824	0.032	2.719	1.0000	0.0029
<i>Persicaria chinensis</i>	44	0.280	1.405	8	0.791	7.333	0.289	2.485	0.9999	0.0074
<i>Thysanolaena latifolia</i>	32	0.204	1.022	34	1.318	3.200	0.126	2.466	1.0000	0.0057
<i>Gomphostemma ovatum</i>	4	0.025	0.128	4	2.240	0.235	0.009	2.377	1.0000	0.0010
<i>Parabaena sagittata</i>	40	0.255	1.278	10	0.264	20.000	0.788	2.329	0.9999	0.0068
<i>Christella dentata</i>	12	0.076	0.383	16	1.845	0.857	0.034	2.262	1.0000	0.0025
<i>Eranthemum pulchellum</i>	29	0.185	0.926	2	0.132	29.000	1.143	2.201	1.0000	0.0053
<i>Pteris elongata</i>	29	0.185	0.926	16	0.132	29.000	1.143	2.201	1.0000	0.0053
<i>Torenia cordifolia</i>	6	0.038	0.192	28	1.976	0.400	0.016	2.184	1.0000	0.0014
<i>Dendrobium jenkinsii</i>	1	0.006	0.032	26	2.108	0.063	0.002	2.142	1.0000	0.0003
<i>Piper khasianum</i>	11	0.070	0.351	24	1.713	0.846	0.033	2.097	1.0000	0.0024
<i>Molineria capitulata</i>	1	0.006	0.032	26	1.976	0.067	0.003	2.011	1.0000	0.0003
<i>Holmskioldia sanguinea</i>	5	0.032	0.160	2	1.713	0.385	0.015	1.888	1.0000	0.0012
<i>Mukia maderaspatana</i>	4	0.025	0.128	12	1.713	0.308	0.012	1.853	1.0000	0.0010
<i>Cyperus laxus</i>	24	0.153	0.767	22	0.132	24.000	0.946	1.844	1.0000	0.0045
<i>Tamarix indica</i>	7	0.045	0.224	4	1.581	0.583	0.023	1.828	1.0000	0.0016

Scientific Name	No of stem	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Cissus repens</i>	2	0.013	0.064	30	1.713	0.154	0.006	1.783	1.0000	0.0005
<i>Pueraria phaseoloides</i>	23	0.146	0.735	16	0.132	23.000	0.907	1.773	1.0000	0.0044
<i>Piper pedicellatum</i>	5	0.032	0.160	4	1.581	0.417	0.016	1.757	1.0000	0.0012
<i>Dioscorea hamiltonii</i>	30	0.191	0.958	32	0.395	10.000	0.394	1.748	1.0000	0.0054
<i>Bambusa vulgaris</i>	21	0.134	0.671	26	0.922	3.000	0.118	1.711	1.0000	0.0040
<i>Conyza leucantha</i>	20	0.127	0.639	2	0.922	2.857	0.113	1.674	1.0000	0.0039
<i>Asparagus racemosus</i>	8	0.051	0.256	2	1.318	0.800	0.032	1.605	1.0000	0.0018
<i>Phaseolus vulgaris</i>	14	0.089	0.447	2	1.054	1.750	0.069	1.570	1.0000	0.0029
<i>Cissampelopsis buimalia</i>	3	0.019	0.096	10	1.449	0.273	0.011	1.556	1.0000	0.0008
<i>Piper chuyva</i>	25	0.159	0.798	26	0.264	12.500	0.493	1.555	1.0000	0.0047
<i>Commelina diffusa</i>	25	0.159	0.798	24	0.395	8.333	0.328	1.522	1.0000	0.0047
<i>Piper attenuatum</i>	19	0.121	0.607	2	0.659	3.800	0.150	1.415	1.0000	0.0037
<i>Angiopteris evecta</i>	14	0.089	0.447	6	0.791	2.333	0.092	1.330	1.0000	0.0029
<i>Ageratum conyzoides</i>	18	0.115	0.575	8	0.527	4.500	0.177	1.279	1.0000	0.0036
<i>Globba racemosa</i>	2	0.013	0.064	4	1.186	0.222	0.009	1.258	1.0000	0.0005
<i>Floscopa scandens</i>	12	0.076	0.383	20	0.791	2.000	0.079	1.253	1.0000	0.0025
<i>Trigonospora caudipinna</i>	8	0.051	0.256	14	0.922	1.143	0.045	1.223	1.0000	0.0018
<i>Codoriocalyx motorius</i>	1	0.006	0.032	14	1.186	0.111	0.004	1.222	1.0000	0.0003
<i>Mimosa pudica</i>	14	0.089	0.447	14	0.659	2.800	0.110	1.216	1.0000	0.0029
<i>Hedychium thyrsoforme</i>	15	0.096	0.479	4	0.132	15.000	0.591	1.202	1.0000	0.0031
<i>Dioscorea prazeri</i>	15	0.096	0.479	2	0.132	15.000	0.591	1.202	1.0000	0.0031
<i>Arundina graminifolia</i>	4	0.025	0.128	16	1.054	0.500	0.020	1.201	1.0000	0.0010
<i>Barleria cristata</i>	16	0.102	0.511	10	0.527	4.000	0.158	1.196	1.0000	0.0032
<i>Kyllinga brevifolia</i>	13	0.083	0.415	10	0.659	2.600	0.102	1.176	1.0000	0.0027
<i>Capillipedium assimile</i>	10	0.064	0.319	14	0.791	1.667	0.066	1.176	1.0000	0.0022
<i>Begonia picta</i>	3	0.019	0.096	6	1.054	0.375	0.015	1.165	1.0000	0.0008
<i>Tetrastigma bracteolatum</i>	3	0.019	0.096	8	1.054	0.375	0.015	1.165	1.0000	0.0008
<i>Persicaria capitata</i>	14	0.089	0.447	4	0.132	14.000	0.552	1.131	1.0000	0.0029
<i>Tectaria gemmifera</i>	14	0.089	0.447	18	0.132	14.000	0.552	1.131	1.0000	0.0029
<i>Dioscorea belophylla</i>	8	0.051	0.256	10	0.791	1.333	0.053	1.099	1.0000	0.0018
<i>Blumea lanceolaria</i>	1	0.006	0.032	18	1.054	0.125	0.005	1.091	1.0000	0.0003
<i>Typhonium trilobatum</i>	16	0.102	0.511	12	0.264	8.000	0.315	1.090	1.0000	0.0032
<i>Oplismenus compositus</i>	9	0.057	0.287	8	0.659	1.800	0.071	1.017	1.0000	0.0020
<i>Rhynchochloa ellipticum</i>	9	0.057	0.287	12	0.659	1.800	0.071	1.017	1.0000	0.0020
<i>Merremia vitifolia</i>	2	0.013	0.064	10	0.922	0.286	0.011	0.997	1.0000	0.0005
<i>Hoya parasitica</i>	12	0.076	0.383	10	0.132	12.000	0.473	0.988	1.0000	0.0025
<i>Oxalis corniculata</i>	12	0.076	0.383	12	0.132	12.000	0.473	0.988	1.0000	0.0025
<i>Thysanolaena latifolia</i>	12	0.076	0.383	4	0.132	12.000	0.473	0.988	1.0000	0.0025
<i>Adiantum cordatum</i>	11	0.070	0.351	2	0.527	2.750	0.108	0.987	1.0000	0.0024
<i>Helminthostachys zeylanica</i>	14	0.089	0.447	4	0.264	7.000	0.276	0.987	1.0000	0.0029
<i>Schefflera pubigera</i>	1	0.006	0.032	12	0.922	0.143	0.006	0.960	1.0000	0.0003
<i>Alpinia calcarata</i>	7	0.045	0.224	4	0.659	1.400	0.055	0.938	1.0000	0.0016
<i>Saccharum spontaneum</i>	12	0.076	0.383	10	0.395	4.000	0.158	0.936	1.0000	0.0025
<i>Sida acuta</i>	13	0.083	0.415	2	0.264	6.500	0.256	0.935	1.0000	0.0027

Scientific Name	No of stem	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Bidens pilosa</i>	12	0.076	0.383	2	0.264	6.000	0.236	0.883	1.0000	0.0025
<i>Stellaria media</i>	12	0.076	0.383	12	0.264	6.000	0.236	0.883	1.0000	0.0025
<i>Boerhavia diffusa</i>	2	0.013	0.064	8	0.791	0.333	0.013	0.868	1.0000	0.0005
<i>Microsorium punctatum</i>	5	0.032	0.160	10	0.659	1.000	0.039	0.858	1.0000	0.0012
<i>Adiantum lunulatum</i>	10	0.064	0.319	10	0.132	10.000	0.394	0.845	1.0000	0.0022
<i>Rungia pectinata</i>	10	0.064	0.319	14	0.132	10.000	0.394	0.845	1.0000	0.0022
<i>Amorphophallus bulbifer</i>	11	0.070	0.351	6	0.264	5.500	0.217	0.832	1.0000	0.0024
<i>Argyreia roxburghii</i>	7	0.045	0.224	8	0.527	1.750	0.069	0.820	1.0000	0.0016
<i>Cleome rutidosperma</i>	4	0.025	0.128	2	0.659	0.800	0.032	0.818	1.0000	0.0010
<i>Rorippa indica</i>	10	0.064	0.319	2	0.264	5.000	0.197	0.780	1.0000	0.0022
<i>Achyranthes bidentata</i>	9	0.057	0.287	4	0.132	9.000	0.355	0.774	1.0000	0.0020
<i>Dendrobium aphyllum</i>	9	0.057	0.287	10	0.132	9.000	0.355	0.774	1.0000	0.0020
<i>Stephania hernandiifolia</i>	9	0.057	0.287	4	0.132	9.000	0.355	0.774	1.0000	0.0020
<i>Chloranthus elatior</i>	8	0.051	0.256	10	0.395	2.667	0.105	0.756	1.0000	0.0018
<i>Merremia hirta</i>	2	0.013	0.064	6	0.659	0.400	0.016	0.738	1.0000	0.0005
<i>Tetrastigma serrulatum</i>	5	0.032	0.160	8	0.527	1.250	0.049	0.736	1.0000	0.0012
<i>Eleocharis palustris</i>	9	0.057	0.287	6	0.264	4.500	0.177	0.728	1.0000	0.0020
<i>Berchemia floribunda</i>	8	0.051	0.256	6	0.132	8.000	0.315	0.703	1.0000	0.0018
<i>Spermacoce ocymoides</i>	8	0.051	0.256	6	0.132	8.000	0.315	0.703	1.0000	0.0018
<i>Boehmeria cylindrica</i>	1	0.006	0.032	4	0.659	0.200	0.008	0.699	1.0000	0.0003
<i>Crinum amoenum</i>	1	0.006	0.032	4	0.659	0.200	0.008	0.699	1.0000	0.0003
<i>Dioscorea pubera</i>	1	0.006	0.032	2	0.659	0.200	0.008	0.699	1.0000	0.0003
<i>Tinospora sinensis</i>	1	0.006	0.032	4	0.659	0.200	0.008	0.699	1.0000	0.0003
<i>Tinospora crispa</i>	4	0.025	0.128	6	0.527	1.000	0.039	0.694	1.0000	0.0010
<i>Begonia satrapis</i>	8	0.051	0.256	10	0.264	4.000	0.158	0.677	1.0000	0.0018
<i>Tylophora indica</i>	3	0.019	0.096	4	0.527	0.750	0.030	0.652	1.0000	0.0008
<i>Eria lasiopetala</i>	7	0.045	0.224	8	0.132	7.000	0.276	0.631	1.0000	0.0016
<i>Ichnocarpus frutescens</i>	7	0.045	0.224	8	0.132	7.000	0.276	0.631	1.0000	0.0016
<i>Saccharum longisetosum</i>	7	0.045	0.224	2	0.264	3.500	0.138	0.625	1.0000	0.0016
<i>Alpinia nigra</i>	5	0.032	0.160	8	0.395	1.667	0.066	0.621	1.0000	0.0012
<i>Cissus elongata</i>	5	0.032	0.160	6	0.395	1.667	0.066	0.621	1.0000	0.0012
<i>Drynaria quercifolia</i>	5	0.032	0.160	2	0.395	1.667	0.066	0.621	1.0000	0.0012
<i>Ficus hederacea</i>	2	0.013	0.064	4	0.527	0.500	0.020	0.611	1.0000	0.0005
<i>Elephantopus scaber</i>	2	0.013	0.064	8	0.527	0.500	0.020	0.611	1.0000	0.0005
<i>Stephania japonica</i>	2	0.013	0.064	2	0.527	0.500	0.020	0.611	1.0000	0.0005
<i>Cyanthillium cinereum</i>	2	0.013	0.064	2	0.527	0.500	0.020	0.611	1.0000	0.0005
<i>Cissampelos pareira</i>	4	0.025	0.128	4	0.395	1.333	0.053	0.576	1.0000	0.0010
<i>Curculigo orchioides</i>	6	0.038	0.192	2	0.264	3.000	0.118	0.573	1.0000	0.0014
<i>Hoya linearis</i>	1	0.006	0.032	8	0.527	0.250	0.010	0.569	1.0000	0.0003
<i>Xanthosoma brasiliense</i>	1	0.006	0.032	2	0.527	0.250	0.010	0.569	1.0000	0.0003
<i>Lycopodiella cernua</i>	6	0.038	0.192	2	0.132	6.000	0.236	0.560	1.0000	0.0014
<i>Asparagus filicinus</i>	6	0.038	0.192	6	0.132	6.000	0.236	0.560	1.0000	0.0014
<i>Abrus pulchellus</i>	6	0.038	0.192	2	0.132	6.000	0.236	0.560	1.0000	0.0014
<i>Angiopteris crassipes</i>	3	0.019	0.096	6	0.395	1.000	0.039	0.530	1.0000	0.0008

Scientific Name	No of stem	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Oberonia ensiformis</i>	3	0.019	0.096	8	0.395	1.000	0.039	0.530	1.0000	0.0008
<i>Ampelocissus sikkimensis</i>	5	0.032	0.160	2	0.264	2.500	0.099	0.522	1.0000	0.0012
<i>Begonia sikkimensis</i>	5	0.032	0.160	2	0.264	2.500	0.099	0.522	1.0000	0.0012
<i>Celtis timorensis</i>	5	0.032	0.160	2	0.264	2.500	0.099	0.522	1.0000	0.0012
<i>Amaranthus viridis</i>	5	0.032	0.160	4	0.132	5.000	0.197	0.489	1.0000	0.0012
<i>Caesalpinia cucullata</i>	5	0.032	0.160	2	0.132	5.000	0.197	0.489	1.0000	0.0012
<i>Crotalaria alata</i>	5	0.032	0.160	2	0.132	5.000	0.197	0.489	1.0000	0.0012
<i>Dioscorea esculenta</i>	5	0.032	0.160	2	0.132	5.000	0.197	0.489	1.0000	0.0012
<i>Hyptis suaveolens</i>	5	0.032	0.160	2	0.132	5.000	0.197	0.489	1.0000	0.0012
<i>Sabia lanceolata</i>	5	0.032	0.160	6	0.132	5.000	0.197	0.489	1.0000	0.0012
<i>Rubia manjith</i>	2	0.013	0.064	2	0.395	0.667	0.026	0.485	1.0000	0.0005
<i>Cyanotis vaga</i>	2	0.013	0.064	2	0.395	0.667	0.026	0.485	1.0000	0.0005
<i>Bulbophyllum cornu-cervi</i>	4	0.025	0.128	4	0.264	2.000	0.079	0.470	1.0000	0.0010
<i>Rhinacanthus calcaratus</i>	4	0.025	0.128	2	0.264	2.000	0.079	0.470	1.0000	0.0010
<i>Setaria palmifolia</i>	4	0.025	0.128	6	0.264	2.000	0.079	0.470	1.0000	0.0010
<i>Stephania glabra</i>	4	0.025	0.128	4	0.264	2.000	0.079	0.470	1.0000	0.0010
<i>Tragia involucrata</i>	4	0.025	0.128	2	0.264	2.000	0.079	0.470	1.0000	0.0010
<i>Tridax procumbens</i>	1	0.006	0.032	4	0.395	0.333	0.013	0.440	1.0000	0.0003
<i>Lindernia ciliata</i>	3	0.019	0.096	2	0.264	1.500	0.059	0.418	1.0000	0.0008
<i>Selaginella monospora</i>	3	0.019	0.096	2	0.264	1.500	0.059	0.418	1.0000	0.0008
<i>Dendrobium fugax</i>	4	0.025	0.128	4	0.132	4.000	0.158	0.417	1.0000	0.0010
<i>Gouania leptostachya</i>	4	0.025	0.128	2	0.132	4.000	0.158	0.417	1.0000	0.0010
<i>Persicaria hydropiper</i>	4	0.025	0.128	2	0.132	4.000	0.158	0.417	1.0000	0.0010
<i>Scoparia dulcis</i>	4	0.025	0.128	2	0.132	4.000	0.158	0.417	1.0000	0.0010
<i>Sphaerosacme decandra</i>	4	0.025	0.128	4	0.132	4.000	0.158	0.417	1.0000	0.0010
<i>Impatiens trilobata</i>	2	0.013	0.064	4	0.264	1.000	0.039	0.367	1.0000	0.0005
<i>Parthenocissus semicordata</i>	2	0.013	0.064	4	0.264	1.000	0.039	0.367	1.0000	0.0005
<i>Piper sylvaticum</i>	2	0.013	0.064	4	0.264	1.000	0.039	0.367	1.0000	0.0005
<i>Aerides multiflora</i>	3	0.019	0.096	4	0.132	3.000	0.118	0.346	1.0000	0.0008
<i>Cheilocostus speciosus</i>	3	0.019	0.096	2	0.132	3.000	0.118	0.346	1.0000	0.0008
<i>Ipomoea nil</i>	3	0.019	0.096	2	0.132	3.000	0.118	0.346	1.0000	0.0008
<i>Mucuna pruriens</i>	3	0.019	0.096	2	0.132	3.000	0.118	0.346	1.0000	0.0008
<i>Thelypteris nudata</i>	3	0.019	0.096	4	0.132	3.000	0.118	0.346	1.0000	0.0008
<i>Centotheca lappacea</i>	1	0.006	0.032	4	0.264	0.500	0.020	0.315	1.0000	0.0003
<i>Rauwolfia serpentina</i>	1	0.006	0.032	2	0.264	0.500	0.020	0.315	1.0000	0.0003
<i>Ipomoea batatas</i>	1	0.006	0.032	2	0.264	0.500	0.020	0.315	1.0000	0.0003
<i>Phrynium pubinerve</i>	1	0.006	0.032	2	0.264	0.500	0.020	0.315	1.0000	0.0003
<i>Cayratia geniculata</i>	2	0.013	0.064	2	0.132	2.000	0.079	0.274	1.0000	0.0005
<i>Dioscorea deltoidea</i>	2	0.013	0.064	2	0.132	2.000	0.079	0.274	1.0000	0.0005
<i>Croton tiglium</i>	2	0.013	0.064	2	0.132	2.000	0.079	0.274	1.0000	0.0005
<i>Luffa cylindrica</i>	2	0.013	0.064	2	0.132	2.000	0.079	0.274	1.0000	0.0005
<i>Pyrrosia lanceolata</i>	2	0.013	0.064	2	0.132	2.000	0.079	0.274	1.0000	0.0005
<i>Aerides odorata</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003
<i>Biophytum sensitivum</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003

Scientific Name	No of stem	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Scleria terrestris</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003
<i>Diplocyclos palmatus</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003
<i>Musa paradisiaca</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003
<i>Nelsonia canescens</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003
<i>Smilax ovalifolia</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003
<i>Tetrastigma thomsonianum</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003
<i>Urtica dioica</i>	1	0.006	0.032	2	0.132	1.000	0.039	0.203	1.0000	0.0003

## ANNEXURE: IIIa

### Phytosociological assesment of dominant seedlings

Name of the Plant	Stem count	Occurance	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Stereospermum tetragonum</i>	67	2	0.427	6.879	4	0.621	0.014	1.378	8.878	1.000	0.006
<i>Syzygium cumini</i>	22	12	0.140	2.259	24	3.727	0.014	1.378	7.364	0.999	0.024
<i>Croton tiglium</i>	59	2	0.376	6.057	4	0.621	0.003	0.345	7.023	1.000	0.006
<i>Sesbania sesban</i>	25	6	0.159	2.567	12	1.863	0.014	1.378	5.808	1.000	0.015
<i>Pterygota alata</i>	1	9	0.006	0.103	18	2.795	0.028	2.757	5.654	0.999	0.020
<i>Chukrasia tabularis</i>	16	6	0.102	1.643	12	1.863	0.021	2.067	5.573	1.000	0.015
<i>Kydia calycina</i>	6	9	0.038	0.616	18	2.795	0.021	2.067	5.478	0.999	0.020
<i>Ziziphus rugosa</i>	27	5	0.172	2.772	10	1.553	0.007	0.689	5.014	1.000	0.013
<i>Magnolia champaca</i>	44	1	0.280	4.517	2	0.311	0.002	0.172	5.000	1.000	0.004
<i>Bauhinia purpurea</i>	6	9	0.038	0.616	18	2.795	0.010	1.034	4.445	0.999	0.020
<i>Crateva religiosa</i>	6	3	0.038	0.616	6	0.932	0.028	2.757	4.304	1.000	0.009
<i>Aphanamixis polystachya</i>	17	6	0.108	1.745	12	1.863	0.007	0.689	4.298	1.000	0.015
<i>Duabanga grandiflora</i>	20	5	0.127	2.053	10	1.553	0.007	0.689	4.295	1.000	0.013
<i>Boehmeria penduliflora</i>	2	2	0.013	0.205	4	0.621	0.034	3.446	4.272	1.000	0.006
<i>Ficus glomerata</i>	16	5	0.102	1.643	10	1.553	0.010	1.034	4.229	1.000	0.013
<i>Cissus repanda</i>	31	2	0.197	3.183	4	0.621	0.003	0.345	4.148	1.000	0.006
<i>Albizia lucidior</i>	14	4	0.089	1.437	8	1.242	0.014	1.378	4.058	1.000	0.011
<i>Schima wallichii</i>	4	5	0.025	0.411	10	1.553	0.021	2.067	4.031	1.000	0.013
<i>Zanthoxylum budrunga</i>	2	7	0.013	0.205	14	2.174	0.014	1.378	3.758	1.000	0.017
<i>Pterospermum acerifolium</i>	6	5	0.038	0.616	10	1.553	0.014	1.378	3.547	1.000	0.013
<i>Chonemorpha fragrans</i>	2	5	0.013	0.205	10	1.553	0.017	1.723	3.481	1.000	0.013
<i>Actinodaphne obovata</i>	27	1	0.172	2.772	2	0.311	0.003	0.345	3.427	1.000	0.004
<i>Albizia lucidior</i>	4	7	0.025	0.411	14	2.174	0.007	0.689	3.274	1.000	0.017
<i>Dillenia pentagyna</i>	22	2	0.140	2.259	4	0.621	0.003	0.345	3.224	1.000	0.006
<i>Casearia graveolens</i>	2	3	0.013	0.205	6	0.932	0.021	2.067	3.204	1.000	0.009
<i>Ficus hispida</i>	2	5	0.013	0.205	10	1.553	0.014	1.378	3.136	1.000	0.013
<i>Acacia pennata</i>	21	2	0.134	2.156	4	0.621	0.003	0.345	3.122	1.000	0.006
<i>Acacia catechu</i>	1	5	0.006	0.103	10	1.553	0.014	1.378	3.034	1.000	0.013
<i>Cinnamomum cecidodaphne</i>	1	7	0.006	0.103	14	2.174	0.007	0.689	2.966	1.000	0.017
<i>Atalantia missionis</i>	1	6	0.006	0.103	12	1.863	0.009	0.861	2.827	1.000	0.015
<i>Murraya paniculata</i>	1	3	0.006	0.103	6	0.932	0.017	1.723	2.757	1.000	0.009
<i>Mussaenda roxburghii</i>	1	4	0.006	0.103	8	1.242	0.014	1.378	2.723	1.000	0.011



Name of the Plant	Stem count	Occurrence	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Pinus roxburghii</i>	1	4	0.006	0.103	8	1.242	0.014	1.378	2.723	1.000	0.011
<i>Careya arborea</i>	1	5	0.006	0.103	10	1.553	0.010	1.034	2.689	1.000	0.013
<i>Wrightia arborea</i>	10	3	0.064	1.027	6	0.932	0.007	0.689	2.648	1.000	0.009
<i>Citrus medica</i>	13	2	0.083	1.335	4	0.621	0.007	0.689	2.645	1.000	0.006
<i>Acacia concinna</i>	19	1	0.121	1.951	2	0.311	0.003	0.345	2.606	1.000	0.004
<i>Machilus gamblei</i>	2	1	0.013	0.205	2	0.311	0.021	2.067	2.583	1.000	0.004
<i>Capparis acutifolia</i>	12	2	0.076	1.232	4	0.621	0.007	0.689	2.542	1.000	0.006
<i>Polyalthia simiarum</i>	20	1	0.127	2.053	2	0.311	0.001	0.138	2.502	1.000	0.004
<i>Tamarindus indica</i>	7	3	0.045	0.719	6	0.932	0.008	0.827	2.477	1.000	0.009
<i>Woodfordia fruticosa</i>	8	2	0.051	0.821	4	0.621	0.010	1.034	2.476	1.000	0.006
<i>Litsea glutinosa</i>	11	2	0.070	1.129	4	0.621	0.007	0.689	2.440	1.000	0.006
<i>Eranthemum griffithii</i>	14	1	0.089	1.437	2	0.311	0.007	0.689	2.437	1.000	0.004
<i>Catunaregam longispina</i>	1	3	0.006	0.103	6	0.932	0.014	1.378	2.413	1.000	0.009
<i>Eurya acuminata</i>	4	3	0.025	0.411	6	0.932	0.010	1.034	2.376	1.000	0.009
<i>Magnolia pterocarpa</i>	10	1	0.064	1.027	2	0.311	0.010	1.034	2.371	1.000	0.004
<i>Leea guineense</i>	5	3	0.032	0.513	6	0.932	0.009	0.861	2.306	1.000	0.009
<i>Cassia siamea</i>	6	1	0.038	0.616	2	0.311	0.014	1.378	2.305	1.000	0.004
<i>Ixora nigricans</i>	16	1	0.102	1.643	2	0.311	0.003	0.345	2.298	1.000	0.004
<i>Ardisia solanacea</i>	17	1	0.108	1.745	2	0.311	0.002	0.172	2.228	1.000	0.004
<i>Calamus viminalis</i>	1	4	0.006	0.103	8	1.242	0.008	0.827	2.172	1.000	0.011
<i>Syzygium operculatum</i>	2	3	0.013	0.205	6	0.932	0.010	1.034	2.171	1.000	0.009
<i>Ficus elastica</i>	1	2	0.006	0.103	4	0.621	0.014	1.378	2.102	1.000	0.006
<i>Phoenix sylvestris</i>	1	2	0.006	0.103	4	0.621	0.014	1.378	2.102	1.000	0.006
<i>Chisocheton cumingianus</i>	14	1	0.089	1.437	2	0.311	0.003	0.345	2.092	1.000	0.004
<i>Amoora rohituka</i>	16	1	0.102	1.643	2	0.311	0.001	0.138	2.091	1.000	0.004
<i>Castanopsis indica</i>	3	1	0.019	0.308	2	0.311	0.014	1.378	1.997	1.000	0.004
<i>Psidium guajava</i>	3	1	0.019	0.308	2	0.311	0.014	1.378	1.997	1.000	0.004
<i>Cinnamomum tamala</i>	3	1	0.019	0.308	2	0.311	0.014	1.378	1.997	1.000	0.004
<i>Callicarpa arborea</i>	3	1	0.019	0.308	2	0.311	0.014	1.378	1.997	1.000	0.004
<i>Aglaia spectabilis</i>	8	2	0.051	0.821	4	0.621	0.005	0.517	1.959	1.000	0.006
<i>Litsea citrata</i>	6	2	0.038	0.616	4	0.621	0.007	0.689	1.926	1.000	0.006
<i>Trevesia palmata</i>	6	2	0.038	0.616	4	0.621	0.007	0.689	1.926	1.000	0.006
<i>Albizia procera</i>	14	1	0.089	1.437	2	0.311	0.002	0.172	1.920	1.000	0.004
<i>Litsea monopetala</i>	12	1	0.076	1.232	2	0.311	0.003	0.345	1.887	1.000	0.004
<i>Bridelia stipularis</i>	4	1	0.025	0.411	2	0.311	0.010	1.034	1.755	1.000	0.004
<i>Artabotrys caudatus</i>	1	3	0.006	0.103	6	0.932	0.007	0.689	1.723	1.000	0.009
<i>Bauhinia scandens</i>	1	3	0.006	0.103	6	0.932	0.007	0.689	1.723	1.000	0.009
<i>Albizia gamblei</i>	4	2	0.025	0.411	4	0.621	0.007	0.689	1.721	1.000	0.006
<i>Sapindus detergens</i>	7	1	0.045	0.719	2	0.311	0.007	0.689	1.718	1.000	0.004
<i>Saurauia roxburghii</i>	7	1	0.045	0.719	2	0.311	0.007	0.689	1.718	1.000	0.004
<i>Litsea citrata</i>	12	1	0.076	1.232	2	0.311	0.001	0.069	1.612	1.000	0.004
<i>Ficus neriifolia</i>	9	1	0.057	0.924	2	0.311	0.003	0.345	1.579	1.000	0.004
<i>Ficus religiosa</i>	4	2	0.025	0.411	4	0.621	0.005	0.517	1.549	1.000	0.006
<i>Aegle marmelos</i>	2	2	0.013	0.205	4	0.621	0.007	0.689	1.516	1.000	0.006
<i>Coffea bengalensis</i>	10	1	0.064	1.027	2	0.311	0.002	0.172	1.510	1.000	0.004
<i>Croton tiglium</i>	8	1	0.051	0.821	2	0.311	0.003	0.345	1.476	1.000	0.004
<i>Terminalia chebula</i>	3	2	0.019	0.308	4	0.621	0.005	0.517	1.446	1.000	0.006

Name of the Plant	Stem count	Occurrence	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Mangifera indica</i>	1	2	0.006	0.103	4	0.621	0.007	0.689	1.413	1.000	0.006
<i>Caryota ochlandra</i>	1	2	0.006	0.103	4	0.621	0.007	0.689	1.413	1.000	0.006
<i>Ventilago denticulata</i>	4	2	0.025	0.411	4	0.621	0.003	0.345	1.376	1.000	0.006
<i>Phyllanthus emblica</i>	3	1	0.019	0.308	2	0.311	0.007	0.689	1.308	1.000	0.004
<i>Oroxylum indicum</i>	1	1	0.006	0.103	2	0.311	0.009	0.861	1.275	1.000	0.004
<i>Stixis suaveolens</i>	3	2	0.019	0.308	4	0.621	0.003	0.345	1.274	1.000	0.006
<i>Streblus asper</i>	2	1	0.013	0.205	2	0.311	0.007	0.689	1.205	1.000	0.004
<i>Mallotus philippensis</i>	2	1	0.013	0.205	2	0.311	0.007	0.689	1.205	1.000	0.004
<i>Terminalia bellirica</i>	5	1	0.032	0.513	2	0.311	0.003	0.345	1.168	1.000	0.004
<i>Cassia fistula</i>	1	1	0.006	0.103	2	0.311	0.007	0.689	1.102	1.000	0.004
<i>Garuga pinnata</i>	1	1	0.006	0.103	2	0.311	0.007	0.689	1.102	1.000	0.004
<i>Cleidion javanicum</i>	1	1	0.006	0.103	2	0.311	0.007	0.689	1.102	1.000	0.004
<i>Pandanus minor</i>	1	1	0.006	0.103	2	0.311	0.007	0.689	1.102	1.000	0.004
<i>Dysoxylum mollissimum</i>	1	2	0.006	0.103	4	0.621	0.003	0.345	1.068	1.000	0.006
<i>Engelhardtia spicata</i>	1	2	0.006	0.103	4	0.621	0.003	0.345	1.068	1.000	0.006
<i>Meyna spinosa</i>	1	2	0.006	0.103	4	0.621	0.003	0.345	1.068	1.000	0.006
<i>Ailanthus grandis</i>	4	1	0.025	0.411	2	0.311	0.003	0.345	1.066	1.000	0.004
<i>Paederia foetida</i>	4	1	0.025	0.411	2	0.311	0.003	0.345	1.066	1.000	0.004
<i>Maesa chisia</i>	2	1	0.013	0.205	2	0.311	0.005	0.517	1.033	1.000	0.004
<i>Bridelia sikkimensis</i>	2	1	0.013	0.205	2	0.311	0.005	0.482	0.998	1.000	0.004
<i>Glochidion thomsonii</i>	5	1	0.032	0.513	2	0.311	0.002	0.172	0.996	1.000	0.004
<i>Adina cordifolia</i>	3	1	0.019	0.308	2	0.311	0.003	0.345	0.963	1.000	0.004
<i>Eriobotrya bengalensis</i>	3	1	0.019	0.308	2	0.311	0.003	0.345	0.963	1.000	0.004
<i>Eugenia formosa</i>	3	1	0.019	0.308	2	0.311	0.003	0.345	0.963	1.000	0.004
<i>Naravelia zeylanica</i>	3	1	0.019	0.308	2	0.311	0.003	0.345	0.963	1.000	0.004
<i>Zanthoxylum nitidum</i>	3	1	0.019	0.308	2	0.311	0.003	0.345	0.963	1.000	0.004
<i>Clausena excavata</i>	5	1	0.032	0.513	2	0.311	0.001	0.138	0.962	1.000	0.004
<i>Wattakaka volubilis</i>	1	1	0.006	0.103	2	0.311	0.005	0.517	0.930	1.000	0.004
<i>Macaranga indica</i>	4	1	0.025	0.411	2	0.311	0.002	0.172	0.894	1.000	0.004
<i>Antidesma acidum</i>	4	1	0.025	0.411	2	0.311	0.002	0.172	0.894	1.000	0.004
<i>Citrus limon</i>	4	1	0.025	0.411	2	0.311	0.002	0.172	0.894	1.000	0.004
<i>Flueggea virosa</i>	4	1	0.025	0.411	2	0.311	0.002	0.172	0.894	1.000	0.004
<i>Sterculia villosa</i>	2	1	0.013	0.205	2	0.311	0.003	0.345	0.860	1.000	0.004
<i>Clerodendrum viscosum</i>	2	1	0.013	0.205	2	0.311	0.003	0.345	0.860	1.000	0.004
<i>Desmodium gangeticum</i>	2	1	0.013	0.205	2	0.311	0.003	0.345	0.860	1.000	0.004
<i>Buddleja asiatica</i>	4	1	0.025	0.411	2	0.311	0.001	0.138	0.859	1.000	0.004
<i>Dysoxylum reticulatum</i>	4	1	0.025	0.411	2	0.311	0.001	0.138	0.859	1.000	0.004
<i>Aglaia spectabilis</i>	3	1	0.019	0.308	2	0.311	0.002	0.172	0.791	1.000	0.004
<i>Entada phaseoloides</i>	3	1	0.019	0.308	2	0.311	0.002	0.172	0.791	1.000	0.004
<i>Litsea laeta</i>	3	1	0.019	0.308	2	0.311	0.002	0.172	0.791	1.000	0.004
<i>Terminalia myriocarpa</i>	3	1	0.019	0.308	2	0.311	0.002	0.172	0.791	1.000	0.004
<i>Lagerstroemia parviflora</i>	1	1	0.006	0.103	2	0.311	0.003	0.345	0.758	1.000	0.004
<i>Acrocarpus fraxinifolius</i>	1	1	0.006	0.103	2	0.311	0.003	0.345	0.758	1.000	0.004
<i>Cissus adenantha</i>	1	1	0.006	0.103	2	0.311	0.003	0.345	0.758	1.000	0.004
<i>Ficus cunia</i>	1	1	0.006	0.103	2	0.311	0.003	0.345	0.758	1.000	0.004
<i>Terminalia catappa</i>	1	1	0.006	0.103	2	0.311	0.003	0.345	0.758	1.000	0.004
<i>Vitex heterophylla</i>	1	1	0.006	0.103	2	0.311	0.003	0.345	0.758	1.000	0.004

Name of the Plant	Stem count	Occurance	D	RD	F	RF	Dm	RDm	IVI	SDI	SWDI
<i>Bombax ceiba</i>	3	1	0.019	0.308	2	0.311	0.001	0.138	0.756	1.000	0.004
<i>Canarium sikkimense</i>	3	1	0.019	0.308	2	0.311	0.001	0.138	0.756	1.000	0.004
<i>Pongamia pinnata</i>	3	1	0.019	0.308	2	0.311	0.001	0.138	0.756	1.000	0.004
<i>Dalbergia stipulacea</i>	2	1	0.013	0.205	2	0.311	0.002	0.172	0.688	1.000	0.004
<i>Neocinnamomum caudatum</i>	2	1	0.013	0.205	2	0.311	0.002	0.172	0.688	1.000	0.004
<i>Semecarpus anacardium</i>	2	1	0.013	0.205	2	0.311	0.002	0.172	0.688	1.000	0.004
<i>Tabernaemontana divaricata</i>	2	1	0.013	0.205	2	0.311	0.002	0.172	0.688	1.000	0.004
<i>Aporosa dioica</i>	3	1	0.019	0.308	2	0.311	0.001	0.069	0.687	1.000	0.004
<i>Litsea salicifolia</i>	2	1	0.013	0.205	2	0.311	0.001	0.138	0.654	1.000	0.004
<i>Macaranga denticulata</i>	2	1	0.013	0.205	2	0.311	0.001	0.138	0.654	1.000	0.004
<i>Butea parviflora</i>	1	1	0.006	0.103	2	0.311	0.002	0.172	0.586	1.000	0.004
<i>Fagerlindia fasciculata</i>	1	1	0.006	0.103	2	0.311	0.002	0.172	0.586	1.000	0.004
<i>Alangium chinense</i>	1	1	0.006	0.103	2	0.311	0.002	0.172	0.586	1.000	0.004
<i>Alstonia scholaris</i>	1	1	0.006	0.103	2	0.311	0.002	0.172	0.586	1.000	0.004
<i>Derris polystachya</i>	1	1	0.006	0.103	2	0.311	0.002	0.172	0.586	1.000	0.004
<i>Dillenia indica</i>	1	1	0.006	0.103	2	0.311	0.002	0.172	0.586	1.000	0.004
<i>Tetrameles nudiflora</i>	1	1	0.006	0.103	2	0.311	0.002	0.172	0.586	1.000	0.004
<i>Syzygium praecox</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Firmiana colorata</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Trevisia nudiflora</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Eurya cerasifolia</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Litsea cubeba</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Machilus villosa</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Sapium baccatum</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Tectona grandis</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Wendlandia coriacea</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Paederia foetida</i>	1	1	0.006	0.103	2	0.311	0.001	0.138	0.551	1.000	0.004
<i>Goniothalamus sesquipetalis</i>	1	1	0.006	0.103	2	0.311	0.000	0.007	0.420	1.000	0.004

## ANNEXURE: IV

### SUBSISTANCE USE AND HABITAT OF NTFP SPECIES

SCIENTIFIC NAME OF PLANTS	VERNACULAR NAME OF PLANTS	Altitudinal distribution (m.)	TYPE (Herb, Shrub & Tree)	PARTS USE	USE
<i>Mangifera indica</i>	Aam	145-370	T	Fruit	Edible
<i>Ageratum conyzoides</i>	Alu jhaar	295-368	H	Leaf	Extract to stop bleeding & in sore

SCIENTIFIC NAME OF PLANTS	VERNACULAR NAME OF PLANTS	Altitudinal distribution (m.)	TYPE (Herb, Shrub & Tree)	PARTS USE	USE
<i>Catunaregam longispina</i>	Amra	305-425	T	Fruit	Chatni & Pickle
<i>Acacia pennata</i>	Arare Kanra	92-298	L	Stem	Dust as gun powder
<i>Sida acuta</i>	Ballu Jhaar	155-175	Sh	Whole plant	Broom
<i>Cheilocostus speciosus</i>	Bet Larang	92-120	L	Stem	Rope
<i>Quercus obtusata</i>	Bhale Kattus	96-130	T	Fruit nut	Edible
<i>Citrus medica</i>	Bhimira/Junglee Limbu	96-150	Sh	Fruit	Edible
<i>Cynodon dactylon</i>	Dubo	150-185	H	Leaf	Puja
<i>Antidesma acidum</i>	Bhotey Archal	128-139	T	Fruit	Edible
<i>Boerhavia diffusa</i>	Lore Saag	95-130	H	Whole plant	Half boiled plant in anemia
<i>Dillenia indica</i>	Chalta	110-395	T	Fruit	Edible
<i>Alpinia nigra</i>	Churumpha	110-130	H	Rhizome	Vegetable
<i>Clausena excavate</i>	Curry pata	138-150	Sh	Leaf	Spice
<i>Glycosmis pentaphylla</i>	Dandisko	95-110	Sh	Leaf	Juice in liver problem
<i>Stephania japonica</i>	Dherphule Lahara/Seto jar ko Dabai	112-315	L	Stem	Used to prepare local brew

SCIENTIFIC NAME OF PLANTS	VERNACULAR NAME OF PLANTS	Altitudinal distribution (m.)	TYPE (Herb, Shrub & Tree)	PARTS USE	USE
<i>Curculigo orchioides</i>	Dhotisarah	100-285	H	Leaf	Pack butter and religious
<i>Maesa chisia</i>	Dudh Seola	128-310	T	Leaf	Delay fermentation
<i>Bambusa tulda</i>	Filling Baans	265-298	H	Stem	Fencing
<i>Angiopteris evecta</i>	Gaikhoret	310-355	Fern (H)	Petiole	Extract in cow's hoof disease
<i>Centella asiatica</i>	Ghortapre	295-345	H	Leaf	Vegetable & diarrhea
<i>Dioscorea prazeri</i>	Githa	275-368	Cl	Tuber	Vegetable
<i>Calamus erectus</i>	Gouribet	92-120	Sh	Stem	Rope
<i>Amorphophallus bulbifer</i>	Gurbe	280-325	H	Leaf & Stem	Vegetable
<i>Tinospora crispa</i>	Gurjo	280-405	Cl	Stem	Fracture of livestock & human blood sugar
<i>Hoya linearis</i>	Harchul	100-120	Cl	Stem	Fracture
<i>Diplocyclos palmatus</i>	Hati karela	200-210	Cl	Fruit	Vegetable
<i>Syzygium cumini</i>	Jamun	118-150	T	Fruit	Edible
<i>Solanum aculeatissimum</i>	Junglee Begun	130-150	Sh	Fruit	Vegetable

SCIENTIFIC NAME OF PLANTS	VERNACULAR NAME OF PLANTS	Altitudinal distribution (m.)	TYPE (Herb, Shrub & Tree)	PARTS USE	USE
<i>Citrus limon.</i>	Junglee Lebu	96-110	Sh	Fruit	Prepare juice
<i>Wendlandia coriacea</i>	Junglee Lichu	265-305	T	Fruit	Edible
<i>Chloranthus elatior</i>	Junka dabai	110-150	H	Leaf	leech bite sore
<i>Typhonium trilobatum</i>	Karengi saag	100-110	H	Leaf	Vegetable
<i>Barleria prionitis</i>	Kharate Jharoo	140-150	Sh	Whole plant	Broom
<i>Smilax ovalifolia</i>	Kukurdyne	85-120	Cl	Tender tip	Vegetable
<i>Ficus sarmentosa</i>	Labar larang	300-370	L	Stem	Rope
<i>Croton tiglium</i>	Lapche	85-305	T	Bark	Rope
<i>Ficus nerifolia</i>	Latka/Kusum	110-130	T	Fruit	Edible
<i>Ageratum conyzoides</i>	Makla Baans	190-285	T	Stem	Building house
<i>Benkara fasciculata</i>	Maidalu Kanra	190-285	T	Fruit	Edible
<i>Macaranga indica</i>	Maledo	100-110	T	Leaf	Religious
<i>Codoriocalyx motorius</i>	Mohoni Jhaar	300-310	H	Leaf	Attract girls
<i>Helminthostachys zeylanica</i>	Muzur Khutte	92-100	Fern	Leaf	Vegetable
<i>Paederia foetida</i>	Pad Larang	280-310	Cl	Leaf	Soup

SCIENTIFIC NAME OF PLANTS	VERNACULAR NAME OF PLANTS	Altitudinal distribution (m.)	TYPE (Herb, Shrub & Tree)	PARTS USE	USE
<i>Cissus repanda</i>	Pani Lahara	92-130	L	Stem	Drink fluid in thirsty
<i>Tephrosia candida</i>	Paniel	110-210	T	Nut	Edible
<i>Scoparia dulcis</i>	Pneumonia ko Dabai	92-305	H	Root	Stomach pain & pneumonia
<i>Psidium guajava</i>	Pyara	100-130	T	Fruit	Edible
<i>Ficus hispida</i>	Ramgua	92-110	T	Nut	Edible
<i>Polyalthia simiarum</i>	Rato Jar Ko Dabai	110-210	L	Stem	Local brew
<i>Duabanga grandiflora</i>	Rato Khirra	95-250	T	Bark	Local brew
<i>Piper peepuloides</i>	Rukh Pipla	130-250	H	Fruit	Cough & cold
<i>Ziziphus jujuba</i>	Sanu Baer	110-130	T	Fruit	Edible
<i>Streblus asper</i>	Seuri	100-150	T	Leaf	Pig fodder
<i>Stephania glabra</i>	Tamarkey	95-180	Cl	Root	Edible
<i>Caryota urens</i>	Kharate Jharoo	130-150	T	Leaf	Broom
<i>Piper pedicellatum</i>	Pipla	130-250	H	Leaf	Religious

## ANNEXURE: V

### COMMERCIAL USE AND HABITAT OF NTFP SPECIES

Scientific name	Local name	Type of plant	Altitudinal distribution	Harvest period	Usage
<i>Phyllanthus emblica</i>	Amlaki	T	308-315	Jan	Medicinal
<i>Terminalia bellirica</i>	Bahera	T	120-298	Feb-Mar	Medicinal
<i>Justicia adhatoda</i>	Basak patta & fruit	Sh	95-110	Dec-Apr	Medicinal

Scientific name	Local name	Type of plant	Altitudinal distribution	Harvest period	Usage
<i>Calamus viminalis</i>	Bet fruit	Sh	100-150	Feb-Mar	Decorative/edible
<i>Calamus acanthospathus</i>	Bet leaf	Sh	100-150	Jan-Dec	Decorative
<i>Thysanolaena latifolia</i>	Broom stick	H	220-265	Jan-Mar	Broom, dry flower
<i>Parthenocissus semicordata</i>	Charchara/ Chai	Cl	110-150	Mar-Apr	Vegetable/Medicinal
<i>Chukrasia tabularis</i>	Chikrasi fruit	T	96-138	Oct-Dec	Decorative
<i>Schima wallichii</i>	Chilauni fruit	T	128-290	Feb-Mar	Decorative
<i>Mahonia napaulensis</i>	Chutro	Sh	110-130	Dec-Apr	Medicinal
<i>Luffa cylindrica</i>	Dhundul chobra	Cl	95-150	Mar-Apr	Decorative & toilet use
<i>Terminalia chebula</i>	Harra	T	150-275	Feb-Mar	Medicinal
<i>Bulbophyllum cornucervi</i>	Jibanti/ Sunakheri	H	92-315	Jan-Dec	Medicinal
<i>Bauhinia scandens</i>	Kanchan spring	T	100-150	Mar-May	Decorative
<i>Acacia catechu</i>	Khair	T	110-130	Oct-Apr	Medicinal
<i>Dysoxylum mollissimum</i>	Lali fruit	T	92-250	Feb-Mar	Decorative
<i>Lagerstroemia hypoleuca</i>	Lampate fruit	T	100-315	Oct-Dec	Decorative
<i>Rubia manjith</i>	Majeto	H	360-400	Jan-Dec	Medicinal
<i>Cinnamomum glaucescens</i>	Malagiri fruit	T	85-100	July-Sept	Medicinal
<i>Musa paradisiaca</i>	Mocha stick	H	150-265	Jan-Dec	Decorative
<i>Bombax ceiba</i>	Musraaj (Shimul atha)	T	100-130	Dec-Apr	Medicinal
<i>Rauvolfia serpentina</i>	Nagbeli/ Sarpagandha	Sh	85-150	Jan-Dec	Medicinal
<i>Bauhinia purpurea</i>	Nagfeni	L	130-250	Jan-Apr	Decorative
<i>Pterygota alata</i>	Narikeli fruit	T	85-110	Jan-Mar	Decorative
<i>Kydia calycina</i>	Phirphire fruit	T	92-110	Dec-Apr	Decorative
<i>Piper longum and Piper pedicellatum</i>	Pipla fruit	H	130-190	July-Oct	Medicinal
<i>Firmiana colorata</i>	Pirpire	T	110-265	Feb-Mar	Medicinal
<i>Sapindus mukorossi</i>	Ritha	T	150-300	Jan-Mar	Medicinal
<i>Shorea robusta</i>	Sal dhup	T	92-315	Jan-Dec	Incense
<i>Asparagus racemosus</i>	Satamuli/ Kurilo/	Sh	92-130	Jan-Dec	Medicinal



Scientific name	Local name	Type of plant	Altitudinal distribution	Harvest period	Usage
<i>Bombax ceiba</i>	<i>Shimul tula</i>	T	100-130	April	Handicraft
<i>Acacia concinna</i>	<i>Sikakai</i>	L	85-100	July-Oct	Medicinal
<i>Zanthoxylum budrunga</i>	<i>Timboor fruit</i>	T	92-130	July-Sept	Medicinal
<i>Oroxylum indicum</i>	<i>Totala fruit/seed</i>	T	130-305	Jan-Mar	Medicinal

## ANNEXURE: VI

### COMMERCIALY LESS IMPORTANT NTFP SPECIES AND THEIR HABITAT

SCIENTIFIC NAME OF PLANTS	VERNACULAR NAME OF PLANTS	Altitudinal distribution (m.)	TYPE (Herb, Shrub & Tree)	PARTS USE	USE
<i>Desmodium confertum</i>	Ankhley	Altitudinal distribution of species	Sh	Fruit	Med
<i>Piper sylvaticum</i>	Bhotey Pipla	155-368	H	Fruit	Med
<i>Piper mullesua</i>	Chabuk	110-130	Sh	Fruit	Adultarant with Pipla
<i>Piper pedicellatum</i>	Chai Larang	130-150	Cl	Leaf	During Laxmi Puja Bahe-Bangali taken with veg
<i>Phyllanthus emblica</i>	Kainchi Pata	230-310	Cl	Leaf & Fruit	Decorative
<i>Ficus semicordata</i>	Khanyo	220-390	T	Fruit	Edible

SCIENTIFIC NAME OF PLANTS	VERNACULAR NAME OF PLANTS	Altitudinal distribution (m.)	TYPE (Herb, Shrub & Tree)	PARTS USE	USE
<i>Amoora spectabilis</i>	Khopote Lali	85-133	T	Fruit cover	Decorative
<i>Dioscorea pubera</i>	Kukur Tarul	310-390	Cl	Root	Med
<i>Magnolia champaca</i>	Magare	92-130	T	Leaf vein	Decorative
<i>Pterygota alata</i>	Narieli	128-245	T	Fruit cover	Decorative
<i>Sterculia villosa</i>	Odal	110-270	T	Fruit cover	Decorative
<i>Piper betloides</i>	Paan	85-128	Cl	Leaf	Med
<i>Magnolia pterocarpa</i>	Patpate	85-130	T	Bark	Adulterated in Dalchini
<i>Alpinia calcarata</i>	Purundi	360-370	H	Seed	Sowing

## ANNEXURE: VII

### SLOPE, CROWN COVER (%) AND GROUND COVER (%) IN STUDIED PLOTS ACROSS THE SEASONS

SEASONS							
Plot No.	Slope	WINTER		PRE-MONSOON		POST MONSOON	
		Crown cover (%)	Ground cover (%)	Crown cover (%)	Ground cover (%)	Crown cover (%)	Ground cover (%)
1	2	50	52.5	60	27	60	57
2	2	50	38	60	17.5	45	12
3	1	50	28.2	45	18.4	45	47.5
4	0	60	34.5	65	18.6	40	55.5
5	0	55	51	62	60.9	55	5.5

SEASONS							
Plot No.	Slope	WINTER		PRE-MONSOON		POST MONSOON	
		Crown cover (%)	Ground cover (%)	Crown cover (%)	Ground cover (%)	Crown cover (%)	Ground cover (%)
6	0	80	29.2	70	45.2	90	7.5
7	0	75	31.5	50	16	40	48
8	0	80	40	40	19.5	25	25.5
9	1	45	37.4	60	19.5	70	25
10	0	65	21.5	80	26.1	40	7
11	0	80	27.5	85	21.5	80	28
12	0	45	43	40	51.2	40	34.5
13	0	80	34	80	21	85	16.5
14	0	85	22.2	40	21.5	90	16
15	0	80	20.2	70	18	60	18
16	0	65	26.2	80	18.9	55	36.5
17	0	60	25	40	12.5	95	31
18	0	45	16.7	60	16	60	35
19	0	30	31	65	26.5	50	82
20	0	65	18	30	16.5	80	46.5
21	0	60	24.2	90	10	90	34.5
22	0	10	20.5	65	14	60	42
23	0	15	8.5	35	37.5	75	37.5
24	0	0	86	50	14	65	75
25	0	60	18	50	34.5	80	16.5
26	0	50	21.2	30	26.5	70	79
27	0	40	15.5	50	27	80	20
28	0	60	23.5	30	21.5	72	47
29	8	10	26.2	25	30	65	45
30	4	55	27.5	70	41	50	72
31	2	30	12.9	80	22.5	60	47
32	0	0	80.5	72	16.5	75	91.5
33	2	40	26	85	20.5	90	15.5
34	36	25	17.5	70	46.5	45	31.5
35	25	10	1.5	60	15	50	33.5
36	37	50	21.5	20	0	65	40.5
37	32	75	7.5	55	24.5	80	18
38	28	50	21.5	30	25	85	19
39	33	85	21	10	87	0	67
40	6	40	35.6	40	35	70	36.5
41	18	50	13.5	70	28	60	21
42	36	5	9.7	25	15.5	50	30

SEASONS							
Plot No.	Slope	WINTER		PRE-MONSOON		POST MONSOON	
		Crown cover (%)	Ground cover (%)	Crown cover (%)	Ground cover (%)	Crown cover (%)	Ground cover (%)
43	34	80	17.5	55	22.5	10	18.5
44	8	70	36.7	60	11.5	50	41.5
45	0	5	12	50	16	50	41
46	42	60	7.6	25	7	40	52
47	33	0	49.5	80	20.5	0	32
48	30	90	6	0	75.5	50	59
49	32	45	13.5	50	32	60	26.5
50	65	50	10	0	28.5	5	13

## ANNEXURE: VIII

### ASSOCIATION OF NTFPS WITH DOMINANT TREES

PHYTOSOCIOLOGY BETWEEN DOMINANT TREE SPECIES AND NTFPs (Presence/Plot)										
Name of NTFPs	<i>Shorea robusta</i>	<i>Aglaia spectabilis</i>	<i>Polyalthia simitarum</i>	<i>Duabanga grandiflora</i>	<i>Tetrameles nudiflora</i>	<i>Wendlandia coriacea</i>	<i>Aphanamixis polystachia</i>	<i>Magnolia pterocarpa</i>	<i>Schinus wallichii</i>	<i>Tectona grandis</i>
<i>Mangifera indica</i>	0	0	0	0	0	0	0	0	0	0
<i>Rorippa indica</i>	2	1	0	0	0	0	0	0	0	0
<i>Catunaregam longispina</i>	2	0	1	0	1	0	0	0	0	0
<i>Mimosa himalayana</i>	3	1	2	0	0	0	1	0	0	0
<i>Sida acuta</i>	7	4	3	2	4	0	0	0	2	
<i>Cheilocostus speciosus</i>	2	0	1	3	2	1	1	4	0	0
<i>Quercus obtusata</i>	2	0	1	8	4	1	1	7	0	0
<i>Citrus medica</i>	1	0	0	2	1	0	0	2	0	0
<i>Cynodon dactylon</i>	1	1	0	1	0	0	0	0	0	0
<i>Antidesma acidum</i>	3	1	1	1	2	0	0	1	0	1
<i>Dillenia indica</i>	2	0	2	0	0	0	1	0	0	0
<i>Clausena excavata</i>	6	4	5	10	9	0	1	7	3	1
<i>Glycosmis pentaphylla</i>	0	0	0	1	0	0	0	1	0	0
<i>Stephania japonica</i>	8	3	3	7	10	1	1	3	1	2
<i>Curculigo orchiioides</i>	1	1	1	2	1	1	0	1	0	0
<i>Maesa chisia</i>	1	1	0	1	1	0	0	0	1	0
<i>Bambusa tulda</i>	2	1	2	1	2	1	0	1	0	0
<i>Angiopteris evecta</i>	1	0	1	0	1	0	0	0	0	0





**PHYTOSOCIOLOGY BETWEEN DOMINANT TREE SPECIES AND NTFPs  
(Presence/Plot)**

Name of NTFPs	<i>Shorea robusta</i>	<i>Aglaia spectabilis</i>	<i>Polyalthia simiarum</i>	<i>Duabanga grandiflora</i>	<i>Tetraneles nudiflora</i>	<i>Wendlandia coriacea</i>	<i>Aphananixis polystachia</i>	<i>Magnolia pterocarpa</i>	<i>Schima wallichii</i>	<i>Tectona grandis</i>
<i>Aegle marmelos</i>	0	0	0	0	0	0	0	0	0	0
<i>Phyllanthus fraternus</i>	0	0	0	0	0	0	0	0	0	0
<i>Ficus semicordata</i>	0	0	0	0	0	0	0	0	0	0
<i>Dysoxylum mollissimum</i>	1	1	2	5	4	0	0	5	0	0
<i>Molineria capitulata</i>	2	2	4	0	1	1	1	0	0	2
<i>Dioscorea pubera</i>	1	0	1	0	0	0	0	0	0	0
<i>Magnolia champaca</i>	1	0	0	3	1	0	0	3	0	0
<i>Sterculia villosa</i>	4	2	2	3	2	0	1	2	1	1
<i>Piper betloides</i>	7	3	2	11	10	1	1	9	1	0
<i>Magnolia pterocarpa</i>	4	8	15	0	0	0	0	15	1	1
<i>Alpinia calcarata</i>	0	0	0	0	0	0	0	0	0	0
<i>Ipomoea batatas</i>	0	0	0	0	0	0	0	0	0	0
<i>Eriophorum comosum</i>	0	1	1	0	0	0	0	0	0	0
<i>Citrus limon</i>	2	3	2	5	4	0	1	4	1	0

## ANNEXURE: IX

**SURVIVAL RATE OF DIFFERENT SPECIES OCCURRED IN STUDIED PLOTS**

Name of the Plant	Seedling	Sapling	Tree	Survival ratio
<i>Albizia lucida</i>	0	2	1	no seedling
<i>Bauhinia acuminata</i>	0	2	2	no seedling
<i>Antidesma diandrum</i>	0	1	1	no seedling
<i>Trema politoria</i>	0	1	1	no seedling
<i>Anthocephalus chinensis</i>	0	0	1	no seedling
<i>Artocarpus chaplasha</i>	0	0	1	no seedling
<i>Celtis tetrandra</i> Roxb.	0	0	1	no seedling
<i>Combretum nanum</i>	0	0	1	no seedling
<i>Cryptocarya amygdalina</i>	0	0	2	no seedling
<i>Elaeocarpus floribundus</i>	0	0	3	no seedling
<i>Gmelina arborea</i>	0	0	2	no seedling
<i>Goniothalamus sesquipedalis</i>	0	0	2	no seedling
<i>Grewia serrulata</i>	0	0	1	no seedling
<i>Lagerstroemia speciosa</i>	0	0	8	no seedling
<i>Mangifera sylvatica</i>	0	0	1	no seedling
<i>Mezoneurum cucullatum</i>	0	0	4	no seedling

Name of the Plant	Seedling	Sapling	Tree	Survival ratio
<i>Pueraria sikkimensis</i>	0	0	3	no seedling
<i>Quercus spicata</i>	0	0	1	no seedling
<i>Shorea robusta</i>	0	0	99	no seedling
<i>Sorindeia madagascariensis</i>	0	0	1	no seedling
<i>Toona ciliate</i>	0	0	3	no seedling
<i>Toona microcarpa</i>	0	0	2	no seedling
<i>Zizyphus mauritiana</i>	0	0	1	no seedling
<i>Dysoxylum mollissimum</i>	1	2	45	4500
<i>Tectona grandis</i>	1	0	37	3700
<i>Wendlandia coriacea</i>	1	0	22	2200
<i>Trewia nudiflora</i>	1	5	18	1800
<i>Syzygium praecox</i>	1	8	16	1600
<i>Butea parviflora</i>	1	3	12	1200
<i>Croton tiglium</i>	8	10	75	938
<i>Pinus roxburghii</i>	1	0	9	900
<i>Careya arborea</i>	1	2	8	800
<i>Lagerstroemia parviflora</i>	1	2	8	800
<i>Schima wallichii</i>	4	2	32	800
<i>Terminalia catappa</i>	1	0	7	700
<i>Dalbergia stipulacea</i>	2	9	12	600
<i>Firmiana colorata</i>	1	5	6	600
<i>Garuga pinnata</i>	1	1	5	500
<i>Acacia catechu</i>	1	0	4	400
<i>Alstonia scholaris</i>	1	0	4	400
<i>Ficus cunia</i>	1	0	4	400
<i>Tetrameles nudiflora</i>	1	0	4	400
<i>Castanopsis indica</i>	3	2	11	367
<i>Syzygium operculatum</i>	2	7	7	350
<i>Magnolia pterocarpa</i>	10	15	31	310
<i>Casearia graveolens</i>	2	8	6	300
<i>Sterculia villosa</i>	2	1	6	300
<i>Cissus adenantha</i>	1	0	3	300
<i>Engelhardtia spicata</i>	1	0	3	300
<i>Goniothalamus sesquipedalis</i>	1	0	3	300
<i>Vitex heterophylla</i>	1	0	3	300
<i>Duabanga grandiflora</i>	20	7	58	290
<i>Mallotus philippensis</i>	2	3	5	250
<i>Aporosa dioica</i>	3	7	7	233
<i>Wrightia arborea</i>	10	1	21	210
<i>Litsea salicifolia</i>	2	5	4	200



Name of the Plant	Seedling	Sapling	Tree	Survival ratio
<i>Streblus asper.</i>	2	5	4	200
<i>Catunaregam longispina</i>	1	2	2	200
<i>Cassia fistula</i>	1	1	2	200
<i>Cinnamomum cecidodaphne</i>	1	0	2	200
<i>Dillenia indica</i>	1	0	2	200
<i>Terminalia bellirica</i>	5	1	8	160
<i>Neocinnamomum caudatum</i>	2	5	3	150
<i>Bridelia sikkimensis</i>	2	4	3	150
<i>Albizia gamblei</i>	4	1	6	150
<i>Macaranga denticulate</i>	2	0	3	150
<i>Litsea citrata</i>	6	5	8	133
<i>Callicarpa arborea</i>	3	0	4	133
<i>Ventilago denticulate</i>	4	0	5	125
<i>Pterospermum acerifolium</i>	6	2	7	117
<i>Pterygota alata</i>	1	5	1	100
<i>Boehmeria penduliflora</i>	2	4	2	100
<i>Aegle marmelos</i>	2	1	2	100
<i>Mangifera indica</i>	1	1	1	100
<i>Acrocarpus fraxinifolius.</i>	1	0	1	100
<i>Bauhinia scandens</i>	1	0	1	100
<i>Chonemorpha fragrans</i>	2	0	2	100
<i>Derris polystachya</i>	1	0	1	100
<i>Eurya cerasifolia</i>	1	0	1	100
<i>Litsea cubeba</i>	1	0	1	100
<i>Machilus villosa</i>	1	0	1	100
<i>Naravelia zeylanica</i>	3	0	3	100
<i>Oroxylum indicum</i>	1	0	1	100
<i>Pandanus minor</i>	1	0	1	100
<i>Phoenix sylvestris</i>	1	0	1	100
<i>Phyllanthus emblica</i>	3	0	3	100
<i>Sapium baccatum</i>	1	0	1	100
<i>Wattakaka volubilis</i>	1	0	1	100
<i>Chisocheton cumingianus</i>	14	4	12	86
<i>Ailanthus grandis</i>	4	6	3	75
<i>Macaranga indica</i>	4	6	3	75
<i>Albizia lucidior</i>	4	0	3	75
<i>Litsea citrata</i>	12	5	8	67
<i>Stixis suaveolens</i>	3	3	2	67
<i>Bombax ceiba</i>	3	0	2	67
<i>Canarium sikkimense</i>	3	0	2	67

Name of the Plant	Seedling	Sapling	Tree	Survival ratio
<i>Eriobotrya bengalensis</i>	3	0	2	67
<i>Eugenia formosa</i>	3	0	2	67
<i>Terminalia chebula</i>	3	0	2	67
<i>Amoora spectabilis</i>	8	10	5	63
<i>Trevesia palmate</i>	6	4	3	50
<i>Machilus gamblei</i>	2	3	1	50
<i>Bridelia stipularis</i>	4	2	2	50
<i>Ficus hispida</i>	2	2	1	50
<i>Antidesma acidum</i>	4	1	2	50
<i>Maesa chisia</i>	2	1	1	50
<i>Semecarpus anacardium</i>	2	1	1	50
<i>Zanthoxylum budrunga</i>	2	1	1	50
<i>Aphanamixis polystachya</i>	17	2	8	47
<i>Leea guineense</i>	5	6	2	40
<i>Syzygium cumini</i>	22	0	8	36
<i>Psidium guajava</i>	3	2	1	33
<i>Aglaia spectabilis</i>	3	0	1	33
<i>Entada phaseoloides</i>	3	0	1	33
<i>Litsea laeta</i>	3	0	1	33
<i>Terminalia myriocarpa</i>	3	0	1	33
<i>Actinodaphne obovata</i>	27	11	7	26
<i>Ficus religiosa</i>	4	0	1	25
<i>Cissus repanda</i>	31	3	7	23
<i>Albizia lucidior</i>	14	2	3	21
<i>Dillenia pentagyna</i>	22	0	4	18
<i>Kydia calycina</i>	6	2	1	17
<i>Crateva religiosa</i>	6	1	1	17
<i>Cassia siamea</i>	6	0	1	17
<i>Sapindus detergens</i>	7	0	1	14
<i>Saurauia roxburghii</i>	7	0	1	14
<i>Tamarindus indica</i>	7	0	1	14
<i>Stereospermum colais</i>	67	3	9	13
<i>Amoora rohituka</i>	16	2	2	13
<i>Ficus neriifolia</i>	9	13	1	11
<i>Acacia pennata</i>	21	1	2	10
<i>Litsea glutinosa</i>	11	6	1	9
<i>Ixora nigricans</i>	16	1	1	6
<i>Chukrasia tabularis</i>	16	0	1	6
<i>Ficus glomerata</i>	16	0	1	6
<i>Acacia concinna</i>	19	0	1	5

Name of the Plant	Seedling	Sapling	Tree	Survival ratio
<i>Magnolia champaca</i>	44	1	2	5
<i>Duabanga sonneratioides</i>	59	0	2	3
<i>Ziziphus rugosa</i>	27	3	0	0
<i>Cinnamomum tamala</i>	3	1	0	0
<i>Fagerlindia fasciculata</i>	1	1	0	0
<i>Adina cordifolia</i>	3	0	0	0
<i>Alangium chinense</i>	1	0	0	0
<i>Albizia procera</i>	14	0	0	0
<i>Ardisia solanacea</i>	17	0	0	0
<i>Artabotrys caudatus</i>	1	0	0	0
<i>Atalantia missionis</i>	1	0	0	0
<i>Bauhinia purpurea</i>	6	0	0	0
<i>Buddleja asiatica</i>	4	0	0	0
<i>Calamus viminalis</i>	1	0	0	0
<i>Capparis acutifolia</i>	12	0	0	0
<i>Caryota ochlandra</i>	1	0	0	0
<i>Citrus limon.</i>	4	0	0	0
<i>Citrus medica</i>	13	0	0	0
<i>Clausena excavate</i>	5	0	0	0
<i>Cleidion javanicum</i>	1	0	0	0
<i>Clerodendrum viscosum</i>	2	0	0	0
<i>Coffea bengalensis</i>	10	0	0	0
<i>Croton roxburghii</i>	20	0	0	0
<i>Desmodium gangeticum</i>	2	0	0	0
<i>Dysoxylum reticulatum</i>	4	0	0	0
<i>Eranthemum griffithii</i>	14	0	0	0
<i>Eurya acuminata</i>	4	0	0	0
<i>Ficus elastica</i>	1	0	0	0
<i>Flueggea virosa</i>	4	0	0	0
<i>Glochidion thomsonii</i>	5	0	0	0
<i>Litsea monopetala</i>	12	0	0	0
<i>Meyna spinosa</i>	1	0	0	0
<i>Murraya paniculata</i>	1	0	0	0
<i>Mussaenda roxburghii</i>	1	0	0	0
<i>Paederia foetida</i>	4	0	0	0
<i>Pongamia pinnata</i>	3	0	0	0
<i>Sesbania sesban</i>	25	0	0	0
<i>Tabernaemontana divaricata.</i>	2	0	0	0
<i>Woodfordia fruticosa</i>	8	0	0	0
<i>Zanthoxylum nitidum</i>	3	0	0	0

# ANNEXURE: X

Name of NTFPs	Quantity	Price in local level (Rs.)	Gross income of harvesters (Rs.)	Price in outside market (Rs.)	Gross income of primary trader (Rs.)	Income (Rs.)	Expenditure (storing/Transporting, etc.) (Rs.)	Net profit of primary trader (Rs.)
<i>Phyllanthus emblica</i>	500kgs	8/kg	4000	12/kg	6000	2000	1200	800
<i>Terminalia bellerica</i>	500kgs	3/kg	1500	400/100kgs	2000	500	300	200
<i>Justicia adhatoda</i>	500kgs	200/kg	100000	250/kg	125000	25000	15000	10000
<i>Calamus viminalis</i>	100000kgs	15/kg	1500000	20-30/kg	2000000	500000	300000	200000
<i>Calamus acanthospathus</i>	100000pcs	80/100 pcs	80000	100/100 pcs	100000	20000	12000	8000
<i>Thysanolaena latifolia</i>	200000pcs	100/1000 pcs	20000	140/1000 pcs	28000	8000	4800	3200
<i>Parthenocissus himalayana</i>	100000kgs	5/kg	500000	10-25/kg	1000000	500000	300000	200000
<i>Chukrasia tabularis</i>	5000pcs	30/1000 pcs	150	40/1000 pcs	200	50	30	20
<i>Schima wallichii</i>	4000kgs	200/kg	800000	350/kg	1400000	600000	360000	240000
<i>Mahonia napaulensis</i>	100kgs	5/kg	500	10-12/kg	1000	500	300	200
<i>Luffa cylindrica</i>	230000pcs	10/1000 pcs	2300	30/1000 pcs	6900	4600	2760	1840
<i>Acacia catechu</i>	500000 kgs	50/kg	25000	60-70/kg	30000	5000	3000	2000
<i>Terminalia chebula</i>	500kgs	2/kg	500	300/100 kgs	1500	1000	600	400
<i>Bulbophyllum cornu-cervi</i>	10000kgs	10/kg	100000	20/ kg	200000	100000	60000	40000
<i>Dysoxylum mollissimum</i>	100000kgs	300/100kg	300000	550/100 kg	550000	250000	150000	100000
<i>Duabanga grandiflora</i>	5000pcs	30/1000 pcs	150	40/1000 pcs	200	50	30	20
<i>Rubia manjith</i>	200kgs	10/kg	2000	15-20/ kg	3000	1000	600	400
<i>Cinnamomum glaucescens</i>	200kgs	30/kg	6000	50/kg	10000	4000	2400	1600
<i>Musa paradisiaca</i>	5000pcs	100/1000 pcs	500	120-150/ 1000pcs	600	100	60	40
<i>Bombax ceiba</i>	150kgs	15/kg	2250	20-25/ kg	3000	750	450	300
<i>Rauvolfia serpentin</i>	100kgs	40/kg	4000	60/kg	6000	2000	1200	800
<i>Bauhinia scandens</i>	25000pcs	100/100pcs	25000	700/100 pcs	175000	150000	90000	60000
<i>Pterygota alata</i>	100000pcs.	1000/1000 pcs	100000	1200/1000 pcs	120000	20000	12000	8000
<i>Kydia calycina</i>	100000kgs	5/kg	500000	7-11/kg	700000	200000	120000	80000
<i>Piper longum</i>	108kgs	40/kg	4320	58-65	6400	2080	1248	832
<i>Firmiana colorata</i>	500kgs	10/kg	5000	15	7500	2500	1500	1000
<i>Sapindus mukorossi</i>	150000kgs	3/kg	450000	10-16	1500000	1050000	630000	420000
<i>Shorea robusta</i>	300kgs	10/kg	3000	15-20	4500	1500	900	600
<i>Asparagus racemosus</i>	60kgs	30/kg	1800	40	2400	600	360	240
<i>Bombax ceiba</i>	200kgs	20/kg	4000	30-40	6000	2000	1200	800

Name of NTFPs	Quantity	Price in local level (Rs.)	Gross income of harvesters (Rs.)	Price in outside market (Rs.)	Gross income of primary trader (Rs.)	Income (Rs.)	Expenditure (storing/Transporting, etc.) (Rs.)	Net profit of primary trader (Rs.)
<i>Acacia concinna</i>	10000kgs	10/kg	100000	12-15	120000	20000	12000	8000
<i>Piper pedicellatum</i>	1300kgs	8/kg	10400	12	15600	5200	3120	2080
<i>Bauhinia purpurea</i>	100000pcs	2/pc	200000	4-5	400000	200000	120000	80000
<i>Zanthoxylum budrunga</i>	1500kgs	8/kg	12000	15	22500	10500	6300	4200
<i>Oroxylum indicum</i>	300kgs	15/kg	4500	25-30	7500	3000	1800	1200
			5768870		9640800	3871930	2323158	1548772