Impact of Plantation Forests on the Plant Diversity of Terai and Duars region of West Bengal, India

A thesis submitted to the University of North Bengal for the award of Doctor of Philosophy in Botany

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DECLARATION

I declare that the thesis entitled **"Impact of Plantation Forests on the Plant Diversity of Terai and Duars region of West Bengal, India"** has been prepared by me under the guidance of Dr. A.P. Das, [Retired Professor] Department of Botany, University of North Bengal. No part of this thesis has formed the basis for the award of any degree or fellowship previously.

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CERTIFICATE

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ABSTRACT

Biodiversity is the part and parcel of our daily life and livelihood and forms the major resources upon which future generations in different communities and nations depend. Biodiversity secures life sustaining goods and processes and is the foundation for human health. All animals including man are almost totally reliant on plants, directly or indirectly for their survival. It supports all, – food security, dietary health and livelihood sustainability. Plant diversity forms the essential foundation of most of our terrestrial ecosystems. But the depletion of biodiversity is one of the major threats to the existence not only for humankind but for the entire biosphere.

Generally the term plantation is used as an abbreviation for Plantation forest (i.e. Planted forest) and/or Forest Plantation. Plantations cover 5 % of global forests, supply about 35 % of the world's round-wood. They may also play an important role in alleviating pressure on natural forests for timber and fuel wood production. Plantations cover wide parts of the earth's surface and in 2000 it was about 187 million hectares, which is now greatly exceeds that of the native natural forests and the process is progressing at high rate all over the globe. This is much more prominent in some European countries and about 70 % of the total forest area in United Kingdom is Plantation.

India is one of the ten most forest-rich countries of the World along with the Russian Federation, Brazil, Canada, USA, China, Democratic Republic of the Congo, Australia, Indonesia and Sudan. India's forest cover grew at 0.22% annually during 1990 – 2000 and at 0.46 % per year during 2000 – 2010. India's forest cover has increased from 68 mha (24% of the total area of the country) to 69.8 mha in 2012. This increase in forest cover is mainly due to the rapid expansion of plantations and for arrest of depletion of forests.

Initiation of cultivation of tea, its rapid expansion, different developmental activities, increases in population started to degrade the forest cover of Terai –Duars region of Bengal. With the rapid decline of forest cover in Terai and Duars region, mainly with the Governmental initiatives, plantations of some selected species have been raised over wide areas in different times. Majority of these plantations are monocultural or with few species only. Most of the species used for plantation are commercially viable, tree in habit, many exotics, and form dense and continuous canopy within three to five years. None of these features, in fact, is in favour of the reclamation of natural vegetation and thereby do not support the conservation activities. The inter relationship of plantation forests and biodiversity is quite complex

and that become more complex when the issue of the effects of plantation forests over the biodiversity is considered.

Plantation affects biodiversity and environment both ways, direct and indirect. Rapidly growing interest in developing plantation forests is one of the most important reasons of replacing and clearing of environment friendly natural forests which positively impacts physical and biological environment as well as the biodiversity of the area.

Rapidly growing plantation forests have been accompanied by increased concerns about the potential environmental impacts. The concern also focus on the potential loss of soil fertility and productivity in case of short harvest rotations, risks associated with introducing exotic elements and catastrophic pest infestations. Developing monoculture plantations and the implications of replacing natural forests and associated flora and fauna lead to the formation of vegetation which became biologically very less diverse.

In question of impact of plantations on biodiversity, all the environmentalists, sponsors and others who are concern with the plantation forests, biodiversity and its conservation, get separated into two groups. One group holds the opinion that plantation forests enhances or favours biodiversity whereas the second lot opposes the first group of thinkers.

The present work was proposed to trace the impacts of plantation forests on plant diversity of Terai-Duars belt of West Bengal. Terai - Duars region of West Bengal is the Sub-Himalayan or foot hills region of the Indian state that extends from Nepal to Assam. Geographically this area is located from 26°16′00" N to 27°00′00" N latitudes and from 87°59′30" E to 89°53′00" E Longitudes and bordered by Hilly region of Darjeeling district and Bhutan to the North and by Cooch Behar, North Dinajpur and Bangladesh to the South. The entire Terai-Duars belt is a part of the *Eastern Himalaya* which is renowned for its diverse and rich biological resources. This zone is regarded as one of the most resource rich centres of Bengal and its diverse habitats are ideal home for a large number of flora, fauna and microbes. The present dissertation was designed to assess the influences of plantation forest on phyto-diversity of the study area and the main theme behind the selection of methodology is to compare different types of plantation with adjacent natural vegetation that was predominant in entire Terai-Duars belt and considered to be the standard land-use pattern. The comparison emphasized on the vegetation structures and phyto-sociological attributes along with a number of other aspects. Three-tire Nested Quadrate (20m x 20m for trees or canopy; 5m x 5m for shrubs or under-storey and 1m x 1m for ground cover) was adopted for sampling vegetation (Misra, 1968; Shimwell, 1971; Tripathi & Misra, 1971; Phillips, 1959; Malhotra, 1973; Das & Lahiri, 1997 and Kadir, 2001)

Random sampling plot survey has been done in consecutive three seasons during Pre-Monsoon, Post-Monsoon and in winter. From the present survey it was found that the plantation affected biodiversity in different ways. It reduced species diversity by unifying the vegetation and species richness also. It increased the concentration of dominance of few species and thus homogenizes the vegetation. Plantation soils were found to be different from the soil from natural forests. Allelopathic assay of some commonly planted species on selected herbs were performed and it was expressed that teak had strong allelopathic effects on that test herbs. It reduced germination percentage, inhibited shoot, roots and seedling growth etc. Other test trees also showed some short of effect. Not only that few exotic species were surveyed for their impacts on local biodiversity and it was revealed that the exotic alien species also hamper biodiversity by homogenizing the local diversified flora by reducing the species richness and species diversity and increasing uniformity of vegetation and thus hampered the local ecosystem also. Recording of NTFPs and medicinal plants, showed the richness of this tract of marshy vegetation in NTFPs contents and the medicinally important plant species. Not only in NTFPs contents, but the belt was found to be very rich in tribal community and traditional knowledge systems. Terai and Duars region was found to harbour a number of RET elements also.

In conclusion it can be said that different type of plantations affected plant diversity in different sites in different ways. Mixed plantation which had similarity with natural vegetation affected the phytodiversity in lesser extent than the teak, jarul-benteak, jarul, and sal-chilauni plantation. Thus it is to mention that for the sake of biodiversity and ecosystem of this resources rich area, creation of plantation mainly the monoclonal plantation should be avoided in and around the natural forest which are the unique home to numerous plant species.

PREFACE

The entire Terai – Duars belt is a part of the *Eastern Himalaya* which is renowned for its diverse and rich biological resources. This zone is regarded as one of the most resource rich centres of Bengal and its diverse habitats are ideal home for a large number of flora, fauna and microbes. Before the establishment of human settlement almost the entire tract was wrapped with dense forests. But rapid development of hilly Darjeeling town after the historical visit of Capt. Lloyd and Mr. Grant in 1827, introduction of Tea cultivation in Terai and Duars region and its rapid expansion started eliminating the dense vegetation. Not only that the Dhupi [*Cryptomeria japonica* (Thunb. *ex* L.f.) D. Don] plantation in Darjeeling for supplying wood for tea packing boxes, indirectly affected the vegetation of Terai.

A large number of tribal people from different region were brought to the Terai – Duars region to supply with the Tea worker and labours in other developmental activities. Population of this region started increasing in a very high rate, dense and virgin forests were cleared for housing and farming land, building materials and fuel woods. In one side pressure from rapidly growing population and their needs and on the other hand construction of roads, rails and expansion of tea gardens began to fragment the vegetation and posed threats to the phytodiversity of the area.

With the rapid decline of forest cover in Terai and Duars region, mainly with Governmental initiatives, plantations of some selected species have been raised over wide areas in different times. Majority of these plantations were monocultural or with few species only. Most of the species used for plantation are commercially viable, tree in habit, many exotics, and form dense and continuous canopy within three to five years. None of these features, in fact, is in favour of the reclamation of natural vegetation and thereby do not support the conservation activities.

Thus along with the multiple factors posing threats simultaneously to this unique vegetation and forests of this area, different types of plantations of both native and non-native species, and mono-cultural or mixed, supposed to have some effects on phyto-diversity and environments of Terai-Duars region. One the other hand in question of influence of plantation in biodiversity, the whole universe is segregated into two groups – one in favour of plantation and the other against it. Plantations are being addressed as “Biological Dessert” and some large environmental organizations are running an anti-plantation campaign, like the Rainforest Action Network and Greenpeace.

At the same times there is no any of the systematic study to understand the effects and/or performances of such artificial vegetation, apart from the economic gains and floristic aspects. So the present study provided considerable bulk of data on plantations and natural vegetations of Terai-Duars belt, their comparative accounts and the actual impacts of plantation forests on the natural vegetation and the phyto-diversity as well as its role in conservation of biodiversity of the study area.

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Abbreviation and Symbol used

°C	Degree centigrade
ABGH	Above ground herbaceous biomass
ASFR	Austrailia's State of the Forest Report
AV	Average
B	Both plantation and natural vegetation
BM	Biomass
CD	Concentration of Dominance
CI	Conservation International
CL	Climber
CON	Control
D	Density
DFO	Divisional Forest Officers
F	Frequency
FA	Fringe Area
FAM	Family
FAO	Food and Agricultural Organization
FPB	Forest Practices Board
FRA	Global Forest Resources Assessment
FSI	Forest Survey of India
g	Gram
GEN	Genera, Genus
GER	Germination
GFU	George Fox University
H	Herb
H', SWI	Shannon-Weiner Index
ha	Hectare
hr, h	Hour
ICIMOD	International Centre for Integrated Mountain Development
IPGRI	International Plant Genetic Resources Institute
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature and Natural Resources
IVI	Importance Value Index
km	Kilometre
m	Metre
Max	Maximum
MFP	Forest Practice Board
mha	Million Hectare
MI	Menhinic's Index
Min	Minimum
mm	Millimeter
MSSRF	M.S. Swaminathan Research Foundation
Mt.	Mount
NCA	The National Commission on Agriculture
NF	Natural Forest
NRVK	North Rajabhatkhawa
NTFP	Non Timber Forest Produces
NV	Natural Vegetation
OTA	Offfice of Technology Assessment
P	Plantation
POM	Postmonsoon
ppm	Parts per million
PRM	Premonsoon
RA	Relative Abundance
RD	Relative Density
RET	Rare, Endemic and Threatened Elements
RF	Relative Frequency
RH	Relative Humidity
RL	Root length
RVI	Root vigour index
S	Shrub
SDL	Seedling length
SDVI	Seedling vigour index
SI	Similarity Index
SL	Shoot length
spp., SP	Species
sq	Square
SVI	Shoot vigour index
T	Tree
UNEP	United Nations Environmental Programme
W, WIN	Winter
WRI	The World Resources Institute
WWF	World Wide Fund for Nature
Σ	Summation

Introduction

"*The most wonderful mystery of life may well be the means by which it created so much diversity from so little physical matter*."

E.O. Wilson, 1992

"*Our National Food Security depends on our ability to conserve all our biological wealth*."

M.S. Swaminathan, 1997

1.1. BIODIVERSITY

Biodiversity has been well known for its immense value for humankind in the present century, although it has been serving a lot for the mankind since the pre-historic era. Biological diversity, which Darwin (1859) called as '*Life's endless forms*' and Frankel (1970) as '*the essence of life*' is rooted deep into all the sphere of human life and activity (Krishnamurthy, 2003). During the last three decades, biodiversity, that forms the backbone of human sustenance, has drawn the attention of numerous scientists, policy makers and even the common people (Kumar & Asija, 2000). But the grand value of biodiversity is yet to be known. So far, only around 20 % of the existing species is discovered, named and classified. Whereas, till now, more than 80 % of those are unknown to us (Krishnamurthy, 2003) and the Biologists are in search of that yet unknown treasure of biological diversity. On the other hand, biological elements are facing severe threats of extinction due to some natural phenomena and/or man's self destructive activities, before they are discovered.

Different organizations, authorities and the nations in union are now realized the situation and are trying to sustain, preserve and to conserve biodiversity as well as to save the green earth that can sustain the endless form of the living world. It should be a fundamental duty of every individual man to protect and preserve biodiversity and our environment.

1.1.1. Definition

Biodiversity, the combined-abbreviated form for 'Biological Diversity', is very widely used by scientific communities, as well as the general public, environmental groups, conservationists, industrialists and economists. The term '*Biological Diversity*' was mentioned by Gerbilskii & Petrunkevitch (1955) in the context of intraspecific variation in behavior and life history (Magurran, 2004) and became popular around 1980 (Lovejoy, 1980a,b; Norse & McManus, 1980). Contraction of the term, '*Biological Diversity*' into '*Biodiversity*' was done during the first planning meeting of the 'National Forum on Biodiversity' held at Washington DC in September 1986 (UNEP, 1995) and published in a book entitled '*Biodiversity*' (Wilson & Peters, 1998). Then it was further popularized by the United Nations Conference on Environment and Development (UNCED) held in 1992 at Rio de Janeiro (Krishnamurthy, 2003) which is popularly known as 'Rio Summit' or 'Earth Summit'. Scientific communities and social scientists defined biodiversity in various ways. Jutro (1993) identified about fourteen definitions and that indicates the complexity of the concept.

'*Biological diversity refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequency. For biological diversity, these items are organized at many levels, ranging from complete ecosystem to the chemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, genes and their relative abundance*' (OTA, 1987).

According to McNeely *et al*. (1990) Biodiversity '*encompasses all species of plants, animals and the micro-organisms and the ecosystems and ecological processes of which they are parts. It is an umbrella term for the degree of natures' variety, including both the number and frequency of ecosystem, species or genes in a given assemblage.*'

United Nations Environment Programme (UNEP) in 1992 defined Biodiversity as '*the variability among living organisms from all sources including, inter alia terrestrial, marine and other aquatic ecosystem and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'*.

Definition sponsored jointly by WRI, IUCN and UNEP (1992) is '*the totality of genes, species and ecosystem in a region.*'

Biodiversity signifies variability of all the life forms of the nature and covers entire array of variation in and variability among the organisms and system at regional, landscape, ecosystem and habitat levels and at the organizational to gene levels (Ricklefs & Miller, 2000).

Biodiversity is considered in terms of gene, species and ecosystems which correspond with *genetic diversity*, *species diversity* and *ecosystem diversity*. *Genetic Diversity* also known as *intraspecific or infraspecific diversity* and means the diversity within and between populations of species. Genetic diversity of a species can exist at three different level — genetic diversity within individuals (heterozygosity), genetic diversity among individuals within a population and genetic diversity among population. Diversity or variability of species within a community is known as *species diversity* or *taxonomic* or *organismal diversity*. *Species diversity* is measured by different indices and methods — *species richness* (indicated by total number of species in an area), *species abundance* (indicated by the total number of individuals of a species in an area) and *species evenness* (represented by equitability of species as given by their relative abundance). The diversity at the ecological or habitat level is called as *Ecological Diversity* or *Ecosystem Diversity* (Heywood, 1994; Norse, 1994). It is the intricate network of different species present in local ecosystem and dynamic interplay between them (Kumar & Asija, 2000). Many other scientists (Wilson, 1988; Szaro & Shapiro, 1990; Szaro & Salwasser, 1991) mentioned another form of biodiversity, known as *Landscape Diversity* (Krishnamurthy, 2003) which is defined as the diversity at landscape level (Noss, 1996). Scheiner (1992) called it as *Pattern Diversity* as the landscape has a pattern consisting of repeated habitat components.

Krishnamurthy (2003) stated that the definitions given by UNEP (1992) and jointly by WRI, IUCN and UNEP (1992) are mostly used, quoted and officialised. But Castri & Younes (1996) emphasized the interaction within, between and among the different levels of biodiversity, which is the essential mechanism to shape the features and functions of biodiversity and mentioned the lack of this interaction of these two definitions given by UNEP (1992) and jointly by WRI, IUCN and UNEP (1992).

Diversity at both the species and ecosystem levels consist of *alpha diversity (α), beta diversity (β) and gamma diversity (γ)* and were introduced by Whittaker (1960). Alpha-diversity is the species diversity within a community or habitat at a more local scale. Beta-diversity is the inter-community diversity expressing the rate of species turnover per unit change in habitat. Gamma diversity is overall diversity at landscape level and includes both alpha diversity (α) and beta diversity (β). Plant-diversity or Phyto-diversity means the variety and variability among the plants from all the sources. Phyto-diversity is essential for the sustenance of life on earth.

1.1.2. Significance of Biodiversity

Biodiversity is the part and parcel of our daily life and livelihood and forms the major resources upon which future generations in different communities and nations depend. The great classical Economist, Smith (1776) remarked that '*the origin of all wealth came from the bosom of earth*' that implies the immense value and significance of biodiversity.

Value of biodiversity may be of private and social. Private value of biodiversity needs to be understood to ascertain the driving force behind the loss of biodiversity whereas its social value is to understand for conserving it (Perrings, 1997; Krishnamurthy, 2003).

Biodiversity secures life sustaining goods and processes and is the foundation for human health. All animals including man are almost totally reliant on plants, directly or indirectly for their survival. It supports all, – food security, dietary health and livelihood sustainability. Plant diversity forms the essential foundation of most of our terrestrial ecosystems.

The vast genetic variety available in terrestrial plants, animals and micro-organisms offers a wealth of possibilities for the betterment of mankind in the production of food, fodder and forage, medicine, horticultural and ornamental plants, timber, fiber, rattans and canes, dyes and other chemicals, fuel and renewable energy and a host of other products used in small and large scale industries and in domestic and international trade.

It provides important resources for traditional and modern medicines and for the research on medicine and about 25,000 species of plants have been recorded so far as traditional medicines (Heywood, 1992). There is wide variety of naturally derived drugs which still serve as important therapies in medicine today. Examples of drugs those are in use for many years and have importance even today include digitalin, aspirin, quinine, atropine, scopolamine, morphine, ergot alkaloids like ergotamine and ergonovine, ephedrine, reserpine, pilocarpine etc. Some more recent examples are the anti-cancer agents, vinblastine and vincristine from the common periwinkle, which is used to treat Hodgkin's disease, leukemia and testicular cancer; taxol which is obtained from yew (*Taxus baccata* and *T. wallichiana*) and used to treat ovarian and lung cancer (Young, 1999).

Biodiversity also plays a role in regulation of infectious diseases and its control and has social, cultural and spiritual importance. Intact ecosystem can reduce disaster risk and relief and recovery efforts.

Agricultural biodiversity plays a crucial role in sustaining and strengthening food, nutrition, health and livelihood security throughout the globe and provide crucial raw materials for improving productivity and quality of crops, livestock and fish and confers multiple benefits — ecological, economic, nutritional and cultural (MSSRF, IPGRI and GFU, 2005) and not only that, thousands of species is used as ornamentals in parks and gardens – both public and private, as street or avenue trees and for shade and shelter.

1.1.3. Biodiversity in danger

Depletion of biodiversity is one of the major threats to the existence not only for humankind but for the entire biosphere (Anonynous, 1996). Though Charles Darwin (1859) predicted that in the natural conditions the unfit species become extinct but threats to biodiversity arise when the rate of extinction exceeds the rate of speciation. Natural extinction of species due to geological and meteorological catastrophe is not uncommon (Anonynous, 1996) and now the anthropogenic activities have been the major threats to biodiversity (Leemans, 2001) and became the major cause of extinction (Wilson, 1988). The day when early man learnt to tame fire (Das, 2011) and started exploiting various forest products, from that moment the loss of biodiversity was initiated and since then the process is going on at a very high rate, both on local and global scale (Given, 1996).

As a result we are losing about 5.2 million hectares of forest cover around the world (FAO, 2010) and 3 species being extinct in every hour (Stearns *et al*, 2000). The situation is much severe in tropical zone (FAO, 1991). In Tropical Asia 65% of the total natural forests has been destroyed so far. Though India has recorded increase in net forest cover in recent past but natural forests have decreased and in the post independent period India has lost 4696 Million hectares of forest (MoEF, 1999) and the existing forests are under severe threats particularly in the Himalayas, uplands of Central India and Western Ghats (WWF & ICIMOD, 2001; Dhar, 2002; Ninan, 2007).

Kumar & Asija (2000) identified a variety of factors which are responsible for the loss of biodiversity and its depletion. These are:

1. **Developmental pressure**: developmental pressure includes construction, forest based industries, hydrel and irrigation projects, mining, drilling for oil, pollution, resource extraction, road construction and transport, extension of settlement areas and industries, etc.

2. **Encroachment:** it covers agriculture, expansion of forest villages, fishery, grazing, habitat depletion or change, horticulture, monoculture forestry, new settlements, shifting cultivation, siltation of river bed, teak and rubber cultivation, etc.

3. **Exploitation**: Large scale exploitation by local authorities as revenue resources, firewood or MFP collection, food gathering and food hunting by meat loving population, poaching and illegal hunting, smuggling of timber and other forest produces, unregulated collection of medicinal plants and orchids, etc. and those are mostly work under the influence of uncontrolled market forces. Collection made by scientific/educational institutions and trophies or specimen collection as hobbies are also blamed for biodiversity loss but the impact of such activities is insignificant.

4. **Human induced disasters**: Floods, major oil spills, wildlife depredation, epidemic pests, natural and man-made forest fire including jhumming are some such factors.

5. **Managements of natural resources**: Diseases, fire and management tool, genetic uniformity, hybridization, inadequate water and food for wildlife, increased competition, introduction of exotic species, lack of patronage for local/native species, lack of pollinator and dispersal agents, low population/ restricted range of distribution, predation, etc.

6. **Management of human resources**: Change in people's lifestyle, conflicting/increasing demand, dilution of traditional values, erosion of indigenous knowledge, generation gap, human harassment, ignorance and lack of awareness, inadequate trained human resources, inappropriate land use, lack of effective management, negative attitude, tourism development, influence of valueless costly education, thirst for property, etc.

7. **Political and policy issues**: Civil unrest and political movement, armed conflict, intercommunity conflict, intervention failure, lack of clear policy, effective implementation of concerned rules and regulations, lack of interdepartmental coordination, lack of intervention, military activities, refugees, reduction in size of migratory corridors both for plants and animals.

Threatened Plants Committee of International Union for Conservation of Nature and Natural Resources (IUCN, 2006) has demarked about twenty factors which are considered as the main threats to the plants and are:

1. Grazing
2. Forestry
3. Ploughing of old grassland
4. Regeneration of Scrub
5. Changes in arable farming
6. Flooding
7. Drainage
8. Water pollution
9. Air pollution
10. Industrialization and urbanization
11. Road construction
12. Traditional rural practices
13. Dam construction
14. Mining and quarrying
15. Pressure from introduced plants
16. Tourism and infrastructural facility development in coastal/inland area
17. Collection of horticultural purposes/ academic purpose
18. Critically low population
19. Natural causes
20. Lack of pollinators

In Indian subcontinent the scenario of loss of biodiversity is almost same and the extremely rich and diversified flora faces lots of threats. Karthikeyan (2000) has summarized the major threats affecting biodiversity in India. These are population pressure and encroachment of the forested area, large scale removal of natural resources, habitat destruction and exotic weeds.

1.1.4. Conservation of Biodiversity

Conservation of Biological diversity along with its exploitation has been practicing for centuries (Meffe & Carroll, 1994) and that traditional conservation efforts were based on an economic and utilitarian philosophy (Krishnamurthy, 2003). India also has a long and glorious history of conservation of nature in the form of worshipping trees, forests, rivers, ponds, mountains and different animals which are believed to be abode of different Gods and Goddesses. Importance of sacred groves in traditional conservation is now well-known especially in Asiatic countries. The Convention on Biological Diversity held in Rio de Jeneiro in 1992 strongly emphasized the need for conservation of biological diversity of this planet and in recent years its conservation along with sustainable utilization has become the most important and burning topic for the survival of human beings on this earth (Singh & Chowdhery, 2002). Conservation of biodiversity can be attempted at three levels – genetic level, species level and ecosystem level which constitute different level of biological organization and are interconnected (Krishnamurthy, 2003). Though the conservation of biodiversity is achieved through *in-situ* and *ex-situ* modes, in the modern era both of these modes of conservation are practiced together for better result. *Ex-situ* conservation means the conservation of a species outside of its natural habitat like Zoological parks and Gardens and Botanical Gardens. In India there is a chain of Botanical Gardens, of which Indian Botanic Garden (BSI), Howrah is the most important one. Therefore, *in-situ* conservation receives high preference over *ex-situ* mode and is achieved through the establishment of Protected Area Networks. Under the Wildlife Protection Act and Indian Forest Act different types of Protected Areas have been recognized in India including National Park, Wildlife Sanctuary, Game Reserve, Closed Area, Reserved Forest and Protected Forest.

1.1.4.1. Role of IUCN in conservation activities

IUCN that stands for International Union for Conservation of Nature and Natural Resources, is a federative membership organization, composed essentially of governments or governmental agencies, scientific, professional and conservation organizations and now is also known as the World Conservation Union (Krishnamurthy, 2003). In co-operation with the United Nations and other intergovernmental agencies as well as its sister organizations – the WWF, it aims to influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable. (http://fur.ca/conservation/iucn/).

IUCN works through its six Commissions, namely (i) Commission on Education and Communication (CEC), (ii) Commission on Environmental, Economic and Social Policy (CEESP), (iii) World Commission on Environmental Law (WCEL), (iv) Commission on Ecosystem Management (CEM), (v) Species Survival Commission (SSC) and (vi) World Commission on Protected Areas (WCPA), which all promotes different aspects of conservational activities directly and/or indirectly. IUCN runs field projects for habitat and species conservation around the world and the organization is best known for compiling and publishing the IUCN Red List, which assesses the conservation status of species worldwide and thus play crucial role in conservation of biodiversity. The IUCN Red List of Ecosystems is of global standard to assess the conservation status of ecosystems and is applicable at local, national, regional and global levels. It also organizes and supports several conferences and workshops on biodiversity.

The IUCN Program on Protected Areas (PPA), a Secretariat Program based in IUCN HQ and the IUCN World Commission on Protected Areas (WCPA), the world's leading network of protected areas, are two important programs that work together as to deliver IUCN's work in relation to protected areas (www.iucn.org/westasia). About 10 types of protected areas have been recognized by IUCN, of which World Heritage Sites and Biosphere Reserves have international standard and recognition (WRI, 1992). It recognizes Biodiversity Hotspots of Conservation also. IUCN plays vital role in recognition of Biodiversity Hotspots and has modified the concept and criterion of hotspots stating that it must hold at least 1500 endemic plant species and have lost 70 % of its original habitat is lost (Mittermeier *et al*. 2011).

I. Biodiversity Hotspots: The Himalaya Biodiversity Hotspot

The concept of '*Biodiversity Hotspot*' was brought in by Myers (1988) on the basis of total endemics and the rate of natural habitat loss. Biodiversity hotspots or simply Hotspots are nothing but the concentration of unique biodiversity. Hotspots support a number of threatened taxa and ecosystems and they deserve conservational attention. Uniqueness of biodiversity, amount of habitat lost and protected and magnitude of endemism along with some other factors are regarded as important criteria for recognition of Hotspots. Biodiversity hotspot must have lost at least 70 % of its original native vegetation.

Initially, 13 biodiversity hotspots were documented worldwide and then further 12 more hotspots were added (Myers *et al.* 2000). After that IUCN added 9 more regions to already existed list of biodiversity hotspots amounting total 34 numbers of hotspots all over the globe (CI, 2005).

Planet earth is unique in its capacity to support lives on it, and is the only habitat for over 40 millions of living organisms that form the basic level of biodiversity. Although the living organisms spread all over the globe but they are not uniformly distributed. Somewhere they are concentrated in number and variety while in other places their number and variation is too less. Depending on the distributional patterns, variations and concentration of floral elements different phyto-geographer divided the planet into different Kingdoms and Subkingdoms. Indian region or Indian sub-continent falls under Indo-Malayan subkingdom of Paleotropical Kindgom (Good, 1974) and is divided into a number of botanical provinces.

The Himalayas is recognized for its ecosystem services to the Asian region as well as to the world as it maintain slope stability, regulate hydrological integrity, sustain high levels of biodiversity and human wellbeing also. It is exclusive and inimitable in respect of biodiversity, and is receiving topmost priority for biodiversity conservation in global agendas since last few decades (Sharma *et al.* 2010).

Among the Hotspots Himalaya is the most important one from the view points of phytodiversity, endemism and occurrences of threatened taxa and it covers northern Pakistan, Nepal, Bhutan and the northwestern and northeastern states of India. It spreads over around 750,000 km² areas and includes the world's highest mountain, Mt. Everest and several of the world's deepest river gorges. The diversity in landforms results in diverse ecosystems to from alluvial grasslands and subtropical broadleaf forests to alpine meadows above the tree line (Anonymous, 1996).

The Himalaya hotspots is divided into two regions: the Eastern Himalaya, which covers parts of Nepal, Bhutan, the northeast Indian states of West Bengal, Sikkim, Assam, and Arunachal Pradesh, southeast Tibet and northern Myanmar; and the Western Himalaya covering the Kumaon-Garhwal, northwest Kashmir, and northern Pakistan (http://www.cepf.net/resources/hotspots/Asia-Pacific/Pages/Himaaya.aspx on 19.5.16).

Vegetation cover of the Himalaya Hotspot is 185,427 km², which is the home for around 10,000 species of plants of which 3,160 Species is endemic to this region. Not only that, it nurtures important populations of numerous large birds and mammals, including vultures, tigers, elephants, rhinos and wild water buffaloes.

Table 1.1. Species diversity and endemism in Himalaya Hotspot (http://tech-organic.blogspot.in/2011/09/himalayan-biodiversity-hotspot.html on 19.05.2016)

Taxonomic Group	Species	Endemic Species	Endemism (%)
Plants	10,000	3,160	31.6
Mammals	300	12	4
Birds	977	15	1.5
Reptiles	176	48	27.3
Amphibians	105	42	40
Freshwater Fishes	269	33	12.3

Biodiversity of the Himalayas also subject to face different type of threats due to over exploitation of natural resources, population explosion, extensive clearing of forests and grasslands for cultivation and settlement development, overgrazing by domestic livestock, widespread logging, manmade fire, accidental spread out of fire that convert the forests and grasslands into denuded land and habitat (www.conservation.org). Not only that, illegal poaching, overexploited for traditional medicinal plants, fuel wood collection and too much extraction of non-timber forest produces, both for domestic consumption and export, unplanned and poorly managed tourism has led to environmental deterioration in the Himalayan belt (Das, 2011).

At the beginning, McNeely (1990) recognized 12 Mega-diversity countries globally, which harbour 70 % of the total flora of the world (Groombridge, 1992). India is one of the seventeen megadiversity countries of the world and is the home to 17500 species of flowering plants (Sing & Choudhery, 2002). However, at present 17 Megadiversity countries are recognized by Conservation International (http://www.biodiversitya-z.org/content/megadiverse-countries on 11/05/2017)

1.1.4.2. Plant diversity of Eastern Himalaya

Eastern Himalaya, one of the twelve phyto-geographic regions recognized in India, covers Eastern Nepal in the West to Arunachal Pradesh in the East and passes through Darjeeling district of West Bengal, and the states like Sikkim and Arunachal Pradesh (Clarke, 1898; Hooker, 1904; Chatterjee, 1940). Though extends over a small area, covering only 850 km stretch (Gansser, 1964), Eastern Himalayas is regarded as the heaven for countless plant species and exhibits the richest flora in Indian sub-continent (Rao & Murti, 1990). Though too much of anthropogenic activities started degrading the greenery, still there are many patches of vegetation in the Eastern Himalaya those remain untouched and virgin.

Several plant explorers, botanists, researchers and plant-hunters from round the world (Das 1995, 2004) have worked on the vegetation of Eastern Himalaya and categorized it in different ways (Rao, 1994). East Himalayan flora consists of (i) Tropical evergreen forests, (ii) Subtropical forests, (iii) Temperate forests, (iv) Subalpine and (v) Alpine forests (Sahni, 1981). But, Mehra *et al,* (1985) grouped East Himalayan vegetation under three major types along with some sub-types.

Based on the previous workers including Griffith (1847), Hooker (1849), Hara (1966, 1971), Rao (1974), Ohashi (1975) and Rao & Hazra (1986), later on in 1994 Rao classified vegetation of Eastern Himalaya into following altitudinal types with numerous sub-types:

1. Tropical Forest
(i). Tropical evergreen forests
(ii). Tropical grasslands
(iii). The Sub-tropical forests
2. Temperate Forest
(i). Cool broad leaved forests of Eastern Himalaya wet temperate forests.
(ii). Evergreen Oak forest and
(iii). Temperate Rhododendron-Conifer forests
3. Sub-alpine Forest
4. Alpine Forest

The Eastern Himalayan zone is extremely diverse and rich in floristic elements and several factors have been recognized for this. Those include topographic variation, different altitudinal zones – from plateaus and valleys to ice capped mountains; climatic variables in different climatic zones; high to moderate to low precipitation zones; horse-shoe shaped alignment of folds; lesser height than Central and Western Himalayas; confronting of monsoon winds coming from Bay of Bengal containing heavy load of moisture that causes heavy rainfall and moist and warmer environment (Anonymous, 1996).

About 63% of flowering plant families in India are represented in this region. Some families like Coriariaceae, Nepenthaceae, Turneraceae, Illiciaceae, Ruppiaceae, etc. which are represented in India by one or two species of a solitary genus are found here (Rao, 1994). About 9000 species of flowering plants have been recorded from this floristic zone (Myer, 1988; Wilson, 1992) which shares highest forest cover in Indian phytochorion (FSI, 2003). The Eastern Himalaya is very wealthy having a great number of orchids, tree-ferns, primulas and blue poppies. Eastern Himalaya hosts about 650, 70, 34 and 58 species of orchids, *Rhododendron*, *Hedychium* and bamboo respectively against the Indian representative numbers are 1200, 82, 60 and 100 respectively (Rao, 1994; Rai, 2006; Mao, 2012). A large number (ca 82) of wild relatives of cultivated plants have been recorded from this zone like *Houttuynia cordata* Thunb., *Myrica esculenta* Buch.-Ham. *ex* D. Don, *Betula alnoides* Buch.-Ham. *ex* D. Don, *Alnus nepalensis* D.Don and others. This is a natural store house of numerous lifesaving drug plants like *Coptis teeta* Wall., *Paederia foetida* L., *Sinopodophyllum hexandrum* (Royle) T.S. Ying, *Nardostachys grandiflora* DC., *Panax pseudo-ginseng* Wall., *Cheilocostus speciosus* (J.Koenig) C.D. Specht, *Acorus calamus* L., etc. Diversity of primitive flowering plants in Eastern Himalaya, like *Magnolia griffithii* Hook.f. & Thomson, *Magnolia pterocarpa* Roxb., *Houttuynia cordata* Thunb., *Myrica esculenta* Buch.-Ham. *ex* D. Don, *Betula alnoides* Buch.-Ham. *ex* D. Don, *Alnus nepalensis* D.Don, *Schisandra neglecta* A.C.Sm., etc. are also remarkable. Not only for flowering plants, Eastern Himalaya is also well known for its diversified non-flowering plants like ferns and fern allies, liverworts and mosses, algae, fungi and lichens. About 500 species of ferns occur in this phytogeographical region and this accounts almost 50 % of the total Indian fern species (Rao, 1994).

I. Endemism in Eastern Himalaya

This phytogeographic zone exhibits a great extent of confinement of flora in correspondence with the Indian sub-continent. About 39 % of recorded flora from Eastern Himalaya is endemic (Wilson, 1992) and this is further supported by the estimation of endemic plants by Nayar (1996), that shows occurrence of 1808 endemic species in Eastern Himalaya out of total 5725 species found in India. Recent workers like Das (1995, 2004), Bhujel & Das (2002), Ghosh & Das (2009) has contributed to the endemism of Eastern Himalaya. The region is home for several interesting and rare plants as well as the primitive angiosperms that led to the consideration of Eastern Himalaya as '*Sanctuaries of Ancient Flora*' (Rao, 1994). Takhtajan (1969) treated this zone as '*Cradle of Flowering Plants*'. Recent workers (Shrestha, 1982; Das, 1986, 1995, 2004; Lama, 2004; Rai, 2006) believe that the

Eastern Himalaya have been playing as the meeting ground for diverse floral elements from adjoining areas and is an important centre for speciation.

Some plant species endemic in this zone are *Uvaria lurida* Hook.f. & Thomson, *Magnolia griffithii* Hook.f. & Thomson, *Ardisia quinquangularis* A.DC., *Eria barbata* (Lindl.) Rchb. f., *Paphiopedilum insigne* (Wall.) Pfitz., *Hedychium calcaratum* Rao & Verma, *Nepenthes khasiana* Hook. f., *Magnolia lanuginosa* (Wall.) Figlar & Noot., *Coptis teeta* Wall. etc.

1.1.4.3. Plant diversity in India

Indian region, the most distinct biogeographic regions of the world extends over 3,280,383 sq km and is diverse in its climatic, altitudinal and ecological habitats. Its climate ranges from almost rainless areas to the highest rainfall areas in the world; altitude varies from sea level to highest mountain and the habitat type from humid to hot desert, cold desert to icy mountain ranges (Rao, 1994). These extreme variety and variability of habitats, climates and altitudes are the main reasons for the richness of Biodiversity in India (Das, 1995, 2002, 2004, 2011; Rai, 2006) and its richness of the vegetation cover is well known and the region is considered to be one of the twelve megadiversity countries recognized first by McNeely in 1990 (Groombridge, 1992). It now covers three '*Conservational Hotspots of Biodiversity*' out of 34 recognized world-wide by IUCN (CI, 2005). N.I. Vavilov (1926) considered the Indian region as '*the Hindustan Centre of Origin of Cultivated Plants*'. Not only that, Sir J.D. Hooker (1904) mentioned that the Indian flora is more varied than that of any other country of equal area in the eastern hemisphere, if not in the world.

This sub-continent possesses scrub forest, tropical evergreen rain forest, costal mangrove, temperate forests, alpine flora, xerophytic vegetation etc (Rao, 1994; Rai, 2006). Well mixing of floristic components from the surrounding countries is the main feature of the Indian flora which posses African, Arabian, Middle Asian, Mediterranean, European, Siberian, Tibetan, Chinese, Japanese, South-East Asian, Malaysian, Australian, Sri Lankan floral elements (Anonymous, 1996). Based on this observation, Sir J.D. Hooker (1904) concluded that India has no flora as a separate entity but an admixture of the floras from the neighbouring countries. But, the phytogeographers after critical analysis came to the conclusion that India has its own distinct flora (Rao, 1994).

Champion & Seth (1968) recognized 16 major forest types in India along with several minor types. Major forest types of India as proposed by them are as follows:

1. Tropical Wet evergreen Forest
2. Tropical Semi-evergreen Forest
3. Tropical Moist-deciduous Forest

4. Littoral and Swamp Forest
5. Tropical Dry-deciduous Forest
6. Tropical Thorn Forest
7. Tropical Dry Evergreen Forest
8. Sub-Tropical Broad-Leaved Hill Forest
9. Sub-Tropical Pine Forest
10. Sub-Tropical Dry Evergreen Forest
11. Montane Wet Temperate Forest
12. Himalayan Moist Temperate Forest
13. Himalayan Dry Temperate Forest
14. Sub-Alpine Forest
15. Moist Alpine Forest, and
16. Dry Alpine Scrub.

Udvardy (1975) recognized 10 biogeographic regions in India that represent 3 basic Biomes and 2 natural realms within the territory of the Indian Republic. Several phytogeographers (Hooker, 1854, 1904; Clarke, 1898; Chatterjee, 1940, 1962; Razi, 1955; Puri, 1960; Rao, 1974; Rodges & Panwar, 1988) have worked on phytogeography of Indian region and divided it variously. Major phyto-geographic regions of India are;

1. Trans-Himalaya
2. West Himalaya
3. East Himalaya
4. North-East India
5. The Indian Desert
6. Semi-arid zone
7. Gangetic plain
8. Western Ghats
9. Deccan peninsula
10. Indian coasts
11. Andaman and Nicobar Islands; and
12. Lakshadweep Islands

India covers only 2.4 % of the global geographic area and over 45000 species of plants have been reported from the Indian region that represent 11 % of the known plants species from the world (Rao, 1994; Singh & Chowdhery, 2002). So far 17500 species of flowering plants reported from India (Singh & Chowdhery, 2002). Approximately half of the world's aquatic plants occur in India and a large number of primitive flowering plants (at least 131 species) are found in India (Rao, 1994). India has remarkable record in agro-biodiversity with 167 crop species and their wild relatives and is regarded as 'the Centre of Origin' of 30,000 – 50,000 varieties of crop plants that made the nation to rank 7th in the world for contributing to the world agriculture (Kumar & Asija, 2000). Not only the angiosperms but plenty of Algae, Fungi, Bacteria, Lichens, Bryophytes and Pteridophytes have been enumerated (Anonymous, 1996). Flora of India is renowned for its high degree of endemism (Chatterjee, 1940, 1962; Nayer, 1980; Rao, 1994; Ahmedulla, 2000; Sharma, 2000; Mao *et al.* 2001; Bhujel & Das, 2002); about 33 % of recorded floras are endemic in the North East, Western Ghats, North-West Himalaya and the Andaman and Nicobar Islands. Number of endemic species of Indian Flora is about 6000 (Chatterjee, 1940). About 2500, 2600, 800 and 200 species are endemic in North-Eastern Region, Western Ghats and Peninsular region, North Western Himalaya and Andaman-Nicobar Islands respectively (Chatterjee, 1940, 1962; Nayar, 1980). Separation of Indian flora from neighboring countries by the great Himalayas in the North and different oceans in peninsular region led to high degree of endemism of Indian floras. Considering this high degree of endemism Takhtajan (1969) recognized this region as '*Cradle of Flowering plants'*.

1.2. FORESTS AND PLANTATIONS

1.2.1. Forests

Forests make up about 30% of the total land cover on earth and are of incredible value to life. These are stores of carbon and play large variety of important roles including climate control and watershed functioning and are the sources of innumerable raw materials that humans depend on.

1.2.1.1 Etymology

The term '*forest'* is derived from Middle English '*Foreign'* that means outside. In English it was first introduced as the word for wild land set aside for hunting. Some authorities claim that Through several stages of modification it is derived via Old French, from the late Latin phrase *forestis silva* (= outside wood) which is further derived the Latin *foris* (meaning outside). Generally, it means a growth of trees and other plants covering a large area (American Heritage Dictionary of the English Language.2011).

1.2.1.2. Definition

'Forest' has been defined in many ways and the fact reflects the diversity of forests and forest ecosystems in the world and of the diversity of human approaches to forests. So many useful definitions of "forest" exist in published form but the definition put forward by the FAO (1998) is considered as the basic one. Accordingly 'a forest is a land area of more than 0.5 ha, with a tree canopy cover of more than 10%, which is not primarily under agricultural or other specific non-forest land use' (FAO, 1998; FRA, 2000). In the case of young forests or regions where tree growth is climatically suppressed, the trees should be capable of reaching a height of 5 m *in-situ*, and of meeting the canopy cover requirement (more than 10%).

1.2.1.3. Type of forests

Different types of forests have been recognized around the world on the basis of different parameters including geography, climate, dominant vegetation, gross appearance or physiognomy and species composition. Depending on biomes forests are broadly classified into three major types - tropical forests, temperate forests and boreal forests.

Tropical forests are the ecologically most rich, occur near the equator and are most threatened due to logging and clearance for agriculture and settlement. Salient features of this forest biome are - multi-layered continuous Canopy that allow little light to penetrate, highly diversified flora, about 100 different tree species per square km, 25 – 35 m tall trees with buttressed trunks and shallow roots and mostly evergreen and presence of epiphytes (including orchids and bromeliads), vines, ferns, mosses and palms. This type of forests is further classified into different sub types like tropical rainforests, dry coastal forests, montane cloud forests and semi-arid savannah woodlands. (http://www.fs.fed.us/global/ lzone/student/ tropical.htm).

Temperate forests occur in eastern North America, north eastern Asia, and western and central Europe. Well-defined seasons with a distinct cold winter characterize this forest biome. Due to the shorter growing season temperate forests regenerate more slowly than tropical forests thus only scattered remnants of original temperate forests remain.

This type of forest biome is characterized by evenly distributed precipitation (75 – 150 cm) throughout the year, about 10°C average temperature, mild Summer (21°C) and sub zero winter temperature, litter rich fertile soil, moderately dense canopy that allows light to penetrate, well-developed and richly diversified under storey vegetation and occurrences of only 3 – 4 tree species per sq km. Moist conifer and evergreen broad-leaved forests, Dry conifer forests, Mediterranean forests, Temperate coniferous and Temperate broad-leaved rainforests are the major type of Temperate forests determined mainly by seasonal distribution of rainfall (www.eco-portal.com/ Forests/ Forest_Types/ Temperate_Forests/ welcome. asp).

Boreal forests, alternatively also known as taiga, represent the largest terrestrial biome and found in northern areas with shorter, warm summers and long winters. These are mostly found in Europe, Asia, Siberia, and North America. Plant life in the boreal forest is sturdy due to stunted growth in low temperature, consisting mainly of evergreen and other resilient vegetation. Generally the Boreal forests occur between latitudes of 50 and 60 degrees north and thus named so as boreal means northern. The forests consist of mostly evergreen conifers – pine, fir and spruce and some deciduous genera such as birch and poplar (http://www.ucmp.berkeley.edu/glossary/gloss5/biome/forests.html #boreal).

Depending on logging, forests are classified as primary and secondary forests. *A primary forest* is a type of forest that has never been logged and has developed following natural disturbances and under natural processes, regardless of its age. Whereas, *secondary forests* are vegetation that have been logged and recovered naturally or artificially into a forested structure. In Europe, both primary and secondary forests has different connotation and refers to an area of forest land which has probably been continuously wooded at least throughout the historical times and it has not been completely cleared or converted to another land use type for any period of time. While a forest land which has come across a period of complete clearance by humans with or without a period of conversion to another land use is regarded as secondary forest.

1.2.2. Natural Forests

Forests are either directly affected by human activities such as cutting, planting and drainage, or indirectly by manipulation of the grazing regime, air pollution and other factors and very little untouched forest is left in the world. This is happening almost in every corner of the planet and is directly or indirectly influenced by human activities.

In the Temperate and Boreal Forest Resources Assessment (TBFRA)-2000, UN-Economic Commission for Europe and FAO on the basis of human intervention characterized forests and other wooded land as *natural forests* (undisturbed by man), *semi-natural forests* (under some degree of management, past human intervention) and *plantation forests* [forests under active management] (Kirby *et al.* 1984).

Natural forest is a forest which has spontaneously generated itself on the location and which consists of naturally immigrant tree species. This type of forest can be more or less influenced by culture, e.g. by logging or regeneration techniques, but the forests must not have been subject to regeneration by sowing or planting (The National Forest and Nature Agency, 1994 & http://www.geus.dk/departments/environ-hist-climate).

The World Resources Institute (WRI) coined the term "frontier forests" to describe forested areas that are relatively undisturbed by human activity and are large enough to maintain their biodiversity, including viable populations of wide-ranging species. Frontier forests constitute about 40% of total forest area (WRI, 1997; http://www.wri.org/wri/ffi/).

Land that has either a crown cover of 5 to10 percent of trees which are able to reach a height of 5 m at maturity; or a crown cover of more than 10 percent of trees not able to reach a height of 5 m at maturity; or with shrub or bush cover of more than 10 percent is called *Other Wooded Land*.

Another type of forest is *social forests* what is defined in Ninth Commonwealth Forestry Congresses as forest which aims at producing flow of protection and recreation benefits for community (Tiwari, 1983). Social forestry program is recommended by the National Commission on Agriculture (NCA, 1976) and the main task assigned to it is to meet the community requirements.

1.2.3. Plantation or Plantation Forests

Generally the term plantation is used as an abbreviation for Plantation forest (i.e. Planted forest) and/or Forest Plantation. Plantations cover 5 % of global forests and supply about 35 % of the world's round-wood (FAO, 2010a). They may also play an important role in alleviating pressure on natural forests for timber and fuel wood production.

1.2.3.1. Definition

The term, *plantation* is informal and not defined precisely. Generally it means a long artificially established forest, farm or estate, where crops are grown. According to Collins English Dictionary (1991) plantation means '*an estate, especially in tropical countries, where cash crops such as rubber, oil palm, etc. are grown on a large scale'*.

A *plantation forest* or *forest plantations* are afforested land or a secondary forest established by planting or direct seeding. A gradient exists among plantation forests from even-aged, single species monocultures of exotic species with a fiber production objective to mixed species, native to the site with both fiber and biodiversity objectives. These gradients also reflect the capability of the plantation forest to maintain "normal" local biological diversity. ASFR (2003) has defined the term plantation as 'intensively managed stands of trees of either native or exotic species created by the regular placement of seedlings or seeds (http://worldforestry.blogspot.in/2008/06/australias-state-of-forests-report-2003.html)'. Plantation forest is usually easily distinguished from natural forests by the trees planted in straight lines. It is can be monoculture or polyculture over a large area and does not include extensive naturally occurring stands of plants that have economic value. But another different view is there, regarding the use of these two terms, which distinguished them on the basis of the existing stand and the degree of planting.

Food and Agricultural Organization of United Nations has recently revisited the definition of "planted forests" and "plantation forests" (FAO, 2005). Accordingly Planted forest means *'forest stand in which trees have predominantly been established by planting, deliberate seeding or coppicing, where the coppicing is of previously planted trees (this includes all stands established by planting or seeding of both native and non native species)'* and '*Forest Plantation'* means the Forest stand in which trees have been established by planting or/and deliberate seeding or coppicing (where the coppicing is of previously planted trees) with either native species or non-native species that meet all the following criteria: (i) one or two or a few species, (ii) even-aged, and (iii) regular spacing (FAO, 2005; Kanowski *et al.* 2005). Plantation forests or planted forests are even-aged stands of a single or a mixture of tree species established primarily for wood production, land restoration, fuel-wood or amenity or other purposes.

1.2.3.2. Objectives of Plantation

Plantations are established for a variety of reasons. Primary objectives of almost all plantations are the production of large quantities of wood and fiber like timber and paper production (Lindenmayer *et al.* 2003). Social and environmental objectives are considered as secondary objectives, especially in the projects funded by Govt. or other developmental agencies (FAO, 1992; Evans, 1992). Now-a-days, plantation and forest management are increasingly becoming an integral part of biodiversity conservation (Eyecott *et al.* 2006) along with its role in delivering a range of products and benefits like sawn timber production, wood fiber and other wood based products, shelterbelts for animals and crops, the provision of multiple environmental benefits through addressing land degradation, salinity and soil erosion, generation of biomass, storage of carbon etc (http://www.ffic.com.au/plantations). Some industrial plantation are grown for non-timber forests products such as gum, resins, oils, etc. Community forests are raised for extraction of fuel-wood, fodder, fruit and other non-forest products as well as protection to water, soil resources and for restoration benefits (Parrota *et al.* 1997).

Sawyer (1993) has mentioned following reasons for establishing plantations:

1. Compensation for lack of resources from natural forests due to deforestation
2. Fulfilling demands for lumber, pulp, and paper products
3. To meet demand for high quality species
4. To develop export market
5. To restore degraded sites and protect watersheds
6. To provide domestic uses like firewood, posts and home fences
7. To protect the genetic diversity of forests species *ex situ*
8. To produce desired species that fails to regenerate naturally
9. To supply potential markets for carbon sequestration and
10. To provide forests uses on previously unproductive sites when natural forests are not accessible.

The purpose of fast-wood plantation differs from that of plantation and is to produce large volume of small diameter logs at competitive prices as quick as possible as raw material for pulping and paper industries (Huy, 2004).

In 2000, plantations which covers 5 % of global forest, supplied about 35 % of the world's round-wood (FAO, 2010). Pine, spruce, eucalyptus, poplar, teak, Sal etc. are widely planted far beyond their natural range because of their fast growth rate, tolerance of rich or degraded agricultural land and potential to produce large volumes of raw material for industrial use. Though in ecological terms, plantations are always young forests and lack the type of growth, soil or wildlife typical of old-growth natural forest ecosystems, some crucial component of natural forest ecosystems like decaying dead wood etc. are missing. However, they can be managed in different ways to enhance their role in biodiversity protection and may provide some kind of ecosystem services like maintenance of nutrient capital, protection of watersheds and soil structure as well as storage of carbon. They may also play an important role in alleviating pressure on natural forests for timber and fuel wood production.

1.2.3.3. Type of plantation

The *Global Forest Resource Assessment, 2000* by Food and Agricultural Organization of United Nations recognizes three broad categories of plantations: (i) ***Industrial plantations***, which produce wood or fiber to supply wood-processing industries and charcoal for industrial use; (ii) ***Non-industrial plantations***, which produce fuel-wood for domestic use, or are established to protect soil and water resources; and (iii) **Plantations whose purpose and end products are unspecified**. Fast-wood plantations are industrial plantations (FAO, 2001). However, FAO’s figures make no distinction between fast-wood and other types of industrial plantations. Generally, the Industrial plantations are fast-wood plantations and found in Brazil, Indonesia, China, India, South Africa, Thailand, Vietnam, Malaysia, Venezuela, Swaziland, Chile, Portugal, Spain, Argentina, Uruguay, South Africa and Australia (Evans, 1992).

Sometimes plantations may be divided into some other types: Industrial plantations, farm or home plantations, environmental plantations, high value food crops, fishing plantations etc. *Industrial plantations* which are usually even-aged and often consist of just one or two species are established to produce a high volume of wood in a short period of time. Plantations which are grown by state forestry authorities and/or the paper and wood industries and other private landowners, have replaced the natural forest in southern and southeastern Asia (Cossalter & Pye-Smith, 2003). These species can be exotic or indigenous. The plants used for the plantation are often genetically altered for desired traits such as growth and resistance to pests and diseases in general and some other desired specific traits. Wood production on a tree plantation is generally higher than that of natural forests.

Farm or *Home Plantations* are typically established for the production of timber and fire wood for domestic use and sometimes for sale and the management may be less. But it is difficult to distinguish the farm plantation from naturally regenerated forest.

Environmental plantations are established for environmental protection such as watershed or soil protection, erosion control, landslide stabilization and windbreaks etc. They are raised to foster native species and promote forest regeneration on degraded lands as a tool of environmental restoration.

High-yield, intensively managed, short rotation plantations are called *fast-wood plantations* or fiber farms and often managed on a short-rotation basis and are becoming more widespread in South America, Asia and other areas.

Depending upon the tree species used for planting, plantation forests are of two types – *Exotic species plantation* and *Native species plantation.* Exotic species plantations are Intensively managed forests with > 30% canopy cover, which have been planted by people with species not naturally occurring in that country. Native species plantations are Intensively managed forests with > 30% canopy cover, which have been planted by people with species that occur naturally in that country.

Again on the basis of number(s) of plant species used plantation may be of *Monoculture* and *Polyculture* or *mixed plantation*. In case of monoculture plantation only one species is selected to be planted whereas a number of plant species are used in ploycutlural or mixed plantations which is now preferred over the single species plantation forests.

Plantation which are intensively managed for commercial purpose, set in blocks of a single species, which produce industrial round wood at high growth rate (mean annual increment of no less than $15m^3$/ha) and which are harvested in less than 20 year rotation is known as Fast-wood plantation (Cossalter & Pye-Smith, 2003). This type of plantation is nothing but a type of monocultural and industrial plantation.

A large number of species are used for raising plantation and their selection is based on the locality, objectives and type of plantations. These are *Tectona grandis, Casuarina equisetifolia, Dalbergia sissoo, Gmelina arborea, Swietenia macrophylla, Terminalia* spp., *Eucalyptus* spp., *Pinus* spp., *Acacia* spp. and others. Among these some widely used ones in tropical countries are *Eucalyptus* spp., some species of *Pinus, Tectona grandis, Acacia* spp. etc.

1.2.3.4. History of plantation

The practice of planting trees goes back to ancient times (Cossalter & Pye-Smith, 2003) but planting tree as a means of regenerating forests and afforesting bare land is relatively recent. The nineteenth century witnessed a little bit of plantation establishments but tree planting began in earnest in the first half of the 20th century in Western Europe, the United States, Australia, New Zealand, South Africa and a small number of developing countries such as India, Chile, Indonesia and Brazil (Evans, 1992).

Since 1950s establishment of plantations attained an ever increasing extent in the tropics and subtropics and during this period Japan, Korea and China embarked on massive reforestation programs. The 1960s witnessed the launching of large-scale plantation programs in many tropical and subtropical countries, and between 1965 and 1980 the area devoted to tropical plantations became triple (Cossalter & Pye-Smith, 2003).

According to the *Global Forest Resource Assessment 2002*, conducted by FAO, the global Plantation estate increased from 17.8 million hectares in 1980 to 43.6 million hectares in 1990 and 187 million hectares in 2000 (FAO, 2001). A third of today's plantations are found in the tropics and two thirds in temperate and boreal zones. China, United States, the Russian Federation, India and Japan each possessing over 10 million hectares of plantations and are accounts for 65 % of the world's plantations. The FAO assessment estimates the global rate of new planting at 4.5 million hectares a year, with Asia accounting for 79 % and South America 11 %. However, there is significant increase of plantations established for industrial purposes between 1991 and 2000.

Since its initiation, plantations are replacing natural forests very fast. According to FAO (2001) about 7 % of the natural dense forests getting lost in the tropics due to the conversion of land into plantations and the remaining 93% of the land is being converted to agriculture and other human settlements. There are more than one million hectares of recently established eucalypt plantations in southern China (Xu *et al.* 2000).

1.2.3.5. Present scenario of Plantation

Plantations cover wide parts of the earth's surface and in 2000 it was about 187 million hectares (FAO, 2000), which is now greatly exceeds that of the native natural forests and the process is progressing at high rate all over the globe. This is much more prominent in some European countries (French *et al.* 2008) and about 70 % of the total forest area in United Kingdom is Plantation (FAO, 2006).

At the beginning of the twenty-first century forest plantation amounted to about 5% of global forest cover. Fast-wood plantations are high-yielding, intensively managed, rotate in short duration and are becoming widely popular in South America, Asia and other areas.

Teak is a widely planted hardwood species in warm areas having extremely high commercial demand and some other important and potential species include *Eucalyptus* spp., *Acacia* spp., *Casuarina equisetifolia*, *Dalbergia sissoo, Gmelina arborea, Swietenia macrophylla, Terminalia* spp., etc.

Table 1.2. Different sub-regions of Teak plantation all over the globe in Million Hectare [mha]

Sub-region	Net area of teak plantation [mha]		Sub-region	Net area of teak plantation [mha]
West Sahelian Africa	4.02		Insular Southeast Asia	706.01
East Sahelian Africa	14.85		Tropical Asia	2,107.89
Moist West Africa	87.88		Tropical Oceania	3.03
Southern Africa	2.8		Central America	22.29
Tropical Africa	109.55		Caribbean	8.06
South Asia	1,099.60		Tropical South America	2.72
Continental Southeast Asia	302.28		Tropical America	33.07

1.2.3.6. Plantation in Indian sub-continent

India is one of the ten most forest-rich countries of the World along with the Russian Federation, Brazil, Canada, USA, China, Democratic Republic of the Congo, Australia, Indonesia and Sudan. India's forest cover grew at 0.22% annually during 1990 – 2000 and at 0.46 % per year during 2000 – 2010 (www.en.wikipedia. org/wiki/forestry _in_india). India's forest cover has increased from 68 mha (24% of the total area of the country) to 69.8 mha in 2012 (FSI, 2013).

Booth & Nambiar (2000) traced the scenario in Kerala, where there were rich forests and abundant supply of tropical timber, and which supported a major inter-state timber trade. But, deforestation has brought this to an arrest. Though the uses of timber for house construction have decreased due prohibitive price and scarcity, current use is estimated to be 2.6 to 3.0 million m^3 for a population of more than 29 million.

Table 1.3. Estimated net plantation area of major plantation species in 1995

Plantation Species	Area in Hectare	Tropical Plantations (%)
Eucalyptus spp.	9,949,588	17.7
Acacia spp.	3,904,307	7
Tectona grandis	2,246,559	4
Casuarina spp.	787,200	1.4
Dalbergia sissoo	626,020	1.1
Gmelina arborea	418,050	0.7
Swietenia macrophylla	151,214	0.3
Terminalia spp.	303,957	0.5

India is the world's largest grower of *Eucalyptus* spp. They occupy 4.8 million ha (Davidson, 1995) and represent about 25 % of the country's plantation estates. Because natural forests cannot be harvested in India, plantations of various tree species are becoming increasingly important for the supply of forest products including industrial timber and domestic firewood.

1.3. IMPACT OF PLANTATION FORESTS ON BIODIVERSITY: MYTHS AND THE REALITY

Biodiversity refers to the variety and variability of all the biological organisms at their species, genetic and ecosystem levels and plantations or plantation forests, irrespective of their types and objectives, are an important part of the ecosystem and environment of that particular area where they are established. Thus plantation forests become a component of biodiversity of that area as the natural forests are. In other words biodiversity include plantations raised at the same locality, if any, and there must be a relationship between them. The inter relationship of plantation forests and biodiversity is quite complex and that become more complex when the issue of the effects of plantation forests over the biodiversity is considered.

Plantation affects biodiversity and environment both ways, direct and indirect. Rapidly growing interest in developing plantation forests is one of the most important reasons of replacing and clearing of environment friendly natural forests, which positively impacts physical and biological environment as well as the biodiversity of the area.

Rapidly growing plantation forests have been accompanied by increased concerns about the potential environmental impacts. The concern also focus on the potential loss of soil fertility and productivity in case of short harvest rotations, risks associated with introducing exotic elements and catastrophic pest infestations. Developing monoculture plantations and the implications of replacing natural forests and associated flora and fauna lead to the formation of vegetation which became biologically very less diverse (Bowyer, 2006).

In question of impact of plantations on biodiversity, all the environmentalists, sponsors and others who are concern with the plantation forests, biodiversity and its conservation, get separated into two groups. One group holds the opinion that plantation forests enhances or favours biodiversity whereas the second lot opposes the first group of thinkers.

Questions have been raised over the environmental effects of plantation forests as significant difference has been found between the plantations and natural forest regarding tree species composition, stand structure and rotation length etc. (French *et al.* 2008.) and some large environmental organizations are running serious anti-plantation campaign, like the *Rainforest Action Network* and *Greenpeace*.

Generally exotic species are used for raising plantation as they return superior yield, are tolerant to native pests, better adapted over native trees for their wider ecological amplitude and capacity to access the resources easily (Harrison *et al.* 2000). There is a common belief that the managed forests negatively influence the biodiversity. Some argue that monocultures prevent understorey vegetation growth thereby resulting decreased biodiversity and soil fertility (Poore & Fries, 1985; Abbasi & Vinithan, 1997).

The widely held view among the ecologists is that plantation forests are on average, less favourable as habitat for a wide range of taxa, particularly in case of even aged single species stands involving exotic species (Hunter, 1999; Hartley, 2002) and are harmful to the environment and have a reputation for being “Biological deserts” (Allen *et al.* 1995; Dyck, 1997; Hartman *et al.* 2010).

The replacement of natural forest with tree plantations has caused several social problems along with environmental hazards and that made them controversial. Plantations which are established for the production of fiber provide much narrower range of services for the local forest-dependent people. Many ecologists raised objections on exotic plantation as they generally consume native species, infect native species with diseases and drastically change the functioning of ecosystem (Vitousek *et al.* 1997; Wilcove *et al.* 1998) and are thought to be one of the serious causes of species declines and habitat degradation (Antonio & Meyerson, 2002). Much of the opposition to *fast wood plantations* is based on the belief that they have high damaging impact on the environment. They are seen as threats to Biodiversity, to water resources and to soil fertility. Many environmental groups also fear that genetically modified tree plantation will lead to many other serious problems in future and will be responsible for spreading of pests and diseases (Huy, 2004).

Some argue that monoculture exhaust soil water and nutrient resources, prevent under-storey growth, decrease biodiversity, causes soil erosion and loss of fertility (Shiva *et al.* 1982), hamper nutrient cycle of the surface soil, breaks out diseases and pathogens and lead to ecological imbalances.

Comparison of vegetation of ground layer in plantation with that of natural vegetation reveals that the former one is more even than the later. Overall richness and density of plants at ground layer in the natural forests is higher compared to plantations (Das & Lahiri, 1997; Tripathi & Singh, 2009) and that may be an indication of reducing biodiversity by plantation.

Plantation of exotic species may cause catastrophic outbreak of pests and diseases leading to huge loss (Nair, 2001). Plantations, particularly monocultures, are at much greater risk of catastrophic losses than natural forests. The introduction of exotics tends to alter natural balances that serve to keep pathogenic organisms in check in ecosystems (Nair, 2001). Pure Teak plantations are susceptible to defoliating pests, particularly when under storey growth is suppressed and site conditions are suboptimal (Chaiglom, 1990). The dhupi (*Cryptomeria japonica*) plantations in Darjiling Hills caused serious damage to local biodiversity as the dark forest floor is completely unsuitable for the growth and survival of local species of plants, animals and microbes (Das & Lahiri, 1997).

Concerns about the impact of plantations on soil moisture and water yield are mostly related to the depletion of soil moisture that reduces the stream flow. Establishment of plantation on grassland sometimes diminishes flow of local streams with the formation of close canopy, particularly during dry seasons, due to the interception and re-evaporation of rainfall at the crown level. Certain species like eucalyptus which account for as much as 25 % of the plantation area worldwide – may use far more water than species that occur in natural forests, drawing down the water table in some localities. In the Pampas grasslands of Argentina the brackish groundwater lies under shallow freshwater lenses that provide drinking water and when grasslands had been converted to forest plantations the freshwater lenses were eliminated (Werth & Avissar, 2005).

Intensively managed plantation led to soil compaction, erosion, and degradation of physical, chemical and nutritional properties of soil (Wigley & Roberts, 1997). Plantations tend to be kept in an early successional stage, with maximum removal of biomass from the site at harvest and are said to be less efficient for trapping released nutrients, as fewer roots exists near the surface. The ultimate result is significant nutrient loss over the harvested areas.

The result of the increased deforestation directly and indirectly caused by the banana plantation has impacted the physical and biological environments in Costa Rica. About 75 % of all diversity is held within the tropical forests (Panayotou & Ashton, 1992). The destruction of tropical rainforest habitat results in the loss of numerous species of plants and animals. In the Sarapiqui Valley of Costa Rica, expansion of banana plantation has resulted in the near extinction of 18 known tree species (Mara, 1998). Sometimes maintenance of high yields requires frequent and intense applications of agrochemicals- fertilizers, herbicides, nematicides, etc. The intensive use of chemicals the local environment has been heavily contaminated (Astorga, 1998). In different parts of the world, aquifers that supply water to that region is heavily contaminated by different pesticides; many of those are used in nearby plantations (Wheat, 1996).

Plantations necessarily have vastly lower biodiversity than surrounding native forests and other type of vegetation due to high stocking density and lack of structural diversity. Being wide in species diversity and more heterogeneous in composition of species natural forest in comparison to plantations provides suitable habitat and forage for the large herbivores. On the other side plantations are unable to provide suitable habitat and forage for the local wild animals (Tripathi & Singh, 2009). Some plantation trees, such as pines and eucalyptus, can be at high risk of fire damage because their leaf oils and bark resins which are highly flammable and become explosive under some conditions.

Contrary to this, some studies have found that fast growing tree plantation favours regeneration of under growth plants from surrounding forests, increases fertility, and biodiversity and help in artificial regeneration and rehabilitation (Harrington & Ewel, 1997; Loumeto & Huttel, 1997; Thapa *et al.* 2011)

Recent studies (Parrotta, 1995; Otsoma, 2000; Viisteensari *et al.* 2000) have shown that they can help in enhancing the recruitment, establishment and succession of native woody species by functioning as foster ecosystem, as they stabilizes the soil and create conditions favourable for native animals and plants to re-colonize (Yirdaw, 2002; Rawat *et al.* 2009). Some considered that exotics too have some beneficial effects on biodiversity (Lugo, 1997; Hartmann *et al*. 2010).

Plantations protect vegetation against soil erosion and man-made fires and also may serve to rehabilitate ecosystem properties when natives are not capable of recolonizing immediately. Their high growth rate and productivity is likely to replenish environmental condition that can improve the conditions for re-establishment of native flora (Martinez, 2007). In some semi arid zones where anthropogenic disturbances have destroyed almost all the natural forests, plantation forests can be very fruitful in reviving the biodiversity of indigenous flora (Rawat *et al.* 2009).

Using of small number of fast-growing short-lived tree species which are equivalent to early successional pioneer species, which will create a canopy that shade out grasses and other weeds, and diminish the fire hazard. Not only has that it facilitated colonization of the site by a wider range of species from nearby intact forests (ITTO, 2002; Elliott et al. 2003; Lamb et al. 2005).

The tree species used in a plantation is an important factor while detecting the impact of plantation forests. Where non-native varieties or species are grown, few of the native fauna are adapted to exploit these that lead to further loss of biodiversity. However, even non-native tree species may serve as corridors for wildlife and act as buffer for native forests, reducing edge effect.

Plantations may be used successfully to keep saline groundwater below crop rooting zones and in many countries plantations are being used to dry waterlogged soils and alleviate flooding (Werth & Avissar, 2005).

In the Kyoto Protocol, there are proposals encouraging the use of plantations to reduce carbon dioxide levels but this idea is being challenged by some groups on the grounds that the sequestered CO_2 is eventually released after harvest.

Managed forests sometimes favours regeneration of native species e.g. *Ficus benghalensis, Ficus semicordata, Madhuca longifolia, Toona ciliata* and *Ziziphus* *rugosa* seemed to have regenerated well in managed forests in Katerniaghat Wildlife Sanctuary in Northern India which were not found in natural forest. In commercial plantations species of early successional stages could be promoted and enhances the overall biodiversity at landscape level (Tripathi & Singh, 2009).

If a plantation is established on abandoned agricultural land, or highly degraded land, it can result in the improvement of both habitat and biodiversity. A planted forest can be profitably established on lands that will not support agriculture or suffer from lack of natural regeneration.

Many have suggested that plantation development will take pressure off natural forests by reducing or eliminating the need for harvesting within them. In principle this is true because due to the high productivity of plantations less land is needed. Many point to the example of New Zealand, where 19 % of the forest area provides 99 % of the supply of industrial round wood. It has been estimated that the world needs for fiber could be met by just 5 % of the plantation forest (Sedjo & Botkin, 1997). However, there is considerable disagreement on this point.

An afflicted plantation can in some cases be cleared of pest species cheaply through the use of a prescribed burn, which kills all lesser plants but does not significantly harm the mature trees (Lamb *et al.* 2005).

But, another group of researchers have noted that exotics face lower risks than native species, since introduction of a species into a region that is outside of its natural range separates that species from its natural pests and can thus improve health and performance, at least in the short term.

Though there are large number of environmental concerns and problems associated with the establishment and management of some forest plantations, the benefits of plantations of rapidly growing trees are so significant that further development of forest plantations is virtually assured (FAO, 2007). Ecological impact of plantation forest is very much specific to the site where the plantation is to be established or already established. If planted forests replace natural forest a reduction in biodiversity and loss of habitat will likely result (Hartmann *et al.* 2010). A group of workers assures that forest plantations operate sustainably in every sense of the word, and they provide the greatest possible array of benefits. It is necessary to take steps to address known problem areas and concerns, and international forest policy needs to be developed to counter current efforts to leave vast areas of natural forests in a non-managed state (Hunter, 1999).

The Proposed Work

The present work was proposed to trace the impacts of plantation forests on plant diversity of Terai-Duars belt of West Bengal. Terai-Duars belt of West Bengal is a part of the Terai Arch Landscape in Northern India which extends over a large area eastward from the Yamuna River across Himachal Pradesh, Haryana, Uttaranchal, Uttar Pradesh, Bihar, West Bengal, Bangladesh, Bhutan and Assam and east to the Brahmaputra River. The entire belt is lying at foot of the Himalayas and is contiguous with the IUCN recognized Himalaya Biodiversity Hotspot. The marshy tract of dense vegetation shares innumerable important floral elements with the *Himalayan hotspot* and are extremely rich in biodiversity (Das, 1995, 1996, 2004). In drawing attention of biologists, environmentalists and plant explorer the Terai-Duars belt stands second to the Darjeeling Himalaya which in turn is an important segment of *Eastern Himalaya Hotspot*. Thus the area is important enough to the botanist, environmentalist and foresters and the peoples who are involved with forests and plantations from the view point of biodiversity especially, the phyto-diversity. Conducive and variable environments in this belt harbours a widely diverse flora and fauna and favours their evolution, migration from adjoining areas through corridors, and adaptive radiation of species in new ecological niche (Ahmedulla, 2000; Rai, 2006).

2.1. IMPORTANCE OF THE PRESENT WORK

Before the establishment of human settlement almost the entire tract was wrapped with dense forests. But rapid development of hilly Darjeeling town after the historical visit of Capt. Lloyd and Mr. Grant in 1827, introduction of Tea cultivation in Terai and Duars region and it rapid expansion started eliminating the dense vegetation (Ghosh, 2006; Ghosh & Das, 2007). Not only that the Dhupi [*Cryptomeria japonica* (Thunb. *ex* L.f.) D. Don] plantation in Darjeeling for supplying wood for tea packing boxes, indirectly affected the vegetation of Terai.

A large number of tribal people from different region were brought to the Terai-Duars region to supply with the Tea worker and labours in other developmental activities. Population of this region started increasing in a very high rate, dense and virgin forest were cleared for housing and farming land, building materials and fuel woods. In one side pressure from rapidly growing population and their needs and on the other hand construction of roads, rails and expansion of tea gardens began to fragment the vegetation and posed threats to the phytodiversity of this area (Das, 2004; Rai, 2006).

In Terai region, at Siliguri on the bank of river Mahananda, a giant sawmill was established for shaping up large Sal trees into railways sleepers and that had encouraged slaughtering of millions of Sal and other trees and ultimately wiping out of large extents of greenery.

In 1862 and 1874 tea plantation was spread out in Terai and Duars respectively, which was first initiated in 1835 in Lebong. Vigorously growing tea gardens started replacing characteristic forests, grassland, herbs land, scrubs and other types of landform that apparently appeared to be valueless (Ghosh *et al.* 2004). In addition to this in 6^{th} (1965-66 to 1974-75) and 7^{th} (1975-76 to 1984-85) working plan of Forest Department converted vast extents of natural vegetation in Duars into teak plantation for eradication of herbs and shrubs (Das, 2004). To face the demands for fuel woods of tea gardens and wood based industries a huge area was also converted into wet mixed type of forest by planting different types of trees in mixed (Sarkar, 2014).

With the rapid decline of forest cover in Terai and Duars region, mainly with the Governmental initiatives, plantations of some selected species have been raised over wide areas in different times. Majority of these plantations are monocultural or with few species only. Most of the species used for plantation are commercially viable, tree in habit, many exotics, and form dense and continuous canopy within three to five years. None of these features, in fact, is in favour of the reclamation of natural vegetation and thereby do not support the conservation activities.

Thus along with the multiple factors posing threats simultaneously to this unique vegetation and forests of this area, different types of plantations of both native and non-native species, and mono-cultural or mixed, supposed to have some effects on phyto-diversity and environments of Terai-Duars region. One the other hand in question of influence of plantation in biodiversity, the whole universe is segregated into two groups- one in favour of plantation and the other against it. Plantations are being addressed as “Biological Dessert” and some large environmental organizations are running an anti-plantation campaign, like the Rainforest Action Network and Greenpeace.

At the same times there is no any of the systematic study to understand the effects and/or performances of such artificial vegetation, apart from the economic gains and floristic aspects (Gamble, 1875, 1878; Prain, 1903; Burkill, 1916; Cowan & Cowan, 1929; Cowan, 1929a; & Biswas, 1956, 1966) in the conservation of biodiversity. However, Shebbeare (1961) worked on ‘Taungyan’ plantation in Nothern Bengal and Ghosh (2006) studied some aspects of tea plantation in North Bengal. Recently Sarkar *et al.* (2010a,b), Sarkar & Das (2010) and Sarkar (2011) explored the ethnobotanical aspects of Duars whereas Saha *et al.* (2013) has estimated the medicinal plants of this area.

On the other hand it is important to understand that the study area is situated at the foot of "Himalaya Hotspot" recognized by IUCN and very rich in biodiversity. No data is available regarding the similarities and differences in the vegetation structure and the role playing by plantation in the conservation of area's biodiversity.

Thus the present study is important enough to gather some information on plantations and natural vegetations of Terai-Duars belt, their comparative accounts and the actual impacts of plantation forests on the natural vegetation and the phyto-diversity as well as its role in conservation of biodiversity of the study area.

2.2. DIFFERENT ASPECTS OF THE WORK

The present study attempts to determine the influences and/or impacts of different type of plantation forests on plant diversity of the Terai-Duars belt of West Bengal which is represented by the natural vegetation of this area. This will be performed by comparing different type of plantation forests like mono-cultural plantation, mixed plantation, plantation of exotic species and that of native ones, with natural vegetation located at the same ecological zone. Here natural vegetation will be treated as standard land use pattern of this area. They will be compared on the basis of following aspect:

1. Vegetation structure and Phytosociology
2. Different diversity indices
3. Soil parameters
4. Above ground herbaceous biomass
5. NTFPs and Medicinal Plants
6. Traditional knowledge and ethnobotany
7. RET elements
8. Aggressive exotic weeds
9. Allelopathy

2.3. OBJECTIVES OF THE PRESENT WORK

Present dissertation aims to detect the impacts of plantation forests on natural vegetation that represents the existing phyto-diversity of this area along with the attempt to understand some others aspects of plantation and natural vegetation. The objectives of the study are outlined as follows:

- Determination of impact of plantation forests on natural vegetation
- Determination of vegetation structure, species richness, diversity pattern etc. of plantation and natural vegetation

- Recognition of Rare, Endemic and Threatened plants
- To analyze the changes in soil characteristics in plantation and compare with natural vegetation
- To invent and record the NTFP potential and ethnobotanical importance
- Survey and recording of ethnobotanical knowledge of the tribal people living in and adjoining area
- Determination of impact of aggressive exotic plant species over the local flora and vegetation
- Determination of allelopathic effects of plantation species on some important elements

Along with the above mentioned objectives regeneration status of trees, determination of soil seed bank, occurrences of exotic weeds and their impacts and detection of effect of plantation on above ground herbaceous biomass productivity will be measured.

It is expected that the properly collected and processed data will provide us further data on natural vegetation and on plantation forest for first time. It will help us to understand the impacts of plantation on plant diversity of this area along with the followings:

- The vegetation structure and species composition of the plantation as well as the natural forests will be clearly understood
- Further data on Non Timber Forest Produces (NTFPs) from both the natural vegetation and plantations will be recorded.
- Traditional Knowledge system related to natural forests and plantation if any will be revealed and ethnobotanically important plants of this area will be recoded.
- Occurrences of any Rare Endemic and Threatened plants in plantation and natural vegetation will be traced and their population structure will be known.
- Impacts of plantation on soil parameter, if any, could be identified
- Occurrences of important medicinal plants, their uses and status will be recorded

Not only that the study will help to understand the allelopathic effects (if any) of trees used in plantation on some important and selected plants, occurrences of exotic elements and their impacts, a comparative account of the above ground herbaceous biomass production of natural forest and the plantation forests. All these parameters together will make our understanding of the impacts of plantation on biodiversity clear.

After acquiring all these information it will be easier to frame a proper strategy for conservation practice, redesigning the plantation, selection of species for plantation and improvement of habitat for RET plants.

Study Area

3.1. INTRODUCTION

Terai (or **Tarai = moist land**) refers to a belt of marshy region full of jungles situated at the foot of a hill especially at the foot of the Himalayas. The entire zone of marshy grasslands, savannas and forests at the base of the Himalayas and extending from the Yamuna River in the west to the Brahmaputra River in the east is known as Terai region and is distributed in India, Nepal and Bhutan.

On the other hand, the term 'Duars' which is derived from the word 'Doors' and means passages in both Assamese and Bengali languages. There were eighteen such passages through which the Bhutanese people used to communicate with the people living in the fertile flood plains at the foothills of the Eastern Himalaya in North-East India around Bhutan. Thus, the entire resource rich plain of West Bengal and Assam around Bhutan is known as Duars. It extends over 8,800 sq km and is divided by the Sankosh River into two parts – the eastern and the western Duars. Eastern Duars is in Assam whereas the Western Duars is included in the state of West Bengal.

3.2. LOCATION AND TOPOGRAPHY

Terai - Duars belt of West Bengal is the Sub-Himalayan or foot hills region of the Indian state that extends from Nepal to Assam. Geographically this area is located from 26°16′00" N to 27°00′00" N latitudes and from 87°59′30" E to 89°53′00" E Longitudes and bordered by Hilly region of Darjeeling district and Bhutan to the North and by Cooch Behar, North Dinajpur and Bangladesh to the South.

It consists of Jalpaiguri and Alipurduar districts, Siliguri sub-division and southern part of Kurseong sub-division of Darjeeling district. Sometimes Terai and Duars are used synonymously for this entire low-lying moist belt at the foot of majestic Himalayas. But the part of this belt consisting of entire Siliguri sub-division, southern and lower part of Kurseong sub-division and a small part of Jalpaiguri district lying west to the river Tista is known as Terai whereas the eastern part of Tista composed of remaining portion of Jalpaiguri and entire Alipurduar District is known as Duars.

The Bhabar, a forested belt of rock, gravel, and soil eroded from the Himalayas with deep seated (from 5 to 37 meters deep) water table is lies above the Terai belt. Below the Terai lies the great Upper Gangetic plain. Botanically, it is defined as the region of forest trees and the average altitude of the Terai ranges from 90 —100 m.

Duars is divided into two distinct types of land forms - plains and undulated areas. The land of Jalpaiguri district is bounded by the piedmont plains which gradually graded into the alluvial plains in further south (Mohanta, 2004). On the other hand, Alipurduar district appears quite hilly. The topography of Terai region is uneven and the altitude ranges from 62 to 350 m, whereas that of Duars ranges from 90 to 1750 m.

3.3. GEOLOGY AND SOIL

Mallet (1874) has made an excellent account of geology of the foothills along with the Sub-Himalayan areas. All along the foothills of the Darjeeling District the Siwaliks are steeply overthrust by Damudas formation (Lower Gondwanas). Damudas are coal-bearing rocks of Gondwana age and here it appears as an inverted section, highly tectonized and differs from Damudas of Peninsular India (Rai, 2006). Upper part of Duars mainly consists of Siwaliks and older Quaternary formation dominated by thick boulders and conglomerate horizons and the lower portion appears as a fluvial terrace deposit.

Soil of this marshy Sub-Himalayan belt consists of almost horizontal layers of unconsolidated sand, silt, pebbles and gravels (Ghosh, 2006). Jana (1997) described the soils of this zone as alternating bed of sand of different sizes, gravels and boulders. Soil is porous, deep, light textured, with moderate organic matter and low Phosphate, Potassium, and micronutrient contents (Bhattacharjee, 2001). The pH of the soil is acidic as leaching of the bases takes place from the surface of the soil to low horizon due to heavy rain (Rai, 2006). The Duars soil is of light texture and alluvial in nature. It is defined as sandy loam to loamy sand and has high permeability and porosity. This type of soil is the product of weathering of fluvial clastics. Soil of the basin between Jaldhaka and Tista is composed of hard black clay and that in the northern upland of Duars is ferruginous clay. Chakraborty *et al.* (2002) discussed the variability of Duars soils. He characterized the soil of the northern Duars as clay loam and sandy loam. Whereas, in the southern part of Duars the soil type is less varied consisting of light friable load. Variability in the depth of soil is an important geological feature in southern Duars (Das, 2000)

3.4. DRAINAGE SYSTEM

The Terai-Duars belt of West Bengal is criss-crossed by a large number of the monsoon-swollen Himalayan Rivers, rivulets and streams. Main rivers of Terai are Mahananda, Balason and Mechi. Tista is the major river in Duars which originated from the Zemu glacier in North Sikkim and joins the mighty Brahmaputra in Bangladesh. Torsa, Jaldhaka, Diana, Karatoya, Raidak and Kaljani are other important rivers passing through Duars. Most of these rivers originated from Himalayan hills, flow from North-east to South-West and are mostly rain fed, except the Tista and Jaldhaka which are glacier fed rivers. Lish, Ghish and Murti are other important rivers of Duars region. All these rivers and their tributaries carry down a huge amount of sediments and deposited in this area.

3.5. CLIMATE

The climate of Terai-Dooars belt is more or less similar to that of the remaining districts of North Bengal and mostly of humid subtropical type. Due to its proximity to the hills, it faces longer winter and receives heavier rainfall.

3.5.1. Seasons of the year

Being extended from the foothills of Himalaya in North to the Upper Gangetic Plains in South and diverse in topographical and altitudinal conditions, this belt shows difference in its climatic conditions from tropical to sub-tropical type. The seasons generally follow the course of adjacent Sub-Himalaya and plains together and led to the creation of various types of vegetation. Recognized main prevailing seasons are Summer, Monsoon or Rainy season, Autumn and Winter which circumscribe the entire year. March April and May – these three months comprises the summer which is characterized by brief squalls and thunderstorms that often arrive from the north or northwest and is known as *kaal-baisakhi*. Summer is mild and prevails for a very short duration of the year. Monsoon or the rainy seasons extends from June to September. The branch of the Indian-ocean-monsoon wind, which is called as the Bay of Bengal branch of monsoon wind, moves in a northwest direction during this season and brings the major parts of rain to this belt. Autumn which is very short in this belt extends from the mid to last of September up to first or second week of November and is characterized by clear visibility, light clouds and dry and pleasant weather. The last half of November to February comprises the winter which is mild over the plains in the southern portion with average minimum temperatures of 15° C. A cold and dry northern wind blows in the winter that reduces the humidity level. But the northern part of Terai – Duars belt experiences a little bit of harsh winter. Foggy nights and mornings with cold temperature are the characteristic features of the winter.

3.5.2. Temperature

Due to the variation in altitudinal range Terai – Duars region experiences spatial alteration in temperature also (Table 3.1).The plains are warm and hot throughout the year except a short period during winter. As it is located at the foot of Himalaya and contiguous with it, the temperature is rarely excessive in Terai-Duars belt. Average Monthly maximum temperature varies between 23˚C – 32˚C in January and September respectively whereas the average monthly minimum temperature ranges from 10°C in January to 24.6°C in September.

Sometimes in winter it falls down to 8.5° C. January is the coldest month and the minimum and maximum temperature ranges from 8.5˚C – 11.6˚C and 22.6˚C – 24.5˚C. From the end of March it begins to get warmer and from May to September it is rather hot – average monthly maximum and minimum temperature ranges from 31.15˚C – 32.19˚C and 21.74˚C – 24.67˚C respectively. Southern plain of this belt is comparatively hot whereas the northern undulating parts are relatively cooler.

3.5.3. Rainfall

The area receives rainfall almost throughout the year except the winter. The maximum amount of rainfall is brought about by the South-West monsoon .The South-West monsoon travelling across the Indian Ocean and the Bay of Bengal carries heavy moisture and causes showers throughout last quarter of April to first quarter of October and maximum amount of rainfall occurs in July. Minor amount of rain fall is also found during December to March as because of the retreating of North-East Monsoon. This area receives a high annual precipitation and the average annual rainfall received during 2000 – 2013 ranges from 418 – 545 cm amounting the average annual precipitation as 476.3 cm. This high rainfall is restricted within a period of 103 to 110 days during monsoon

Table 3.1. Average monthly maximum and minimum temperature during 2000 to 2013 [As recorded in Central Tobacco Research Institute, Dinhata, Coochbehar]

Month		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Aver
Jan	Max	22.7	22.8	23.2	22.1	22.6	23.8	22.4	22.1	24.5	23.6	23.5	22.8	22.6	23.7	23.03
	Min	10.0	8.7	10.7	8.4	9.3	8.5	10.9	8.9	10.6	11.6	9.8	10.2	10.6	10.4	9.90
Feb	Max	24.4	25.0	26.6	22.5	26.0	26.2	27.2	23.5	23.7	27.7	26.7	26.9	24.4	23.8	25.33
	Min	10.5	11.9	11.5	9.9	11.0	13.1	15.4	13.2	10.4	13.1	12.1	10.5	11.3	12.1	11.86
Mar	Max	28.2	30.6	29.3	27.7	30.8	29.3	30.8	28.3	28.4	31.0	30.2	28.9	29.5	29.4	29.46
	Min	15.8	15.1	15.6	13.6	17.2	15.2	16.0	15.2	16.8	15.5	15.7	17.2	16.5	16.1	15.82
Apr	Max	30.8	31.7	28.8	30.5	28.5	31.0	30.8	29.6	30.0	29.3	29.7	28.9	30.2	28.8	29.90
	Min	20.7	20.2	17.6	19.5	19.3	17.5	20.5	20.1	20.2	18.0	19.4	18.9	20.6	19.8	19.45
May	Max	31.0	31.2	30.1	32.1	31.9	30.6	27.2	32.5	31.2	31.6	30.2	32.5	32.1	31.9	31.15
	Min	22.5	22.4	21.7	21.1	21.3	18.7	22.7	23.2	22.2	18.9	22.4	22.7	23.2	21.3	21.74
Jun	Max	31.6	31.6	31.0	33.9	32.1	31.6	30.9	30.7	30.6	32.6	31.6	31.0	31.5	33.9	31.76
	Min	23.7	23.7	24.0	22.6	22.7	22.6	24.4	24.3	24.2	21.8	24.4	24.5	22.6	22.7	23.44
Jul	Max	31.7	31.7	30.4	32.7	31.3	29.5	32.1	30.5	30.9	32.7	31.6	30.4	29.8	31.2	31.18
	Min	25.2	25.2	24.2	24.2	23.0	25.2	25.6	24.8	25.1	24.1	23.6	24.1	23.5	22.8	24.33
Aug	Max	31.4	31.4	30.0	34.4	33.9	32.1	32.7	32.0	30.7	31.5	31.4	31.4	30.0	34.4	31.95
	Min	25.2	25.2	22.4	25.6	24.9	25.0	25.6	25.8	24.6	24.2	25.2	23.1	25.0	23.6	24.67
Sept	Max	31.1	31.1	32.0	34.5	32.1	33.2	31.0	30.9	31.6	33.1	31.2	33.6	31.2	34.1	32.19
	Min	24.0	24.0	23.6	24.5	23.6	24.8	24.2	24.5	24.3	23.6	22.6	23.2	24.8	23.7	23.96
Oct	Max	31.6	31.6	30.8	31.3	30.2	29.4	30.9	30.7	31.2	31.2	29.9	30.1	29.4	31.2	30.68
	Min	22.4	22.4	21.3	21.6	19.6	20.8	21.1	22.0	21.5	20.1	19.6	20.8	21.1	22.0	21.16
Nov	Max	27.5	27.5	28.0	28.9	29.0	27.9	26.8	28.7	28.0	27.8	28.7	26.8	27.9	27.7	27.94
	Min	17.1	17.1	16.4	17.2	14.6	15.4	16.5	16.9	15.1	14.8	15.7	17.0	15.4	16.3	16.11
Dec	Max	24.7	24.7	24.3	25.6	27.2	25.9	24.5	24.6	24.5	24.0	25.1	24.1	25.9	24.4	24.96
	Min	10.9	10.9	12.6	12.6	11.3	11.6	12.3	11.1	14.0	11.2	11.8	12.6	12.3	14.1	12.09

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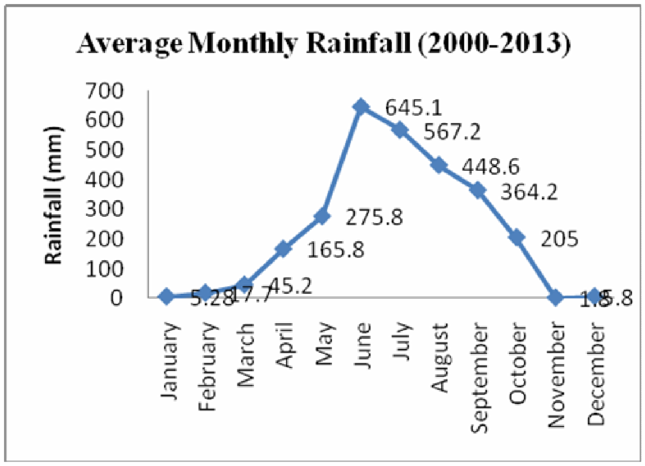

Figure 3.1. Average monthly Rainfall during 2000-2013 [as recorded in Central Tobacco Research Institute, Dinhata, Coochbehar].

3.5.4. Relative humidity

Terai-Duars, the belt of marshy region full of jungles at the foot of Himalayas, experiences a high relative humidity (RH) with only less variation. Annual average maximum and minimum relative humidity during 2000 – 2013 varied between 82.48 – 94 % and 69.33 – 79.33 % in this region.

Table 3.2. Relative humidity (RH %) during 2000 to 2013 [as recorded in Central Tobacco Research Institute, Dinhata, Coochbehar]

Year	Average Relative Humidity (%)		Year	Average Relative Humidity (%)	
	Max (at 06:32 hr)	**Min (at 13:32 hr)**		**Max (at 06:32 hr)**	**Min (at 13:32 hr)**
2000	94.00	79.33	2007	92.67	69.33
2001	82.48	77.25	2008	92.42	70.83
2002	89.67	76.92	2009	88.58	73.58
2003	90.50	75.67	2010	91.71	75.20
2004	90.08	71.00	2011	90.40	72.11
2005	90.67	76.08	2012	88.62	72.30
2006	93.33	75.17	2013	92.1	75.00
Maximum average 90.52			**Minimum average 74.27**		

3.6. FOG FORMATION AND SUN-SHINE

Fog formation during the winter is an important feature of Terai-Duars region. Fog consists of visible cloud, water droplets or ice crystals suspended in the air at or near the Earth's surface. Presence of numerous water bodies along with the other factor favourable for fog formation like wind condition and topography prevails in this belt, led to fog formation during winter and it reduces visibility to less than 1 kilometre and sometimes the visibility becomes zero. Transpiration from plants which adds water vapour to the air also plays a vital role in fog formation during the winter nights.

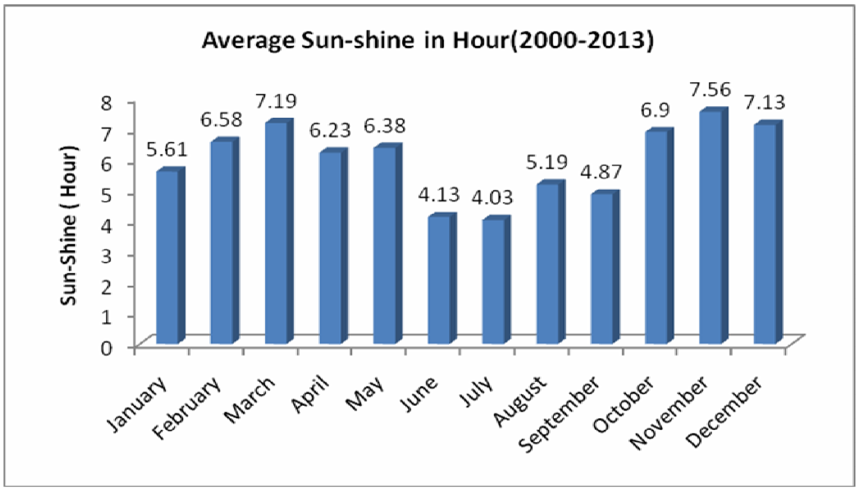

Figure 3.2. Average monthly Sun-shine in Terai-Duars belt during 2000 – 2013 [as recorded in CTRI, Dinhata, Coochbehar].

Terai-Duars region of West Bengal shows considerable variation in Sun-shine that it receives throughout the year. Minimum and maximum amount of relative sun-shine occurs during the Monsoon or rainy season i.e. in the month of June (4.13 h) and July (4.03h); and during summer (7.19h in March) as well as in autumn (7. 56h in September).

3.7. POPULATION AND THE TRIBES

Population of this belt is mixture of the native people and the people from adjoining areas. Native people this region is of Mongoloid origin. Numerous tribes who are the rich source of traditional knowledge system (Das *et al.* 2007), are scattering throughout this belt of huge biological resources. Rabha, Mech, Toto, Koch Rajbongshi, Tamang or Murmi, Limbu, Lepcha and Dhimal are dominant tribes over here (Bhattacharya, 2004). After establishment of stretches of tea gardens a large number of population were imported from Nepal, Chota Nagpur and Santhal Parganas to meet the demand for tea garden worker (Ghosh, 2006). Most of them belong to Oraons, Mundas, Kharia, Mahali, Lohara and Chik Baraik community.

3.8. BIOLOGICAL RESOURCES

The entire Terai-Duars belt is a part of the Eastern Himalaya which is renowned for its diverse and rich biological resources. This zone is regarded as one of the most resource rich centres of Bengal and its diverse habitats are ideal home for a large number of flora, fauna and microbes.

3.8.1. Flora and Vegetation

Terai - Duars belt of West Bengal is extremely rich in plant resources and its diverse floristic components are greatly influenced by the Himalayan elements. Different type of vegetation in this marshy belt of dense forests and the grasslands are unique home to a large number of endemic and/or threatened plants (Das, 1996; Das *et al.* 2003; Rai, 2006).

Forests and the Vegetation of Terai-Duars region mainly are of (i) Tropical and Plain Vegetation and (ii) Subtropical vegetation. Tropical and Plain Vegetation is characterized by high temperature and heavy rainfall and extended from plains to 800 m. Dominant feature of this vegetation is very dense deciduous forest with *Shorea robusta* as dominant species. Bhujel (1996) divided this vegetation into four sub types – Reverine forest, Sal forest, Dry mixed forest and Wet mixed forest. The Sub-tropical forest contiguously lies above the vegetation of Terai - Duars plain and extends upto 1600 m. This vegetation is affected by dry winter and wet monsoon and tropical genera and species form the main components. Both the Terai and Duars region have excellent Savannah type of thick and dense grasslands, which supported to development two Wildlife Sanctuary - Jaldapara Wildlife Sanctuary and Chapramari Wildlife Sanctuary, and two National Parks — Gorumara National Park and Buxa National Park in this zone (Anonymous, 1997).

Different workers (Mukerjee, 1965; Banerjee, 1993; Sikdar, 1984; Mohanta, 2004) worked on vegetation of Duars. On the basis of composition and distribution of the major floristic elements Sikdar (1984) described vegetation of Duars as following five types:

1. Semi-Evergreen Forest
2. Moist Deciduous Forest
3. Dry Deciduous Forest
4. Sal Forest; and
5. Grasslands

Vegetations of this zone broadly fall under Tropical moist deciduous forests along with different sub types as recognized by Champion and Seth (1968). Among those (i) Eastern Bhabar and Terai Sal Forest ($3C/C_{1b}$) and (ii) Northern Dry deciduous Seral Sal, Khair, Sissoo, Simul association ($5B/1S_2$) are dominant types.

However, Mohanta (2004) prepared a vegetation cover map using remote sensing and GIS and classified the vegetation of Duars as – (i) Semi-evergreen forest, (ii) Sal mixed forest, (iii) Mixed Sal forest, (iv) Sub-tropical broad leaved hill forest, (v) Sal forest, (vi) Bamboo brakes, (vii) Riverine forest, (viii) Forest plantation, (ix) Teak plantation, (x) Degraded forest, (xi) Savannahs, (xii) Scrubs, (xiii) Grass land, (xiv) Agriculture and (xv) Tea garden.

Review of Literature

During last few decades of Nineteenth century when plantation was established in different parts of our planet earth only the advantages of planting trees in large scale was considered. The urge behind the initiation of plantation was nothing but the betterment of humankind, their society and environment and silently for the mother earth. They felt need for planting trees in large scale when they realized the shortage of supply of their required substances from natural forests which were dominant at that time and in a large extent around them. No one raised any question of its consequences and concerns. But rapidly growing interest in developing plantation forests has been accompanied with increased concerns about the potential environmental impacts of plantations in large scale. That makes the environmentalists, conservationists and others concerned to think seriously about its impact on biodiversity and environment. Thus the scientific approaches to detect and evaluate the impacts of large scale plantations were initiated.

4.1. THE GLOBAL SCENARIO

Throughout the Globe several workers studied the plantation forests to understand their ecological consequences. Moir (1966) studied the influence of *Ponderosa pine* on herbaceous vegetation. Sydes & Grime (1981a, b) studied the effects of tree leaf litter on herbaceous vegetation in deciduous woodlands. Hill & Stevens (1981) worked on the density of viable seeds in soils of forest plantations in upland Britain and Crozier & Boerner (1984) tried to understand the effects on distribution patterns in understory herb vegetation under different tree species in mixed mesophytic forest. Kirby (1988) studied the Changes in the ground-cover flora under plantations on ancient woodland sites. Chou (1991) worked on *Pinus radiata* plantation and found perspectives of disease threats in large-scale *Pinus radiata* monoculture in New Zealand. Hansen *et al.* (1991) chalked out the biodiversity in managed forests and highlighted on conservation. Kelty (1992) compared the productivity of monocultures and mixed-species stands.

Impact of plantation on biodiversity and environment was studied by many other workers including Rosoman (1994), Maclaren (1995, 1996), Danielsen & Heegaard (1995), Halpern & Spies (1995), Chiarucci & Dedominicis (1995), Allen *et al.* (1995), McLaren (1996), and Michelsen *et al.* (1996). Freedman (1998) and Freedman *et al.* (1994), found Impacts of plantation on biodiversity in the Greater Fundy Ecosystem. Chritensen & Emborg (1996) studied the biodiversity in natural versus managed forests in Denmark; Pott (1997) on plantation forestry in South Africa and its impact on biodiversity and water; Geldenhuys (1997) on native forest regeneration in pine and eucalypt plantations in the Northern Province of South

Africa; Oberhauser (1997) on s econdary forest regeneration beneath *Pinus kesiya* plantations in the northern Thai highlands; Keenan *et al.* (1997) on restoration of plant biodiversity beneath tropical tree plantations in Northern Australia; Hampson & Peterken (1998) on enhancing the biodiversity of Scotland's forest resources through the development of a network of forest habitats; Norton (1998) on indigenous biodiversity conservation and plantation forestry; Bunnell *et al.* (1998) on the problems in forestry and biological diversity. Lamb (1998) highlighted on large-scale ecological restoration of degraded tropical forest lands; and Nixon & Worrell (1999) indicated the impact of plantations on biodiversity.

Mason *et al.* (1999) has worked on the use of native species in plantation forests, Lindenmayer (1999) on biodiversity conservation in managed forests, and Cannell (1999) on environmental impacts of monoculture forests. Scott *et al.* (1999) worked on soil carbon storage in plantation forests and pastures in New Zealand. Brockerhoff *et al.* (2001) estimated biodiversity in New Zealand plantation forests; Yirdaw (2001) on diversity of naturally-regenerated native woody species in forest plantations in the Ethiopian highlands. Peterken (2001) showed the ecological effects of introduced tree species in Britain. Strauss (2001) has studied on the plantations and native Australian forests; Hartley (2002) on rationale and methods for conserving biodiversity in plantation forests; Hofstede *et al.* (2002) studied the impact of pine plantations on soil and vegetation in the Ecuadorian High Andes; and Nagaike (2002) on differences in plant species diversity between conifer (*Larix kaempferi*) plantations and broad-leaved (*Quercus crispula*) secondary forests in central Japan. Humphrey *et al.* (2002) indicated the potential contribution of conifer plantations to the UK Biodiversity Action Plan. Henson (2003) and Henson & Chang (2003) worked on oil palm plantations and its effects including forest loss; Sample (2003) on forest plantations; Quine *et al.* (2003) on plantations; Van Wesenbeeck *et al.* (2003) on strong effects of a plantation with *Pinus patula* on Andean subparamo vegetation; Ehrenfeld (2003) on effects of exotic plant invasions on soil nutrient cycling processes in USA; Nagaike & Hayashi (2004) on effects of extending rotation period on plant species diversity in *Larix kaempferi* plantations in central Japan.

Cusack & Montagnini (2004) studied the role of native species plantations in the recovery of understory woody diversity in degraded pasturelands of Costa Rica whereas Lee *et al.* (2005) on natural regeneration in exotic tree plantations in Hong Kong. Lemenih & Teketay (2005) traced the effects of prior land use on the recolonization of native woody species under plantation forests in the highlands of Ethiopia and Eyecott *et al.* (2006) worked on ecological patterns of plant diversity in plantation forest managed by clear felling in UK; Arrieta & Suarez (2006) on the contribution of Scots pine (*Pinus sylvestris*) plantations for the regeneration of holly (*Ilex aquifolium*) in Mediterranean Central Spain; Carnus *et al.* (2006) on planted forests and biodiversity; Nagaike *et al.* (2006) on plant species diversity in a managed forest landscape composed of *Larix kaempferi* plantations and abandoned coppice forests in central Japan, Newmaster *et al.* (2006) on restoration of floral diversity through plantations on abandoned agricultural land, Chey (2006) on impacts of forest conversion on biodiversity as indicated by moths, Shi *et al.* (2007) on the effects of diversity of arbuscular mycorrhizal fungi in the rhizosphere of Dipterocarpaceae in natural and plantation forests in China.

Barlow et al. (2007a) measured the biodiversity value of tropical primary, secondary, and plantation forests. Koonkhunthod *et al.* (2007) studied on composition and diversity of woody regeneration in a 37 year old teak (*Tectona grandis*) plantation in Northern Thailand, Barlow *et al.* (2007b) on litter fall and decomposition in primary, secondary and plantation forests in the Brazilian Amazon. Marcos *et al.* (2007) compared the community structure and soil characteristics in *Pinus sylvestris* plantations of different ages and a natural pine forest. Aubin *et al.* (2008) and Berndt *et al.* (2008) worked on relevance of exotic pine plantations as a surrogate habitat for ground beetles where native forest is rare, Pawson *et al.* (2008) on non-native plantation forests as alternative habitat for native forest beetles in a heavily modified landscape, Koh & Wilcove (2008) on the destruction of tropical biodiversity through the cultivation of oil palm, Onaindia & Mitxelena (2009) on potential uses of pine plantations to restore native forests in a highly fragmented river basin, Soo *et al.* (2009) on the floristic diversity responses in young hybrid aspen plantations to land-use history and site preparation treatments. Duan *et al.* (2009) traced the differences in plant species diversity between conifer plantations and natural forests in middle of the Loess plateau. Gomez-Aparicio *et al.* (2009) also worked on pine plantations. Al-Nafisi *et al.* (2009) depicted the positive impacts of mangrove plantations on Kuwait's Coastal environment.

Pare *et al.* (2009) worked on regeneration and spatial distribution of seedling populations in Sudanian dry forests in relation to conservation status and human pressure, Hadi *et al.* (2009) on tree diversity and forest structure in nothern Siberut, Mentawai islands, Indonesia, Zakaria *et al.* (2009) on the composition of plant communities at six study plots in Penang forest reserves in Malaysia and Gonzales & Nakashizuka (2010) on broad-leaf species composition in *Cryptomeria japonica* plantations with respect to distance from natural forest and others.

Recently Bremer & Farley (2010) worked on plantation forest and their effects on plant species richness. Pawson *et al.* (2013) worked on plantation forests, climate change and biodiversity. Very recently Braun and Vogt (2014) assessed the risks imposed by plantation forestry on plant biodiversity in the Hotspot Central Chile and Li *et al.* (2014) detected the effect of young poplar plantations on under-storey plant diversity in china.

4.2. IN INDIAN SUB-CONTINENT

In Indiana sub-continent various scientists have worked in the related field i.e. on plantation forests and its impacts on plant diversity in India. Panigrahi *et al.* (1969) contributed to the Botany of the Terai Forests of the Bahraich District of Uttar Pradesh, Singh & Misra (1979) worked on structure and functioning of natural, modified and silvicultural ecosystem in Eastern Uttar Pradesh; Upreti (1982) studied the phytosociology and state of regeneration of Oak-Forest at Nainital, Das & Ramkrishanann (1985) on the litter dynamics in Khasi Pine (*Pinus kesiya* Royle *ex* Gordon). Pandey (1986) also worked on litter production and decomposition, mineral release and biochemical diversity of forests and plantation; Parthasarathy & Mahadevan (1987) on floristic account of forest types in Kalakad reserve forest, Western Ghats; Parthasarathy (1988) on phytogeographic analysis of the flora of Kalakad reserve forest Western Ghats; Singh & Singh (1991) on species structure, dry matter dynamics and carbon flux of a dry tropical forest; Gupta & Shukla (1991) on composition and dynamics of associated plant communities of sal plantations; Parthasarathy *et al.* (1992) on plant species diversity and human impact in the tropical wet evergreen forests of Southern Western Ghats; Singh *et al.* (1993) on production and decomposition of leaf litter in Sal, Teak, *Eucalyptus* and Polar forests in Uttar Pradesh; Visalakshi (1995) on vegetation analysis of two tropical dry evergreen forests in southern India; Nayar (1996) on Hotspots of endemic plants of India, Nepal and Bhutan; Parthasarathy & Karthikeyan (1997a, b, c) on diversity of trees and liana species and population structure in a tropical dry evergreen forest, biodiversity and population density of woody species in a tropical evergreen forest and plant biodiversity inventory and conservation.

Gopisundar (1997) worked on abundance, diversity and distribution of ground herbs in a tropical lowland evergreen rainforest at Agumbe, Karnataka; Shankar *et al.* (1998) on ecosystem reconstruction through '*taungya'* plantations following commercial logging of dry mixed deciduous forests in Darjeeling Himalaya; Scott *et al.* (1999) on soil carbon storage in plantation forests and pastures; Pandey & Shukla (1999) on plant diversity and community patterns along the disturbance gradient in plantation forests of Sal (*Shorea robusta*); Pandey (1999) on comparative vegetation analysis and Sal regeneration in relation to their disturbance magnitude in some Sal forests. Parthasarathy (1999) studied the tree diversity and distribution in undisturbed and human-impacted sites of tropical wet evergreen forest in southern Western Ghats; Xiong & Nilsson (1999) on effect of plant litter on vegetation; Pandey (2000) on population status and regeneration strategy of some perennial legumes in plantation forests of North-Eastern Uttar Pradesh; Chittibabu & Parthasarathy (2000) on understory plant diversity in a tropical evergreen forest in Kolli hills, Eastern Ghats; Maikhuri *et al.* (2000) on the growth and ecological impacts of different agro-forestry tree species in central Himalaya; Jha *et al.* (2000) on deforestation and land use changes in Western Ghats; Bhat & Murali (2001) on phenology of understory species of tropical moist forest of Western Ghats region of Uttara Kannada district in South India; Pandey & Shukla (2001) on regeneration strategy and plant diversity status in degraded Sal forests; Shankar (2001) on high tree diversity in a sal dominated lowland forest of Eastern Himalaya; Pandey & Shukla (2003) on plant diversity in managed Sal forests of Gorakhpur; Webb & Sah (2003) on structure and diversity of natural and managed Sal forest in the Terai; Sagar *et al.* (2003) on tree species composition, dispersion and diversity along a disturbance gradient in a dry tropical forest region of India; Bhuyan *et al.* (2003) on tree diversity and population structure in undisturbed and human-impacted forest stands of tropical wet evergreen forest in Arunachal Pradesh; Padalia *et al.* (2004) on phytosociological observations on tree species diversity of Andaman Islands; Mishra *et al.* (2004) on anthropogenic disturbance on plant diversity and community structure of a sacred grove in Meghalaya; Sharma (2005) on impact of coal mining on vegetation; Raghubanshi *et al.* (2005) on the invasive alien species and Biodiversity in India; Goutam & Devoe (2006) on cological and anthropogenic niches of Sal forest and prospects for multiple-product forest management; Kumari & Tripathi (2007) on phytosociological studies of the pteridophytes in Terai forest of North India; Timilsina *et al.* (2007) on community analysis of Sal forests; Reddy *et al.* (2007) phytosociological observations on tree diversity of tropical forest of Simlipal Biosphere Reserve, Orissa; Kumar (2008) on litter decomposition and calcium, potassium release in *Acacia auriculiformis* plantation forest floor; Sukumaran & Raj (2008) on rare, endemic, threatened (RET) trees and lianas in the sacred groves of Kanyakumari district; Mishra *et al.* (2008) on vegetation ecology of the Simlipal Biosphere Reserve, Orissa; Baishya *et al.* (2009) on distribution pattern of above-ground biomass in natural and plantation forests of humid tropics in northeast India, Tripathi & Singh (2009) on species diversity and vegetation structure across various strata in natural and plantation forests in Katerniaghat Wildlife Sanctuary; Rasingam & Parthasarathy (2009) on diversity of understory plants in undisturbed and disturbed tropical lowland forests of Little Andaman Island; Rawat *et al.* (2009) on structure of understorey vegetation in native and exotic plantations of Semi-Arid Regions of Punjab; Kulkarni *et al.* (2009) on biomass production by *Sesbania sesban* L. when grown under different tree environments; Mani & Parthasarathy (2009) on tree population and above-ground biomass changes in two disturbed tropical dry evergreen forests of peninsular India; Bremer & Farley (2010) on plantation and its role to restore biodiversity; Panda (2010) on the role of fungi in relation to litter decomposition associated with *Casuarina equisetifolia* L. in coastal sand dunes of Orissa; Panda *et al.* (2010) on litter decomposition dynamics associated with cashew nut plantation in coastal habitat of Orissa; Thapa *et al.* (2011) on effect of plantation on plant biodiversity and soil status of tropical forest ecosystem in Meghalaya, northeast India.

4.3. IN WEST BENGAL

Most of the works done previously in West Bengal are either on floristic aspects or in the field of ethnobotany and a very few are on ecological aspects of plantation and natural vegetation. Initially the flora and vegetation of Bengal was explored by Hooker (1848, 1854b), Hooker & Thomson (1855), Long (1857, 1858, 1859a, 1859b), Clarke (1876, 1885), King (1886), Haines (1896, 1906), Carter (1917), Cowan (1929b), Prain (1930b), Agharkar & Ghosh (1931), Anonymous (1935, 1960, 1963, 1966a, 1997), Biswas (1940) Shebbeare (1941), Chatterjee (1958a), Ghosh & Daniel (1959), Ghosh (1959), Mehra & Bir (1964), Chaudhuri (1965b), Chandra & Bhattacharyya (1966), Biswas (1966), Hara (1966, 1971), Mathew

(1966, 1969, 1971, 1981), Bennet (1969), Biswas (1971), Basak (1973), Hooker (1972-1897, 1904, 1907), Hara *et al.* (1978, 1979, 1982), Bhattacharyya & Maiti (1983), Krishna & Das (1972), Sain (1959, 1974), Yonzone (1975), Jain *et al.* (1975), Ohashi (1975), Chanda (1977), Kundu *et al.* (1981), Majumdar *et al.* (1984), Mukherjee (1984) and others.

Then Tamang & Yonzone (1982) studied the vegetation of North Bengal. Giri & Nayar (1983b), Das & Chanda (1986), Kundu & Pal (1997), Mukherjee (1998) studied and listed the threatened and endemic plants of Bengal. Kapoor *et al.* (1989) worked on forest and vegetation of Darjeeling Himalayas, A.K. Samanta (1998) on taxonomy and phytosociology of the Angiospermic Climbers of Darjeeling and Sikkim Himalaya.

Maiti & Guha Bakshi (1981), De & Mukhopadhyay (1984) worked on invasion of exotic weeds in West Bengal as well as the Weed flora. Hore & Tripathi (1985), Das *et al.* (1985), C.R. Das (1985), Bhujel (1986), Mukherjee & Deb Roy (1987), Das & Chanda (1987, 1988 & 1990) worked on flowering calendar of the angiospermic flora of Darjeeling hills.

Basu & Paul (1989), Das & Lahiri (1990, 1997), Chakraborty (1991, 1996), Grierson & Long (1983, 1984, 1987, 1991, 1999), Das & Lama (1992), Patra *et al.* (1992), Mondal (1992), Noltle (1994, 2000), Samanta (1995, 1996, 2006a, 2006b), Das (1995, 2004), Bhattacharyya (1996), Mahata *et al.* (1998), Mukherjee & Chaudhuri (1998), Chakravarty *et al.* (1999), Basu & Pradhan (2000), Rai (2001), Das *et al.* (2002), Rai & Das (2002, 2005), Saha (2005) further studied on composition and diversity of Bengal flora. Kundu (2006) studied and listed the threatened and endemic plants of Bengal.

Then different aspects of flora of West Bengal was further explored by Maiti (2004), Das & Ghosh (2007), Bhunia *et al.* (2008), Kumar *et al.* (2009), Panda *et al.* (2009). Das *et al.* (2008) worked on Plant resources in the protected areas and proposed corridors of Darjeeling. Naskar (1986) studied the *Avicennia* L. plantation and its role on brackish water fisheries.

Chaudhury (1964), Sengupta (1967c), Yonzone *et al.* (1981), Yonzone & Mondal (1982), Mukherjee & Rai (1984), Yonzone *et al.* (1984, 1985, 1996), Pal (1988), Basnet & Chetri (1999), Basu & Gautam (2002), Rai & Bhujel (2002), Chettri *et al.* (2005), Panda (2006, 2009), Rai *et al.* (2007a, 2007b) and Soren *et al.* (2008) worked on ethnobotany of Bengal whereas Biswas & Chopra (1940) on common medicinal plants of Darjeeling and the Sikkim Himalayas. Biswas (1956a) worked on common medicinal plants of Darjeeling and Sikkim Himalaya and Rai *et al.* (2008) invented the medicinal trees in lower hills of Darjeeling.

Only few workers studied the ecological aspect of West Bengal forests. Sarkar (2003) worked on Indian plant biodiversity and their conservation, Anonymous (1964b) on nursery and plantation, Banerjee (1992) on ecological status of *Shorea robusta* of West Bengal. Roy Choudhury (1956) recorded the progress of forestry in Bengal. Das & Lahiri (1997) compared the ground covering vegetation among different types of contiguous vegetation on Tiger Hill in the Darjeeling district. Das (2002) recorded the naturalization of 114 species of exotics in the vegetation of Darjeeling Hills. Bhakat & Maiti (2003) studied the invasion of exotic species causing displacement and destruction of plant diversity in four contiguous district of South West Bengal. Das *et al.* (2010a) enlisted the medicinal plants in three MPCAs in Terai and Duars.

4.4. IN TERAI-DUARS OF WEST BENGAL

Terai-Duars region of west Bengal lying at the foot of Himalaya was explored by different botanist from different parts of the world. Gamble (1875, 1878), Prain (1903a), Burkill (1916) worked on the Terai - forests, Cowan & Cowan (1929), Cowan (1929a), Anonymous (1957) on trees of Duars and Terai. Chaudhuri (1960a, b) studied on Principal grasses and grassland habits of North Bengal, Datta (1964) on common weeds of Darjeeling, Mukherjee (1965, 1972) on the vegetation of the Jalpaiguri district of West Bengal. Chaudhuri (1969, 1970) critically analysed the vegetation of North Bengal and its special ecological features. Anonymous (1970) worked on the Buxa Forest Division, Ghosh & Ghosh (1978) on the flora of Buxa division of Jalpaiguri district (Duars), Sikdar (1981b, c, 1984a, 1985) on flora and the Vegetation and Flora of Jalpaiguri District.

Others who worked on flora of Terai Duars belt are - Sikdar & Ghosh (1981), Sikdar & Samanta (1983), Sikdar *et al.* (1983) , Sikdar & Rao (1984) on the flora of Buxa forest division, Jalpaiguri district, Safui *et al.* (1985) on flora of Duars, Chaudhuri & Chakraborty (1976) on genetic and specific diversity of the vegetation of North Bengal, Das *et al.* (1982), Das (1986) on the Floristics and Palyonology, Aditya & Ghosh (1989) on flora of Terai-Duars, Banerjee (1992, 1993) on Plant Resources of Jaldapara rhino Sanctuary, Bhujel & Yonzone (1994), Hegde (1994), Bhujel (1996).

Das (1996) rediscovered *Streptocaulon sylvestre* Wt. – an endangered and little known endemic plant of Eastern India. Das & Lahiri (1997) performed phytosociological studies of the ground flora in different types of vegetation. Das (1998) worked on the floristic and palynology. Bist & Katham (1999), Bhujel *et al.* (2001) on floras, Bhujel & Das (2002) endemic status of the dicotyledonous flora of Darjeeling District, Basnet (2004) on common weed flora in forest plantation of Darjeeling hills of W.B, Datta *et al.* (2002) on aquatic macrophytes of Apalchand Reserve in the Jalpaiguri, Ghosh *et al.* (2004) on weed flora of tea gardens of Darjeeling – terai, Kadir & Das (2002) on habitat of *Streptocaulon sylvestrie* an endemic and critically endangered Asclepiad, Shraddha *et al.* (2004), Paul (2008b) on flora, Bandyopadhyay & Mukherjee (2005a) on Diversity of aquatic and wetland vascular plants, Bandyopadhyay *et al.* (2006) also worked on flora of Terai Duars, Bandyopadhyay & Mukherjee (2008) on trees and shrubs of Koch Bihar district, Bandyopadhyay & Mukherjee (2010) on diversity of climbing plants, Das *et al.* (2010b) worked on floristic aspect.

Several author worked on ethnobotany and tribes of Terai - Duars of West Bengal. Aditya & Ghosh (1988), Bandyopadhyay & Mukherjee (2005b, 2006), Bandyopadhyay *et al.* (2005), Bhujel *et al.* (1984a, 1984b), Chakraborty *et al.* (2008), Chaudhuri *et al.* (1982a,b), Chowdhury & Das (2007) , Das (1998), Das *et al.* (1983a, 1983b), Dixit *et al.* (1978), Ghosh (1986), Ghosh & Das (2004, 2007a, 2007b, 2007c), Mandal & Yonzone (1987), Mohanty (2008), Molla & Roy (1984, 1985, 1996), Mudgal *et al.* (1999), Mukherjee & Mukherjee (1987), Srivastsva *et al.* (2003), Yonzone (1996), Das & Raha (1967), Sanyal (1955) worked in the field of ethnobotany and medicinal plants and Anonymous (1980) worked on Totos of Jalpaiguri district.

Anonymous (1997a) worked on forest resources of Darjeeling District, Banerjee *et al.* (2000) on minor forest products of Buxa Tiger Reserve, Kadir & Das (2007) on endangered and endemic plants, Kadir *et al.* (2009) on ecology of sub Himalayan grass land, Pandit *et al.* (2004) on Non-timber forest produces from Jaldapara Wild Life Sanctuary, Shebbeare (1961) on Nothern Bengal '*Taungyan'* plantation. Recently Sarkar *et al*. (2010b), Sarkar and Das (2010, 2011, 2012) and Sarkar (2011), Moktan & Das (2014) explored the ethnobotanical aspects of Duars whereas Saha *et al*. (2013) have estimated the medicinal plants of this area.

Das *et al.* (2010a, b) surveyed the Medicinal Plants from Terai and Duars of West Bengal and documented *Piper* L. (Piperaceae) in Terai, Duars and the hills of Darjeeling and Sikkim Himalayas and published a checklist of Angiospermic Climbers of Darjiling and Sikkim parts of Eastern Himalaya including Terai and Duars. Mitra *et al.* (2010) showed the efficacy of some East Himalayan Medicinal Plants on ethanol induced gastric ulcer in albino rats. Sarkar *et al.* (2010b) documented the ethnobotany of *Kirat Parab* of *Magar* Community in Buxa Duar area. Ghosh & Das (2011) recorded useful and poisonous tea garden weeds from the Darjiling District. Das & Yadav (2011) reported about the distribution of *Gnetum montanum* in Terai and Duars belt.

Different authors have reported a number of taxa for the first time from this region. Das *et al.* (2010c) reported *Acampe papilloa* (Lindley) Lindley var. *flava* Das *et al.* (*var. nov*.) from the Duars region. Chowdhury *et al.* (2011) reported the occurrence of *Soliva anthemifolia* (A. Jussieu) R. Brown (Asteraceae) in Eastern India. Moktan *et al.* (2012) newly recorded *Oplismenus undulatifolius* (Arduino) P. Beauvois [Poaceae] for West Bengal. Rai & Das (2012) recorded *Primula kingii* G.Watt (Primulaceae) which is a new record for West Bengal. Chowdhury *et al.* (2013) recorded *Ludwigia peruviana* (Linnaeus) H. Hara [Onagraceae] for first time in West Bengal. Ghosh *et al.* (2013) rediscovered *Hibiscus fragrans* Roxburgh (Malvaceae) from Jaldapara National Park in Duars of West Bengal. Chowdhury & Das (2014) recorded *Hygrophila erecta* (N.L. Burman) Hochreutiner [Acanthaceae] which is also a new record of occurrence for West Bengal, India. Chowdhury *et al.* (2015) newly reported *Murdannia keisak* (Hasskarl) Handel-Mazzetti (Commelinaceae) as new record.

Chowdhury & Das (2011) comparatively analysed the herbaceous plants in some Natural and Plantation forests of Terai and Duars region. Moktan & Das (2011) analysed the dominance-diversity and Species richness of herb species in the foothill forests of Kurseong. Rai & Das (2011) recognized the forest types in lower hills of Darjiling Himalaya using satellite and ground truth data. Nirola & Das (2011) worked on Cyperaceae A.L. Jussieu of Darjeeling. Sarkar & Das (2012) estimated the contribution of forest flora in rural livelihood: a study of Jayanti, Buxa Tiger Reserve. Biswas *et al.* (2012) worked on flora of Gossaihat Beel, Jalpaiguri Forest Division. Moktan & Das, (2012) Phytosociologically characterized the forested vegetation in the sub-tropical region of Darjiling Himalaya. Shukla & Chakravarty, 2012) describrd humid tropical foothill forest in Indian eastern Himalayas. Chowdhury & Das (2013) recorded aquatic and semi-aquatic macrophytic diversity of the river Karala at Jalpaiguri. Moktan & Das (2013) analysed diversity and distribution of invasive alien plants along the altitudinal gradient in Darjiling Himalaya, India. Choudhury *et al.* (2013) worked on diversity of *Cinnamomum* Schaeffer (Lauraceae) in Terai and Duars region of West Bengal, India. Biswas *et al.* (2013) worked on floristic diversity of Rasik Beel and its adjoining areas in Coochbehar district of West Bengal. Shukla *et al.* (2014) estimated the plant diversity at Chilapatta Reserve Forest of Terai Duars in subhumid tropical foothills of Indian Eastern Himalayas. Choudhury *et al.* (2014) worked on diversity of *Litsea* Lamarck [Lauraceae] in Terai and Duars regions of West Bengal. Chettri *et al.* (2014) studied ethnobotanical of the Tea garden workers of Darjiling Hills. Moktan & Das (2014) worked on plant species richness and phytosociological attributes of the vegetation in the cold temperate zone of Darjiling Himalaya. Saha *et al.* (2014) Surveyed for NTFP plants of the Gorumara National Park in the Jalpaiguri district of West Bengal. Chowdhury & Das (2014, 2015) worked on sustainable utilization of wetland leafy vegetables of Terai and Duars, West Bengal, India and on ethnopharmacological survey of wetland plants used by local ethnic people in Sub-Himalayan Terai and Duars of West Bengal. Sarkar & Das (2015) recorded use of floral elements in Jainti under Buxa Tiger Reserve in West Bengal, India. Roy & Das (2015) worked on ethnobotany of Rajbanshi cuisine from the northern part of West Bengal.

Notable works on impacts of plantation on phytodiversity of this region are really lacking. That’s why present study was designed to trace the impacts of plantation forests on the plant diversity of the Terai and Duars region.

Methodology

The present dissertation was designed to assess the influences of plantation forest on phyto-diversity of the study area and the main theme behind the selection of methodology is to compare different types of plantation with adjacent natural vegetation that was predominant in entire Terai-Duars belt and considered to be the standard land form. The comparison emphasized on the vegetation structures and phyto-sociological attributes along with a number of other aspects. Accordingly, a wide array of methodologies has been followed to carry out such diverse type of task and they are detailed below with proper citation.

5.1. SELECTION OF PLANTATION AND NATURAL TRACTS OF VEGETATION

The study area includes two Forest Divisions- Darjeeling and Jalpaiguri division and three administrative districts - Darjeeling, Jalpaiguri and Alipurduar. These two forest divisions were visited consulting with the respective DFOs and the forest ranges having plantation of different ages and types as well as the natural vegetations adjacent to that, were selected for the study. Preference was given to those areas having plantations and natural vegetation under same environmental and ecological conditions. Three such sampling sites were spotted in different parts of Terai-Duars Belt.

Site I: North Rajabhatkahwa (NRVK) area in Buxa Tiger Reserve, where along with Natural vegetation a plenty of Teak plantation, Jarul plantation and Jarul-Benteak plantation were found.

Site II: Sursuti Beat in Lataguri Reserve Forests where both the natural vegetation and plantations (Teak plantation, Sal-Chilauni plantation and mixed plantations) are available.

Site III: Noth Sevoke area in Mahananda Wlidlife Sanctuary with good quality natural vegetation along with Teak and Jarul plantation.

5.2. VEGETATION STRUCTURE

Three-tire Nested Quadrate (20m x 20m for trees or canopy; 5m x 5m for shrubs or under-storey and 1m x 1m for ground cover) was adopted for sampling vegetation (Misra, 1968; Shimwell, 1971; Tripathi & Misra, 1971; Phillips, 1959; Malhotra, 1973; Das & Lahiri, 1997 and Kadir, 2001).

5.2.1. Identification of specimens

Identification of the specimens was done in the field as far as possible with their local names while unidentified voucher specimens were collected. But as the study sites were located in and around the reserved area and the Dept. of forest did not allowed to collect the plant material from reserved or other category of protected forest. Jain & Rao (1977) was followed for the preparation of Harbarium.

5.2.2. Phytosociological analysis

For both the different types of plantations and the natural vegetations, the number of trees, shrubs and herbs were recorded to find their Frequency, Density, Abundance, Relative Frequency, Relative Density and Relative Abundance and finally to compute Important Value Index following Misra (1966), Das & Lahiri (1997) and Rai (2006). Random sampling plot survey has been done in consecutive three seasons during Pre-Monsoon, Post-Monsoon and in the winter.

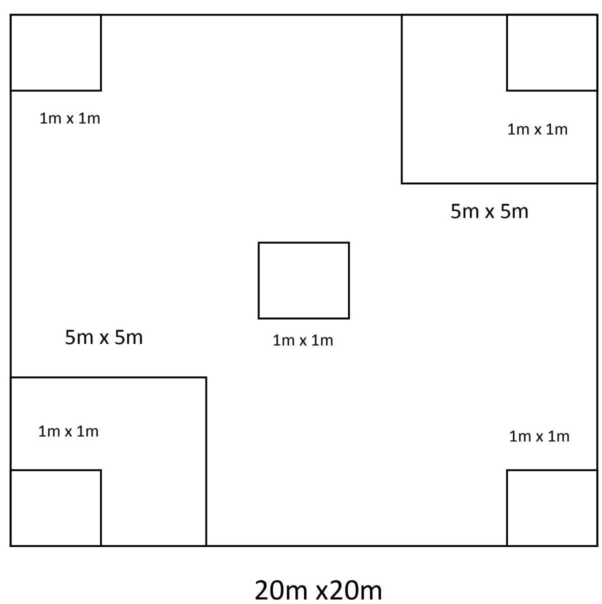

Figure 5.1. Layout of nested quadrate

5.2.2.1. Frequency

Frequency is defined as the degree of dispersion of an individual species in a community and indicates the chance of its occurrence in a particular habitat. Relative frequency (RF) is the percentage of frequency of a particular species to the total frequency of all other species in the same habitat. They are calculated as follows.

$$\text{Frequency (F)} = \frac{\text{Number of quadrates in which the species occurs}}{\text{Number of quadrates studied}}$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency value for a species}}{\text{Total of Frequency value for all the species}} \times 100$$

5.2.2.2. Density

Density of a species is its abundance in unit area of a particular habitat and expresses its numerical strength in a community. It is good indicator of rarity or dominance of a species and of standing biomass and productivity of the habitat (Ambashant *et al.* 1995; Rai, 2006).

Percentage of density of a species to that of all the species in same the habitat/ community is termed as Relative density (RD).

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

$$\text{Relative Density (RD)} = \frac{\text{Density value for a species}}{\text{Total of Density value for all the species}} \times 100$$

5.2.2.3. Abundance

Abundance indicates the commonality of a species in a habitat under study. Relative abundance is also the percentage of abundance of a species to that of all the species occurring in that habitat and the formulae for calculating them are as follows.

$$\text{Abundance (A)} = \frac{\text{Total number of individuals of a species}}{\text{Number of quadrate in which the species occurs}}$$

$$\text{Relative abundance (RA)} = \frac{\text{Abundance value for a species}}{\text{Total of abundance value for all the species}} \times 100$$

5.2.2.4. Importance Value Index (IVI)

Important Value Index is valuable statistical measures for the analysis of phyto-sociology and plant community and it provides an overall idea of a species and its importance in the plant community. It is derived by summing up Relative Frequency, Relative Density and Relative Abundance.

Importance Value Index (IVI) = RA + RD+ RF

5.2.3. Biodiversity Indices

As Diversity indices are important surrogates for measuring biodiversity (Sarkar and Margules, 2002) different diversity indices were studied to comprehend the diversity of plant communities, in both the plantation and natural vegetation, in time and space. Different biologists have formulated a numbers of diversity biodiversity indices of which following three were selected for diversity study in case of present work.

5.2.3.1. Species Diversity Index [Shannon-Weiner Index (1963)]

Shannon-Weiner Index (1963) is one of the widely used indices for measuring species diversity, which is the expression of community structure and indicates the complexity of a habitat, of an ecosystem and incorporates both the species richness and evenness components. Higher value of this index i.e. higher diversity is encountered in case of low dominance showing large number of species and large evenness components.

Shannon-Weiner Index (1963)

$$H' = - \Sigma [(ni/N)\ln(ni/N)]$$

Where, 'H'' is index value

'ni' number of individuals of a species

'N' total number of species in the habitat type

5.2.3.2. Species Richness [Menhinick's Index (1964)]

Species richness is nothing but another mode of expression of the diversity and is defined as the number of species present in a sample or habitat per unit area and thus based on the total number of species and total number of individuals in a sample or habitat. Menhinick's index (1964) was chosen for the understanding of species richness. This index emphasizes the rare species unlike Shannon-Weiner Index (1963).

Menhinick's Index (1964)

$$D = S/\sqrt{N}$$

Where, 'D' is the index value

'S' total number of species

'N' total number of individuals of all species.

5.2.3.3. Similarity Index [Sorensen's Index (1968)]

Similarity index is much more important in case of present study as it help to compare different habitat type and their stability for migration and evolution. Here Sorensen's Index (1968) of similarity was followed to compare plantations and natural vegetation.

Sorensen's Index (1968)

$$S = 2C/(a+b)$$

Where, 'S' is the index value

'C' number of species common to both sites

'a' number of species in site A

'b' number of species in site B

5.2.3.4. Concentration of dominance [Simpson's index (1949)]

To measure concentration of dominance Simpson Index (1949) was used.

Simpson's Index (1949)

$$\lambda=\Sigma pi^2$$

where, ' λ' is the index value

'pi' is the proportional abundance of the i^{th} species

Pi= ni/N

'ni' number of individuals of a species

'N' total number of species in the habitat type

5.3. ESTIMATION OF ABOVEGROUND HERBACEOUS BIOMASS

Biomass is an important parameter to understand the functional aspect of an ecosystem (Cornet, 1981) and it also helps to understand the physical and chemical attributes of the soil. For the present study, estimation of biomass was a crucial aspect for comparing the primary productivity of natural vegetation with that of planted forest. Only above ground herbaceous biomass was estimated for the present work following "harvest and estimate" method (Tadmor *et al.* 1975; Scurlock *et al.* 1999, 2002) based on a single harvest at the peak of live biomass.

Above ground herbaceous biomass was collected or harvested by clipping at ground level from 25cm×25cm area of each upper right and lower left quadrate of 1m×1m during the post monsoon vegetation survey when the productivity reaches at peak. Harvested biomass were placed in perforated paper bags and dried to constant mass at 80°C using hot air oven and weighed (Garnier *et al*. 2007 and Das *et al.* 2008). The experimental data were processed using MS Office Excel 2007.

5.4. RECOGNITION OF RARE, ENDEMIC AND THREATENED ELEMENTS

Eastern Himalaya is renowned for its endemic flora as well as the other category of threatened elements (Das, 1986; Bhujel, 1996; Das, 2002). The study area is located just at the foot of the Darjeeling Himalaya which is in important part of Eastern Himalaya from the view point of phyto diversity as well as its overall biodiversity. Keeping this in mind and it was assumed that there may be some threatened category of floral elements, the area was screened for Rare, Endemic and Threatened [RET] plants. RET elements were recognized with the help of Red Data Book for Indian Flora (Nayar & Sastry, 1987, 1988, 1990; Ahmedulla & Nayar, 1987; Bhujel, 1996; Ahmedulla, 2000; Bhujel & Das, 2002; Rai, 2006), Flora of India (Botanical Survey India) and following the IUCN guidelines (IUCN, 2014) for determination of different classes of threatened plants.

5.5. DOCUMENTING NON TIMBER FOREST PRODUCES

To collect data on Non Timber Forest Produces (NTFPs) of the Terai-Duars belt from both the Natural and plantation forest and to compare these two types of vegetations in respect of Non timber forest produces, a combination of methods were used. Maximum amount of data was collected during the vegetation study as a number of knowledgeable and local people on behalf of forest department accompanied the author then. Mainly the methodology followed by Jain, 1981, 1987, 1991; Rai *et al.* 1998; Rai & Bhujel, 1999; Rai, 2002; Jain & Mudgal, 1991; Sarkar, 2011, 2014; Santra & Roy, 2002 and Das, 2005 were followed for this purpose. During the survey, enquiry was made with the local people about the NTFPs which they collect. Few local markets in or around the study area were also visited to gain an overview of NTFP used for different purpose and the materials and voucher specimens were collected, processed and identified following the methodology described previously.

5.6. RECORDING OF ETHNOBOTANICAL KNOWLEDGE AND PLANTS

For recording ethnobotanical or Traditional knowledge and related plants and plant materials from the plantation and natural vegetation and the adjoining areas of Terai-Duars belt, the methodology suggested and adopted by Schutles (1962), Jain (1981, 1987, 1991), Rai *et al.* (1998), Rai and Bhujel (1999) and Rai (2002), Sarkar (2011) were followed with some modification in some cases. Sometimes information was collected by various technique like open interview and discussion with local informants. When questionnaire is used to collect data, the same was prepared by following Jain & Mudgal (1991) and Tag (2007).

The field work was carried out over 3 years from 2008 to 2010 in different forest of Terai-Duars belt of west Bengal and the fringes. Most of the information was collected during the phyto-sociological study and from the knowledgeable forest workers belonging to the tribal community, from local people found nearby, the cowboys, firewood collectors, fodder collectors, *Oajhas* or rural medicine men at the time of their collection of plant materials from the forest. In some cases, where found nearby, village markets were visited in search of those plant materials collected from the forest and are sold. In some cases the elder and the knowledgeable person were also visited and consulted to collect the ethno-botanical knowledge of the area.

5.7. SURVEY AND DOCUMENTATION OF MEDICINALLY IMPORTANT PLANTS

Terai-Duars region is a rich source of important and rare medicinal plant (Das *et al.* 2010a) that corresponds to the rich and wide phyto-diversity it harbours. In the present study medicinally important plants, their uses and distribution in both the plantation areas and natural vegetation were documented. Most of the data were collected during the study of vegetation and phyto-sociology. Available literature on medicinal plants were also consulted for identification and documentation and the methodology suggested and followed by Jain (1991), Rai *et al* (1998), Rai and Bhujel (1999, 2002, 2007a), Santra & Roy (2002) and were adopted.

5.8. CHARACTERIZATION OF SOIL

Different workers had reported the modification of soil characters by plantation (Ehrenfeld, 2003; Thapa *et al.* 2011). That's why the soil parameters like- soil texture, moisture content, soil organic carbon, nitrogen and available potash and phosphorus were included in the present study. Soil samples were collected as per method prescribed by Misra *et al.* (2009) from natural and plantation forests from two layers (0 – 15cm and 15 – 30cm depth).Various physico-chemical properties of the soil were analyzed using standard methods (Piper, 1966; Jackson, 1958): Soil P^H using digital P^H meter 335 (Systronic), moisture by gravimetric method, soil texture by Bouyoucos hydrometric method (Allen *et al.* 1974), organic carbon (Walkley & Black, 1934; Walkley, 1947), N_2 content by Kjeldal method (Allen *et al.* 1974), Available sulphur by colorimetric method (Anderson & Ingram, 1993; Ensminger, 1954) and phosphorus by Bray's method-I (Bray & Kurtz, 1945). The soil samples were analysed in Department of Tea Science, University of North Bengal.

5.9. IMPACT OF AGGRESSIVE WEEDS

Impact of aggressive weeds on local flora was assessed following a combination of methodology suggested by Misra (1968), Acharyya (1998), Rai (2004) and Ghosh (2006). Both the invaded and non invaded area under same environmental conditions were surveyed to collect the phyto-sociological data, relative density, relative abundance and relative frequency and IVI of the weeds in invaded areas were calculated and the processed data was analysed for their impacts on plant society of the study area.

5.10. ASSESSMENT OF ALLELOPATHIC EFFECTS

To assess the allelopathic effects of different plantation species (Teak, Sal, Jarul and Chilauni) native plants, few of them were selected which were encountered during the phyto-sociological survey. Selection of plants which were supposed to have allelopathic effects was based on their stenches of planting i.e. which were used to raise plantation over large areas whereas the species on which allelopathic effects were assessed were selected on the basic of their occurrences, medicinal or other importance, their conservational status, availability of seeds etc. The methodology suggested and used by Putnam and Duke (1978); Kadir (2001); Datta & Ghosh (1987) and Ghosh (2006) were followed.

5.10.1. Collection of seeds

Mature seeds of the test plants [*Andrographis paniculata* (Burm. f.) Wall *ex* Nees, *Plumbago zeylanica* L., *Ocimum gratissimum* L.*, Senna occidentalis* (L.) Link, *Oxalis corniculata* L. were collected from study area and Garden of medicinal plants, University of North Bengal and stored at 4°C in brown envelops for the assessment.

5.10.2. Preparation of extract

For preparation of extracts fresh leaves of the plantation species were collected in airtight zip pouch, brought to the laboratory and washed thoroughly. Then 100 g of fresh leaves were crushed in 250 ml of distilled water using Sandoz mixer grinder machine, filtered through muslin cloth and then Whatman No.1 filter paper and the final volume was adjusted to 1000 ml and used as mother or stock solution (100 %). Then different solution of desired concentrations 25 %, 50 %, 75 %, were prepared by proper dilution with distilled water from the stock solution (Hoque *et al.* 2003).

5.10.3. Germination tests

Before germination tests, healthy seeds of test plants were soaked in 0.1% $MgCl_2$ solution for 3 minutes for surface sterilization and washed with 1% $AgNO_3$ solution to remove adhering $MgCl_2$ and then washed several times with distilled water. Then 20 healthy seeds placed in a sterile 15cm glass petriplates lined with single layer of Whatman filter paper which was moistened sufficiently by adding 15ml of the test solutions. This was set in three replicates along with a control in which the filter paper was moistened with 15ml of distilled water. The petriplates were kept under constant temperature (room temperature) for germination which is indicated by the emergence of radical. After the germination started it was left for 14 days more for recording different parameters like number of seeds germinated, length of roots and shoots, number of lateral roots etc.

Then the data collected from the experiment were processed and analysed statistically using MS Excel 2007. Different formulae which were used to calculate percentage of viability, germination percentage, percentage of inhibition of germination, percentage of inhibition of shoot length and root length, shoot and root vigour index etc. are as mentioned below.

Germination Percentage:

The percentage of germination was calculated using the formula which was followed by Lama (2004), Ghosh (2006) and Acharyya (1998).

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100$$

Percentage of inhibition or stimulation:

Saxena *et al* (1995) was followed to calculate the percentage of inhibition or stimulation.

$$\text{Percentage of inhibition or stimulation} = \frac{\text{Germination \% in desired solution} - \text{Germination \% in Control solution}}{\text{Germination \% in control solution}} \times 100$$

Percentage of viability:

To determine the percentage of viability and the percentage of non-viability of seeds the formula suggested by Acharyya (1998) and Lama (2004) were adopted.

$$\text{Percentage of viability} = \frac{\text{Number of viable seeds in desired solution}}{\text{Number of viable seeds in control solution}} \times 100$$

Percentage of inhibition or stimulation of root length, shoot length and seedling length:

Percentage of inhibition or stimulation of root, shoot and seedling length were calculated by applying the following formula (Acharyya, 1998).

$$\text{Inhibition or stimulation of root length (\%)} = \frac{\text{Root length in desired solution} - \text{Root length in Control}}{\text{Length of root in Control solution}} \times 100$$

$$\text{Inhibition or stimulation of shoot length (\%)} = \frac{\text{Length of shoot in desired solution} - \text{Length of shoot in Control solution}}{\text{Length of shoot in Control solution}} \times 100$$

$$\text{Inhibition or stimulation of seedling length (\%)} = \frac{\text{Length in desired solution} - \text{Length in Control}}{\text{Length of seedling in Control solution}} \times 100$$

Shoot vigour index, root vigour index and seedling vigour index:

Shoot vigour index, root vigour index and seedling vigour index were determined adopting the formula suggested by Thind and Malik (1988) and followed by Acharyya (1998), Lama (2004) and Ghosh (2006).

Shoot vigour index = Percentage of germination × shoot length

Root vigour index = Percentage of germination × root length

Seedling vigour index = Percentage of germination × seedling length

Shoot-root Ratio:

For determination of shoot root ratio Bajpai *et al.* (1995) was followed

$$\text{Shoot: Root} = \frac{\text{Length of shoot}}{\text{Length of root}}$$

Fresh weight of seedlings in control solution and different extract concentration was measured to determine the inhibition or stimulation of fresh weight of seedlings.

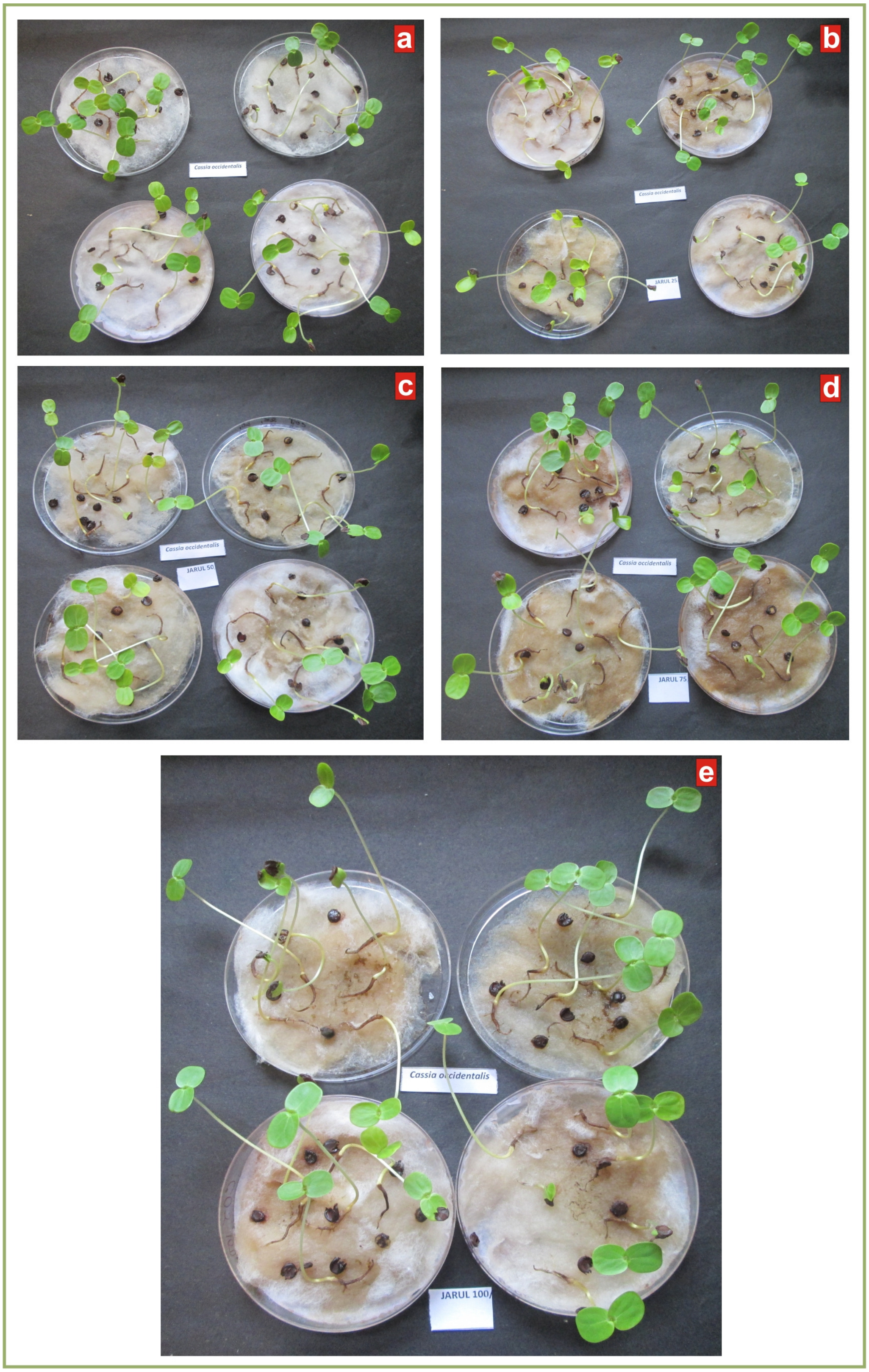

Figure 5.2. Experimental set up for allelopathic effect of Jarul on *S. occidentalis*: **a.** Control; **b.** 25%; **c.** 50%; d. 75%; **e.** 100%

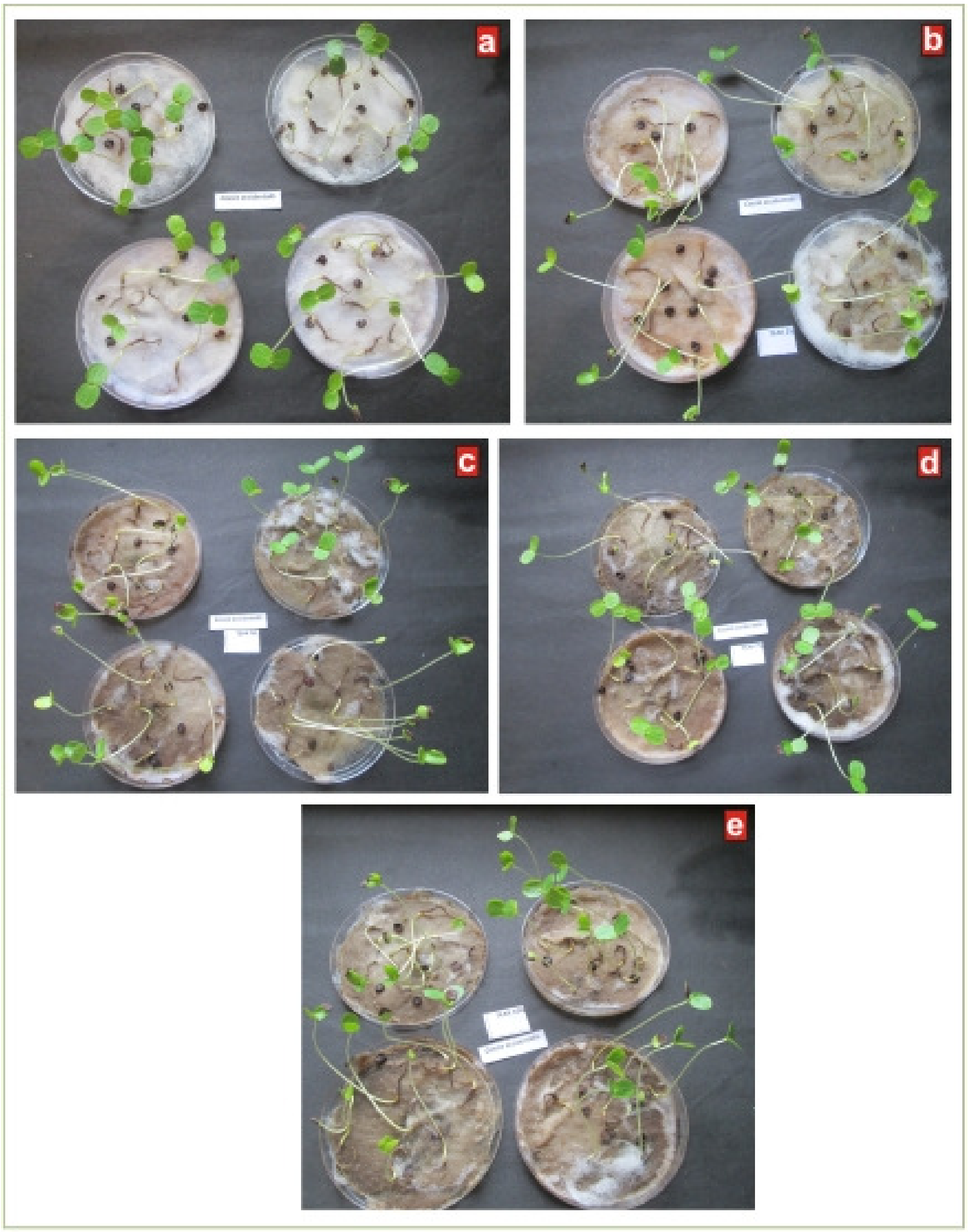

Figure 5.3. Experimental set up for allelopathic effect of Teak on *S. occidentalis*: **a.** Control; **b.** 25%; **c.** 50%; **d.** 75%; **e.** 100%

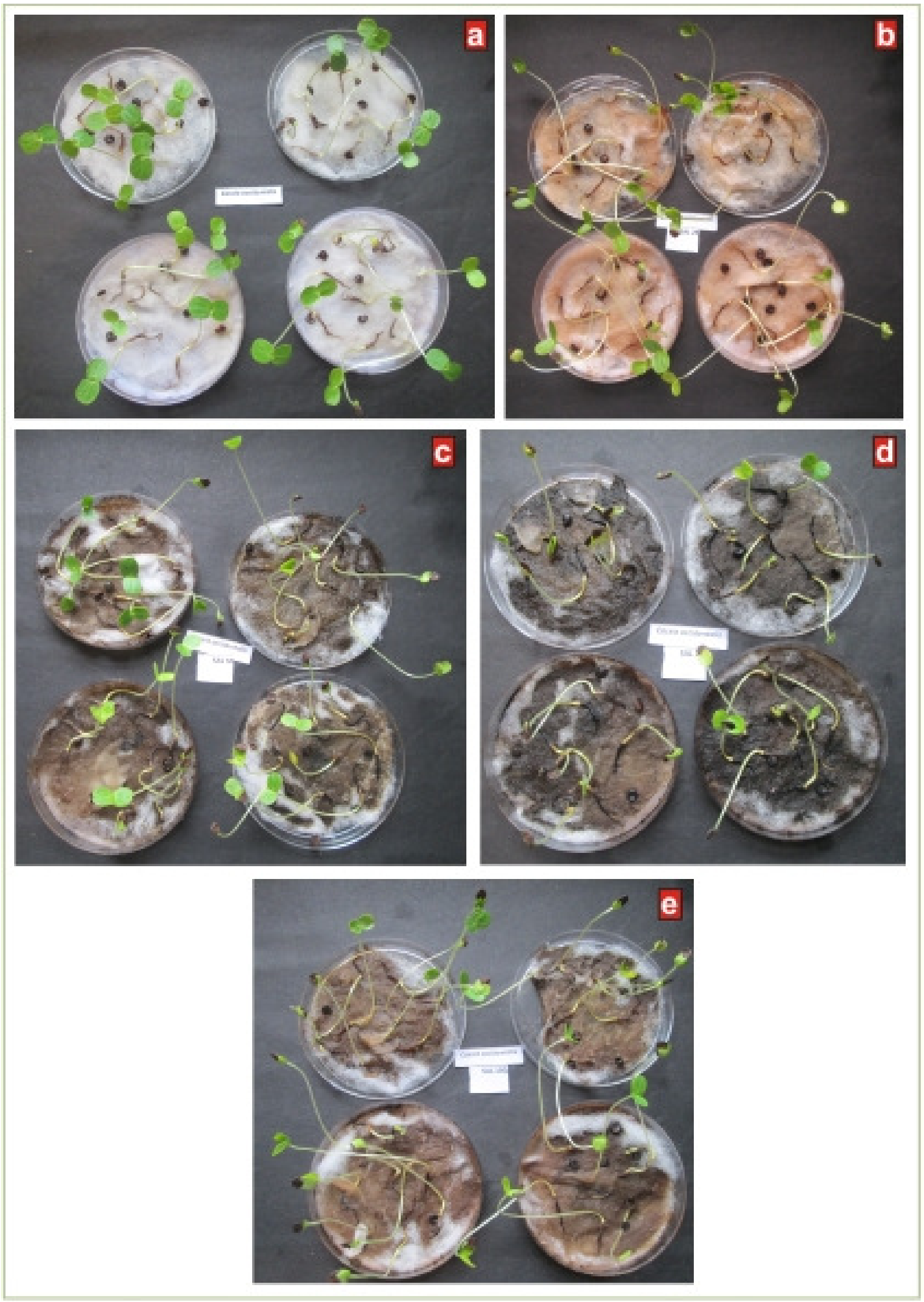

Figure 5.4. Experimental set up for allelopathic effect of Sal on *S. occidentalis*: **a.** Control; **b.** 25%; **c.** 50%; **d.** 75%; **e.** 100%

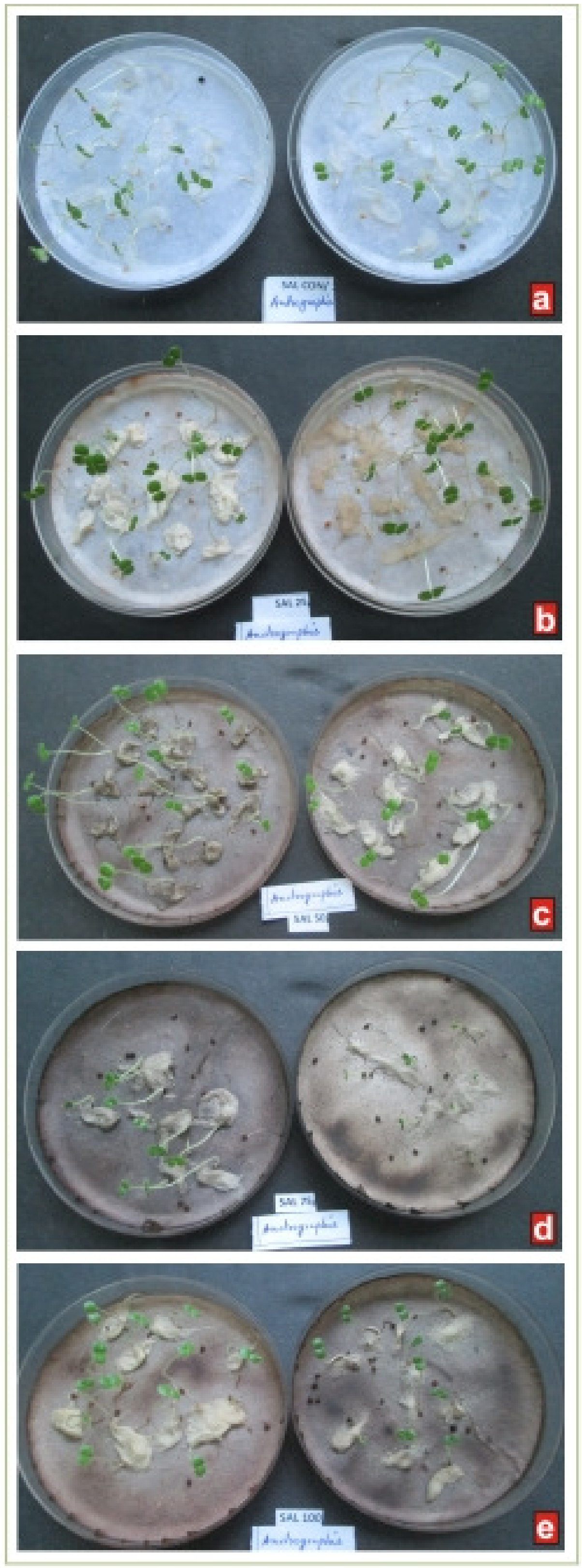

Figure 5.5. Experimental set up for allelopathic effect of Sal on *A. paniculata*: **a.** Control; **b.** 25%; **c.** 50%; **d.** 75%; e. 100%

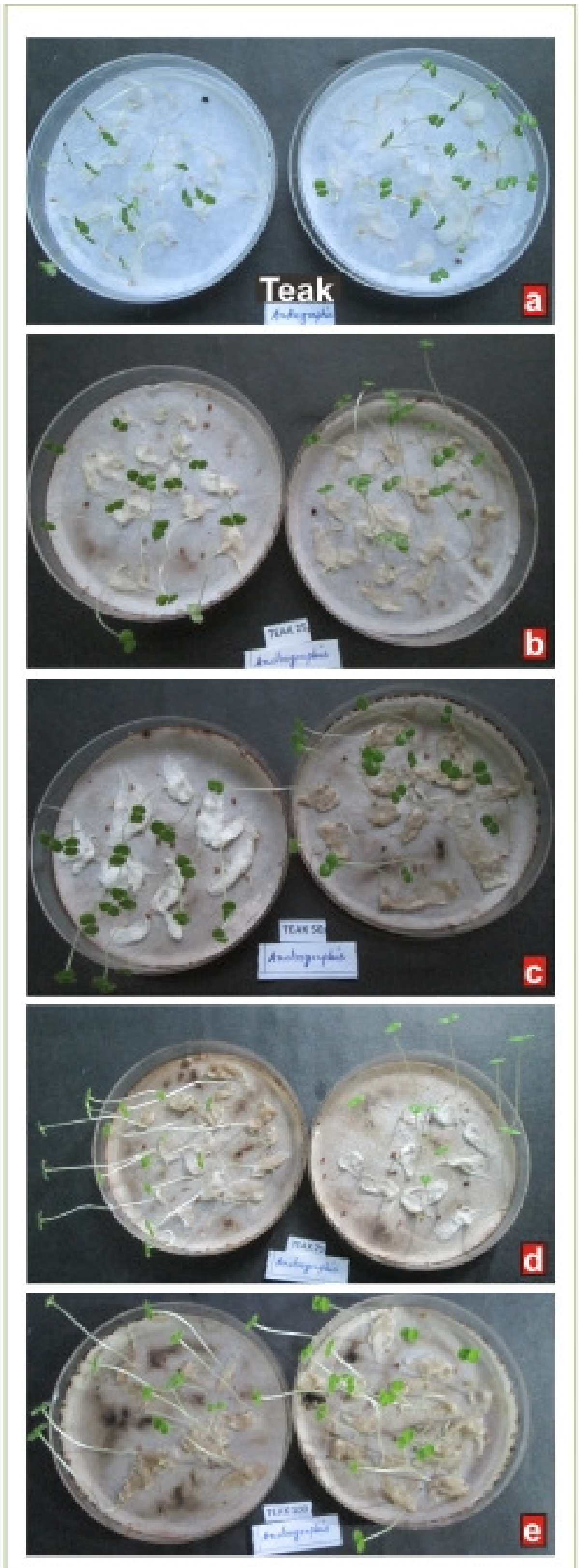

Figure 5.6. Experimental set up for allelopathic effect of Teak on *A. paniculata*: **a.** Control; **b.** 25%; **c.** 50%; **d.** 75%; e. 100%

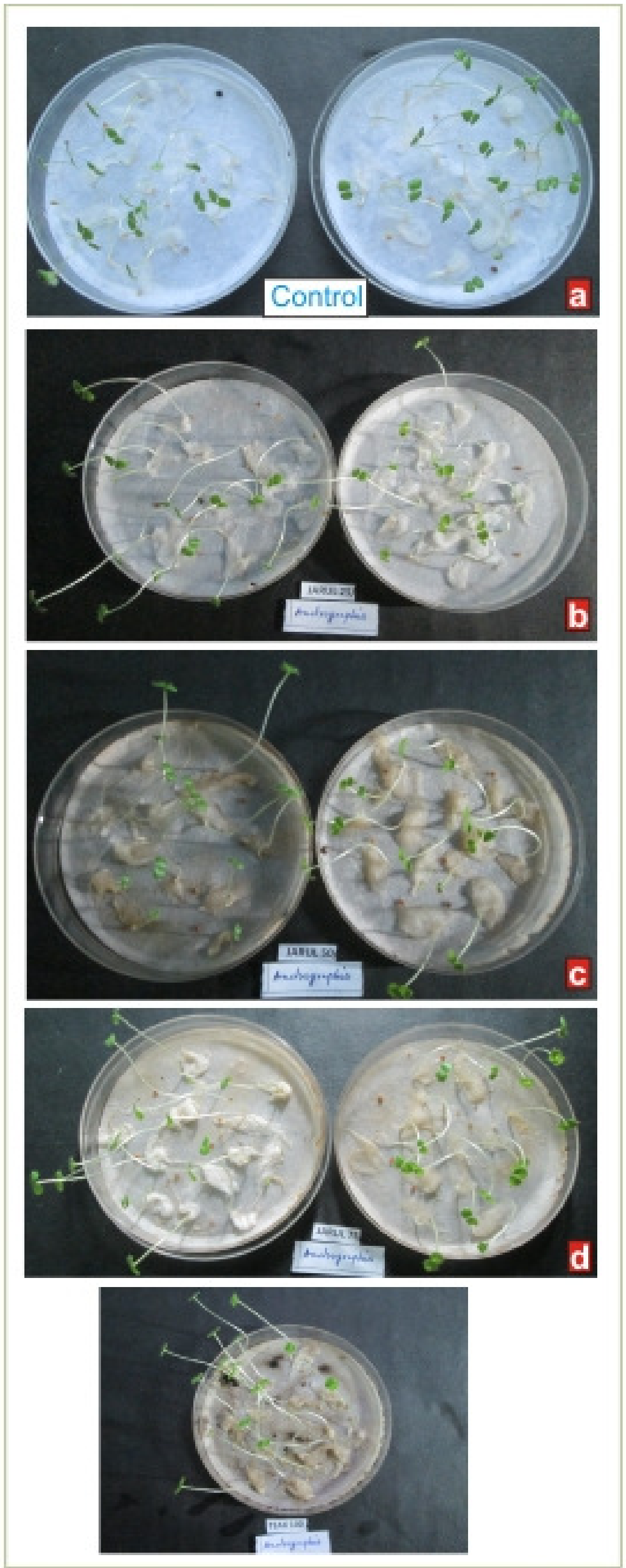

Figure 5.7. Experimental set up for allelopathic effect of Jarul on *A. paniculata*: **a.** Control; **b.** 25%; **c.** 50%; **d.** 75%; **e.** 100%

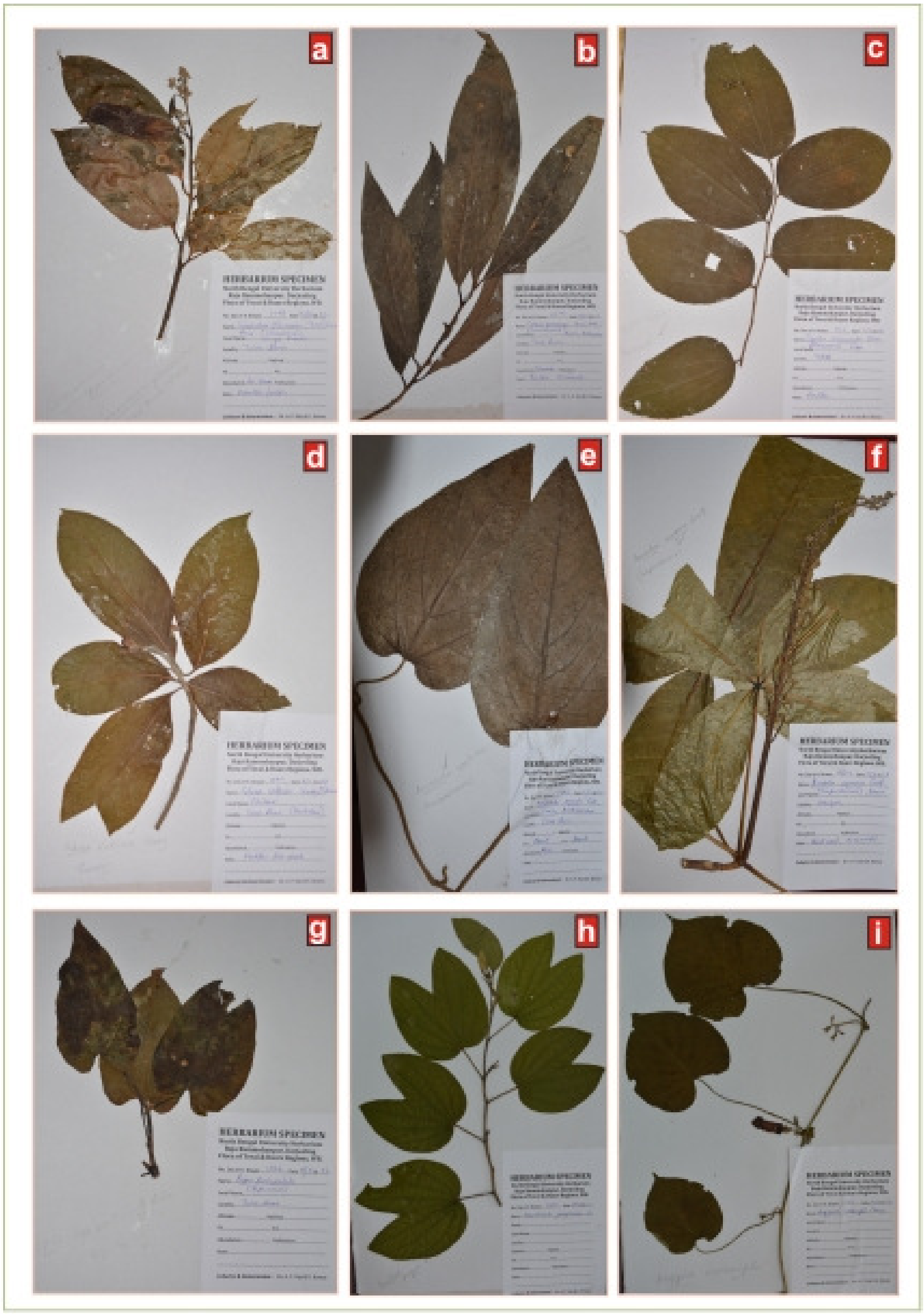

Figure 5.8: Images of Herbarium specimens: **a.** *Cinnamomum glaucescens*, **b.** *Litsea panamaja*, **c.** *Grewia eriocarpa*, **d.** *Schima wallichii*, **e.** *Aesculus assamica*, **f.** *Aristolochia tagala*, **g.** *Piper boehmerifolia*, **h.** *Bauhinia purpurea*, **i.** *Argyreia roxburghii*

Result

In the present study, Terai-Duars belt of the state of West Bengal has been considered for understanding the phytosociological attributes of natural vegetation, which is regarded as the native land cover, and different type of plantations and ultimately to speculate the impact of plantation forest on plant diversity of this area. The study area covers plains of Darjeeling district and entire Jalpaiguri and Alipurduar districts and extends over 8,800 sq km area. Forests and the Vegetation of this region is mainly of Tropical and plains vegetation which is characterized by high temperature and heavy rainfall and is divided into four sub types – Reverine forest, Sal forest, Dry mixed forest and Wet mixed forest. The Sub-tropical forest contiguously lies above the vegetation of Terai - Duars plain. Terai and Duars region have excellent Savannah type of thick and dense grasslands. As the present dissertation is designed to assess the influences of plantation forests on phyto-diversity of the study area, the main theme behind the methodology is to compare different types of plantations with adjacent natural vegetation that was predominant in the entire belt and considered to be the standard land-form.

Two Forest Divisions – Darjeeling and Jalpaiguri and three administrative Districts - Darjeeling, Jalpaiguri and Alipurduar are included under the study area. These two forest divisions were visited consulting with the respective DFOs and the forest ranges having plantation of different ages and types as well as the natural vegetations adjacent to that, were selected for the study. Preference was given to those areas having plantations and natural vegetation under same environmental and ecological conditions. Three such sampling sites were spotted in different parts of Terai-Duars Belt. These are-North Rajabhatkahwa, Sursuti Beat in Lataguri and North Sevokeforest area.

The chapter discusses the result on phytosociology of natural vegetation and different plantation forests, analysis of different biological indices and other parameters which have been considered for comparison of natural vegetation with different type of plantations and finally to construe their impacts on rich and unique phyto-diversity in this stretch of marshy foothill region.

6.1. VEGETATION STRUCTURE AND PHYTOSOCIOLOGY

For characterization of vegetation and analysis of different phytosociological attributes a total of 166 sample plots were laid in natural vegetation and different plantations in the selected sites. Out of these 166 quadrates a total 95 nested quadrates were laid in Natural vegetation of Terai – Duars belt to characterize the tree, shrub and herb layers. Out of these 95 quadrates 50 were studied in NRVK site whereas 20 and 25 quadrates were studied in Sevoke and Lataguri sites respectively. 71 nested quadrates were studied in differen plantations of of terai duars region.

6.1a. Vegetation structure and community analysis

***Natural vegetation*:** Natural vegetation of Terai – Duars region appeared to be quite rich and diverse in floristic component. A total of 446 species of plants belonging to 312 genera and 97 families were recorded from the sampled sites of the study area. Among them 14 species belonging to 11 genera and 10 families were pteridophyta. Out of the Angiospermic species 135 were trees, 79 species shrubs, 126 species herbs and 92 species of climbers (Table 6.1). Highest number of species was reordered for Leguminosae (33 spp.), followed by Lamiaceae (22 spp.), Acanthaceae (19 spp.), Rubiaceae (19 spp.), Euphorbiaceae (18 spp.), Malvaceae (15 spp.), Apocynaceae (13 spp.) etc. Asteraceae, Lauraceae and Vitaceae were recorded with 12 species each whereas Poaceae with 11 species, Meliaceae and Urticaceae with 9 species.

Table 6.1. Number of different taxa and habit wise distribution of plants recorded from natural vegetation

Site	Species	Genus	Family	Tree	Shrubs	Herbs	Climbers	Fern
Lataguri	331	244	92	97	65	89	68	12
NRVK	281	226	81	90	48	72	62	9
Sevoke	224	188	68	76	42	49	51	6
Entire region	446	312	97	135	79	126	92	14

The tree layer was inhabitated by 134 species belonging to 107 genera and 46 families. 255 species belonging to 184 genera and 70 families, and 321 species under 239 genera and 81 families were found to be inhabitated in the shrub and herb layer respectively (Table 6.2). Tree layer was dominated by Leguminosae representing 12 species and was followed by Meliaceae and Malvaceae (9 spp.), Lamiaceae (8 spp.), Lauraceae (6 spp.), Combretaceae (6 spp.), Euphorbiaceae (6 spp.) etc. Shrub-layer was also dominated by Leguminosae representing 19 species. Other associated families in the shrub layer were Euphorbiaceae (17 Spp.), Rubiaceae (15 spp.), Vitaceae (12 spp.), Lamiaceae (11 spp.), Malvaceae (11 spp.), Apocynaceae (11 spp.), Lauraceae (9 Spp.), Rutaceae (9 spp.), Acanthaceae (7 spp.) etc. Acanthaceae with 22 species, dominated the herb layer and was followed by Leguminosae (21 spp.), Lamiaceae (14 spp.) etc. Other frequent families in this layer were Asteraceae, Euphorbiaceae, Vitaceae, Poaceae, Commelinaceae, Urticaceae etc.

NRVK site: In NRVK site, tree layer was represented by 89 species of angiosperm belonging to 81 genera and 39 families. Malvaceae and Leguminosae – these two families co-dominated among the trees and presented 8 species each. Meliaceae, Lauraceae, Lamiaceae, Euphorbiaceae, Apocynaceae, Phyllanthaceae etc are other abundant families. Shrubs and herb layers are represented by 138 species under 121 genera and 51 families; and 193 species under 163 genera and 64 families respectively and thus natural vegetation of NRVK site was represented by 281species belonging to 226 genera and 81 families (Table 6.2) and frequent families were Leguminosae (16 spp.), Rubiaceae (14 spp.), Malvaceae (13 spp.), Lamiaceae (12 spp.), Acanthaceae, Apocynaceae, Euphorbiaceae, Phyllanthaceae, Vitaceae etc.

Table 6.2. Layer wise distribution of different taxa in Natural forests

Site	Layer of vegetation in				
	Taxa	**Tree**	**Shrub**	**Herb**	**Total**
NRVK	**Species**	89	138	193	281
	Genera	81	121	163	226
	Family	39	51	64	81
Lataguri	**Species**	67	199	219	331
	Genera	60	159	171	244
	Family	32	67	77	92
Sevoke	**Species**	74	117	119	224
	Genera	68	99	109	188
	Family	34	41	48	68
Entire Terai-Duars	**Species**	134	225	321	446
	Genera	107	184	239	312
	Family	46	70	81	97

Lataguri site: Natural vegetation of Lataguri region represents 331 species belonging to 244 genera and 92 families of plants including 12 species of pteridophyta belonging to 10 genera and 10 families. Among the recorded species, 97 were trees, 65 shrubs, 89 herbs and 68 species were climbers.Tree layer was represented by 67 species 60 genera and 32 families, of which Meliaceae, Lauraceae, Elaeocarpaceae, Lamiaceae, Malvaceae, Moraceae, Anacardiaceae, Apocynaceae, Leguminosaeetc were abundant ones. Meliaceae was presented by 7 members whereas Lauraceae was represented by 6 species. Shrub layer represented 199 species, 159 genera and 67 families whereas herb layer was represented by 219 species, 171 genera and 77 families (Table 6.2).

Euphorbiaceae and Leguminosae are the highest occurring families represented by 14 species each. Other more abundant families were Rubiaceae represented by 12 species, Lauraceae and Vitaceae represented by 9 species each, Lamiaceae presented by 7 species, Apocynaceae, Malvaceae, Moraceae etc. Lamiaceae, Leguminosae, Acanthaceae, Poaceae, Asteraceae, Euphorbiaceae, Vitaceae, Commelinaceae, Zingiberaceae etc. were the highly abundant families in herb layer. Each of Lamiaceae and Leguminosae is represented by 14 species; Acanthaceae by 12 species and Poaceae by 10 species.

Sevoke site: 74 species of trees belonging to 68 genera and 34 families represented the canopy layer of natural vegetation in Sevoke site. Leguminosae and Meliaceae were recorded for highest number of species (7spp. each) and were followed by Euphorbiaceae (6 Spp.), Malvaceae (5 spp.), Apocynaceae, Combretaceae, Lamiaceae (4 spp. each) etc. Total 117 species belonging to 99 genera and 41 families; and 119 species belonging to 109 genera and 48 families represented the shrubs and herb layer respectively (Table 6.2).

Dominant families of shrubs layer were Euphorbiaceae (11 spp.), Leguminosae (9 spp.), Lamiaceae (7 spp.), Malvaceae (7 spp.), Annonaceae (6 spp.), Apocynaceae (6 spp.), Acanthaceae (5 spp.), Lamiaceae (5 spp.), Rubiaceae (5 spp.) etc.Acanthaceae, the most abundant family, presented 12 spp. and was followed by Asteraceae (8 spp.), Leguminosae (7 spp.), Poaceae (6 spp.), Lamiaceae (5 spp.), Malvaceae (5 spp.), Rubiaceae (5 spp.) etc. in ground-cover vegetation.

Plantation: A total 280 species of plant belonging to 197 Genera and 77 families were recorded from plantation areas, where 71 quadrates were laid. Out of these 71 quadrates, 23 quadrates were laid in NRVK area, of which 5 nested quadrates were studied in mixed plantation, whereas 8 and 10 quadrates were studied in Jarul and Teak plantation respectively. Recorded plant species were classified into 82 trees, 52 shrubs, 81 herbs, 53 climbers (Table 6.3). Leguminosae were recorded for highest number of species (24 spp.) followed by Lamiaceae (12 spp.). Asteraceae, Phyllanthaceae and Rubiaceae were represented by 11 species each. Other families with higher occurrences were Malvaceae (10 spp.), Acanthaceae (9 spp.), Vitaceae (8 spp.) etc.

In Lataguri site, total 25 quadrates were studied, of which 5 quadrates were laid in mixed plantation and 10 quadrates were studied in each of sal-chilauni and teak plantation. In north Sevoke site total 18 nested quadrates were studied to collect data on plantation forest. 8 quadrates were laid in Jarul plantation and 10 quadrates in teak plantation. In addition to the above, a patch of Jarul plantation was studied in Satali area of Rajabhatkhawa forest, where total 5 nested quadrates were laid.

NRVK Site: Total 154 species belonging to 133 genera and 60 families were recorded from NRVK site. Among them 43, 31, 38 and 26 species were trees, shrubs, herbs (including 7 ferns) and climbers respectively (Table 6.3).From Teak plantation of this site 26 species of trees belonging to 23 genera and 18 families were recorded in the tree layer whereas from shrub and herb layer, 48 species belonging to 46 genera and 23 families; and 70 species under 68 genera and 39 families were recorded respectively. Dominant family in the tree layer was Lamiaceae which was presented by 4 species. Other abundant families were Leguminosae (3 spp.), Apocynaceae (2 spp.), Combretaceae, (2 spp.) Lythraceae (2 spp.) Meliaceae (2 spp.) etc.

Table 6.3. Number and habit wise distribution of of different taxa recorded from plantations

Site	Plantation	Species	Genus	Family	Tree	Shrubs	Herbs	Climbers	Fern
Lataguri	**Mixed**	111	96	53	33	20	41	17	--
	Sal-chilauni	109	92	49	28	25	31	25	--
	Teak	127	112	50	34	27	48	18	--
	Total	**201**	**163**	**71**	**60**	**35**	**58**	**40**	**8**
Nrvk	**Jarul-benteak**	78	67	39	15	20	27	16	--
	Mixed	118	106	61	38	19	38	23	--
	Teak	120	111	53	37	27	37	19	--
	Total	**154**	**133**	**59**	**43**	**31**	**31**	**26**	**7**
Sevoke	**Jarul**	123	111	57	31	25	39	28	--
	Teak	125	108	55	37	26	37	25	--
	Total	**166**	**135**	**64**	**49**	**37**	**41**	**31**	**8**
Satali	**Jarul**	71	63	40	15	12	23	15	6
Terai-Duars region		**280**	**197**	**77**	**82**	**52**	**81**	**53**	**12**

In shrubs layer, Euphorbiaceae and Malvaceae presented 5 species each and were the pair of dominant families. They were followed by Lamiaceae, Leguminosae and Rubiaceae – all having 4 species, Phyllanthaceae (3 spp.), Rutaceae (3 spp.), Bignoniaceae (2 spp.), Combretaceae etc. Asteraceae was presented by 6 spp. in herb layer and dominated the ground cover vegetation of teak plantation in NRVK site. It was followed by Leguminosae (5 spp.), Rubiaceae (5 spp.), Acanthaceae (4 spp.), Commelinaceae (4 spp.), Malvaceae (3 spp.), Menispermaceae (3 spp.), Phyllanthaceae (3 spp.), Apocynaceae (2 spp.) etc.

In NRVK Jarul-Benteak plantation, total 78 spp. belonging to 67 genera and 39 families were found to occur and their habit wise distributions were – 15, 20, 27 and 16 spp. of trees, shrubs, herbs and climbers respectively (Table 6.3).Though 15 spp. of trees were recorded, tree layer was found to be constituted by 11 spp. under 10 genera and 8 families whereas shrub and herb layer were composed of 32 spp. of 29 genera under 20 families and 41 spp. of 36 genera under 24 families respectively. Tree layer was dominated by Lamiaceae (6 spp.), and other abundant families were Lythraceae (4 spp.), Bignoniaceae (2 spp.), Cornaceae (2 spp.), Euphorbiaceae (2 spp.), Magnoliaceae (2 spp.) etc. Shrub layer was dominated by Malvaceae, representing 5 spp. along with Asteraceae (3 spp.), Menispermaceae (2 spp.), Acanthaceae etc.

In case of herb layer dominant family was Asteraceae having 6 number of spp. and other associated and abundant families were Poaceae (6 spp.), Acanthaceae (2 spp.), Leguminosae (2 spp.), Oxalidaceae (2 spp.), Phyllanthaceae (2 spp.) etc.

From mixed plantation of NRVK site, total 118 spp. of plants belonging to 106 genera and 61 families were recorded. Tree shrub and herb layer were inhabitated by 31 spp. belonging to 27 genera and 20 families; 37 spp. under 36 genera and 25 families; and 66 spp., 61 genera and 39 families respectively.

Most abundant families in Tree, shrub and herb layer were Combretaceae and Lythraceae represented by 3 spp. each, Dipterocarpaceae (2 spp.), Lamiaceae (2 spp.), Lauraceae (2 spp.), Leguminosae, Meliaceae, Phyllanthaceae, etc; Leguminosae (4spp), Rubiaceae (4spp), Apocynaceae (2 spp.), Asteraceae (2 spp.), Bignoniaceae (2 spp.), Dioscoreaceae (2 spp.) etc; and Asteraceae (6 spp.), Acanthaceae (4 spp.), Commelinaceae (4 spp.), Leguminosae (4 spp.), Apocynaceae (3 spp.), Phyllanthaceae (3 spp.), Piperaceae etc. respectively. Thus tree, shrubs and herb layer were dominated by Combretaceae and Lythraceae – both represented by 3 spp. of trees; Leguminosae and Rubiaceae both having 4 spp. and Asteraceae having 6 representative spp. respectively.

Lataguri Site: In Lataguri site mixed plantation, sal-chilauni and teak plantation were studied and a total of 201 spp. were recorded from this site. They belonged to 163 genera and 71 families. Out of them 60, 35, 58 and 40 species were trees, shrubs, herbs and climbers respectively. Dominant family in respect of highest number of species in this site was Leguminosae represented by 13 species and was followed by Rubiaceae (10 spp.), Asteraceae (9 spp.), Lamiaceae (9 spp.), Malvaceae (8 spp.), Vitaceae (8 spp.), Apocynaceae (7 spp.), Acanthaceae (6 spp.) etc.

Mixed plantation harboured 31 species belonging to 29 genera and 21 families in tree layer; 39 species of 36 genera under 21 families in shrub layer and 67 species belonging to 58 genera and 36 families in herbaceous vegetation. Tree layer was dominated by Meliaceae having 4 representative species and was followed by Lamiaceae, Leguminosae, Combretaceae, Dipterocarpaceae etc. Annonaceae and Leguminosae each having 5 representative species were jointly dominant in shrub layer and are followed by Lauraceae, Asteraceae, Rubiaceae, Malvaceae, Primulaceae etc. Asteraceae and Poaceae each having 5 representative species were the co-dominant family in herbaceous layer. Other abundant families were Rubiaceae, Acanthaceae, Apocynaceae, Leguminosae, Linderniaceae etc.

Sal-chilauni plantation in Lataguri site was inhabitated by109 species of plants belonging to 92 genera and 49 families and their habit wise distribution was – 28 species of trees, 25 species of shrubs, 25 species of climbers and 31 species of herbs (Table 6.3). Total 18 species belonging to 16 genera and 14 families were recorded from the tree layer and was dominated by Lamiaceae having 3 representative species. 52 species of plants belonging to 48 genera and 30 families were recorded from the shrub layer and the dominant families were Euphorbiaceae, Leguminosae and Rubiaceae in joint, and presented 4 species each. Other abundant families were Lythraceae, Apocynaceae, and Asteraceae etc. On the other hand herbaceous vegetation was inhabitated by 61 species belonging to 54 genera and 35 families of which Asteraceae, Lamiaceae and Poaceae were the most abundant families and each of them were represented by 5 species. Other associated and frequent families in the layer were Piperaceae, Vitaceae etc.

Teak plantation was inhabitated by 127 species belonging to 112 genera and 50 families of which Rubiaceae was the most frequent and dominant one having 9 representative species. Other families with higher number of species were Asteraceae with 8 species, Lamiaceae and Malvaceae with 7 species each. Tree, shrub and herb layer of teak plantation were populated by 21 trees belonging to 20 genera under 13 families, 44 species under 41 genera of 22 families; and 87 species belonging to 79 genera and 41 families respectively.

Tree layer was jointly dominated by Apocynaceae and Lamiaceae family each representing 3 species; and were followed by Combretaceae, Euphorbiaceae, Leguminosae etc. Shrub layer was jointly dominated Euphorbiaceae, Malvaceae and Rubiaceae each having 4 representative species. Other abundant families were Lamiaceae, Leguminosae, Phyllanthaceae, Rutaceae, Combretaceae etc.

Asteraceae dominated the herbaceous vegetation, having 8 species and was followed by Rubiaceae, Vitaceae, Acanthaceae, Apocynaceae, Malvaceae, Phyllanthaceae, Poaceae, Cyperaceae, Lamiaceae etc.

Sevoke site: A total of 18 nested quadrates were laid in Sevoke site and it harboured 166 (including 8 species of pteridophytes) species belonging to 135 genera and 64 families. Among them 49 species were tree, 41 were herbs, 37 were shrubs and 31 were climbers. Leguminosae was recorded for highest number of species (15 spp.) followed by Lamiaceae (10 spp.), Euphorbiaceae and Malvaceae (8spp. each), Acanthaceae (7spp.), Asteraceae (6 spp.) etc.

Table 6.4. Layer wise distribution of species, genera and families in Plantations

Site	Taxa	Layer of vegetation in			
		Tree	Shrub	Herb	Total
Nrvk	Species	49	80	129	205
	Genera	42	71	105	165
	Family	26	36	52	69
Lataguri	Species	49	90	140	210
	Genera	43	78	117	170
	Family	28	37	52	70
Sevoke	Species	44	71	79	167
	Genera	40	60	69	137
	Family	24	30	39	66
Terai- Duars	Species	78	127	194	280
	Genera	62	101	147	197
	Family	32	47	60	77

Jarul plantation in Sevoke site was inhabitated by 29 tree species belonging to 27 genera and 18 families. Total 43 species belonging to 40 genera and 27 families and 62 species belonging to 56 genera and 34 families were recorded from shrub and herb layer respectively. Tree layer was jointly dominated by Euphorbiaceae, Lamiaceae, Leguminosae, Lythraceae and Malvaceae – each of which was represented by 3 species. Shrub layer was dominated by Malvaceae having 5 representative species and was followed by Leguminosae, Asteraceae, Acanthaceae etc. Ground cover vegetation was dominated by Acanthaceae, Leguminosae, Araceae, Vitaceae, Poaceae, Dioscoreaceae etc.

Number of species, genus and family recorded from tree, shrub and herb layer of plantations in different site has been presented in Table 6.4. Number of individuals and taxa recorded from natural vegetation and different plantations in different seasons have been presented in Table 6.5, 6.6, 6.7 & 6.8.

6.1b. PHYTOSOCIOLOGY

For phytosociological analysis raw data was collected in 3 consecutive seasons – winter, Pre-monsoon and Post-monsoon. In case of tree layer sampling was done in two seasons – winter and Post monsoon. As minor changes occurred in canopy layer in a single year, sampling in two seasons only was enough to analyse the phytosociological attributes of the tree layer.

NRVK site: In North Rajabhatkhawa (NRVK) site mixed plantation, teak plantation, jarul-benteak plantation and jarul plantation were studied along with natural vegetation.

Mixed Plantation**:** A total 27 species were recorded from tree layer in winter season from mixed plantation. They were distributed under 23 genera and 19 families, and total 125 individual of trees were recorded (Table 6.5). Highest relative frequency (RF) was found to occur in case of Jarul [*Lagerstroemia speciosa* (L.) Pers.] of family Lythraceae having 7.142 as RF value, and was followed by *Shorea robusta* Gaertn. [RF = 5.714], *Terminalia bellirica* (Gaertn.) Roxb. [RF = 5.714] *Terminalia alata* Wall. [RF = 5.714], *Tectona grandis* L. f. [RF = 5.714], *Neolamarckia cadamba* (Roxb.) Bosser [RF = 4.285], *Bauhinia acuminata* L., *Crateva religiosa* Forst. etc. *Neolamarckia cadamba* (Roxb.) Bosser of family Rubiaceae showed highest importance value index (IVI) that was measured to be 26.108, with relative frequency (RF), Relative density (RD) and relative abundance (RA) value of 4.286, 11.2 and 10.622 respectively. Other species showing high IVI values were *Shorea robusta* Gaertn. [IVI = 20.774, RF = 5.714, RD = 8.8, RA = 6.259]. *Terminalia bellirica* (Gaertn.) Roxb. [IVI = 18.036], *Lagerstroemia speciosa* (L.) Pers. [IVI = 17.185], *Terminalia alata* Wall. [IVI = 16.67], *Bauhinia acuminata* L. [IVI = 15.197], *Crateva religiosa* Forst. [IVI = 15.197], *Leea macrophylla* Roxb. *ex* Hornem. [IVI = 15.197], *Aphanamixis polystachya* (Wall.) Parker, *Magnolia champaca* (L.) Baill. *ex* Pierre etc (Annexure I, Table 1). Combretaceae and Lythraceae were represented by highest number of species – 3 species in each.

In Post monsoon season total 31 species were recorded from the same plantation. They were distributed under 27 genera and 20 families. Total number of individuals recorded was 132 (Table 6.5). Families showing highest number of species were – Combretaceae, Dipterocarpaceae and Lythraceae – all having 3 representative species and were followed by Lauraceae, Leguminosae, Meliaceae etc.

Table 6.5. Number of individuals and taxa recorded in different seasons from NRVK site

Plantation	Number of	Layer of Vegetation							
		Tree		Shrub			Herb		
		Winter	Postmon	Winter	Premon	Postmon	Winter	Premon	Postmon
Teak	Individual	169	181	345	481	962	233	391	565
	Species	22	26	26	29	32	39	43	50
	Genera	20	23	24	29	31	38	42	49
	Family	16	17	16	19	18	25	26	34
Mixed	Individual	125	132	303	419	619	298	548	710
	Species	27	31	28	32	37	51	56	63
	Genera	23	27	28	31	37	49	53	60
	Family	19	20	22	22	25	35	36	37
Jarul-Benteak	Individual	407	412	872	1156	1280	185	315	506
	Species	10	12	16	22	30	23	29	37
	Genera	8	10	15	21	29	23	27	34
	Family	8	8	12	15	20	18	20	23
Jarul (Satali)	Individual	109	122	236	382	473	209	332	558
	Species	12	13	19	22	26	28	32	41
	Genera	11	11	18	21	25	25	29	38
	Family	9	9	14	16	18	22	24	38

Neolamarckia cadamba (Roxb.) Bosser [Rubiaceae] showed highest value of the index [IVI = 24.229] along with 3.947, 10.606 and 9.675 as RF, RD and RA respectively. It was followed by *Shorea robusta* Gaertn. [IVI = 19.298], *Terminalia bellirica* (Gaertn.) Roxb. [IVI = 16.746], *Leea macrophylla* Roxb. *ex* Hornem. [IVI = 15.5367], *Terminalia alata* Wall. [IVI = 15.470], *Lagerstroemia speciosa* (L.) Pers., *Bauhinia acuminata* L., *Casearia vareca* Roxb. etc (Annexure I, Table 2).

In winter season from shrub layers, total 303 individuals belonging to 28 species, 28 genera and 22 families were recorded. Leguminosae presented highest number of species (4 spp.) followed by Rubiaceae having 3 representative species and Lauraceae having 2 species, Apocynaceae etc. Highest IVI value was recorded in case of *Coffea benghalensis* Heyne *ex* Schult. having the index value 97.75 and was the dominant species in shrub layer. It was followed by *Clerodendrum infortunatum* L. having IVI value 47.75, *Litsea glutinosa* (Lour.) Rob. [IVI = 15.87], *Morinda angustifolia* Roxb [IVI = 14.19], *Chromolaena odorata* (L.) King & Rob. [IVI = 11.212), *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [IVI = 9.62] etc. The shrub layer was dominated by *Coffea benghalensis* Heyne *ex* Schult. (Annexure I, Table 3).

In Premonsoon season 419 number of individuals were recorded and they were distributed into 32 species belonging to 31 genera and 22 families and highest number of species were recorded under the family Leguminosae (4 spp.) then Rubiaceae (3 spp), and followed by Asteraceae, Bignoniaceae, and Premonsoon vegetation was nearly similar. Not only that, regarding the dominant species also, Premonsoon shrubby vegetation was similar to winter vegetation as because of dominancy of *Coffea benghalensis* having highest IVI value 82.60 along with 6.59, 43.20, and 32.80 as relative frequency and RA in the same sequence. Other species having high IVI values were – *Clerodendrum infortunatum* L. [IVI = 54.46], *Litsea glutinosa* (Lour.) Rob. (IVI = 14.39), *Morinda angustifolia* Roxb. [IVI = 13.84], *Chromolaena odorata* (L.) King & Rob. [IVI = 12.03], *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [IVI = 11.24] *Solanum aculeatissimum* Jacq, *Ixora athroantha* Bremek, *Urena lobata* L. etc (Annexure I, Table 4).

In Post monsoon, total 619 individuals of shrubs were recorded from the quadrate areas. They were distributed into 37 species, belonging to 37 genera and 25 families. Family Leguminosae and Rubiaceae were represented by 4 species each and were followed by Asteraceae, Bignoniaceae, Dioscoreaceae etc. In this season also shrubby vegetation were dominated by *Coffea benghalensis* having IVI score 64.79 along with RF, RD and RA value to be 6.92, 35.38 and 22.49 respectively. In respect of IVI value, next species were *Clerodendrum infortunatum* L. [IVI = 56.86], *Morinda angustifolia* Roxb. [IVI = 13.00], *Chromolaena odorata* (L.) King & Rob. [IVI = 12.53], *Litsea glutinosa* (Lour.) Rob. [IVI = 11.42], *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult., *Solanum aculeatissimum* Jacq., *Urena lobata* L. etc (Annexure I, Table 5).

Ground cover vegetation of NRVK mixed plantation in winter season, composed of 51 species belonging to 49 genera and 35 families. In winter total number of individuals recorded was 298 whereas in Premonsoon and Post monsoon season 584 and 710 individuals were recorded. They belonged to 56 species, 53 genera and 36 families; and 63 species, 60 genera and 37 families respectively (6.5). Asteraceae presented highest number of species in both Premonsoon and Post monsoon seasons – 6 species in each seasons followed by Acanthaceae having 4 species and Apocynaceae having 3 species. Winter ground cover vegetation was dominated by *Chromolaena odorata* (L.) King & Rob. showing IVI value 15.83 along with 5.56, 7.38 and 2.89 as RF, RD and RA values respectively. *Chloranthus elatior* Link. was co-dominant species having almost similar index value [IVI = 15.36] along with 5.56, 7.05 and 2.76 to be RF, RD and RA values. Following species were *Mikania micrantha* Kunth. [IVI = 13.87], *Diplazium esculentum* (Retz.) Sw. [IVI = 13.61], *Coffea benghalensis* Heyne *ex* Schult. [IVI = 12.21], *Piper mullesua* Buch.-Ham. *ex* D. Don [IVI = 11.12], *Commelina suffruticosa* Blume, *Oplismenus burmanni* (Retz.) Beauv. etc (Annexure I, Table 6).

Premonsoon herbaceous vegetation was found to be co-dominated by a number of species showing more or less similar index value. They were *Mikania micrantha* Kunth. [IVI = 15.81], *Dryopteris sikkimensis* (Bedd.) Kuntze [IVI = 14.13], *Chromolaena odorata* (L.) King & Rob. [IVI = 12.33], *Chloranthus elatior* Link [IVI = 11.85], *Pupalia lappacea* (L.) Juss. [IVI = 10.73], *Oplismenus burmanni* (Retz.) Beauv. [IVI = 9.89], *Coffea benghalensis* Heyne ex Schult. [IVI = 9.74], *Ageratum conyzoides* (L.) L., *Synedrella nodiflora* (L.) Gaertn. etc (Annexure I, Table 7). Postmonsoon herbaceous vegetation was also co-dominated by a group of species. *Dryopteris sikkimensis* (Bedd.) Kuntze was found to have highest of IVI value of 15.88 with 4.91, 8.03 and 2.94 as RF, RD and RA values, and was followed by *Diplazium esculentum* (Retz.) Sw. having IVI value 12.33, *Mikania micrantha* Kunth. [IVI = 10.44], *Chloranthus elatior* Link [IVI = 10.26], *Coffea benghalensis* Heyne *ex* Schult. [IVI = 10.24], *Impatiens trilobata* Colebr. [IVI = 10.21] etc (Annexure I, Table 8).

Teak plantation: In case of teak [*Tectona grandis* L. f.] plantation in NRVK site, a total of 169 trees belonging to 22 species, 20 genera and 16 families; and 181 individuals belonging to 26 species, 23 genera and 17 families were recorded in winter and Post monsoon seasons respectively. Apocynaceae, Combretaceae, Lamiaceae and Lythraceae were found to be presented by 2 species each in winter community of trees. Whereas in post monsoon season tree layer was dominated by Lamiaceae having 4 species, and was followed by Leguminosae having 3 recorded species, then Apocynaceae, Combretaceae, Lythraceae etc. Total 122 individuals of teak plant were recorded from 10 quadrates whereas the total numbers of individuals of all the trees were counted to be 169. Importance Value Index of teak was calculated to be 126.58 along with 19.23, 72.19 and 35.16 as RF, RD and RA values. Other species showing high IVI values were *Lagerstroemia speciosa* (L.) Pers., [IVI = 19.04], *Croton caudatus* Geiseler [IVI = 15.57], *Magnolia pterocarpa* Roxb. [IVI = 12.94], *Terminalia alata* Wall. [IVI = 11.98] etc but all with IVI values below 20 (Annexure I, Table 9).

In post monsoon season, the IVI value of teak was calculated to be 113.96 along with 15.38, 66.85 and 31.73 as RF, RD and RA value in respective order. It was followed by *Croton caudatus* Geiseler having IVI value 19.11, *Lagerstroemia speciosa* (L.) Pers. [IVI = 16.15], *Casearia vareca* Roxb. [IVI = 10.99], *Terminalia alata* Wall. [IVI = 10.32] etc (Annexure I, Table 10). In case of shrub layer, a total of 345 individuals belonging to 26 species, 24 genera, 16 families; 481 individuals belonging to 29 species, 29 genera, 19 families; and 962 individuals belonging to 32 species, 31 genera and 18 families were recorded in Winter, Premonsoon and Post monsoon seasons respectively (Table 6.5). Highest number of species was presented by Rubiaceae having 4 species in case of winter vegetation. Other families showing higher number of species were Lamiaceae having 3 species, Malvaceae, Leguminosae, Lythraceae, Phyllanthaceae etc. In Premonsoon season, Malvaceae represented highest number of species (4 species) followed by Leguminosae (3 species), Rubiaceae (3 species), Euphorbiaceae etc. Post monsoon shrubby vegetation was dominated by Euphorbiaceae having 5 representative species and was followed by Leguminosae (3 spp.), Malvaceae (3 spp.), Rutaceae (3 spp.), Lamiaceae, Lythraceae etc. In winter shrub layer was dominated by *Coffea benghalensis* Heyne *ex* Schult. showing IVI value 67.24 along with 14.89, 35.94 and 16.40 as RF, RD and RA respectively. Other two co-dominant species were *Clerodendrum infortunatum* L. having IVI value 48.47 and *Morinda angustifolia* Roxb. having IVI value 45.86 (Annexure I, Table 11). Premonsoon shrubby vegetation was dominated by *Coffea benghalensis* Heyne *ex* Schult. showing IVI value 61.33 along with RF, RD and RA value to be 12.84, 31.81 and 16.67 respectively. Next species were *Clerodendrum infortunatum* L. having IVI value 49.98, *Morinda angustifolia* Roxb. showing IVI value 42.31, *Chromolaena odorata* (L.) King & Rob (IVI = 19.20) etc (Annexure I, Table 12). *Clerodendrum infortunatum* L. that showed 11.97, 32.33 and 19.61 as RF, RD and RA in respective order was found to be the dominant species in shrub layer of teak plantation in post monsoon season. *Coffea benghalensis* Heyne *ex* Schult. showing 61.57 as IVI value was considered to be co-dominant species and was followed by *Morinda angustifolia* Roxb. [IVI = 34.59], *Chromolaena odorata* (L.) King & Rob [IVI = 15.63], *Clausena excavata* Burm.f. [IVI = 13.01] etc (Annexure I, Table 13).

A total 233 individuals belonging to 39 species, 38 genera and 25 families; 391 individuals belonging to 43 species, 42 genera and 26 families; and 565 individuals belonging to 50 species, 49 genera and 34 families were recorded from the herbaceous vegetation of teak plantation in winter, Premonsoon and Post monsoon season respectively (Table 6.5). Asteraceae was the most abundant family and was represented by 4, 6 and 5 species in winter, Pre monsoon and Post monsoon seasons respectively. It was followed by Rubiaceae having 3 species, Acanthaceae, Apocynaceae, Meliaceae etc in winter; by Commelinaceae, Rubiaceae, Acanthaceae, Leguminosae etc. in premonsoon and Leguminosae, Commelinaceae, Poaceae, Rubiaceae, Acanthaceae etc. in Post monsoon season. *Oplismenus burmanni* (Retz.) Beauv. was dominant species in winter season having index value 31.63 along with 13.01, 15.35 and 3.26 as RF, RD and RA value respectively. Other species having higher IVI values were *Coffea benghalensis* Heyne *ex* Schult. [IVI = 17.34], *Mikania micrantha* Kunth. [IVI = 17.18], *Lygodium flexuosum* (L.) Sw. [IVI = 16.54] etc (Annexure I, Table 14). Premonsoon herbaceous vegetation was co-dominated by *Chromolaena odorata* (L.) King & Rob. having index value 19.02 and *Coffea benghalensis* Heyne *ex* Schult. [IVI = 18.55], *Oplismenus burmanni* (Retz.) Beauv. [IVI = 17.4], *Mikania micrantha* Kunth. [IVI = 17.63], *Diplazium esculentum* (Retz.) Sw. [IVI = 13.92] etc (Annexure I, Table 15). Post monsoon herb layer was co-dominated by, *Coffea benghalensis* Heyne *ex* Schult., *Mikania micrantha* Kunth. and *Diplazium esculentum* (Retz.) Sw. having IVI value 16.80, 16.11 and 14.19 respectively (Annexure I, Table 16).

Jarul-Benteak Plantation: A total of 407 individuals belonging to 10 species, 8 genera and 8 families were recorded from Jarul Ben-teak plantation in winter season. But in post monsoon season a total of 412 numbers of trees belonging to 12 species, 10 genera and 8 families were recorded (Table 6.5). In winter 346 number of jarul plants were recorded out of a total of 407 individuals of all the tree species and IVI value was calculated to be 194.86 for Jarul. Other species with higher IVI values were *Lagerstroemia microcarpa* Wight [IVI = 37.88] and *Leea macrophylla Roxb. ex* Hornem.[IVI = 20.30] (Annexure I, Table 17). In postmonsoon season IVI values for *Lagerstroemia speciosa* (L.) Pers., the dominant species, was 187.90 and was followed by *Lagerstroemia microcarpa* Wight with index value 35.27, and *Leea macrophylla* Roxb. *ex* Hornem. with index value 19.32 (Annexure I, Table 18).

A total 872 individuals of shrubs were recorded in winter season and they were distributed under 15 species belonging to 15 genera and 12 families (Table 6.5). Highest number of species was recorded for Malvaceae (4 spp.), followed by Rutaceae (2 spp.). There were 10 families having single species and the vegetation was somehow homogeneous with two species having nearly equal IVI score – *Clerodendrum infortunatum* L. having IVI value 93.68 and *Coffea benghalensis* Heyne *ex* Schult. having IVI of 83.74. Other species having higher IVI were *Chromolaena odorata* (L.) King & Rob [IVI = 29.00], *Sida acuta* Burm. f. [IVI = 15.87], *Clausena excavata* Burm.f. [IVI = 13.32] etc (Annexure I, Table 19).

In post monsoon season total number of recorded shrubs was 1156 and they were distributed under 22 species belonging to 21 genera and 15 families. Families showing highest number of recorded species was Malvaceae (5 spp.) followed by Asteraceae (3 spp.), and Rutaceae (2 spp.) and other 12 families were represented by single species each. Premonsoon shrubby layer was somewhat homogeneous with 2 species having nearly equal IVI score – *Coffea benghalensis* Heyne *ex* Schult. with IVI score 92.20 and *Clerodendrum infortunatum* L. having index value 76.83. Other species having high IVI score was *Chromolaena odorata* (L.) King & Rob [IVI = 26.48], *Sida acuta* Burm.f. [IVI = 14.54] etc (Annexure I, Table 20).

In post monsoon season, from this layer total 1283 individuals were recorded which were distributed under 30 species, 29 genera and 20 families. Highest number of species was recorded for Malvaceae (5 spp.) followed by Asteraceae (3 spp.), Rubiaceae (3 spp.), Rutaceae (3 spp.) and other 16 families with single species. Like winter and Pre monsoon season, Post monsoon vegetation was somewhat homogeneous assemblage of species with *Coffea benghalensis* Heyne *ex* Schult. [IVI = 80.47], as dominant species. It was followed by *Clerodendrum infortunatum* L. having IVI value 74.82, *Chromolaena odorata* (L.) King & Rob. showed IVI value of 22.81. Other species showed IVI below 10 (Annexure I, Table 21).

From herb layer of Jarul plantation in NRVK site a total of 185 individuals belonging to 23 species, 23 genera and 18 families; 315 individuals belonging to 29 species, 27 genera and 20 families; 506 individuals belonging to 37 species, 34 genera and 23 families were recorded in winter, Premonsoon and Post monsoon seasons respectively (Table 6.5).

Highest numbers of species were recorded for Asteraceae having 4 species and was followed by Poaceae (2 spp.), in winter season. In case of pre monsoon season, highest number of species was represented by Asteraceae (5 spp.), followed by Poaceae (3 spp.), Convolvulaceae, Oxalidaceae and Piperaceae each having 2 species. Highest number of species was recorded for Asteraceae (6 spp.) following Poaceae (5 spp.) and other in case of herbaceous vegetation in post monsoon season. Commelinaceae, Convolvulaceae, Leguminosae, Oxalidaceae and Amaranthaceae – these five families were represented by 2 species each. This vegetation was co-dominated by *Pupalia lappacea* (L.) Juss. having IVI value 25.50 and *Mikania* *micrantha* Kunth. with IVI = 24.61. Other species with high IVI score are *Ageratum houstonianum* Mill. [IVI = 18.75], *Spermacoce alata* Aubl. [IVI = 17.05], *Oplismenus compositus* (L.) P. Beauv. [IVI = 15.46], *Persicaria chinensis* (L.) Gross [IVI = 14.10] etc.

Lataguri site: In Lataguri site mixed plantation, teak plantation and sal-chilauni plantation were sampled.

Mixed plantation: In mixed plantation of Lataguri site total 05 nested quadrates were studied and a total of 111 species belonging to 96 genera and 53 families were recorded. Out of them 41 were herbaceous species, 20 were shrubs, 33 were trees and 17 species were climber. A total of 123 individual of tree belonging to 24 species, 23 genera and 18 families were recorded from canopy layer in winter season whereas in post monsoon season a total of 131 individuals belonging to 31 species, 28 genera and 20 families were recorded (Table 6.6).

Table 6.6. Number of individuals and taxa recorded in different seasons from Lataguri site

Plantation	Number of	Layer of Vegetation							
		Tree		Shrub			Herb		
		Winter	Postmon	Winter	Premon	Postmon	Winter	Premon	Postmon
Teak	Individual	196	216	407	569	1020	258	523	896
	Species	19	21	24	30	34	37	45	69
	Genera	**18**	20	23	28	33	36	44	57
	Family	12	13	14	17	21	25	30	34
Mixed	Individual	123	131	575	642	671	198	276	426
	Species	24	31	22	27	36	48	55	61
	Genera	23	28	20	26	35	44	52	60
	Family	18	20	16	17	21	31	36	36
Sal-Chilauni	Individual	145	171	197	440	466	184	200	465
	Species	15	18	34	46	52	43	48	56
	Genera	13	16	32	43	68	42	45	53
	Family	12	15	22	27	29	31	30	33

Highest numbers of species were recorded for Dipterocarpaceae (3 species), Lamiaceae (3 species), Meliaceae (3 species). Combretaceae and Lythraceae were represented by 2 species each and other 13 families were with a single species in winter season. But in Post monsoon season, highest number of species were recorded for Meliaceae (4 species), Dipterocarpaceae (3 species), Lamiaceae (3 species), Leguminosae (3species) etc. Mixed plantation was a heterogeneous assemblage and more than 2 species having high IVI score instead of dominance by a single species were found. Highest IVI score was recorded for *Neolamarckia cadamba* (Roxb.) Bosser [IVI = 38.06] and *Leea macrophylla* Roxb. *ex* Hornem. [IVI = 38.05] and were followed by *Terminalia alata* Roth. [IVI = 29.24], *Terminalia bellirica* (Gaertn.) Roxb. [IVI = 21.07] etc during winter season (Annexure I, Table 25). In Post monsoon season highest IVI score was recorded for *Neolamarckia kadamba* (Roxb.) Bosser [IVI = 34.44] and was followed by *Terminalia alata* Roth. [IVI = 25.75], *Terminalia bellirica* (Gaertner) Roxb. [IVI =

18.32], *Casearia vareca* Roxb. [IVI = 18.18], *Crateva religiosa* Forst. [IVI = 17.91] etc. Thus it's clear from the IVI score of above mentioned species that post monsoon tree layer was also heterogeneous assemblage of few species instead of single dominancy (Annexure I, Table 26).

From shrub layer a total of 575 individuals belonging to 22 species, 20 genera and 16 families; 642 individuals belonging to 27 species, 26 genera and 17 families; and 671 individuals belonging to 36 species, 35 genera and 21 families were recorded in winter, Premonsoon and Post monsoon season respectively (Table 6.6). Highest number of species was recorded for Lauraceae (5 spp.) and Leguminosae (5 spp.) in winter and Premonsoon. In Post monsoon season Moraceae (5 spp.) and Leguminosae (5 spp.) presented the highest number of species and were followed by Apocynaceae (4 spp.). *Coffea benghalensis* Heyne *ex* Schult. was recorded to be the dominant species in shrubby vegetation in all the three seasons, having IVI score 119.82, 107.64 and 98.97 in winter pre monsoon and post monsoon seasons respectively. It was followed by *Clerodendrum infortunatum* L. with IVI score 39.23, 38.55 and 34.97 in the sane sequence. Thus the shrub layer was nearly homogeneous throughout the year (Annexure I, Table 27, 28 & 29).

In case of herbaceous vegetation number of individuals recorded were – 198 belonging to 48 species, 44 genera and 31 families in winter; 276 individuals belonging to 55 species, 52 genera and 36 families in pre monsoon and 426 individuals belonging to 61 species, 60 genera and 36 families in post monsoon season (Table 6.6). Regarding highest number of species represented by a family, shrubby layer in both Premonsoon and Post monsoon seasons were almost similar. Highest number of species were recorded for Asteraceae (4 spp.) and Rubiaceae (4 spp.) and were followed by Acanthaceae (3 spp.), Apocynaceae (3 spp.), Linderniaceae (3 spp.) etc. in both the Pre and Post monsoon vegetation, whereas in winter season highest number of species was recorded jointly for Acanthaceae, Apocynaceae, Asteraceae and Poaceae – each with three species.

Dryopteris sikkimensis (Bedd.) Kuntze was a dominant species in the herb layer in all the three seasons having IVI score of 32.24, 26.42 and 18.77 in winter, Premonsoon and Post monsoon season in the same sequence. Next to the dominant species were *Pupalia lappacea* (L.) Juss. [IVI = 20.71], *Mikania micrantha* Kunth [IVI = 20.44] in winter (Annexure I, Table 30); *Mikania micrantha* Kunth [IVI = 16.02], *Pupalia lappacea* (L.) Juss. [IVI = 15.75] in Premonsoon (Annexure I, Table 31), and *Pupalia lappacea* (L.) Juss. [IVI = 15.23]; *Diplazium esculentum* (Retz.) Sw. [IVI = 13.00] in post monsoon season (Annexure I, Table 32). Thus ground cover was more or less heterogeneous assemblage of more than one species showing high IVI value.

Sal-Chilauni plantation: A total 109 species belonging to 92 genera and 49 families were recorded from 5 nested quadrates from Sal – Chilauni plantation in Lataguri site. Among the recorded species 28 were trees, 25 were shrubs, 31 were herbs and

25 were climbers. In case of tree layer 145 individuals distributed into 15 species, 13 genera and 12 families were recorded in winter (Table 6.6). Highest number of species was recorded for Combretaceae, Lamiaceae and Lythraceae – all having 2 species each. The canopy layer was dominated by *chilauni* [*Schima wallichii* Choicy] with IVI score 97.25 and was followed by *Shorea robusta* Gaertn. having IVI score 65.87 and the vegetation was almost homogeneous (Annexure I, Table 33). In Postmonsoon season, 171 individuals belonging to 18 species, 16 genera and 15 families were recorded. Lamiaceae was recorded for representing highest number of species (3 spp.). IVI score of the dominant species [*S. wallichii* Choicy] was calculated to be 80.12 in Post monsoon and was followed by 58.67 for *Shorea robusta* Gaertn. A total 197 individuals of shrubs belonging to 34 species, 32 genera and 22 families; 440 individuals belonging to 46 species, 43 genera and 27 families; and 466 individuals belonging to 52 species, 48 genera and 29 families were recorded in winter Premonsoon and Post monsoon season respectively (Table 6.6). Euphorbiaceae was recorded for highest number of species (3 spp.) in winter. Leguminosae presented highest number of species along with Rubiaceae in Premonsoon shrub layer. Both of them were presented by 4 species and were followed by Euphorbiaceae (3 spp.), Lythraceae (3 spp.), Phyllanthaceae (3 spp.) etc. In Post monsoon shrubby vegetation also Leguminosae along with Rubiaceae presented highest number of species (4 spp. each) and were followed by Euphorbiaceae (3 spp.), Apocynaceae (2 spp.) etc. *Clerodendrum infortunatum* L. was found to be the dominant species in shrub layer in both pre and post monsoon season having IVI score 34.94 and 41.48 respectively (Annexure I, Table 36 & 37). *Coffea benghalensis* Heyne *ex* Schult. was in second position in IVI score having 26.87 and 23.32 index value in pre monsoon and post monsoon vegetation of shrubs. In case of winter vegetation, shrub layer was dominated by *Coffea benghalensis* having IVI score 42.84 and was followed by *Clerodendrum infortunatum* L. [IVI = 36.44], *Chromolaena odorata* (L.) King & Rob. [IVI = 22.44], *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [IVI = 19.45] etc.

Total number of individuals recorded from herbaceous vegetation was 184 belonging to 43 species, 42 genera and 31 families; 200 belonging to 48 species, 45 genera and 30 families; 465 belonging to 57 species, 53 genera and 33 families in winter, premonsoon and post monsoon season respectively (Table 6.6). Asteraceae presented highest number of species (5 spp.) in winter vegetation and was followed by Poaceae (3 spp.), Acanthaceae (2 spp.) etc whereas in Premonsoon and Post monsoon herb layer families with highest number of species were Asteraceae and Piperaceae in joint having 4 species each, followed by Lamiaceae (3 spp.), Poaceae (3 spp.) etc.; and Poaceae (5 spp.) followed by Asteraceae (4 spp.), Lamiaceae (4 spp.), Piperaceae (3 spp.) etc. Throughout the year ground cover vegetation in Sal – Chilauni plantation was of more or less similar type having no single dominant species. Instead of that a number of species having higher IVI score formed the important component of the vegetation. They are *Mikania micrantha* Kunth [IVI = 18.48], *Coffea benghalensis* Heyne *ex* Schult. [IVI = 18.29], *Chloranthus elatior*

Link. [IVI = 16.48], *Ichnocarpus frutescens* (L.) Aiton [IVI = 15.60] etc. in winter (Annexure I, Table 38); *Mikania micrantha* Kunth. [IVI = 17.75], *Coffea benghalensis* Heyne *ex* Schult. [IVI = 16.02], *Lygodium flexuosum* L. [IVI = 14.15], *Ichnocarpus frutescens* (L.) Aiton [IVI = 13.87] etc. in Premonsoon (Annexure I, Table 39); and *Imperata cylindrical* (L.) Raeusch [IVI = 13.33]. *Oplismenus burmanni* (Retz.) Beauv. [IVI = 12.41], *Mikania micrantha* Kunth [IVI = 11.31], *Elephantopus scaber* L. [IVI = 11.08] in Post monsoon season (Annexure I, Table 40).

Teak Plantation: A total 127 species distributed under 112 genera and 50 families including 7 ferns were recorded from teak plantation of Lataguri site. They include 34 trees, 27 shrubs, 48 herbs and 18 climbers. Tree layer was represented by 19 species belonging to 18 genera and 12 families, in winter season and a total 196 individuals were recorded and they were distributed under 21 species, 20 genera and 13 families (Table 6.c). Highest number of species was recorded for Lamiaceae (3 species) in winter, Apocynaceae, Combretaceae, Euphorbiaceae, Leguminosae and Rubiaceae were represented by 2 species each. Apocynaceae and Lamiaceae both having 3 species each, Combretaceae, Euphorbiaceae, Leguminosae and Rubiaceae were with 2 species each. IVI score of Teak was recorded 121.89 along with 14.71, 66.84, and 40.35 as RF, RD and RA respectively. It contributed near about half of the IVI score of all the tree species in the habitat. Some other species were *Gmelina arborea* Roxb. [IVI = 16.95], *Croton caudatus* Geiseler [IVI = 16.36], *Pueraria sikkimensis* Prain [IVI = 16.36) showing IVI score next to teak (Annexure I, Table 41). In post monsoon season, IVI score of teak was 111.72 and was followed by *Pueraria sikkimensis* Prain [IVI = 19.84], *Croton caudatus* Geieser [IVI = 18.56], *Gmelina arborea* Roxb. [IVI = 16.88] etc (Annexure I, Table 42).

In shrub layer, total 44 species belonging to 41 genera and 22 families were found to be grown throughout the year. In winter total 407 individuals belonging to 24 species, 23 genera and 14 families were recorded whereas in Premonsoon season number of recorded individuals were 569 and were distributed into 30 species, 28 genera and 17 families (Table 6.6). Post monsoon shrubby vegetation was composed of 34 species, 33 genera and 21 families and 1020 individuals were recorded from the sampled area in this season. Highest number of species were recorded from Rubiaceae (4 spp.) followed by Lamiaceae (3 spp.), Malvaceae (2 spp.), Phyllanthaceae (3 spp.) etc in winter; for Lamiaceae (3 spp.), Leguminosae (3 spp.). Malvaceae (3 spp.), Rubiaceae (3 spp.) in joint in Premonsoon season; and for Euphorbiaceae (4 spp.) followed by Malvaceae (3 spp.), Phyllanthaceae (3 spp.), Rutaceae (3 spp.) etc. in post monsoon season.

Shrub layer was found to be heterogeneous assemblage of 3 co-dominant species in winter season – *Coffea benghalensis* Heyne *ex* Schult. [IVI = 64.08], *Clerodendrum infortunatum* L. [IVI = 48.57] and *Morinda angustifolia* [IVI = 41.22]. They contributed to about 50% of the IVI score of all the species in this season. Some other important species were *Maesa chisia* Buch.-Ham. *ex* D. Don

[IVI = 16.85], *Chromolaena odorata* (L.) King & Rob. [IVI = 15.95], *Urena lobata* L.[IVI = 14.72] etc (Annexure I, Table 43). But in Premonsoon season, shrubs layer converted into homogeneous one, as *Coffea benghalensis* Heyne *ex* Schult. Became dominant species showing IVI score 70.24. Other species having IVI score near the higher end were *Clerodendrum infortunatum* L. [IVI = 46.11] and *Morinda angustifolia* Roxb. [IVI = 35.88] (Annexure I, Table 44).

In Post monsoon season composition of shrubby vegetation was more or less similar with that of Premonsoon one with *Coffea benghalensis* Heyne *ex* Schult. as dominant species having IVI score 69.34. Other important components of Post monsoon vegetation in shrub layer were *Clerodendrum infortunatum* L. [IVI = 46.12], *Morinda angustifolia* Roxb. [IVI = 32.36], *Chromolaena odorata* (L.) King & Rob. [IVI = 16.5] etc (Annexure I, Table 45).

Sevoke site: Jarul and teak plantation were studied in Sevoke site.

Jarul Plantation: A total number of 123 species belonging to 111 genera and 57 families were recorded from all the three layer – tree, shrub and herb layer, of Jarul plantation in Sevoke site and among them 31 species were categorise as tree, 25 species as shrubs, 39 species as herbs and 28 species were grouped as climber.

Table 6.7. Number of individuals and taxa recorded in different seasons from Sevoke site

Plantation	Number of	Layer of Vegetation							
		Tree		Shrub			Herb		
		Winter	Postmon	Winter	Premon	Postmon	Winter	Premon	Postmon
Teak	Individual	208	222	406	699	1055	254	555	720
	Species	25	29	34	41	46	42	49	57
	Genera	24	28	34	40	46	38	46	54
	Family	18	20	20	21	23	26	30	32
Jarul	Individual	147	169	404	571	717	315	659	1013
	Species	23	28	31	36	41	44	52	61
	Genera	22	27	30	35	39	40	48	27
	Family	17	18	21	24	27	26	28	33

Tree layer composed of 23 species, belonging to 22 genera and 17 families and total 147 individuals were recorded from the sampled area in winter season whereas in Post monsoon, a total of 169 individuals belonging to 28 species, 27 genera and 18 families were recorded from canopy layer (Table 6.7). Highest number of species was recorded for a single family Lamiaceae (3 spp.) in winter and was followed by Apocynaceae (2 spp.), Euphorbiaceae (2 spp.), Leguminosae (2 spp.) etc. But in Post monsoon season highest number of species was recorded for 3 families – Euphorbiaceae, Lamiaceae and Malvaceae all having 3 representative species each. In the monoculture of *Jarul* [*Lagerstroemia speciosa* (L.) Pers.], for which IVI score was recorded as 107.13 in winter and was followed by *Callicarpa arborea* Roxb. [IVI = 19.72], *Tectona grandis* L. f. [IVI = 15.71], and *Croton* *caudatus* Geiseler [IVI = 11.81] and others (Annexure I, Table 49). In post monsoon, IVI of the dominant species was recorded to be 94.86 and was followed by *Callicarpa arborea* Roxb. [IVI = 18.61], *Croton caudatus* Geiseler [IVI = 15.77], *Pueraria sikkimensis* Prain [IVI = 11.72] etc (Annexure I, Table 50).

From the shrub layer of Jarul plantation in Sevoke site, 404 individuals belonging to 31 species, 30 genera and 21 families were recorded in winter; 571 individuals belonging to 36 species, 35 genera and 24 families in Premonsoon; and 717 individuals belonging to 41 species, 39 genera and 27 families were recorded (Table 6.7).

Coffea benghalensis Heyne *ex* Schult. and *Clerodendrum infortunatum* L. were co-dominant species showing IVI score 50.34 and 49.93 respectively, in winter season. They were followed by *Urena lobata* L. [IVI = 33.44], *Triumfetta rhomboidea* Jacq. [IVI = 21.76], *Chromolaena odorata* (L.) King & Rob. [IVI = 21.11] etc. Thus the vegetation was more or less heterogeneous assemblage of 3 or 4 specie having more or less same IVI values (Annexure I, Table 51). In Premonsoon and Post monsoon season also the shrub layer was more or less similar in the dominance pattern. But the IVI values of the species were slightly changed. IVI values of *Coffea benghalensis* Heyne *ex* Schult. was recorded to be 43.64 in Premonsoon and 38.38 in Post monsoon season (Annexure I, Table 52 & 53).

From herbaceous vegetation of Jarul plantation in Sevoke site, 315 individuals of herbs were recorded and they were distributed under 44 species, 40 genera and 26 families in winter season. On the other hand, 659 individuals belonging to 52 species, 48 genera and 28 families; and 1013 individuals belonging to 61 species, 57 genera and 33 families were recorded from Premonsoon and Post monsoon vegetation in herb layer respectively (Table 6.7). Highest number of species were recorded for Acanthaceae (5 species) and was followed by Poaceae, Vitaceae, Zingiberaceae etc. – all having 3 species, in winter vegetation. In Premonsoon and Post monsoon season also highest number of species was recorded for Acanthaceae (5 and 6 spp. respectively). Other families with higher number of species were Zingiberaceae, Leguminosae, Amaranthaceae, Araceae etc in Premonsoon and Zingiberaceae, Araceae, Leguminosae, Amaranthaceae, Asteraceae etc in descending order in Post monsoon season.

Herbaceous vegetation was an assemblage of numerous species without any particular species as dominant. In winter season IVI values calculated for *Pupalia lappacea* (L.) Juss. [IVI = 20.97] was quite higher than other and was followed by *Setaria palmifola* (J.Koenig) Stapf. [IVI = 15.44], *Oplismenus burmanni* (Retz.) Beauv. [IVI = 15.21] etc (Annexure I, Table 54). In Premonsoon vegetation IVI score of *Coffea benghalensis* was 19.73. Highest IVI value was calculated for *Diplazium esculentum* (Retz.) Sw. in post monsoon season.

Teak Plantation: A total of 125 species (including 7 Pteridophytic species) belonging to 108 genera and 55 families were recorded from teak plantation in

Sevoke site. They were distributed under 37 species of trees, 26 shrubs, 37 herbs and 25 climbers. Highest number of species was recorded for Leguminosae (11 species) and was followed by Euphorbiaceae (8 spp.), Lamiaceae (8 spp.), Commelinaceae (4 spp.), Rubiaceae (4 spp.), Vitaceae (4 spp.), Amaranthaceae (3 spp.) etc.

As it was an almost monoculture, highest number of individuals were recorded for the planted species i.e teak (142 individuals) while 208 individuals were recorded for all the species in the tree layer from the sampled area. Total 25 species were recorded from the winter vegetation in tree layer, and they were distributed under 24 genera and 18 families (Table 6.7). Highest number of species was recorded for Lamiaceae (4 spp.) and was followed by Leguminosae (3 spp.), Lythraceae (2 spp.), Meliaceae (2 spp.) etc. IVI score of the dominant species [*Tectona grandis* L. f.] was recorded to be 118.12 along with 14.71, 68.27 and 35.15 as RF, RD and RA respectively. Other species with IVI value next to the dominant species were – *Pueraria sikkimensis* Prain [IVI = 16.86], *Bauhinia variegata* L. [IVI = 13.21], *Careya arborea* Roxb. [IVI = 12.23] etc (Annexure I, Table 57).

In Post monsoon season, a total of 222 individuals of trees including 139 individual of Teak were recorded from the tree layer. They belonged to 29 species, 28 genera and 20 families (Table 6.7). Lamiaceae and Leguminosae were found to be presented the highest number of species – 4 species in each case. Euphorbiaceae, Lythraceae and Meliaceae were presented by 2 species each. IVI score of *Teak* [*Tectona grandis* L. f.], the dominant species, was recorded to be 105.78 that was contributed by RF of 13.51, RD of 62.61 and RA of 29.66. Other species next to the dominant one, were *Pueraria sikkimensis* Prain [IVI = 18.16], *Bauhinia variegata* L. [IVI = 12.02], *Crateva religiosa* Forst. f. [IVI = 11.31] etc (Annexure I, Table 58).

In winter season a total of 406 individuals belonging to 34 species, 34 genera and 20 families were recorded from shrub layer. Malvaceae was recorded for highest number of spp. (5 spp.) followed by Rubiaceae (4 spp.), Euphorbiaceae (3 spp.), Acanthaceae (2 spp.) etc. In Premonsoon and Post monsoon season, 699 individuals belonging to 41 species, 40 genera and 21 families; and 1055 individuals belonging to 46 species , 46 genera and 23 families were recorded respectively. Leguminosae with 6 species was recorded for highest number of species and was followed by Malvaceae (5 spp.), Euphorbiaceae (4 spp.), Rubiaceae (4 spp.), Lamiaceae etc. in Premonsoon vegetation. Whereas in Post monsoon vegetation Euphorbiaceae and Leguminosae were recorded for higher number of spp. (6 spp. each), followed by Malvaceae (5 spp.), Rubiaceae (4 spp.), Lamiaceae (3 spp.) etc.

Shrub layer was more or less homogeneous without any single dominant species, throughout the year. But the IVI scores of important species were changed seasonally. In winter the shrub layer was the association of important species like *Coffea benghalensis* Heyne ex Schult [IVI = 49.39], *Clerodendrum infortunatum* L. [IVI = 49.10], *Urena lobata* L. [IVI = 33.06], *Triumfetta rhomboidea* Jacq. [IVI =

21.08], *Chromolaena odorata* (L.) King & Rob. [IVI = 20.21] etc (Annexure I, Table 59). In Premonsoon also the association was almost similar but *Urena lobata* with IVI score 41.37 was in second position instead of third. The composition in Post monsoon season was more inclusive than that of winter and premonsoon due to incorporation of some other species.

A total 254 individuals belonging to 42 species, 38 genera and 26 families were recorded from herbaceous vegetation in winter season, whereas 555 individuals belonging to 49 species, 46 genera and 30 families; and 720 individuals belonging to 57 species, 54 genera, and 32 families, were recorded in Premonsoon and Post monsoon season respectively (Table 6.7).

All over the year, Acanthaceae was found to be represented by highest number of species (6 species) and was followed by Amaranthaceae with 3 species. No single species was found to be dominant in winter and Post monsoon herbaceous layer whereas *Oplismenus burmanni* (Retz.) Beauv. was found showing dominancy to some extent having IVI score 23.90 along with RF, RD and RA values as 1.48, 9.19 and 13.23 respectively. Next one was *Setaria palmifola* having index value 15.90. Winter vegetation was represented by a number of species having similar IVI score. They were – *Setaria palmifola* (J.Koenig) Stapf. [IVI = 19.97], *Oplismenus burmanni* [IVI = 19.84], *Pupalia lappacea* Beauv. [IVI = 17.20], *Commelina diffusa* Burman. f. [IVI = 12.94] etc (Annexure I, Table 62). *Oplismenus burmanni* Beauv. [IVI = 16.05], *Mikania micrantha* Kunth. [IVI = 15.24], *Dioscorea bulbifera* L. [IVI = 14.25], *Commelina suffruticosa* Blume [IVI = 12.90], *Synedrella nodiflora* (L.) Gaertn. [IVI = 12.36] etc were important component of Post monsoon herbaceous vegetation (Annexure I, Table 64). General tendency of this vegetation was – dominancy of Monocolyledonous plants-throughout the year.

Jarul plantation in Satali, under NRVK site was populated by 71 species, 63 genera and 40 families including 6 species of pteridophytes. They were categorized under 15 climbers, 29 herbs, 12 shrubs and 15 trees. Highest number of species was recorded for Asteraceae having 5 species and was followed by Leguminosae (4 species) Convolvulaceae, Dioscoreaceae, Lamiaceae, Moraceae, Urticaceae, Vitaceae – all represented by 3 species. From tree layer, 14 species, 11 genera and 9 families were recorded. In shrub layer 65 species, 64 genera and 19 families were found to occur whereas herb layer harboured 42 species belonging to 39 genera and 28 families.

A total 109 trees belonging to 12 species 11 genera and 09 families were recorded in winter from tree layer whereas in Post monsoon season, number of recorded individual was 122, belonging to 13 species, 11 genera and 09 families (Table 6.5). Leguminosae, Lythraceae and Moraceae were recorded for highest number of species in winter; whereas in Post monsoon, highest number of species were recorded for Moraceae (3 species), and was followed by Lamiaceae (2 species), Leguminosae (2 species), Lythraceae (2 species) etc.

As it was a monoculture of Jarul [*Lagerstroemia speciosa* (L.) Pers.], highest value of IVI was recorded for it [126.15] and that was accompanied by higher values of RF, RD and RA as 13.51, 62.39 and 50.25 respectively. Regarding IVI score the species next to *Jarul*, were *Litsea monopetala* (Roxb.) Pers. [IVI = 28.42], *Albizia lucidior* (Steud.) Nielsen [IVI = 21.86], *Crateva religiosa* Frost. f. [IVI = 18.18] etc (Annexure I, Table 65). In Postmonsoon season IVI score of *Jarul* was recorded to be 120.40 along with 12.82, 59.84 and 47.74 as RF, RD and RA respectively. Species next to *Jarul* were *Litsea monopetala* (Roxb.) Pers. [IVI = 27.56], *Albizia lucidior* (steud.) Nielsen [IVI = 23.14], *Crateva religiosa* Forst f. [IVI = 21.72] etc (Annexure I, Table 66). Thus the tree layer was almost similar in both winter and Post monsoon season.

From shrub layer of *Jarul* plantation, a total of 236 individuals belonging to 19 species, 18 genera and 14 families in winter; 382 individuals belonging to 22 species, 21 genera and 16 families in Premonsoon and; 473 individuals belonging to 26 species, 25 genera and 18 families were recorded in Postmonsoon season (Table 6.5). Asteraceae, Dioscoreaceae, Moraceae, Urticaceae etc. were with highest number of species in winter. In Premonsoon, Primulaceae with 3 species was recorded for highest number of species and was followed by Asteraceae (2 spp.), Dioscoreaceae (2 spp.), Moraceae (2 spp.), Urticaceae (2 spp.) etc. On the other hand Dioscoreaceae was recorded for highest number of species (3 species) in Postmonsoon and was followed by Asteraceae (2 spp.), Moraceae (2 spp.), Primulaceae (2 spp.) etc.

Coffea benghalensis Heyne *ex* Schult. was recorded for high IVI score in all the winter, Premonsoon and Postmonsoon vegetation and thus dominated the vegetation all over the year (Annexure I, Table 67 – 69). Only the index values changed in different seasons: 123.26 in winter, 93.43 in Premonsoon and 81.54 in Postmonsoon season. *Clerodendrum infortunatum* L. was found next to the dominant species in respect of IVI score and the index values for which were calculated to be 45.32, 32.15 and 31.88 in winter, Premonsoon and Postmonsoon in the same order.

A total of 209 individuals belonging to 28 species, 25 genera and 22 families; 332 individuals belonging to 32 species, 29 genera and 24 families; and 558 individuals belonging to 41 species, 38 genera and 29 families were recorded from herbaceous vegetation of *Jarul* plantation in winter, Premonsoon and Postmonsoon season respectively (Table 6.5).

Convolvulaceae was recorded for representing highest number of species in winter and Premonsoon season. Three species were recorded in each season and was followed by Amaranthaceae having 2 species. On the other hand Asteraceae was recorded for largest number of species (4 species) in Postmonsoon season. Clear dominancy by a single species [*Diplazium esculentum* (Retz.) Sw.] was found in case of winter vegetation. IVI score for dominant species was recorded to be 43.34

along with 17.95, 20.57 and 4.81 as RF, RD and RA in the same order. *Dioscorea bulbifera* L. [IVI = 26.28], *Pouzolzia hirta* Blume *ex* Hassk. [IVI = 23.53], *Oplismenus burmanni* (Retz.) Beauv. [IVI = 20.78], *Pupalia lappacea* (L.) Juss. [IVI = 19.45], *Dioscorea pentaphylla* L. [IVI = 17.31] etc. were other species forming a group next to the dominant species (Annexure I, Table 70). In Premonsoon vegetation of herbaceous species, *Diplazium esculentum* Retz. showed the tendency to be the dominant one having IVI value of 34.95 along with RF of 14.50, RD of 16.27 and RA of 4.18. It was followed by *Dioscorea bulbifera* L. having IVI value of 28.98, *Spermacoce alata* Aubl. [IVI = 17.33], *Oplismenus burmanni* (Retz.) Beauv. [IVI = 16.29] etc (Annexure I, Table 71).

No clear dominancy of a single species was found in Post monsoon vegetation. But two species – *Diplazium esculentum* (Retz.) Sw. [IVI = 25.99] and *Dioscorea bulbifera* L. [IVI = 23.17] were found to have co-dominancy. Other species having high IVI were – *Pouzolzia zeylanica* (L.) Benn. [IVI = 13.78], *Chloranthus elatior* Link. [IVI = 13.49], *Oplismenus burmanni* Beauv. [IVI = 12.30] etc. Thus it is better to conclude that the Postmonsoon vegetation of herbaceous species was an assemblage of numerous species without any single dominant species (Annexure I, Table 72).

***Natural Vegetation*:**

NRVK site: In winter season a total of 871 individuals of trees belonging to 88 species, 80 genera and 46 families were recorded from 50 quadrates in tree layer of natural vegetation of NRVK site (Table 6.8). Malvaceae and Leguminosae were recorded for highest number of species – 8 species in each, and was followed by Meliaceae [6 spp.], Lauraceae, Lamiaceae, Euphorbiaceae, Apocynaceae – each with 5 species, Phyllanthaceae with 4 species etc in tree layer.

Table 6.8. Number of individuals and taxa recorded in different seasons from Natural Vegetation

Site	Number of	Layer of Vegetation							
		Tree		Shrub			Herb		
		Winter	Postmon	Winter	Premon	Postmon	Winter	Premon	Postmon
NRVK	Individual	871	893	3412	4436	5825	3025	4506	6735
	Species	88	91	89	102	111	123	134	157
	Genera	80	82	81	88	102	114	131	135
	Family	46	44	80	46	43	55	58	51
Lataguri	Individual	280	291	989	1122	1369	1008	1288	1529
	Species	64	67	127	131	151	112	123	149
	Genera	54	58	107	111	120	94	108	127
	Family	30	30	54	56	56	50	61	62
Sevoke	Individual	274	290	918	1057	1407	1013	1529	1926
	Species	69	73	67	72	76	74	83	90
	Genera	62	66	62	68	71	71	80	88
	Family	32	34	31	29	38	35	49	44

Highest number of individuals was recorded for *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. (85 individuals), followed by *Dendrocnide sinuata* [71 individuals], *Trewia nudiflora* L. [63 individuals] etc. Thus highest IVI value also was recorded for *T. divaricata* [IVI= 17.98], followed by *D. Sinuata* [IVI= 15.00], *T. nudiflora* L. [IVI= 14.50], *Aphanamixis polystachya* (Wall.) Parker [IVI= 10.07], *Leea guinensis* G. Don [IVI= 8.90], *Litsea monopetala* (Roxb.) Persoon [IVI= 8.90], *Polyalthea simiarum* (Hook. f. & Thomson) Hook .f. & Thomson [IVI= 8.45] etc (Annexure I, Table 73). Other important species were – *Casearia vareca*, *Ailanthus integrifolia*, *Tetrameles nudiflora*, *Croton caudatus*, *Agalia spectabilis* etc. Thus the vegetation was not dominated by single species but it was an assemblage of numerous species having more or less similar IVI value.

In post monsoon season, total 893 Individuals belonging to 91 species, 82 genera and 44 families were recorded from tree layer. Highest number of individuals were recorded for *Tabernaemontana divaricata* and was followed by *Dendrocnide sinuata* (Blume) Chew, *Trewia nudiflora* L etc. Like winter vegetation, no prominent dominancy of a single species was recorded in post monsoon season also (Annexure I, Table 74). Nearly similar type of IVI score was shown by the above mentioned species. Thus both the winter and post monsoon tree Layer were of similar type in respect of dominancy pattern and species composition.

In shrub layer total 100 number of 5×5m^2 quadrates were studied in NRVK site and a total of 3412 individuals belonging to 89 species, 81 genera and 40 families; 4436 individuals belonging to 102 species, 88 genera and 46 families; and 5825 individuals belonging to 111 species, 102 genera and 43 families were recorded in Winter, Pre monsoon and Post monsoon season respectively. Vitaceae was recorded for highest number of species (9 spp.) and was followed by Leguminosae & Malvaceae with species each, Apocynaceae, Euphorbiaceae, Rubiaceae with 7 species each, Phyllanthaceae, Rutaceae with 6 species each etc in shrub layer. Highest IVI value was recorded for *Coffea benghalensis* Heyne *ex* Schult. [IVI= 20.61, RF= 3.84, RD= 12.10, & RA= 4.67] and was followed by *Clerodendrum infortunatum* L. [IVI= 18.75, RF= 2.96, RD= 10.52 & RA= 5.27], *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [IVI= 14.22, RF= 4.78, RD= 7.21 & RA= 2.23], *Dendrocnide sinuata* (Blume) Chew [IVI= 12.98], *Morinda angustifolia* Roxb. [IVI= 11.06] etc. in winter vegetation (Annexure I, Table 75).

Premonsoon shrub layer of natural vegetation in NRVK site was an amalgamation of a large number of species with more or less equal index value without any prominent dominancy. That was evident from the RF, RD, RA and IVI values. Highest IVI value was recorded for *Coffea benghalensis* Heyne *ex* Schult. [IVI=18.34], followed by *Clerodendrum infortunatum* L. [IVI=15.7], *Dendrocnide sinuata* (Blume) Chew. [IVI=15.51], *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [IVI=12.20] etc (Annexure I, Table 76).

In post monsoon shrubby vegetation also highest index value was recorded for *Coffea benghalensis* Heyne *ex* Schult. [IVI=20.85, RF=3.74, RD=13.29, RA=3.82] and was followed by *Dendrocnide sinuata* (Blume) Chew. [IVI=12.76], *Pueraria sikkimensis* Prain [IVI=12.34], C*lerodendrum infortunatum* L. [IVI=12.00], *Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [IVI=10.34] etc (Annexure I, Table 77). Thus the vegetation in shrub layer in post monsoon season was an assemblage of a number of species with similar type of index value but without any clear and true dominancy though a tendency of dominancy was noted in case of *Coffea benghalensis* Heyne *ex* Schult.

From groundcover vegetation of NRVK natural forest, total 3025 individuals belonging to 123 species, 114 genera and 58 families; 4506 individuals belonging to 134 species, 131 genera and 58 families; and 6735 individuals belonging to 157 species, 135 genera and 51 families were recorded in Winter, Premonsoon and Postmonsoon season respectively (Table 6.8). Highest number of species was recorded in case of Acanthaceae for herb layer. Other important families were- Leguminosae & Rubiaceae each with 9 species, Lamiaceae with 8 species, Apocynaceae, Araceae Asteraceae, Malvaceae & Vitaceae with 7 species each etc.

Chloranthus elatior Link. was recorded for highest index value [IVI=12.32] and was followed by *Mikania micrantha* Kunth. [IVI=8.04], *Achyrospermum wallichianum* Bentham [IVI=7.00], *Phaulopsis imbricata* (Forssk.) Sweet [IVI=7.00], *Gomphostemma ovatum* wall. *ex* Benth [IVI=5.7] etc (Annexure I, Table 78). Thus *Chloranthus elatior* played the role of the dominant species in the ground cover vegetation in winter population whereas in Premonsoon season highest value of IVI was recorded for *Coffea benghalensis* Heyne *ex* Schult. [IVI=12.2], and was followed by *C. infortunatum* L. [IVI=7.60], *Chromolaena odorata* (L.) King & Rob. [IVI=7.60], *Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook. f. etc (Annexure I, Table 79). Thus *Coffea benghalensis* Heyne *ex* Schult. showed a tendency to be dominant species in Premonsoon vegetation. Postmonsoon vegetation also was represented by a number of species having similar type of index value. Composition of species was more or less similar in all the 3 season but differed in the highest IVI value only. In Postmonsoon season the highest IVI value was recorded for *Coffea benghalensis* Heyne *ex* Schult. and was calculated to be 8.79 only (Annexure I, Table 80).

***Lataguri site*:** It has been mentioned earlier that a total 331 species belonging to 244 genera and 92 families were recorded from natural vegetation of Lataguri site, and their habitual division was like - 101 species of herbs, 65 species of shrubs, 97 species of trees and 68 species of climber. Tree layer in winter season was inhabitated by 64 species belonging to 54 genera and 30 families and a total of 280 individuals were recorded from the sampled area (Table 6.8). Highest number of stem count was found in case of *Machilus glaucescens* (Nees) Wight. with 24 individuals and was followed by *Bauhinia variegata* L. (18), *Stereospermum tetragonum* DC. (17) etc. Highest IVI was recorded for *M. glaucescens* (Nees)

Wight. with index value 16.21 along with 4.39, 8.57 and 3.24 of Relative frequency, Relative density and Relative abundance. Other species with high index value were – *Bauhinia variegata* L. [IVI= 14.82], *S. Tetragonum* DC. [IVI = 13.65], *Baccaurea ramiflora* Lour [IVI= 13.55], *Actinodaphe obovata* (Nees) Blume [IVI = 11.54], *Agalia spectabilis* (Miq.) Jain and Bennet [IVI = 11.45], *Sorindeia madagascariensis* Bail. [IVI = 10.51], *Shorea* r*obusta* Gaertner f. [IVI = 9.50], *Turpinia pomifera* (Roxb.) DC. [IVI = 9.50], *Gynocardia odorata* R. Br. [IVI = 8.49] etc (Annexure I, Table 81). Thus the vegetation was a collection of numerous important species without any prominent dominancy by a single species or even the co- dominancy.

In post monsoon vegetation of trees 291 stem count were recorded for 67 species belonging to 58 genera and 30 families. The highest index value was recorded for *Machilus glaucescens* (Nees) Wight. [IVI = 15.49] and was followed by *B. variegata* L. [IVI = 14.11], *Stereospermum tetragonum* DC. [IVI = 13.00], *Baccaurea ramiflora* Lour. [IVI = 12.90], *Actinodaphe obovata.* (Nees) Blume [IVI = 11.02], *Agalia spectabilis* (Miquel) Jain & Bennet [IVI = 10.90] etc (Annexure I, Table 82). Thus both the winter and post monsoon vegetation of trees were almost similar in respect of species composition and dominance pattern. Only difference was in the index value. Tree layer in the natural vegetation in Lataguri site was an assemblage of numerous species having similar type of index value and were quite stable. Increases in number of stem count from winter to post monsoon was found and that was due to the increase in diameter in breast height (DBH) or more simply for the growth of saplings of some fast growing species.

In winter season 989 individuals of shrubs including saplings of trees belonging to 127 species, 107 genera and 55 families were recorded. On the other hand 1122 individuals belonging to 131 species, 111 genera and 56 families in winter seasons; and 1359 individuals belonging to 151 species, 120 genera and 56 families in premonsoon; and 1369 individuals belonging to 151 species, 120 genera and 56 families in post monsoon seasons, were recorded from the shrub layer of natural vegetation (Table 6.8). *Mikania micrantha* Kunth. was recorded for highest index value in both pre monsoon [IVI= 20.49] and post monsoon season [VI = 21.81] and was followed by *Chromolaena odorata* (L.) King & Rob. [IVI = 9.94], *Justicia adhatoda* L. [IVI = 9.8], *Croton caudatus* Geiseler [IVI = 8.78], *Clerodendrum infortunatum* L. [IVI = 8.29], *Litsea monopetala* (Roxb.) Pers [IVI = 6.94] etc in pre monsoon vegetation.

Other important component of the vegetation were *Capparis acutifolia* sweet [IVI = 6.81], *Baliospermum solanifolium* (Burm.) Suresh. [IVI = 6.25], *Meyna spinosa* Roxb. *ex* Link [IVI = 5.63], *Antidesma bunius* (L.) Spreng. [IVI = 4.88] etc (Annexure I, Table 84). But in post monsoon vegetation *Mikania micrantha* was followed by *Alpinia nigra* (Gaertn.) Burtt [IVI = 12.14], *Alpinia calcarata* (Haw.) Roscoe [IVI = 11.34], *Piper peepuloides* Roxb [IVI = 10.71], *Chromolaena odorata* (L.) King & Rob. [IVI = 10.25], *Phlogacanthu* *thyrsiformis* (Roxb. *ex* Hardw.) Mabb. [IVI = 9.17], *Alpinia nigra* (Gaertn.) Burtt [IVI = 8.80] etc (Annexure I, Table 85). Thus pre monsoon and post monsoon shrub layer were more or less similar in species composition. Though post monsoon vegetation was higher in respect of number of species and the individuals.

A total of 1008 individuals including seedlings of trees and shrubs were recorded from the winter vegetation of herb layer of Natural vegetation in Lataguri site. They belonged to 112 species under 94 genera and 50 families (Table 6.8). Highest value of Relative frequency (RF) was recorded in case of *Mikania micrantha* Kunth. (RF = 10.38) followed by *Piper betlioides* DC. (RF = 6.60), *Oplismenus burmanni* (Retz.) P. Beauv. [RF = 5.09], *Ageratum houstonianum* Miller [RF = 4.34], *Dryopteris sparsa* (D. Don) Kuntz. [RF = 3.96] etc. On the other hand, highest relative density was recorded for *M. micrantha* Kunth [RD = 10.22], followed by *A. houstonianum* Miller [RD = 6.75], *Oplismenus burmanni* (Retz.) P. Beauv. [RD = 6.35], *Dryopteris sparsa* (D. Don) Kuntze [RD = 4.86], *P. betleoides* DC. [RD = 4.06] etc. In case of relative abundance, *Glycosmis pentaphylla* (Retz.) D. Don showed highest value [RA = 3.39], and was followed by *Crinum amoenum* [RA = 1.94], *Elatostemma monandrum* (D. Don) Hara [RA = 1.82], *Eragrostis amabilis* (L) wight & Arn. [RA = 1.74] etc.

Highest IVI value was recorded for *Mikania micrantha* Kunth [IVI = 21.50], followed by *Oplismenus burmanni* (Retz.) P. Beauv. [IVI=12.59], *A. houstonianum* Miller [IVI = 12.52], *P. betleoides* D. [IVI = 11.24], *D. sparsa* (D. Don) Kuntze [IVI = 9.95], *Clerodendrum infortunatum* L. [IVI = 7.57], *Chloranthus elatior* Link [IVI = 6.91] etc. Thus the herb layer was dominated by *M. micrantha* Kunth (Annexure I, Table 86)

A total of 1288 individuals belonging to 123 species, 108 genera and 61 families, and 1529 individuals belonging to 149 species, 127 genera and 62 families, were recorded in Premonsoon and Postmonsoon vegetation of herb layer, respectively (Table 6.8). They included the seedlings of trees and shrubs. Highest relative frequency was recorded for *Phyllanthus urinaria* L. [RF = 7.31], *Pupalia lappacea* [RF = 7.10], *Oplismenus compositus* (L.) P. Beauv, [RF = 4.95], *M. micrantha* [RF = 4.73] etc. In Premonsoon season, whereas *Piper chuvya* (Miguel) C. DC [RF = 7.212], *Oplismenus burmanni* (Retz.) P. Beauv. [RF = 14.66], *D. sikkimensis* (Redd.) Kuntze [RF = 4.02] etc were recorded for higher relative frequency in Postmonsoon season. Highest value of RD was recorded for *Oplismenus compositus* (L.) P. [RD = 9.08], followed by *P. urinaria* L. [RD = 6.83], *Phyrium pubinerve* Blume [RD = 5.20], *Spermacoce alata* [RD = 4.81] etc in Premonsoon (Annexure I, Table 87). *Eranthemum pulchellum* Andrews showed the highest Relative abundance value [RA = 4.55] followed by *Alpinia galanga* (L.) Willd. [RA = 4.44], *Commelina diffusa* Burman f. [RA = 3.25] etc. Regarding the importance value index [IVI], highest score was found in case of *O. compositus* with index value of 15.68 and was followed by *Phyllanthus urinaria* L.[IVI = 14.98], *P. pubinarve* Blume [IVI = 9.77], *M. micrantha* Kunth [IVI = 9.44], *S. alata* [IVI =

9.05], *D. sikkimensis* (Bedd.) O. Kuntze [IVI = 8.56] etc. Thus no clear dominancy of a single species played an important role in the community and formed a homogeneous assemblage.

Sevoke site: A total of 274 individuals of trees belonging to 69 species, 62 genera and 32 families were collected from the canopy layer of natural vegetation of Sevoke site**.** Number of individuals collected in the post monsoon season was – 290 belonging to 73 species, 66 genera and 34 families (Table 6.8). Both in the winter and post monsoon – *Lagerstroemia speciosa* (L.) Pers. was recorded for highest IVI score and calculated values of the index were 19.40 [RF = 5.78, RD = 10.58, RA = 3.03] in winter and 18.38 [RF = 5.50, RD = 10, RA= 2.89] in post monsoon season. In winter tree community dominant species was followed by *Shorea robusta* Gaertner. f. [IVI = 13.86, RF = 5.20, RD = 6.56, RA = 2.09] *Castanopsis indica* (Roxb.) A. DC. [IVI = 10.93, RF = 2.89, RD = 5.11, RA = 2.93], *Agalia spectabilis* (Miquel) Jain & Bennet [IVI = 10.22, RF = 4.05, RD = 4.38, RA = 1.79], *Aphanamixis polystachya* (Wall.) Parker, [IVI = 10.08, RF = 4.62, RD = 4.01, RA = 1.44], *Stereospermum tetragonum* DC. [IVI = 8.68, RF = 4.05, RD = 3.29, RA = 1.35], *Terminalia myriocarpa* Van Heurck & Müll. Arg. [IVI = 8.63], *Firmiana colorata* (Roxb.) R. Br. [IVI = 8.63] etc (Annexure I, Table 89).

On the other hand in post monsoon season dominant species was followed by *Shorea robusta* Gaertner [IVI = 13.14, RF = 4.95, RD = 6.21, RA = 1.99], *Aglaia spectabilis* (Miq.) Jain & Bennet [IVI = 12.12, RF = 3.85, RD = 5.86, RA = 2.42], *Castanopsis indica* (Roxb.) A. DC. [IVI = 10.36, RF = 2.75, RD = 4.83, RA = 2.79], *Aphanamixis polystachya* (Wall.) Parker, [IVI = 10.36, RF = 4.40, RD = 3.79, RA = 1.37], *Stereospermum tetragonum* DC. [IVI = 8.23, RF = 3.85, RD = 3.10, RA = 1.28], *Firmiana colorata* (Roxb.) R. Br. [IVI = 8.19] *Callicarpa arborea* Roxb. [IVI = 7.54] etc (Annexure I, Table 90).

A number of 918 individuals belonging to 67 species, 62 genera and 31 families; 1057 individuals belonging to 72 species, 68 genera, 29 families; and 1407 individuals belonging to 76 species, 71 genera and 38 families, were recorded from shrubs layer in winter, Premonsoon and Postmonsoon seasons respectively (Table 6.8). *Coffea benghalensis* Heyne *ex* Schult. was recorded for highest IVI value [IVI = 24.80] along with 4.98, 14.27 and 5.56 of RF, RD and RA respectively. It was followed by *Chromolaena odorata* (L.) King & Rob. [IVI = 17.53, RF = 3.55, RD = 9.04 and RA = 4.93], *Mikania micrantha* Kunth. [IVI = 18.81, RF = 4.50, RD = 8.61 and RA = 3.70], *Lantana camara* L. [IVI = 10.63, RF = 1.66, RD = 4.14 and RA = 4.84] *Croton caudatus* Geiselar [IVI = 10.01], *Ardisia solanacea* Roxb. [IVI = 8.84], *Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb. [IVI = 8.72], *Ichnocarpus frutescence* (L.) Aiton [IVI = 8.58], *Lygodium flexuosum* (L.) Sw. [IVI = 8.58] etc (Annexure I, Table 91 – 93).

A total of 1013 individuals (including seedlings of trees and shrubs) belonging to 74 species, 71 Genera and 35families were collected from the herbaceous winter vegetation of natural forest in Sevoke site. A total of 1529 individuals belonging to 83 species, 80 genera and 39 families, and 1926 individuals belonging to 90 species, 88 genera and 44 families, were recorded in Premonsoon and Postmonsoon vegetation of herb layer, respectively (Table 6.8). They included the seedlings of trees and shrubs. In winter highest IVI score was recorded for *Coffea benghalensis* Heyne *ex* Schult. [IVI= 14.06] along with 7.79, 5.33 and 0.94 as recorded values of RF, RD and RA respectively. It was followed by *Mikania micrantha* Kunth. [IVI = 12.73, RF = 0.61, RD = 3.45, RA = 8.36], *Oplismenus burmanni* (Retz.) Beauv. [IVI = 12.23, RF = 4.71, RD = 5.82, RA = 1.69], *Chromolaena odorata* L. [IVI = 10.70, RF = 4.71, RD = 4.63, RA = 1.35], *Pupalia lappacea* (L.) Juss. [IVI = 9.54], *Diplazium esculentum* (Retz.) Sw. [IVI = 9.38], *Synedrella nodiflora* (L.) Gaertn. [IVI = 8.93], *Clerodendrum infortunatum* L. [IVI = 8.49] etc (Annexure I, Table 94).

In Premonsoon and Postmonsoon vegetation also *Coffea benghalensis* was recorded for highest IVI values – 11.77 along with RF = 5.50, RD = 5.10, RA = 1.17 in Premonsoon and 10.15 along with RF = 3.21, RD = 5.09 and RA = 1.85 in Postmonsoon. Other associated species were – *Oplismenus burmanni* (Retz.) Beauv. [IVI = 8.90], *Dryopteris sikkimensis* (Bedd.) Kuntze [IVI = 8.78], *Chromolaena odorata* L. [IVI = 8.73], *Pupalia lappacea* [IVI = 8.70], *Synedrella nodiflora* [IVI = 7.75], *Axonopus compressus* (Sw.) P. Beauv. [IVI = 7.72], *Clerodendrum infortunatum* L. [IVI = 7.23] etc (Annexure I, Table 95). On the other hand in Postmonsoon season, *Coffea benghalensis* Heyne *ex* Schult. was followed by *Chromolaena odorata* L. [IVI = 9.75], *Clerodendrum infortunatum* L. [IVI = 8.25], *Diplazium esculentum* (Retz.) Sw. [IVI = 7.93], *Mikania micrantha* Kunth. [IVI= 7.85], *Synedrella nodiflora* (L.) Gaertn. [IVI = 7.54], *Dryopteris sikkimensis* (Bedd.) Kuntze [IVI = 6.38], *Morinda angustifolia* Roxb. [IVI = 6.05] etc (Annexure I, Table 96). Thus the herbaceous vegetation was almost similar in respect of species composition and dominancy pattern as there was no dominant species in single but a number of species played leading role in the vegetation.

6.2. BIODIVERSITY INDICES

Different biodiversity indices were studied to understand the diversity of plant community of plantation and natural vegetation, in space and time. Species diversity index [Shannon-Weiner index (1963)], Species richness [Menhinick's index (1964)], Concentration of dominance [Simpson's index (1949)] and Sorensen's similarity index (1968) were calculated for measuring species diversity in ecosystem, species richness, measurement of concentration of dominant species and its magnitude and for comparison of natural vegetation with that of different types of plantation in the study area.

6.2.1. Shannon-Weiner index (1963), Menhinick's index (1964) and Simpson's index (1949):

Species diversity index [Shannon -Weiner index (1963)], Species richness [Menhinick's index (1964)] and Concentration of dominance [Simpson's index (1949)] for tree, shrub and herb layers in Natural vegetation of Lataguri, NRVK and Sevoke sites were calculated and has been presented in tables 6.9 – 6.11.

A. Natural vegetation:

I. *Lataguri site:* In Lataguri site for the tree layer of natural vegetation Species diversity index [Shannon-Weiner index (1963)], Concentration of dominance [Simpson's index (1949)] and Species richness [Menhinick's index (1964)] were calculated to 9.48, 0.700 and 0.229, respectively, in winter vegetation, whereas in post monsoon the indices values were determined at 9.689, 0.642 and 0.230. For comparison of different seasonal vegetation average of the index values was calculated. For tree layer of natural vegetation in Lataguri site the average index values were 9.583, 0.671 and 0.229 in the same sequence (Table 6.9). Similarity index between the tree layer in winter and post monsoon seasons were found to be 0.90.

Table 6.9. Different Biodiversity indices of Natural vegetation in Lataguri site

Study site	Vegetation	Sampling season	Shannon-weiner index	Conc of dominance	Menhinick's index
Lataguri	Tree layer	Winter	9.479	0.7	0.229
		Post mon	9.686	0.642	0.23
		Average	9.583	0.671	0.229
	Shrub layer	Winter	16.453	1.9	0.128
		Pre mon	14.713	2.871	0.117
		Post mon	15.884	3.227	0.11
		Average	15.683	2.663	0.118
	Herb layer	Winter	16.124	2.605	0.111
		Pre mon	16.946	3.44	0.108
		Post mon	17.833	3.221	0.097
		Average	16.968	3.089	0.106

Shannon-Weiner index [SWI] for shrub layer was found to be 16.453, 14.713 and 15.884 in winter, Premonsoon and post monsoon seasons respectively and the average value of three seasons was 15.683. Concentration of dominance [CD] was found to be 1.90, 2.871 and 3.227 in winter, Pre-monsoon and post-monsoon season. Menhinick's index [MI] was found as 0.128, 0.117 and 0.110 in winter, Pre-monsoon and post-monsoon periods. Diversity index of herb layer was quite high 16.124 in winter, 16.946 in pre-monsoon and 17.833 in post-monsoon. Menhinick's index for the same layer was higher than the tree and shrub layers. Concentration of dominance was also higher and measured to be 3.089.

II. *NRVK site:* In NRVK site, for natural vegetation Shannon -Weiner index for tree, shrub and herb layers were calculated to be 14.409 (14.302 in winter and 14.515 in post-monsoon), 0.553 (0.42 in winter, 1.09 in pre-monsoon and 0.15 in post-monsoon seasons) and 32.432 (29.84 in winter, 29.54 in Pre-monsoon and 37.92 in post-monsoon seasons). So, the herb layer was much more diverse than the tree and shrub layers. Concentration of dominance for the tree, shrub and herb layers was recorded as 3.575, 83.791 and 18.32 respectively. Menhinick's index was calculated to be 3.013, 1.493 and 2.034 for tree, shrub and herb layers respectively (Table 6.10). Thus the natural vegetation of NRVK site was diverse and quite rich.

Table 6.10. Different Biodiversity indices of Natural vegetation in NRVK site

Study Site	Vegetation	Sampling Season	Shannon-Weiner Index	Conc of Dominance	Menhinick's Index
NRVK	Tree Layer	Winter	14.302	3.637	2.981
		Post Mon	14.515	3.512	3.045
		Average	**14.409**	**3.575**	**3.013**
	Shrub Layer	Winter	0.422	67.974	1.523
		Pre Mon	1.087	77.557	1.531
		Post Mon	0.149	105.841	1.454
		Average	**0.553**	**83.791**	**1.493**
	Herb Layer	Winter	29.836	10.456	2.236
		Pre Mon	29.536	19.965	1.953
		Post Mon	37.923	24.54	1.913
		Average	**32.432**	**18.32**	**2.034**

III. *Sevoke site:* Species diversity (Shannon-Weiner index) was calculated to be 9.60, 9.02 and 19.71 in tree, shrub and herb layers respectively. Concentration of dominance was found to be 0.53, 16.91 and 7.26 in case of shrub and herb layers in the same sequence. Menhinick's index of species richness was found to be 0.25, 0.07 and 0.058 in case of tree; shrub and herb layer respectively (Table 6.11). So, herb layer was high in species diversity than tree and shrub layers. But species richness was recorded as highest for the tree layer.

Table 6.11. Different Biodiversity indices of Natural vegetation in Sevoke site

Study Site	Vegetation layer	Sampling Season	Shannon-Weiner Index	Conc of Dominance	Menhinick's Index
Sevoke	Tree Layer	Winter	9.504	0.54	0.252
		Post Mon	9.703	0.517	0.252
		Average	**9.604**	**0.529**	**0.252**
	Shrub Layer	Winter	12.085	9.489	0.073
		Pre Mon	10.133	14.126	0.068
		Post Mon	4.836	27.101	0.054
		Average	**9.018**	**16.905**	**0.065**
	Herb Layer	Winter	16.499	5.288	0.073
		Pre Mon	20.147	7.883	0.054
		Post Mon	22.483	8.61	0.047
		Average	**19.71**	**7.26**	**0.058**

B. Plantations: Species diversity index, Species richness and Concentration of dominance for tree, shrub and herb layers of different Plantations in Lataguri, NRVK, Sevoke and Satali (NRVK) sites has been presented in Tables 6.12 – 6.15.

Table 6.12a. Biodiversity indices of Mixed Plantations in Lataguri sites

Plantation	Layer	Season	Shannon-Weiner Index	Concentration of Dominance	Menhinick's Index
Lataguri Mixed Plantation	Tree	Winter	5.184	2.356	0.211
		Post Mon	6.526	1.316	0.237
		Average	**5.855**	**1.836**	**0.224**
	Shrub	Winter	47.455	294.853	0.038
		Pre Mon	34.752	206.337	0.042
		Post Mon	19.092	116.157	0.063
		Average	**33.766**	**205.782**	**0.048**
	Herb	Winter	7.358	1.166	0.242
		Pre Mon	9.674	1.169	0.199
		Post Mon	12.582	1.657	0.143
		Average	**9.871**	**1.331**	**0.195**

Species diversity was higher [SWI=33.77] in shrub layer than the tree layer [SWI=5.86] and herb layer [SWI=9.87] in case of mixed plantation in Lataguri site. Concentrations of dominance for tree, shrub and herb layer were calculated to be 1.836, 205.78 and 1.33 respectively. Menhinick’s index of species richness showed lower value for all the tree [0.224], shrubs [0.048] and herb layer [0.195]. But tree layer was a little rich than the shrub and herb layer (Table 6.12a).

Herb layer of Lataguri sal-chilauni plantation was comparatively more diverse than that of shrub and tree layer and the Shannon-Weiner index was calculated to be 10.054, 7.444 and 5.17 for herb, shrub and tree layer respectively. Concentration of dominance (Simpson’s index) was found to be 1.165, 7.475 and 26.977 for these three layer in the same frequency Menhinick’s index of species richness was found to be 0.20, 0.13 and 0.10 for those three layer in similar fashion (Table 6.12b).

Table 6.12b. Biodiversity indices of Sal-Chilauni Plantations in Lataguri sites

Plantation	Layer	Season	Shannon-Weiner Index	Conc of Dominance	Menhinick's Index
Lataguri Sal-Chilauni	Tree	Winter	6.77	30.742	0.103
		Post Mon	3.57	23.213	0.105
		Average	**5.17**	**26.977**	**0.104**
	Shrub	Winter	5.788	7.429	0.173
		Pre Mon	8.134	7.401	0.105
		Post Mon	8.41	7.594	0.112
		Average	**7.444**	**7.475**	**0.13**
	Herb	Winter	8.208	0.809	0.234
		Pre Mon	8.563	0.697	0.24
		Post Mon	13.392	1.989	0.123
		Average	**10.054**	**1.165**	**0.199**

Table 6.12c. Biodiversity indices of Teak Plantations in Lataguri sites

Plantation	Layer	Season	Shannon-Weiner Index	Conc of Dominance	Menhinick's Index
Lataguri Teak Plantation	Tree	Winter	-8.34	48.47	0.097
		Post Mon	-5.247	41.419	0.097
		Average	**-6.794**	**44.945**	**0.097**
	Shrub	Winter	-14.175	59.48	0.059
		Pre Mon	-17.754	82.081	0.053
		Post Mon	-37.64	184.328	0.033
		Average	**-23.19**	**108.63**	**0.048**
	Herb	Winter	8.055	3.066	0.143
		Pre Mon	10.642	6.231	0.086
		Post Mon	13.622	8.609	0.066
		Average	**10.773**	**5.969**	**0.098**

Species diversity of tree and shrub layer of teak plantation of Lataguri site was very poor having calculated index value of – 6.794 in case of tree layer and – 23.19 in case of shrub layer. But the herb layer was pretty rich having the Shannon-Weiner index value of 10.773. Concentration of dominance was highest in shrub layer [108.63] and was followed by tree layer [44.945] while herb layer showed 5.969 as concentration of dominance value. Menhinick's index of species richness was calculated to be 0.097, 0.048 and 0.098 for tree, shrub and the herb layer in the similar sequence (Table 6.12c).

Species diversity was least [SWI= - 8.494] in shrub layer, moderate in tree layer [SWI= 7.095] and highest in herb layer [SWI= 12.914] of mixed plantation in NRVK site. Concentration of dominance was calculated to be 1.074, 48.978 and 2.972 in case of tree, shrubs and herb layer respectively. Menhinick's index of species richness was least in shrub layer [MI= 0.056], moderate in herb layer [MI= 0.122] and higher in tree layer [MI= 0.23] (Table 6.13a).

Table 6.13a. Biodiversity indices of different layer of vegetation in NRVK Mixed Plantation

Vegetation Layer	Season	Shannon-Weiner Index	Conc. of Dominance	Menhinick's Index
Tree	Winter	6.991	1.203	0.13
	Post Mon	7.198	0.945	0.144
	Average	**7.095**	**1.074**	**0.137**
Shrub	Winter	-7.127	39.802	0.075
	Pre Mon	-8.05	45.69	0.06
	Post Mon	-10.304	61.441	0.033
	Average	**-8.494**	**48.978**	**0.056**
Herb	Winter	10.236	1.317	0.167
	Pre Mon	13.563	3.629	0.11
	Post Mon	14.942	3.969	0.088
	Average	**12.914**	**2.972**	**0.122**

Table 6.13b. Biodiversity indices of different layer of vegetation in NRVK Teak Plantation

Layer of Vegetation	Season	Shannon-Weiner Index	Conc. of Dominance	Menhinick's Index
Tree	Winter	-5.122	31.092	0.025
	Post Mon	-2.284	22.019	0.029
	Average	**-3.703**	**26.556**	**0.027**
Shrub	Winter	-8.514	38.744	0.018
	Pre Mon	-12.363	55.953	0.019
	Post Mon	-44.002	203.679	0.023
	Average	**-21.626**	**99.459**	**0.021**
Herb	Winter	8.55	2.201	0.124
	Pre Mon	10.144	3.87	0.092
	Post Mon	12.954	4.558	0.073
	Average	**10.549**	**3.543**	**0.097**

Different diversity indices of teak plantation in NRVK site has been represented in table 6.13b. Shannon-Weiner index for shrub layer of teak plantation in NRVK site was found to be very low - 21.626, low in tree layer [SWI= 3.703] and high enough in herb layer [SWI= 10.549]. Concentration of dominance was very high in shrubby layer [99.459] high in tree layer [26.556] and low in herb layer [3.543]. Species richness was calculated very less in shrub layer [MI= 0.021] and tree layer [0.027] and was higher in herb layer [MI= 0.097].

Species diversity in tree and shrub layers of Jarul-Benteak plantation in NRVK site was very low and the SWI was calculated to be -116.911 and -125.319 in respective order. That of the herb layer was little higher and was calculated to 4.722. As expected the concentration of dominance for tree and shrub layers were very high as 1128.90 and 870.372 in tree and shrub layers in the same order. That of the herb layer was lesser than the tree and shrub layers and was calculated to be 9.987. Menhinick's index of species richness also indicated the poorness of tree [MI=0.225] and shrub [MI=0.076] layers and little bit of richness species in herb layer [MI=0.119] (Table 6.13c).

Table 6.13c. Biodiversity indices of different layer of vegetation in NRVK Jarul-Benteak Plantation

Layer of Vegetation	Season	Shannon-Weiner Index	Conc. of Dominance	Menhinick's Index
Tree	Winter	-131.19	1332.37	0.216
	Post Mon	-102.632	925.43	0.235
	Average	**-116.911**	**1128.9**	**0.225**
Shrub	Winter	-153.963	1131.938	0.092
	Pre Mon	-130.774	914.095	0.076
	Post Mon	-91.22	565.084	0.06
	Average	**-125.319**	**870.372**	**0.076**
Herb	Winter	3.153	8.028	0.171
	Pre Mon	3.723	11.042	0.096
	Post Mon	7.289	10.892	0.089
	Average	**4.722**	**9.987**	**0.119**

Jarul plantation in Sevoke site also showed least species diversity in shrub layer; lower diversity in tree layer but higher diversity in herb layer and that was revealed by the Shannon-Weiner index value of - 2.95, 0.37 and 14.25 in case of shrub, tree and herb layer respectively. Concentration of dominance of the shrub, tree and herb layer was calculated to be 30.85, 14.101 and 4.695 respectively (Table 6.14a). Menhinick's index of species richness was found to be least in shrub layer [MI=0.07] low in herb layer [MI=0.90] and higher in tree layer [MI=0.16].

Table 6.14a. Different Biodiversity indices of Jarul Plantations in Sevoke sites

Plantation	Layer of Vegetation	Season	Shannon-Weiner Index	Conc. of Dominance	Menhinick's Index
Sevoke Jarul	Tree	Winter	-0.55	16.058	0.156
		Post Mon	1.289	12.154	0.166
		Average	**0.37**	**14.106**	**0.161**
	Shrub	Winter	-4.018	28.568	0.077
		Pre Mon	-2.897	31.581	0.063
		Post Mon	-1.936	32.402	0.057
		Average	**-2.95**	**30.85**	**0.066**
	Herb	Winter	10.847	2.059	0.14
		Pre Mon	14.676	4.869	0.079
		Post Mon	17.236	7.157	0.06
		Average	**14.253**	**4.695**	**0.093**

Similar trend was found in teak plantation in Sevoke site regarding the species diversity i.e. least diverse shrub layer [SWI= - 6.619], less diverse tree layer [SWI= -3.149] and higher diversity in herb layer [SWI=11.895] and that was supported by the highest concentration of dominance in tree layer [27.869] and least concentration of dominance in herb layer [4.042]. Species richness [Menhinick's index] was least in shrub layer [MI=0.062] and higher in tree layer [MI=0.125] and in herb layer it was calculated to be 0.111. (Table 6.14b)

Table 6.14b. Different Biodiversity indices of Teak Plantations in Sevoke sites

Plantation	Layer of Vegetation	Season	Shannon-Weiner Index	Conc. of Dominance	Menhinick's Index
Teak (Sevoke)	Tree	Winter	-4.526	32.262	0.12
		Post Mon	-1.771	23.476	0.131
		Average	**-3.149**	**27.869**	**0.125**
	Shrub	Winter	-2.19	23.73	0.084
		Pre Mon	-8.062	46.031	0.059
		Post Mon	-9.605	61.839	0.044
		Average	**-6.619**	**43.867**	**0.062**
	Herb	Winter	9.732	1.555	0.165
		Pre Mon	12.175	5.016	0.088
		Post Mon	13.779	5.556	0.079
		Average	**11.895**	**4.042**	**0.111**

Species diversity was least in shrub layer of Jarul plantation in Satali and was calculated to be -14.78. It was lower in tree layer also [SWI= - 6.324]. But the herb layer was little rich having Shannon-Weiner Index value of 6.55 and concentration of dominance was calculated to be very high [76.20] in shrub layer, high in tree layer [33.351] and low in herb layer [7.736]. Menhinick's index of species richness also was very lesser in shrub layer having calculated value of 0.064. In tree and herb layer species richness was calculated to be 0.108 and 0.101 respectively (Table 6.15)

Table 6.15. Different Biodiversity indices of Jarul Plantations in Satali area

Plantation	Layer of Vegetation	Sampling Season	Shannon-Weiner Index	Conc. of Dominance	Menhinick's Index
Jarul (Satali)	Tree	Winter	-6.324	33.506	0.11
		Post Mon	-6.324	33.195	0.107
		Average	**-6.324**	**33.351**	**0.108**
	Shrub	Winter	-14.516	69.252	0.081
		Pre Mon	-17.029	87.487	0.058
		Post Mon	-12.803	71.862	0.055
		Average	**-14.783**	**76.20**	**0.064**
	Herb	Winter	5.408	5.144	0.134
		Pre Mon	5.886	8.113	0.096
		Post Mon	8.356	9.95	0.073
		Average	**6.55**	**7.736**	**0.101**

6.2.2. Similarity index: Similarity index between different seasonal vegetations (layer wise) in natural vegetation and plantations were calculated and has been represented in Table 6.16 – 6.18.

A. ***Natural Vegetation***: In case of natural vegetation, tree layer in winter and post-monsoon season was almost similar in all the three sites (Lataguri, Sevoke and NRVK) and similarity index (Sorensen similarity index) was calculated to be 0.901, 0.983 and 0.944 in Lataguri, NRVK and Sevoke site respectively. Shrub layer of natural vegetation in Lataguri site was almost similar in winter and Pre monsoon season and Sorensen index was calculated to be 0.822 (Table 6.16).

Table 6.16. Similarity index between different seasonal vegetations (layer wise) in Natural forest in Lataguri site

SITE	Layer	Similarity Index Between	Similarity Index
Lataguri	Tree Layer	Tree-Win & Tree- Postmonsoon	0.901
	Shrub layer	Shrub-Win & Shrub-Premonsoon	0.822
		Shrub-Premon & Shrub-Postmonsoon	0.624
		Shrub-Win & Shrub-Postmonsoon	0.597
	Herb layer	Herbs-Win & Herbs-Premonsoon	0.519
		Herbs-Pre & Herbs - Postmonsoon	0.610
		Herbs-Win & Herbs-Postmonsoon	0.490

Similarity index between the shrubs layer in Pre monsoon and Post monsoon season was calculated to be 0.624 while the index value was found to be 0.597 in between winter and Post monsoon shrub layer. In Lataguri site similarity index of herb layers in different seasons was found to be 0.519, 0.610 and 0.490 for herb layer in winter and Pre monsoon; Pre monsoon and Post monsoon herb layer; and winter and Post monsoon herb layer respectively.

In NRVK site also, shrub layer in different seasons was very similar having index value of 0.702, 0.779 and 0.710 for winter and Pre monsoon vegetation; Pre monsoon and Post monsoon vegetation of shrubs; and winter and Post monsoon shrub layer respectively. Index value for herb layer in winter and Pre monsoon; Pre monsoon and Post monsoon; and winter and Post monsoon, were calculated to be 0.677, 0.694 and 0.793 respectively (Table 6.17).

Table 6.17. Similarity index between different seasonal vegetations (layer wise) in Natural forest in NRVK site

SITE	Layer	Similarity Index Between	Similarity Index
NRVK	Tree Layer	*Tree-Win & Tree- Postmonsoon*	0.983
	Shrub layer	Shrub-Win & Shrub-Premonsoon	0.702
		Shrub-Premon & Shrub-Postmon	0.779
		Shrub-Win & Shrub-Postmonsoon	0.710
	Herb layer	Herbs-Win & Herbs-Premonsoon	0.677
		Herbs-Pre & Herbs - Postmonsoon	0.694
		Herbs-Win & Herbs-Postmonsoon	0.793

In Sevoke site, shrub layer in winter and pre monsoon season are similar by 46% and is revealed by calculated index value of 0.46. In case of shrub layer in pre monsoon and post monsoon, Sorensen's index of similarity was found to be 0.595 and 0.587 for the vegetation in winter and post monsoon season. In case of herb layer Sorensen's index was calculated to be 0.943, 0.659 and 0.598 for herb layer in winter and pre monsoon vegetation; Pre monsoon and Post monsoon vegetation; and winter and Post monsoon vegetation in respective order (Table 6.18).

Table 6.18. Similarity index between different seasonal vegetations (layer wise) in Natural forest in Sevoke site

SITE	Layer	Similarity Index Between	Similariry Index
Sevoke	Tree Layer	Tree-Win & Tree- Postmonsoon	0.944
	Shrub layer	Shrub-Win & Shrub-Premonsoon	0.460
		Shrub-Premon & Shrub-Postmonsoon	0.595
		Shrub-Win & Shrub-Postmonsoon	0.587
	Herb layer	Herbs-Win & Herbs-Premonsoon	0.943
		Herbs-Pre & Herbs - Postmonsoon	0.659
		Herbs-Win & Herbs-Postmonsoon	0.598

B. *Plantation*: In plantation also, the similarity index between tree layer in winter and tree layer in post monsoon season, for all plantations in all the three sites were calculated above 0.81 i.e. they are similar by 81% or more (Tables 6.19 – 6.22). Shrub layer was different to some extent in some cases like shrub layer in Pre monsoon and Post monsoon season in teak plantation in NRVK site having the calculated index value of 0.459 (Table 6.19a).

Table 6.19a. Similarity index between different seasonal vegetations (layer wise) in teak plantations in NRVK

Plantation	Vegetation Layer	Similarity Index Between	Similarity Index
Teak Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.917
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.727
		Shrub-Premonsoon & Shrub-Postmonsoon	0.459
		Shrub-Win & Shrub-Postmonsoon	0.552
	Herbs	Herbs-Win & Herbs-Premonsoon	0.585
		Herbs-Pre & Herbs - Postmonsoon	0.624
		Herbs-Win & Herbs-Postmonsoon	0.652

Similarly index value of shrub layer of winter and Post monsoon season was found to be 0.464 in Jarul Benteak plantation (Table 6.19b). But the index values were higher in case of other vegetations and it ranges from 0.63 to 0.93 in case of Pre monsoon and Post monsoon shrub layer; from 0.48 to 0.86 in case of winter and post monsoon shrub layer; and from 0.69 to 0.93 in case of winter and pre monsoon shrub layer. Similarity index value in between Pre monsoon herb layer and Post monsoon herb layer ranges from 0.44 to 0.90 in all the three sites. That of winter herb and Post monsoon herb layer ranges from 0.40 to 0.86; and from 0.59 to 0.89 in case of winter herb and pre monsoon herb.

Table 6.19b. Similarity index between different seasonal vegetations (layer wise) in Jarul-Benteak plantation in NRVK

Plantation	Vegetation Layer	Similarity Index Between	Similarity Index
Jarul-Benteak	Tree	Tree-Win & Tree- Postmonsoon	0.818
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.737
		Shrub-Premonsoon & Shrub-Postmonsoon	0.7697
		Shrub-Win & Shrub-Postmonsoon	0.4647
	Herbs	Herbs-Win & Herbs-Premonsoon	0.731
		Herbs-Pre & Herbs - Postmonsoon	0.849
		Herbs-Win & Herbs-Postmonsoon	0.667

Table 6.19c. Similarity index between different seasonal vegetations (layer wise) in mixed plantation in NRVK

Plantation	Vegetation Layer	Similarity Index Between	Similarity Index
Mixed Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.897
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.933
		Shrub-Premonsoon & Shrub-Postmonsoon	0.928
		Shrub-Win & Shrub-Postmonsoon	0.863
	Herbs	Herbs-Win & Herbs-Premonsoon	0.897
		Herbs-Pre & Herbs - Postmonsoon	0.908
		Herbs-Win & Herbs-Postmonsoon	0.86

Table 6.20a. Similarity index between different seasonal vegetations (layer wise) in Teak plantations in Lataguri site

Plantation	Layer	Similarity Index Between	Similarity Index
Teak Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.95
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.704
		Shrub-Premons & Shrub-Postmon	0.625
		Shrub-Win & Shrub-Postmonsoon	0.483
	Herbs	Herbs-Win & Herbs-Premonsoon	0.585
		Herbs-Pre & Herbs - Postmonsoon	0.442
		Herbs-Win & Herbs-Postmonsoon	0.396

Table 6.20b. Similarity index between different seasonal vegetations (layer wise) in Mixed plantations in Lataguri site

Plantation	Layer	Similarity Index Between	Similarity Index
Mixed Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.842
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.857
		Shrub-Premon & Shrub-Postmonsoon	0.794
		Shrub-Win & Shrub-Postmonsoon	0.655
	Herbs	Herbs-Win & Herbs-Premonsoon	0.835
		Herbs-Pre & Herbs - Postmonsoon	0.828
		Herbs-Win & Herbs-Postmonsoon	0.771

Table 6.20c. Similarity index between different seasonal vegetations (layer wise) in Sal-Chilauni plantations in Lataguri site

Plantation	Layer	Similarity Index Between	Similarity Index
Sal-Chilauni Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.849
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.8
		Shrub-Premon & Shrub-Postmon	0.919
		Shrub-Win & Shrub-Postmonsoon	0.767
	Herbs	Herbs-Win & Herbs-Premonsoon	0.791
		Herbs-Pre & Herbs - Postmonsoon	0.857
		Herbs-Win & Herbs-Postmonsoon	0.78

Table 6.21. Similarity index between different seasonal vegetations (layer wise) of plantations in Sevoke

Plantation	Layer	Similarity Index Between	Similarity Index
Jarul Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.863
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.896
		Shrub-Premonsoon & Shrub-Postmonsoon	0.909
		Shrub-Win & Shrub-Postmonsoon	0.806
	Herbs	Herbs-Win & Herbs-Premonsoon	0.896
		Herbs-Pre & Herbs - Postmonsoon	0.903
		Herbs-Win & Herbs-Postmonsoon	0.838
Teak Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.889
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.693
		Shrub-Premonsoon & Shrub-Postmonsoon	0.897
		Shrub-Win & Shrub-Postmonsoon	0.7
	Herbs	Herbs-Win & Herbs-Premonsoon	0.879
		Herbs-Pre & Herbs - Postmonsoon	0.811
		Herbs-Win & Herbs-Postmonsoon	0.747

Table 6.22. Similarity index between different seasonal vegetations (layer wise) of Jarul plantation in Satali

Plantation	Layer	Similarity Index Between	Similarity Index
Jarul Plantation	Tree	Tree-Win & Tree- Postmonsoon	0.96
	Shrubs	Shrub-Win & Shrub-Premonsoon	0.857
		Shrub-Premonsoon & Shrub-Postmonsoon	0.898
		Shrub-Win & Shrub-Postmonsoon	0.8
	Herbs	Herbs-Win & Herbs-Premonsoon	0.767
		Herbs-Pre & Herbs - Postmonsoon	0.849
		Herbs-Win & Herbs-Postmonsoon	0.783

Table 6.23. Similarity index between different plantation and natural vegetations (layer wise and seasonal) Lataguri site

Site	Between	Layer	Similarity Index Value in		
			Winter	Pre Monsoon	Post Monsoon
Lataguri	Natural Veg & Teak Plantation	Tree	0.169	-	0.227
		Shrub	0.146	0.217	0.195
		Herb	0.268	0.321	0.308
	Natural Veg & Sal-Chilauni Plantation	Tree	0.228	-	0.282
		Shrub	0.248	0.297	0.305
		Herb	0.323	0.246	0.320
	Natural Veg & Mixed Plantn Plantation	Tree	0.244	-	0.327
		Shrub	0.201	0.209	0.203
		Herb	0.325	0.303	0.286
NRVK	Natural Veg & Teak Plantation	Tree	0.234	-	0.171
		Shrub	0.055	0.137	0.322
		Herb	0.321	0.271	0.348
	Natural Veg & Jarul Benteak Plantation	Tree	0.102	-	0.117
		Shrub	0.190	0.161	0.298
		Herb	0.178	0.233	0.278
	Natural Veg &Mixed Plantation	Tree	0.261	-	0.311
		Shrub	0.342	0.284	0.419
		Herb	0.310	0.284	0.355
Sevoke	Natural Veg & Teak Plantation	Tree	0.362	-	0.412
		Shrub	0.238	0.389	0.459
		Herb	0.448	0.470	0.579
	Natural Veg & Jarul Plantation	Tree	0.304	-	0.356
		Shrub	0.286	0.407	0.427
		Herb	0.339	0.341	0.500
Satali	Natural Veg & Jarul Plantation	Tree	0.160	-	0.154
		Shrub	0.204	0.161	0.277
		Herb	0.238	0.253	0.303

In Lataguri site similarity indices of tree, shrub and herb layers of natural vegetation and teak plantation were calculated to be 0.235, 0.239 and 0.371 in respective order (Table 6.23). Thus all the three layers i.e. tree, shrub and herb layer of teak differ significantly from that of the natural vegetation and the herb layer is much more different.

In case of Sal-Chilauni plantation also tree, shrub and herb layers differed from the tree, shrub and herb layer of natural vegetation and that was revealed by lower value of Sorensen's index – 0.244, 0.352, 0.335 in respective order. But the mixed plantation showed greater similarity of its tree layer with that of natural vegetation [SI = 0.794], moderate similarity with herb layer [SI= 0.490] and lesser similarity with the shrub layer [SI= 0.342].

In NRVK site tree and shrub layer of teak plantation showed least similarity with that of the natural vegetation and was clear from the Sorensen's index value of 0.231 and 0.311 in respective order. On the other hand herb layer of teak plantation was near to moderately similar [SI = 0.410]. Jarul Benteak plantation showed very dissimilarity in all its 3 layers i.e. tree, shrubs and herb layers with that of natural vegetation and the calculated index values were found to be 0.12, 0.258 and 0.247, in case of tree, shrub and herb layer in respective order. Same type of trend was found in case of mixed plantation and the index values were calculated to be 0.283, 0.342 and 0.332 for tree, shrub and herb layer in the same sequence.

In Sevoke site tree layer of teak plantation was different from that of the natural vegetation [SI = 0.338]; shrub layer was also different [SI = 0.40]. But the herb layer showed moderate similarity [SI = 0.502]. Jarul plantation also showed the differences in the tree shrub and herb layers with the calculated index value of 0.349, 0.356 and 0.427 in respective order. But the difference in herb layer was lesser than other two layers. Tree, shrubs and herb layers of Jarul plantation in Satali site under NRVK region, showed the dissimilarity with that of the natural vegetation and that was evident from lesser value of Sorensen's index – 0.16, 0.254 and 0.272 in case of tree, shrub and herb layer in the same order. Seasonal variation of the similarity index was also calculated between the natural vegetation and plantations and is represented in Table 6.24.

Table 6.24. Sorensen's Similarity index between Natural forests and different Plantations (Layer wise)

Site	Similarity Index Between	Sorensen's Similarity Index		
		Tree Layer	Shrub Layer	Herb Layer
Lataguri	Natural Veg & Teak Plantation	0.2353	0.2390	0.3714
	Natural Veg & Sal-Chilauni Plantation	0.2449	0.3529	0.3357
	Natural Veg & Mixed Plantation	0.7949	0.3421	0.4908
NRVK	Natural Veg & Teak Plantation	0.2316	0.3118	0.4106
	Natural Veg & Jarul Benteak	0.1200	0.2588	0.2479
	Natural Veg & Mixed Plantation	0.2833	0.3429	0.3320
Sevoke	Natural Veg & Teak Plantation	0.3883	0.4064	0.5024
	Natural Veg & Jarul Plantation	0.3495	0.3563	0.4272
Satali	Natural Veg & Jarul Plantation	0.1600	0.2545	0.2723

6.3. IMPACT OF AGGRESSIVE WEEDS

The study area was invaded by a number of aggressive and exotic weeds. *Parthenium hysterophorus* L., *Lantana camara* L., *Mimosa invisa* Colla, *Tithonia diversifolia* (Hemsl.) A. Gray, *Ageratum houstonianum* Mill. Etc. are some of the important weeds of exotic origin and having strong aggressiveness. For the present study, *P. hysterophorus*, *L. camara*, *M. invisa*, *A. houstonianum* and *T. diversifolia* were considered to be assessed for their impact on local flora and vegetation. Some areas in Terai region mainly in Sukna, Salbari, Simulbari and adjoining areas were intensively invaded by these weeds. Side by side a patch of vegetation that was not invaded by them was detected through visual observation. Those non-invaded areas were considered to be the native land use pattern. A total 50 quadrates of 5 × 5 m size were laid out for the shrubby species [e.g. *Mimosa invisa*]. Out of those 50 quadrates, 25 were studied in invaded area and other 25 quadrates were laid out on non-invaded areas. Each of the 5 × 5 m quadrates contained two 1 × 1 m quadrates in its opposite corner to study the herbaceous species as well as the seedlings of shrubby species. Thus a total 100 quadrates of 1 × 1 m size were studied for the assessment of impact of exotic weeds [*M. invisa*, *T. diversifola* and *L. camara*]. On the other hand for *Parthenium hysterophorus* also a total 100 quadrates (1 × 1 m) were laid out, – 50 of those are in invaded areas and the other 50 quadrates in non-invaded areas. Phytosociological parameters for these weed was represented in tabular form (Annexure IIA, Table 1 – 6).

In the present study from a total of 813 individuals belonging to 62 species, 61 genera and 27 families were recorded from the shrub layer of non-invaded area which was considered to be the native type of vegetation. From the herb layer of non-invaded areas, a total of 1393 individuals belonging to 87 species, 81 genera and 39 families were recorded. But in case of invaded areas, a total of 915 individuals belonging to 46 species, 46 genera and 21 families; and 1485 individuals belonging to 71 species, 66 genera and 34 families, were recorded from shrub and herb layers respectively (Figure 6.3.1).

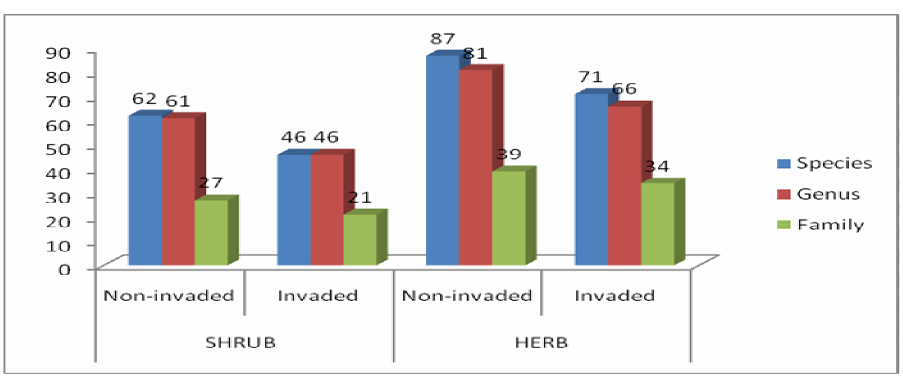

Figure 6.3.1: Number of different taxa in weed-invaded and non-invaded area

Leguminosae was recorded for highest number of 9 species in invaded areas and was followed by Lamiaceae (6 spp.), Acanthaceae (3 spp.), Compositae (3 spp.), Phyllanthaceae (3 spp.) Malvaceae (3 spp.) etc in shrub layer. In herb layer, Compositae presented highest number of 7 species and was followed by Lamiaceae (5 spp.), Leguminosae (5 spp.), Malvaceae (4 spp.) Poaceae (4 spp.) etc. In shrub layer of non-invaded areas, Leguminosae was recorded for highest number of 8 species. Other families with higher number of species were Malvaceae with 7 species, Lamiaceae with 6 species, Apocynaceae and Euphorbiaceae each with 4 species; Acanthaceae, Phyllanthaceae and Rubiaceae each with 3 species, etc. As in herb layer of invaded areas, Asteraceae was recorded for presenting maximum number of species (7 species) in case of herb layer of non-invaded areas. Other families with higher number of species were Lamiaceae (6 spp.), Leguminosae, Malvaceae and Poaceae each with 5 species, Rubiaceae (4 spp.), etc.

Picture of shrub layer: In shrub layer of non-invaded areas or control site, highest value of IVI was recorded for *Clerodendrum infortunatum* L. having an index value of 29.69 along with Relative Frequency [RF] of 5.246, Relative Density [RD] of 16.851 and Relative Abundance [RA] of 7.592. Other species with high IVI score were include *Coffea benghalensis* [IVI = 25.318; RF = 4.012; RD = 13.41; RA = 7.898], *Triumfetta rhomboidea* [IVI = 20.12; RF = 4.320; RD = 10.209; RA = 5.585], *Urena lobata* [IVI = 18.21; RF = 4.32; RD = 8.98; RA = 4.91], *Mikania micrantha* [IVI=16.74; RF=5.86; RD=7.75; RA=3.12], *Tabernaemontana divaricata* [IVI = 9.14; RF= 3.70; RD= 3.32; RA= 2.12], *Marraya paniculata* [IVI= 7.56], *Dendrocnide sinuata* [IVI=7.36] (Annexure IIA, Table 1). Thus *C. benghalensis* was turned out to be the most dominant species. But, the magnitude of dominancy was not so prominent (Figure 6.3.2) and was evident from more or less equal IVI of about 5 species.

Thus it can also be inferred that the vegetation was not truly dominated by a single species but with a number of species. So, the shrub layer in non-invaded areas showed heterogeneous mixture of a number of species those play important role in the vegetation.

On the other hand, in shrub layer of invaded area highest value of IVI was recorded for *Mimosa invisa* to be 61.43 [RF = 8.71; RD = 35.74; RA = 16.97]. Other species with higher IVI score were *Lantana camara* [IVI = 28.83; RF = 5.81; RD =13.44; RA = 9.58], *Mikania micrantha* [IVI = 24.35; RF = 8.71; RD = 10.60; RA = 5.04], *Clerodendrum infortunatum* [IVI = 16.65], *Chromolaena odorata* [IVI = 13.78] *Tithonia diversifolia* [IVI = 13.52], *Coffea benghalensis* [IVI = 13.48], *Argyreia roxburghii* [IVI = 10.42], *Tabernaemontana divaricata* [IVI = 8.38] etc.

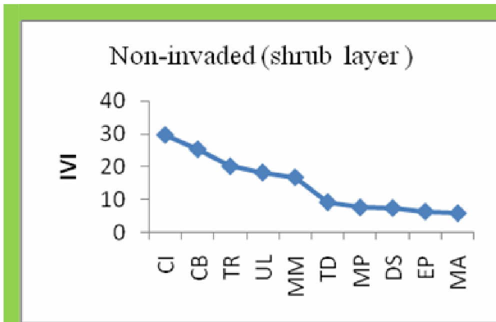

Figure 6.3.2. IVI scores of top ten species in non-invaded shrub layer

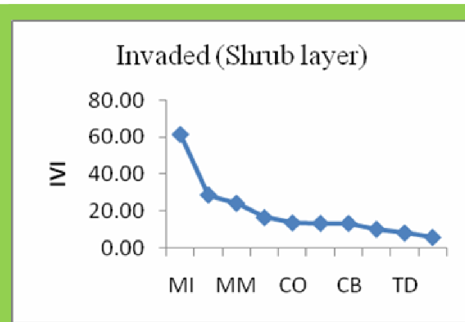

Figure 6.3.3. IVI scores of top ten species in invaded shrub layer

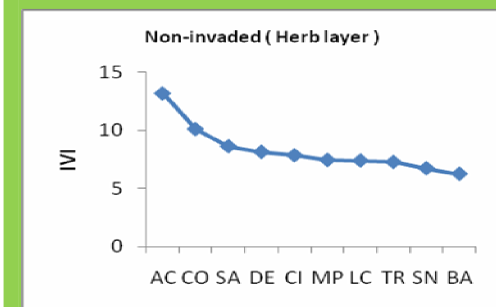

Figure 6.3.4. IVI scores of top ten species in non-invaded herb layer

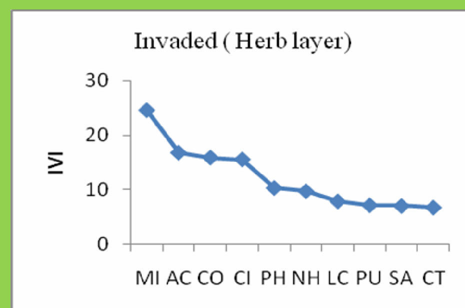

Figure 6.3.5. IVI scores of top ten species in invaded herb layer

Thus the vegetation was dominated by *M. invisa* and the magnitude of dominancy was much more than any other shrubby species (Figure 6.3.3) in the vegetation as presented in Annexure IIA, Table 2. Not only that the second dominant species [*Lantana camara*] is also a well-known invasive weed. Another aggressive weed *Tithonia diversifolia* was also on the higher side of IVI score and dominance pattern and it replaced most of the native species from their own habitat in the invaded areas.

Picture of herb layer: In herb layer of non-invaded areas, *Ageratum conyzoides* was recorded for its highest IVI score of 13.21 along with highest relative density (RD = 6.21), RF of 1.03 and RA of 5.97. It was followed by *Chromolaena odorata* [IVI = 10.12; RF = 1.29; RD = 5.00; RA = 3.84], *Sida acuta* [IVI = 8.63; RF = 0.26; RD = 1.73; RA = 6.43], *Diplazium esculentum* [IVI = 8.15; RF = 1.80; RD = 4.1; RA = 2.25], *Clerodendrum infortunatum* [IVI = 7.85], *Mimosa pudica* [IVI = 7.44], *Lantana camara* [IVI = 7.39], etc. (Annexure IIA, Table 3).

On the other hand, in the invaded area, highest value of IVI was found for *Mimosa invisa* seedlings [IVI=24.60], which actually forms an almost continuous mat, along with RF of 6.60, RD of 14.34 and RA of 3.65. *Ageratum conyzoides*, *Chromolaena odorata* and *Clerodendrum infortunatum* together formed a group of co-dominant species having IVI scores of 16.81, 15.93 and 15.57 in respectively. But, the difference in IVI score of dominant species and co-dominant group of species was quite broad. Other species having higher IVI score were *Parthenium hysterophorus*

[IVI = 10.35], *Natsiatum herpeticum* [IVI = 9.74], *Lantana camara* [IVI = 7.89], *Mimosa pudica* [IVI = 7.18], etc. (Annexure IIA, Table 4). Thus the herb layer also in invaded areas, was homogeneous type of vegetation with *Mimosa invisa* as dominant species. Dominance diversity curve of top ten species (based on IVI scores) of both non-invaded and invaded areas are presented in Figure 6.3.4 and 6.3.5 respectively.

Diversity indices: Species diversity index (Shannon-Weiner index) for shrub layer was calculated to -10.48 and 8.03 for invaded and non-invaded tracts of vegetation respectively. Concentrations of dominance of these 2 types of vegetation were recorded to be 67.10 and 13.14 in the same order. Thus high species diversity and lower dominance was found in non-invaded areas. Whereas the situation was just reverse in invaded areas, i.e. lower diversity and higher concentration of dominance (Figure 6.3.6). This was further supported by lower value of Menhinick's index of species richness, MI = 0.05, for invaded areas that indicated the poor species richness in invaded area. In case of non-invaded area the species richness index was calculated to a higher value of MI = 0.076 than that of invaded area. Similarity index of Sorensen was also calculated between these two vegetation tracts to 0.70. The vegetation in both the invaded and non-invaded areas was more of less similar in respect of species composition but differ in dominance pattern and species diversity.

For herb layer of invaded and non-invaded areas, species diversity was calculated to be 10.46 and 19.99 respectively. It indicated the less diverse vegetation of invaded areas than the non invaded one; and was further supported by the high concentration of dominance (22.50) in invaded areas than the lower value (6.36) of concentration of dominance in non-invaded site. Higher Menhinick's index value also was found in case of non-invaded areas. Similarity index of these two vegetations was found to be 0.87.]

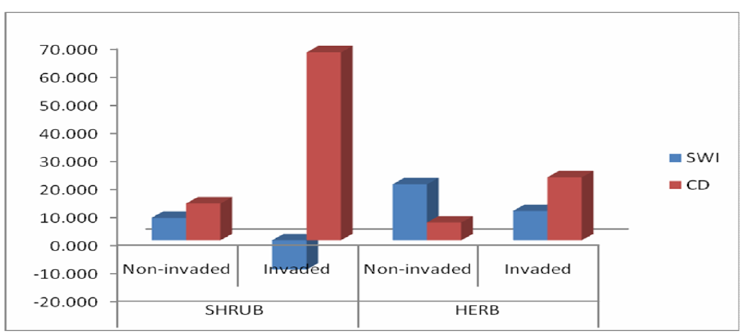

Figure 6.3.6. Shannon-Weiner Index [SWI] and Concentration of Dominance [CD] of shrub and herb layer in innvaded and non-invaded vegetation.

Impact of Parthenium hysterophorus: A total of 1408 individuals belonging to 63 species, 57 genera and 24 families were recorded from *Parthenium* invaded areas; and from non-invaded areas total 1519 individuals belonging to 76 species, 68 genera and 30 families were recorded. Highest number of species was recorded for Compositae

(15 species) from areas not invaded by *Parthenium*, and was followed byPoaceae and Rubiaceae with 6 species each, Amaranthaceae with 5 species, Euphorbiaceae with 4 species and others. In case of *Parthenium* invaded areas also, Asteraceae was represented with highest number of species (15 species), and it was followed by Amaranthaceae (5 spp.) Rubiaceae (5 spp.), Euphorbiaceae (4 spp.), Poaceae (4 spp.), Lamiaceae (3 spp.) and others.

In non-invaded areas *Axonopus compressus* was found to have highest score of IVI = 11.66 [RF of 3.65, RD of 5.86 and RA of 2.15] and was followed by *Senna tora* having IVI of 10.37 [RF = 3.93, RD = 4.81, RA = 1.64], *Amaranthus viridis* [IVI = 9.31], *Ageratum houstonianum* [IVI = 8.31], *Chromolaena odorata* [IVI = 7.32], *Chrysopogon aciculatus* [IVI = 7.20], etc. (Annexure IIA, Table 5).

Thus there was no single dominant species but a group of species formed the main component of the vegetation in herb layer of non-invaded areas. On the other hand, in case of invaded areas *P. hysterophorus* was found to have highest score of IVI [43.26] along with RF of 7.12, RD of 28.20 and RA of 7.95 and so was the dominant species (Annexure IIA, Table 6). IVI score of *P. hysterophorus* was found to be 4 times of the following species, *Axonopus compressus* [IVI = 11.48, RF = 4.69, RD = 4.76, RA = 2.03]. Other species with higher IVI values were *Senna tora* [IVI = 1072], *Ageratum houstonianum* [IVI = 7.18], *Chromolaena odorata* [IVI = 6.88], *Kyllinga nemoralis* [IVI = 6.82], etc. Thus *A. compressus* and S. *tora* are recognized as co-dominants. Herbaceous vegetation in *Parthenium* invaded areas was of quite uniform type. Both the invaded and non-invaded areas showed similar type of IVI score for co-dominant species but in invaded areas *Parthenium* was densely populated. It was further explained by the dominance diversity curve for top ten species for both, the non-invaded and invaded areas (Figures 6.3.7 & 6.3.8).

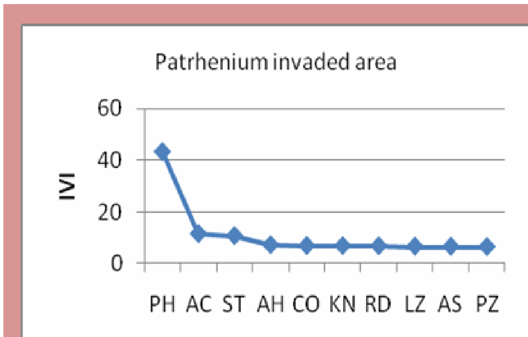

Figure 6.3.7. Dominance diversity curve of Top ten species in *Parthenium* invaded area

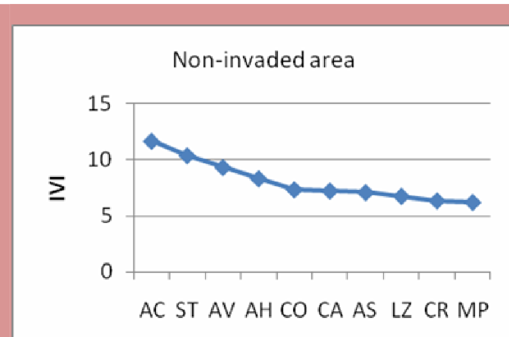

Figure 6.3.8. Dominance diversity curve of Top ten species in *non*-invaded area

Diversity indices: different diversity indices were calculated for *Parthenium* invaded and non-invaded areas. *Parthenium* invaded area was poor in species diversity whereas the non-invaded area was found to be rich enough and was evident by species diversity or Shannon-Weiner index value of 6.26 and 21.34 in invaded and non-invaded areas respectively. Concentration of dominance for invaded areas was quite high (46.31) indicating the dominance of a single species [*P. hysterophorus*]. On the other hand, for non-invaded areas it was found to be much less, only 8.72, which express that the vegetation was a heterogeneous assemblage and with no single species dominating the vegetation. Species richness of the invaded area was calculated to be lesser 0.045 and it is higher for the non-invaded area (0.080). Similarity index of these two vegetations i.e. *Parthenium* invaded and non-invaded areas was calculated to be 0.906. So they were quite similar in respect of species composition but widely differ in dominance pattern.

6.4. ABOVE GROUND HERBACEOUS BIOMASS PRODUCTION

Biomass is an important parameter to understand the functional aspects of an ecosystem (Cornet, 1981) and it also helps to understand the physical and chemical attributes of the soil. Above ground biomass is a useful measure for assessing changes in forest structure (Brown *et al.* 1989). Estimation of biomass is a crucial aspect for comparing the primary productivity of natural vegetation with that of planted forest. Above ground herbaceous biomass (AGHB) production under different tree plantations and natural forest in Terai–Duars belt of West Bengal was measured in the present study and recorded significant differences in AGHB production under plantations and natural vegetation. In Terai region, natural vegetation which was regarded as the native landuse pattern, produced 2800.32 g/m^2 of above ground herbaceous biomass of which 1080.16 g/m^2 (38.57 %) was living biomass and 1720.16 g/m^2 (61.43 %) was litter part whereas in teak plantation AGHB production was less and measured at 1737.60 g/m^2 that was the sum of 545.60 g/m^2 (31.40 %) and 1192 g/m^2 (68.60 %) of living and litter part of biomass respectively. Production of AGHB was 37.20 % lesser in teak plantation than the natural vegetation in *Sevoke* site of Terai region (Table 6.25).

Table 6.25. Above ground herbaceous biomass production in Sevoke site.

Vegetation	Season	Dry Mass (g/m^2)			Dry Mass %			Difference
		Living	Litter	Total	Living	Litter	Total	
Natural	Winter	191.68	554.4	746.08	25.69	74.31	26.64	48.62
	Pre Mon	340.8	531.2	872	39.08	60.92	31.14	21.83
	Post Mon	547.68	634.56	1182.24	46.33	53.67	42.22	7.35
	Annual	**1080.16**	**1720.16**	**2800.32**	**38.57**	**61.43**	**100**	**22.85**
Teak Planttion	Winter	65.6	208	273.6	23.98	76.02	15.75	52.05
	Pre Mon	184	484.8	668.8	27.51	72.49	38.49	44.98
	Post Mon	296	499.2	795.2	37.22	62.78	45.76	25.55
	Annual	**545.6**	**1192**	**1737.6**	**31.4**	**68.6**	**100**	**37.2**

Seasonal variations of biomass (AGHB) production were notable for both, in plantation and natural vegetation. Maximum amount of biomass was harvested during the post-monsoon period measuring 1182.24 g/m^2 in natural vegetation and 795.20 g/m^2 in teak plantation that presented 42.22 % and 45.76 % of the annual biomass production respectively. Lowest percent of AGHB was found to be produced during the winter season at 746.08 g/m^2 and 273.60 g/m^2 amounting 26.64 % and 15.77 % of the total annual production in natural vegetation and teak plantation correspondingly (Figures 6.4.1 & 6.4.2).

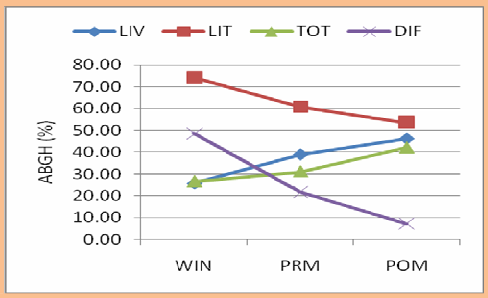

Figure 6.4.1. Seasonal variation in living and litter part of AGHB under natural vegetation in sevoke site.

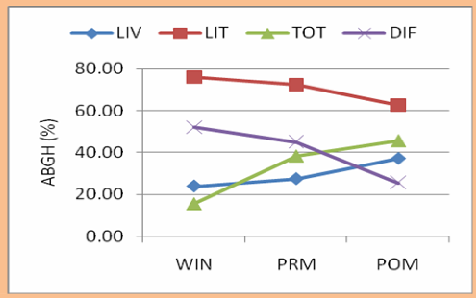

Figure 6.4.2. Seasonal variation in the living and litter part of AGHB production under teak plantation in Sevoke site

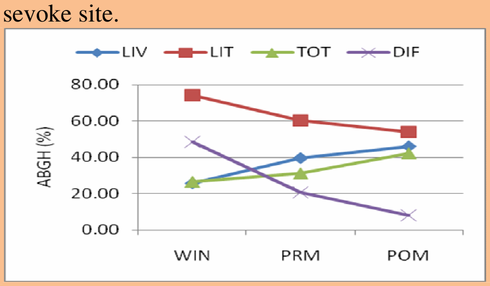

Figure 6.4.3. Seasonal variation in living and litter part of AGHB under natural vegetation in Lataguri site

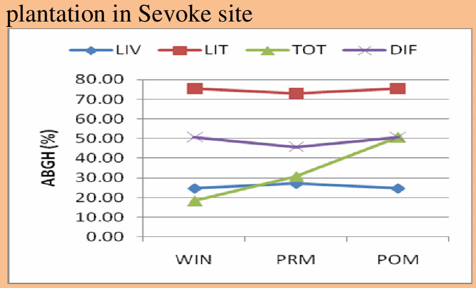

Figure 6.4.4. Seasonal variation in living and litter part of AGHB under Sal-hilauni plantation in Lataguri site

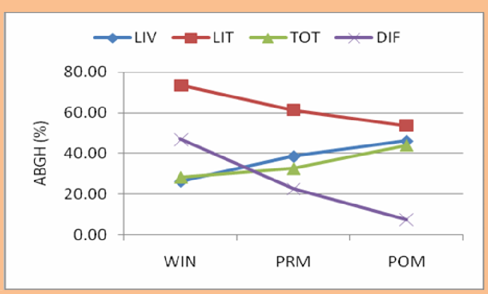

Figure 6.4.5. Seasonal variation in living and litter part of AGHB under natural vegetation in NRVK site

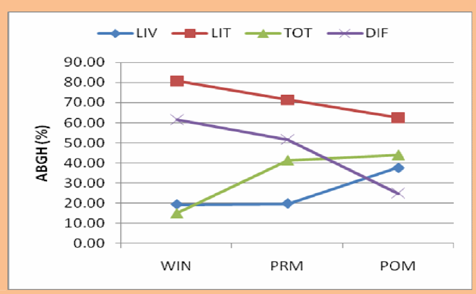

Figure 6.4.6. Seasonal variation in living and litter part of AGHB under teak plantation in NRVK sit

Biomass turnover and degradation of litter part were not dirrectly estimated in the present study but the trend of both biomass turnover and litter degradation pattern in both the natural vegetation and teak plantation were easily predictable.

The litter parts were highest in winter season (74.31 % and 76.02 % of the seasonal production in natural vegetation and teak plantation respectively) and gradually decresed and become lowest in the post-monsoon period (53.67 % in natural vegetation and 62.78 % in teak plantation). In case of living part of the AGHB, the reverse trend was found *i.e.* living masses were lowest in winter (25.69 % and 23.98 % in natural vegetation and teak plantation respectively), then increased gradually and attained the peak during the post-monsoon, 46.33 % in natural vegetation and 37.22 % in teak plantation.

The trends in litter degradation pattern and biomass turnover are almost same in both, natural vegetation and teak plantation in Terai region but the differences were in their rates. In natural vegetation, both the litter degradation and increases in living masses were rapid and during the post monsoon period the difference in litter and living part became less leaving a gap of 7.34 %. But in teak plantation, due to the slow degradation of litter part and production of lesser amount of living mass, a huge difference of 25.56 % persisted even in the post-monsoon period instead of favourable environment for decomposition and degradation of litter component in teak plantation.

In Duars region, sal-chilauni plantation in Lataguri and teak plantation in North Rajabhatkhawa (NRVK) site were studied along with a patch of natural vegetations near the respective plantations. Under sal-chilauni plantation, production of AGHB was measured 1189.86 g/m^2 of which 301.86 g/m^2 (25.37 %) was living biomass and 888 g/m^2 (74.63 %) was litter part whereas in natural vegetation AGHB production was slightly higher than the sal-chilauni plantation and measured to be 1250g/m^2 that was the sum of 450.88 g/m2 (36.05 %) and 831.84 g/m2 (66.51 %) of living and litter part of biomass respectively (Table 6.22). Production of AGHB was 60.86 g/m^2 lesser in sal-chilauni plantation than the natural vegetation. Under teak plantation in NRVK site, production was measured to be 1722.16 g/m^2 of which 473.59 g/m^2 (27.50 %) was living biomass and 1184.52 g/m^2 (68.78 %) was litter part whereas in natural vegetation AGHB production was higher than teak plantation and measured to be 2427.64 g/m^2 that was the sum of 935.86 g/m^2 (38.55 %) and 1491.78 g/m^2 (61.45 %) of living and litter parts of biomass in that order. Production of AGHB was 705.48 g/m^2 lesser in teak plantation than the Natural vegetation. Seasonal variation in production of living and litter parts of AGHB under the natural vegetation, sal-chilauni plantation and teak plantation followed the same pattern both in Terai and Duars region. Maximum amount of litter was found to be accumulated in winter, moderate in pre-monsoon and minimum in post-monsoon periods. On the other hand, least amount of living parts of AGHB were recorded in winter; increased gradually and reached at peak during the post-monsoon period (Figures 6.4.3 & 6.4.4).

Under natural vegetation in Lataguri forest, litter parts were measured 56.67 %, 54.67 % and 52.43 % during winter, pre-monsoon and post-monsoon periods respectively, whereas the living masses were 33.33 %, 35.33 % and 37.57 % in winter, pre-monsoon and post-monsoon seasons (Figure 6.4.5 & 6.4.6). The seasonal variations in litter and living biomass were least under natural vegetation. AGHB productions were nearly same throughout the year.

Table 6.26. Above ground herbaceous biomass production in Lataguri site.

Vegetation	Season	Dry Mass (g/m^2)			Dry Mass %			Difference
		Living	Litter	Total	Living	Litter	Total	
Natural	Winter	187.22	543.01	730.23	25.64	74.36	26.67	48.72
	Pre Mon	337.74	516.43	854.17	39.54	60.46	31.2	20.92
	Post Mon	529.98	623.31	1153.29	45.95	54.05	42.13	8.09
	Annual	**1054.94**	**1682.75**	**2737.69**	**38.53**	**61.47**	**100**	**22.93**
Sal-Chilauni	Winter	53.86	164.8	218.66	24.63	75.37	18.38	50.74
	Pre Mon	99.2	267.2	366.4	27.07	72.93	30.79	45.85
	Post Mon	148.8	456	604.8	24.6	75.4	50.83	50.79
	Annual	**301.86**	**888**	**1189.86**	**25.37**	**74.63**	**100**	**49.26**

That was an indicator of static AGHB production as well as the stability of the vegetation and ecosystem. The differences between litter and living masses in natural vegetation were lesser than the plantations, 23.33 %, 19.35 % and 14.87 % in winter, pre-monsoon and post-monsoon seasons respectively. Same sort of biomass turnover and degradation pattern were found under the natural vegetation in NRVK site also, where litter, living masses, and their differences were 74.36 %, 25.64 %, 48.72 % and 60.46 %, 39.54 %, 20.92 % and 54.05 %, 45.95 %, 8.09 % in winter, pre-monsoon and post-monsoon periods respectively.

Table 6.27. Above ground herbaceous biomass production in NRVK site.

Vegetation	Season	Dry Mass (g/m^2)			Dry Mass %			Difference
		Living	Litter	Total	Living	Litter	Total	
Natural	Winter	173.29	481.46	654.75	26.47	73.53	28.23	47.07
	Pre Mon	291.32	462.33	753.65	38.65	61.35	32.5	22.69
	Post Mon	471.25	547.99	1019.24	46.24	53.76	43.95	7.53
	Annual	**935.86**	**1491.78**	**2427.64**	**38.55**	**61.45**	**100**	**22.9**
Teak Planttion	Winter	49.66	207.75	257.42	19.29	80.71	14.95	61.41
	Pre Mon	139.93	505.37	709.34	19.73	71.24	41.19	51.52
	Post Mon	284	471.4	755.4	37.6	62.4	43.86	24.81
	Annual	**473.59**	**1184.52**	**1722.16**	**27.5**	**68.78**	**100**	**41.28**

Under sal-chilauni plantation, litter (75.37 % of the seasonal product) was more than three times of the green mass (24.63 %) and the difference was also high (50.74 %) in winter season and approximately 3:1 ratio of the litter and living masses was persisted throughout the year. The huge difference in litter and living biomass was mostly due to prevention of growth of herb layer under sal-chilauni plantation by thick layer of dry leaves which are heavily cuticularized and needed long duration of time for degradation.

Seasonal productions of litter and living parts of AGHB under teak plantation in NRVK site showed some sorts of deviation from that of natural vegetation. 80.71 %, 19.29 %; 71.24 %, 19.73 % and 62.40 %, 37.60 % of the total seasonal production were litter and living masses during winter, pre-monsoon and post-monsoon correspondingly. Litter parts were about 4 times of living matter in winter and pre-monsoon, and about 2 times in post-monsoon.

Annual production of AGHB was highest under natural vegetation, 2800.32 g/m^2 in Terai region and 2427.64 g/m^2 in NRVK site of Duars region, followed by teak plantations 1737.6 g/m^2 in Terai zone and 1722.16 g/m^2 2737.69 g/m^2 in NRVK and Lataguri site of Duars region respectively (Table 6.27). In Terai region and NRVK and Lataguri site of Duars region, AGHB productions were suppressed under teak plantations by 1062.72 g/m^2, 705 g/m^2 and 1547.83 g/m^2 respectively. Under sal-chilauni plantation also, production of AGHB was reduced but by lesser amount i.e. 60.86 g/m^2.

6.5. RARE, ENDEMIC AND THTEATENED ELEMENTS (RET)

Terai – Duars belt of West Bengal is located at the foot of the Himalaya and is a contiguous region with the Eastern Himalaya, which is renowned for its endemic flora (Das 2002; Rai 2006) as well as the other categories of threatened plants. A total of 41 species of plants belonging to 27 families were recorded from the study site (Annexure IIB, Table 1) which includes 15 species of trees, 12 climbers, 8 herbs and 6 shrubs. Endemic, Endangered (EN), Near Threatened (NT), Vulnerable (V) and Critically Endangered (CR) – these five categories were recorded and the highest number of species were found to be endemic i.e. 22 species. 9 species were found to be Endangered, 6 species as Vulnerable, 2 species as Near Threatened, 1 species as Critically Endangered and 1 species was recorded to be endemic as well as in Endangered category. Regarding the occurrence of species, Vitaceae was found to have 2 members under RET category [EN = 2] as well as with four endemic species. Apocynaceae represented 3 species [EN = 2, NT = 1]; Lauraceae was also found to represent 1 species as CR and 2 endemic species. One species of Leguminosae was Endemic, 1 Endangered and another species was Vulnerable and thus Leguminosae also was represented by 3 species under the RET category. Meliaceae, Ophioglossaceae and Piperaceae were found to have 2 species each under the RET category. CAMP Workshop-2007 also assessed the threat status of prioritized medicinal plants of West Bengal (mainly from the Terai-Duars region) and was assigned the status of Near Threatened (NT) and above (http://envis.frlst.org). Most of the recorded species are used medicinally and are exploited vigorously. That was claimed to be the main reason behind the threats (Das *et al.* 2010).

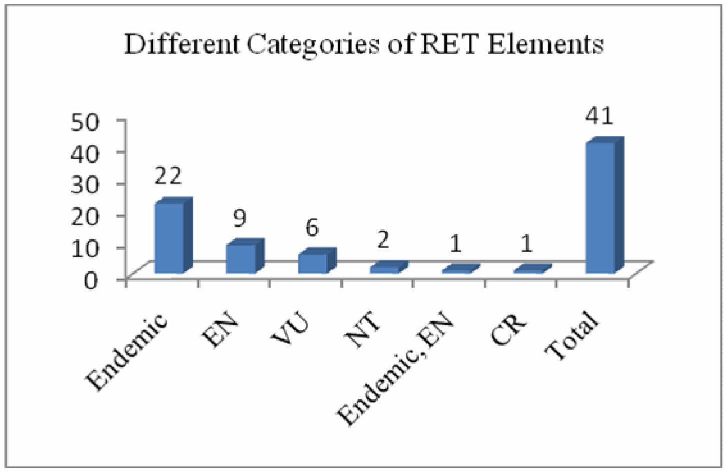

Figure 6.5.1. Number of RET plants of differnt categories in Terai-Duars belt.

6.6. NON TIMBER FOREST PRODUCES (NTFPs)

Non-Timber Forest Produces (NTFPs) are wild plants and animal products derived from forests (FPB, 2004). It may be wild fruits, vegetables, nuts, edible roots, honey, palm leaves, medicinal plants, mushroom, poisons and even the forest soil (Andel, 2006). The concepts of NTFPs differ from the timber products in specific conserevation strategy as sustained lavels of collection of NTFPs do not hamper the integrity of forests and thus plays important role in conservation of ecosystem and socio-ecological relationship and economic development (FPB, 2004).

Terai-Duars belt of West Bengal which is located at the foot of the Himalayas and contiguous with the Himalaya Biodiversity Hotspot for conservation and is unique in its phyto-diversity. Forests of this belt (both plantation and natural vegetation) are the unique sources of NTFPs. During the present study, total 186 species of plants were collected those can be recognized as Non Timber Forest Produces (NTFPs). These include 94 species of trees, 33 herbs, 25 shrubs, 28 climbers, 3 ferns and 3 bamboos (Figure 6.6.1). Out of the total collected NTFPs, 77 species were collected from the natural forest only; 68 species were collected from both the natural forest and plantation; 25 species were collected from fringe areas only. Nine species were found to occur in all of the natural forests, plantations and fringe areas. Four species were collected from natural forests and fringe areas only whereas three species were collected from the plantation only (Figure 6.6.2).

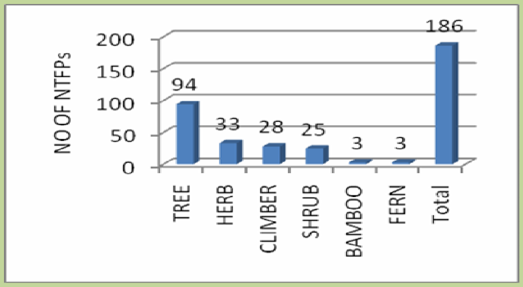

Figure 6.6.1. Different habit class of recorded NTFPs

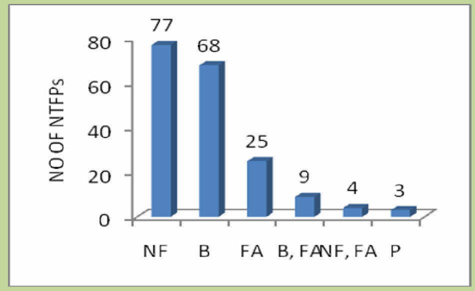

Figure 6.6.2. Occurrences of NTFPs in plantation[P], natural forest [NF] and fringe area [FA]

Important categories of NTFPs recorded from the study area includes edible or food plants, fodder, decorative elements, spices, fuel, relegious material, fibre, aromatic plants, broom, cordage, dye, dhuna, fencing and building materials, brewing materials, detergents, fish poisoning, food plate, hats, insect repellents, preservatives, etc. Though the medicinal plants are an important category of NTFPs, but it was discussed separately under another sub-heading (Medicinal plants) and only those plants having medicinal property along with some other uses, were included in the list of NTFPs (Annexure IIB, Table 2).

6.6.1. MEDICINAL PLANTS

Different types of vegetation in the Terai–Duars belt of west Bengal are rich habitat for important and rare medicinal plants (Das *et al.,* 2010) and it corresponds to the rich and wide phyto-diversity of this region. A total of 319 species of plants belonging to 244 genera and 94 families were recorded from the study area and name of species, families, their common names and habit has been presented in Table 3 of Annexure IIB. Out of the recorded species 114 were herbs, 88 species were trees, 60 species were climbers and other 57 were shrubby species. In respect of number of representative species, Leguminosae stood at first position with the presentation of 31 species from all the habit groups – trees, shrubs, herbs and climbers. Phyllanthaceae having 17 species occupied the second position. Other families having higher number of species were Compositae, Lamiaceae, Malvaceae [each have 15 species], Apocynaceae [13 species], Amaranthaceae [10 species], Rubiaceae [9 species], Euphorbiaceae [8 species], Vitaceae [8 species], Lauraceae, Orchidaceae, Rutaceae, Solanaceae, Zingiberaceae, Acanthaceae etc. Most of the tree species which were recorded to be used medicinally were found to occur either in natural vegetation or in adjoining areas of the forest. But very few of them were spotted within the plantations.

6.7. TRADITIONAL KNOWLEDGE AND ETHNOBOTANY

Ethnobotany is the systematic study of the interactions between a culture and the plants in its environment, particularly the knowledge about and use of such plants (http://medical-dictionary.the freedictionary.com/enthnobotany). The Northernmost rolling plains of North Bengal i.e. the Terai-Duars region is populated by a large number of ethnic groups – *Santal, Mahali, Malpaharia, Oraon, Rajbanshi, Munda, Polia, Mech, Rabha, Toto,* etc. At the same time this foot-hills of region of the Himalaya is well-known for it's extremely rich in Biodiversity (Das, 1996, 2011). Mainly the Phyto-diversity of this partially marshy zone is well known to the botanists as well as to the non-botanists. Having both the availability of rich forests and a large number of tribal groups and their huge populations, an excellent system of traditional knowledge base has been developed in this forested belt of Northern Bengal. During the present survey the richness of traditional knowledge system was revealed in recording of a good number of plants to be used traditionally by the ethnic groups as well as by the rural people (Sarkar, 2011). Plants which were collected to be ethnobotanically important were categorized under different groups depending on their uses.

6.7.1. Edible plants

About 71 species, belonging to 38 families were recorded to be used as food, vegetables, fruits etc. and were categorized under edible plants. Some of those plants were *Alocasia macrorrhizos*, *Annona reticulata, Antidesma acidum, Artocarpus chaplasa, Bauhinia acuminata, Brassica campestris, Cajanus cajan, Chenopodium album, Colocasia esculenata Dioscorea bulbifera, Dioscorea prazeri, Dryopteris sikkimensis, Phyllanthus emblica* etc. Plants which were collected as edible were also been used as medicine in most of the cases. Plant parts used for their medicinal properties were diverse enough – stem, bark, root, leaf, fruits, flower, seeds, gum, twig, etc. (Annexure IIB, Table 4).

6.7.2. Fodder plant

A total of 48 species of plants covering all the habit classes – tree, shrub, herb and climber were recorded to be used as food for the cattle of the tribal as well as by the other rural people in the study area (Annexure IIB, Table 5). Generally twigs, leaves, shoots, fruits, stem etc. were used for fodder purpose and in most cases fodder plants were recorded to be collected from the natural forest or fringe area or from the marginal areas of plantations. Some of the important fodders were *Ziziphus jujuba, Artocarpus lacucha, Albizia chinensis, Ficus benghalensis, Trema orientalis, Bauhinia variegata, Toona ciliata, Ficus religiosa,* etc.

6.7.3. Ethno-veterinary plants

Total 85 species of plants were collected as ethno-veterinary materials were recorded and were found to be very significant in their cattle care. They used different parts of the plants – leaves, roots, rhizome, fruits, bulb, petiole, leaf juice, latex, whole plant, twigs, seed oil, tender shoot, seeds, flowers, cotyledons etc. to cure the common ailments of their domestic animals. Those plants were found to be used along with some other substance like lime, salt, oil etc. Some of the important plant materials found are used in ethno-veterinary treatments were *Allium cepa, Allium sativum, Alocasia macrorrhizos, Alstonia scholaris, Amaranthus spinosus, Amorphophallus bulbifer, Azadirachta indica, Bambusa vulgaris* etc. (Annexure IIB, Table 6). Maximum numbers of plants were used to cure digestive ailment of cattle, mouth sore, poor lactation, dysentery, etc.

6.7.4. Ethno-medicinal plants

A good number of plants were recorded as ethno-medicinally important species. They included all the habit groups like trees, shrubs, herbs, climbers and ferns. These plants were mostly used against common cold, fever, jaundice, cut, sore, anaemia, indigestion, dysentery, malaria, insomnia, weakness, toothache etc. All the plant parts – root, leaf, stem, bark, root-bark, fruits, flowers, twig etc. were used to cure different ailments. Some of the recorded and mostly used ethnomedical plants were – *Centella asiatica*, *Tinospora sinensis*, *Terminalia chebula*, *Terminalia bellirica*, *Saraca asoca*, *Paederia foetida*, *Justicia adhatoda, Aesculus assamica, Aegle marmelos, Alstonia scholaris, Bauhinia vahlii, Bombax ceiba,* etc. (Annexure IIB, Table 7).

6.7.5. Aromatic and Spice plants

Total seven species of plants were found to be used by the forest-dependent people as aromatic plants or as spice. These were *Blumea lacera, Cinnamomum tamala, Clausena excavata, Curcuma aromatica, Zingiber zerumbet* etc (Annexure IIB, Table 8).

6.7.6. Rope and Cordage

A total of eight species of plants were collected, which are used as cordage or rope and were mainly used to tie up the bundle of grasses, fodder, fuel wood etc. Generally the plants having fibrous bark (e.g. member of Malvaceae, Araceae, Celastraceae, etc.) or climbers were used for this purpose. Some of the cordage plants were *Calamus erectus*, *Celastrus paniculatus*, *Grewia asiatica*, *Sterculia villosa,* etc. (Annexure IIB, Table 9).

6.7.7. Decorative and Ornamental plants

A good number of plants or plant parts were found to be used as decorative materials or ornamental plants. These were the integrated part of NTFPs also. Generally the dry fruits, tough leaves or fronds of fern, fibrous mesocarp, inflorescence, infructescence, flowers, seed etc. were used for this purpose. Different parts of plants like– *Luffa acutangula, Lagerstroemia speciosa, Butea monosperma, Duabanga grandiflora, Pandanus unguifer* etc. are used by them as decorative elements (Annexure IIB, Table 10).

6.8. SOIL PARAMETERS

Soil provides the nutrients and water which is very much essential for the growth of plants. On the other hand plants influence and affect the formation of soil, its physical and chemical properties etc. From the very beginning of plantation forestry, fear of soil deterioration in monoculture plantation was expressed (Joshi *et al*. 1997) and different workers had reported the modification of soil properties by plantation (Balagopalan 1995; Michelsen *et al*. 1996; Ehrenfeld 2003; Thapa *et al.*2011). As an important aspect of the present study, different soil parameters, namely soil texture, content, soil organic carbon, nitrogen, available phosphorous and potash were estimated from the soil samples of natural forests and different plantations in the study area. Comparison of plantation and natural forest were made on the basis of the above mentioned soil parameters and the result has been represented in Table 6.28 in a comprehensive way.

Table 6.28. Different Physicochemical properties of Soil in Plantation and Natural forest

Vegetation	Soil Layer	p^H	Moisture Content (%)	Organic Carbon	Potassium (ppm)	Phosphorus (ppm)	Texture			
							Silt %	Clay %	Sand %	Class
Natural Vegetation	Top	5.180	35.29	1.44	112.15	30	30	40	15	Loam
	Sub	5.275	34.98	1.355	108.9	30	30	40	15	
Mixed Plantation	Top	5.198	43.99	1.4475	87.125	25	30	40	25	Clay Loam
	Sub	5.235	42.89	1.3	83.4	20	30	40	23	
Sal-Chilauni Plantation	Top	4.945	42.16	1.485	91	22.5	30	40	25	Clay Loam
	Sub	4.845	42.50	1.355	102.9	27.5	30	39	22	
Teak Plantation	Top	5.045	36.85	2.01	105.95	25	30	40	25	Clay
	Sub	5.145	38.02	1.725	94.15	25	35	45	20	

Soil in natural vegetation was categorized as loam having 30% of silt, 40% of clay and 15% of sand in both the top and sub-soil. Mixed plantation soil was classified as clay loam having 30%, 40% and 25% of silt, clay and sand in top layer and 30%, 40% and 23% of the same in similar sequence in sub-soil. Texture of sal-chilauni plantation also was clay-loam having similar type of proportion of silt, clay and sands as in mixed plantation. Soil of teak plantation was categorized as clay (30%, 40% and 25% of silt, clay and sand in top soil and 30%, 39% and 22% of silt, clay and sand in sub-soil).

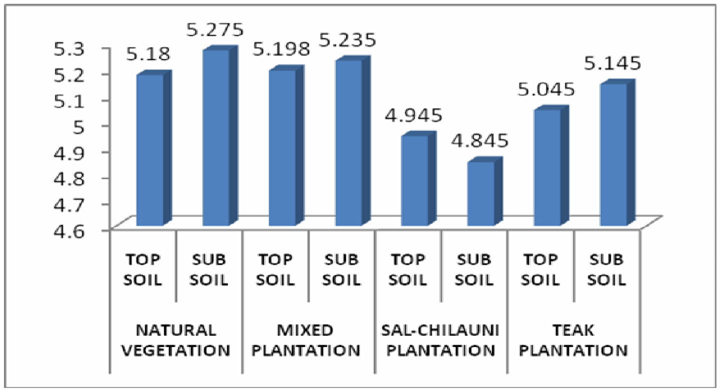

Figure 6.8.1. p^H of top and sub soil of Natural forest and different plantations

p^H of the top and sub-soil of natural vegetation was estimated to be 5.18 and 5.28 respectively. On the other hand, that of the top and sub-soil of mixed plantation, sal-chilauni plantation and teak plantation was found to be, 5.20, 5.24, 4.95, 4.85 and 5.05, 5.15 respectively (Figure 6.8.1). Moisture content of top-soil was found to be lowest (35.29%) in natural forest and highest (43.99%) in mixed plantation. Highest and lowest moisture content in sub-soil were recorded for mixed plantation and natural forest. In all the plantations, soil moisture contents in both top and sub-soil, was higher than the natural forest (Figure 6.8.2).

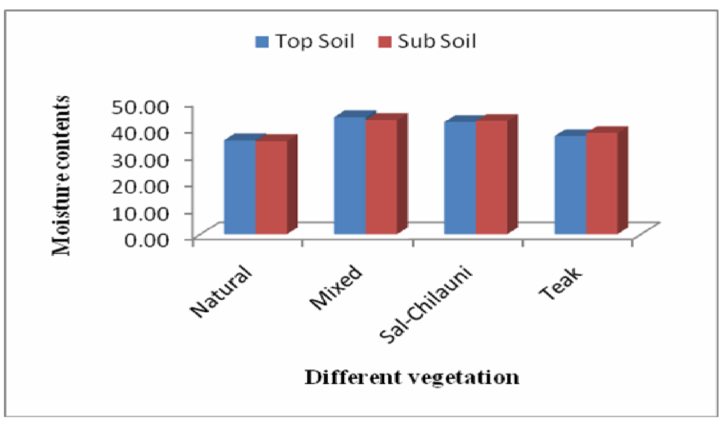

Figure 6.8.2. Moisture contents of top and sub soil of Natural forest and different plantations

Organic carbon content of top and sub layers of soil from different plantations and natural foresthas been represented in Figure 6.8.3. Lowest value of organic carbon in top layer was found in natural forest and the highest value in top soil of teak plantation. In sub-soil, lowest value of organic carbon was found in mixed plantations but highest value was recorded in teak plantation. Top soil in all the four types of vegetations was rich in organic carbon (OC) contents than the sub-soil and difference between OC contents was highest in teak plantation.

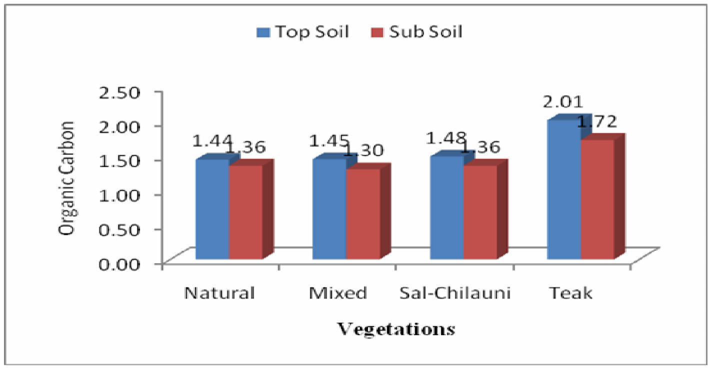

Figure 6.8.3. Organic carbon contents (%) of top and sub-soil of Natural forest and different plantations

Regarding the potassium contents, natural forest was recorded for highest value in both the top and sub-soil. Potassium content was least in both top and sub soil of mixed plantation. In teak plantation 105.95 ppm and 94.15 ppm of potassium content were estimated in top and sub-soil respectively the differences in potassium contents in top and sub-soil was highest (11.8 ppm) in teak plantation. Sal-chilauni plantation differed from all other three types of vegetation in respect of lower potassium contents in top soil than the sub-soil (Figure 6.8.4).

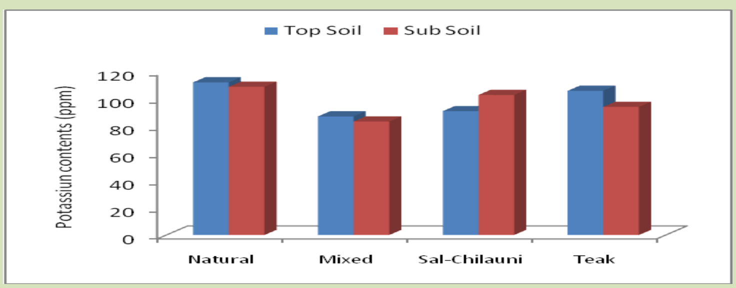

Figure 6.8.4. Potassium contents of top and sub-soil of Natural forest and different plantations

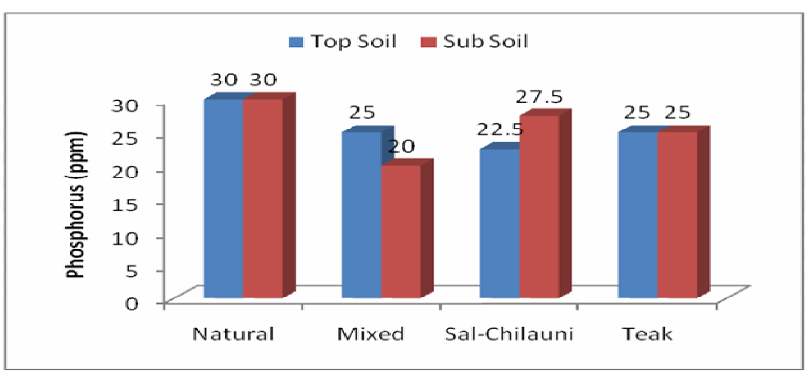

Figure 6.8.5. Phosphorus contents of top and sub-soil of Natural forest and different plantations

Phosphorous contents in both the top and sub layer of soil in the natural vegetation was estimated to be 30 ppm. In teak plantation also, the phosphorous content in both the top and sub soil were same, i.e. 25 ppm. In this respect teak plantation resembles with the natural vegetation. In mixed plantation 25 ppm and 20 ppm of phosphorus content were measured. In Sal-chilauni plantation phosphorus contents (Figure 6.8.5) in top soil (22.5 ppm) was lower than the sub-soil (27.5 ppm).

6.9. ALLELOPATHY

Allelopathy is a natural phenomenon whereby one plant releases some biochemical substances having inhibitory and stimulatory effects on some other plants (Rice, 1984; Mensah *et al.* 2015). Allelopathy acts by addition of phytotoxic elements to the environment and they inhibit germination and/or growth of some other plants. In trees and forests it is an important healthcare issue. Some agroforestry trees have been reported to have some allelopathic effects (Jayakumar *et al.* 1987; Macias *et al.* 2000; Sahoo *et al*. 2007; Manimegalai *et al.* 2012). In the present study allelopathic effects of some trees which are used to create plantation forests by the Forest Department were tested *in vitro* against some local herbaceous species having medicinal or other importance. Tables 11, 12 & 13 under Annexure IIB summarises the results.

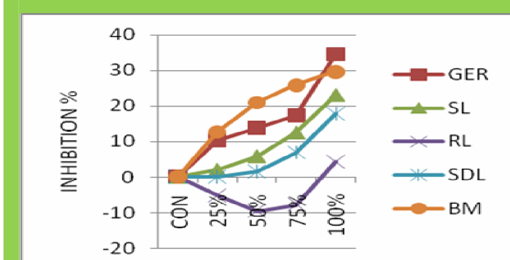

Figure 6.9.1. Effect of Teak leaf extract on germination, shoot length, root length, seedling length and biomass of *Senna occidentalis*

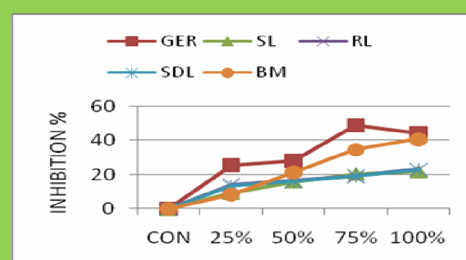

Figure 6.9.2. Effect of Teak leaf extract on germination, shoot length, root length, seedling length and biomass of *Ocimum gratissimum*

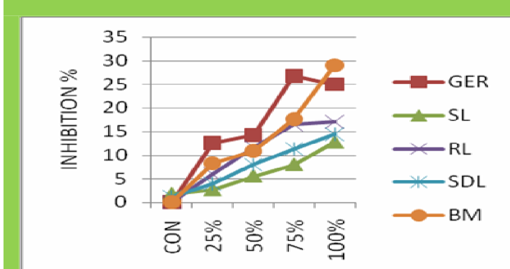

Figure 6.9.3. Effect of Teak leaf extract on germination, shoot length, root length, seedling length and biomass of *Andrographis panicula*

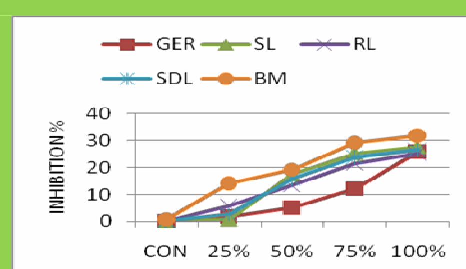

Figure 6.9.4. Effect of Teak leaf extract on germination, shoot length, root length, seedling length and biomass of *Plumbago zeylanica*

Effects of Teak [*Tectona grandis* L.f. of Lamiaceae]: Teak was found to have some effects on germination percentage, shoot, root, seedling length, fresh weight of seedlings of the test plants and other parameters (Figs. 6.9.1 – 10). It inhibited germination and percentage of inhibition were maximum in highest concentration of Teak extract (100 %) and was recorded as 34.48 %, 44.19 %, 25.86 % and 21.43 % in *Senna occidentalis* (L.) Link, *Ocimum gratissimum* L., *Plumbago zeylanica* L. and *Oxalis corniculata* L. respectively (Figures 6.9.1, 2, 4 & 5). But in *Andrographis paniculata* (Burm.f.) Nees the highest percentage of inhibition was found in 75 % concentration of Teak extract (Figure 6.9.3). Percentage of viability of seeds the test plants were according to the percentage of inhibition of seed germination. Inhibitory effect was also noted in case shoot length and root length in *O. gratissimum*, *A. paniculata*, *P. zeylanica* and *O. corniculata*. But in *S. occidentalis* shoot length was inhibited in higher concentration of extract but the root length was slightly stimulated in low to medium concentration of extract. As shoot and root length were inhibited in most of the cases, growth of seedlings were also affected and the seedling-length was also inhibited and the percentage of inhibition in highest concentration of extract were calculated to 17.87 %, 23.01 %, 14.50 %, 26.72 % and 28.46 % in *S. occidentalis O. gratissimum*, *A. paniculata*, *P. zeylanica* and *O. corniculata* respectively. A general trend of reduction in Shoot Vigour Index (SVI), Root Vigour Index (RVI) and Seedling Vigour Index (SDVI) was noted for all the test plants (Figures 6.9.6 – 6.9.10).

The vigour indices were inversely proportional to that of the concentration of Teak extracts. Shoot and root ratio of tested plants were also altered differently by the extracts of Teak leaf. In *S. occidentalis* it was reduced; in *O. gratissimum* it was of more or less similar with that of control; increased in *A. paniculata* and *O. corniculata*; whereas in *P. zeylanica* shoot and root ratio was altered differentially by different concentration of Teak extracts.

Effect of Sal [*Shorea robusta* Gaertn. of Dipterocarpaceae]: Sal exerted inhibitory effect on seed germination of *Senna occidentalis* by 17.86 %, 21.43 % and 25.00 % by extract concentrations of 25 %, 50 % and 75 % respectively (Figure 6.9.11). But in highest concentration of extract (100 %) suppression of germination was lesser, 10.71 % only.

In control, germination percentage was recorded to be 71.67 % whereas in maximum concentration, lowest percentage of germination (41.67 %) was recorded. Thus percentage of inhibition of germination was increased gradually with the increase of extract concentration and culminated into 41.86 % in highest concentration of extract solution. Viability percentage was recorded to be 100.00 %, 88.37 %, 69.77 %, 60.47 % and 58.14 % in case of control, 25 %, 50 %, 75 % and 100 % of extract solution of Sal leaf.

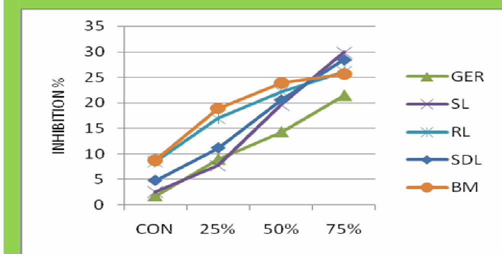

Figure 6.9.5. Effect of Teak leaf extract on germination, shoot length, root length, seedling length and biomass of *Oxalis corniculata*

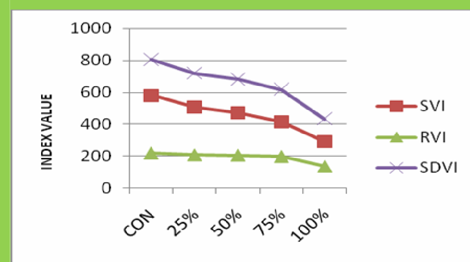

Figure 6.9.6. Effect of Teak leaf extract on shoot vigour index, root vigour index and seedling vigour index *of Senna occidentalis*

Figure 6.9.7. Effect of Teak leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Ocimum gratissimum*

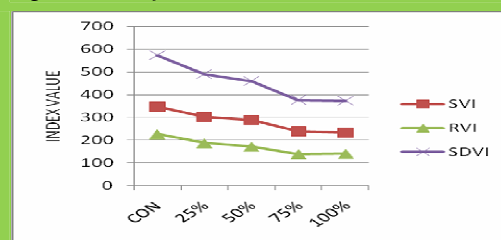

Figure 6.9.8. Effect of Teak leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Andrographis paniculata*

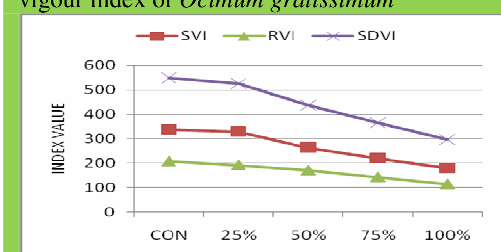

Figure 6.9.9. Effect of Teak leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Plumbago zeylanica*

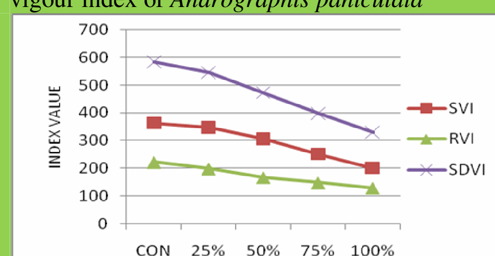

Figure 6.9.10. Effect of Teak leaf extract on shoot vigour index, root vigour index and seedling vigour index *Oxalis corniculata*

On the other hand maximum amount of inhibition in shoot length, root length and seedling length was recorded to be 32.48 %, 42.41 % and 40.78 % in 75 % concentration of the extract. SVI were also reduced by maximum level in 75 % of extract concentration. Shoot-root ratio of *O. gratissimum* seedlings was not affected by the Sal extract. Production of fresh weight by seedlings was also reduced by the extracts and maximum degree of reduction or inhibition was found in highest concentration (100 %).

In case of *A. paniculata,* effect of Sal extract was similar with that on *S. occidentalis*. Shoot-root ratio was increased gradually in different concentrations of extract due to the inhibition of root length. Biomass production was also reduced and percentage of inhibition was found to be highest (46.77 %) by the undiluted (100 %) extract (Figs. 6.9.13 & 6.9.14).

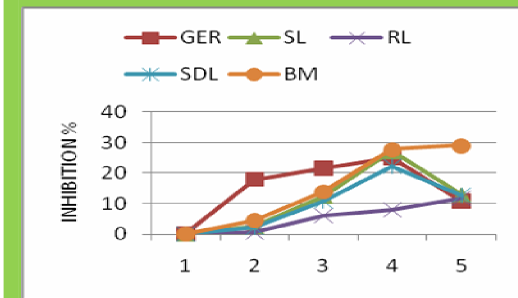

Figure 6.9.11. Effect of Sal leaf extract on germination, shoot length, root length, seedling length and biomass of *Senna occidentalis*

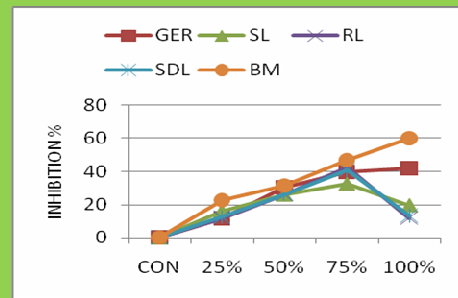

Figure 6.9.12. Effect of Sal leaf extract on germination, shoot length, root length, seedling length and biomass of *Ocimum gratissimum*

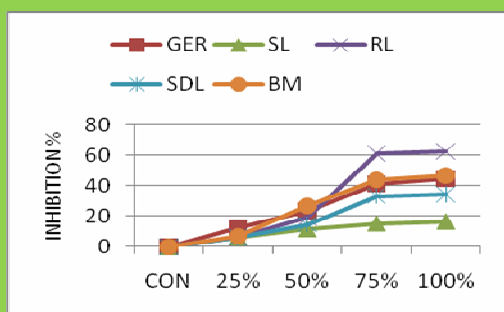

Figure 6.9.13. Effect of Sal leaf extract on germination, shoot length, root length, seedling length and biomass of *Andrographis paniculata*

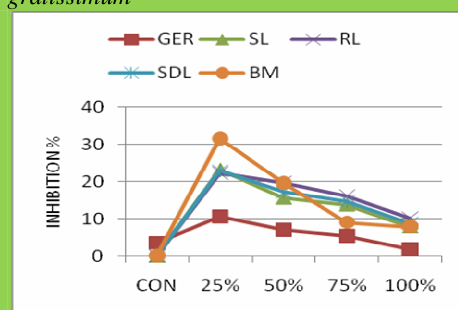

Figure 6.9.14. Effect of Sal leaf extract on germination, shoot length, root length, seedling length and biomass of *Plumbago zeylanica*

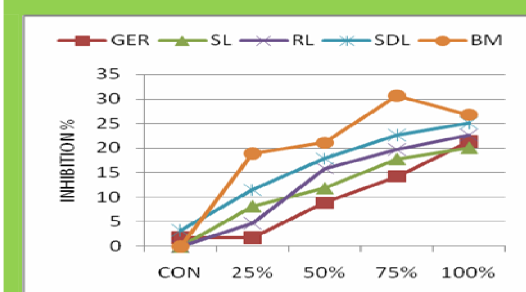

Figure 6.9.15. Effect of Sal leaf extract on germination, shoot length, root length, seedling length and biomass of *Oxalis corniculata*

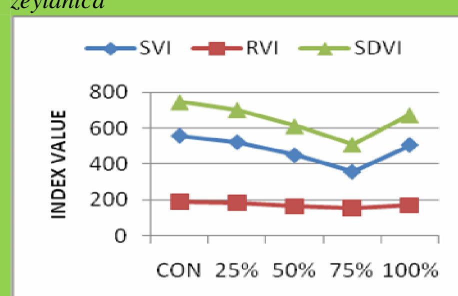

Figure 6.9.16. Effect of Sal leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Senna occidentalis*

In *Plumbago zeylanica*, germination percentage of seeds was slightly increased with the increase of extract concentration, thus percentage of inhibition of seed germination was only 10.71 % in 25 % of extract concentration and other concentrations of extract exerted negligible effect. Accordingly, lowest percentage of seed viability was recorded in extract solution of 25 %. Inhibition of seedling length, along with reduction of shoot and root length was recorded to be 22.94 %

only by lowest concentration of extract solution (25 %). But in case of other higher concentrations of Sal extracts reduction of the seedling length was decreased gradually (Figure 6.9.14). Only 25 % extract solution was found to exert inhibitory effects on shoot vigour (SVI) and seedling vigour indices (SDVI) and calculated values were 222.19, 145.43 and 367.61 respectively (Figure 6.9.19). Shoot-root ratio was increased in case of treatment of different extract solution except 25 % of extract solution in which the ratio was decreased than the control. Regarding the biomass production, reduction in production of fresh weight was the maximum in 25 % extract solution and it was calculated to 31.64 %.

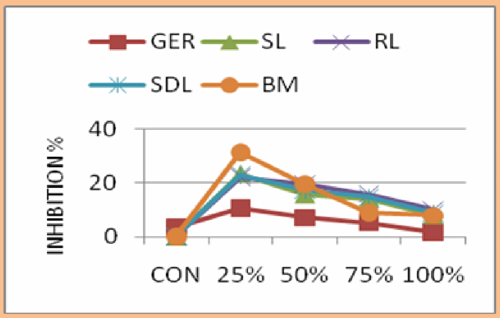

Figure 6.9.17. Effect of Sal leaf extract on shoot vigour index, root vigour index and seedling vigour index *Ocimum gratissimum*

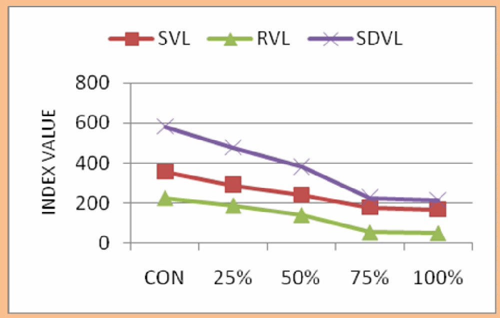

Figure 6.9.18. Effect of Sal leaf extract on shoot vigour index, root vigour index and seedling vigour index *Andrographis paniculata*

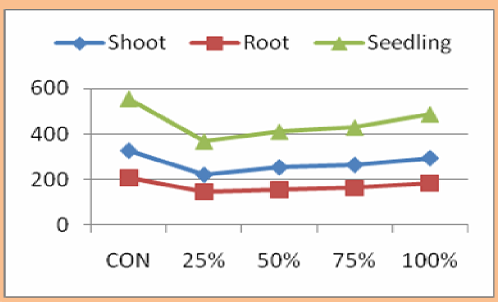

Figure 6.9.19. Effect of Sal leaf extract on shoot vigour index, root vigour index and seedling vigour index *Plumbago zeylanica*

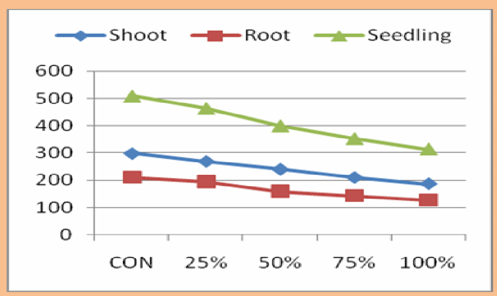

Figure 6.9.20. Effect of Sal leaf extract on shoot vigour index, root vigour index and seedling vigour index *Oxalis corniculata*

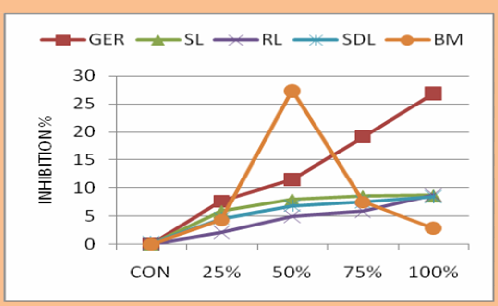

Figure 6.9.21. Effect of Jarul leaf extract on germination, shoot length, root length, seedling length and biomass of *Senna occidentalis*

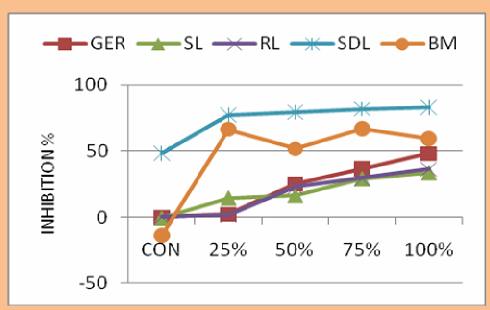

Figure 6.9.22. Effect of Jarul leaf extract on germination, shoot length, root length, seedling length and biomass of *Ocimum gratissimum*

Oxalis corniculata was found to be affected similarly as *S. occidentalis*, by the extract of Sal leaf (Figures 6.9.15 & 6.9.20). Germination percentage was recorded to be 93.33 %, 91.67 %, 85.00 %, 80.00 % and 73.33 % in control, 25 %, 50 %, 75 % and 100 % extract solution respectively. Notable percentage of inhibition of seed germination was recorded by extract solution of 75 % and 100 % and the inhibition percentage was recorded to be 14.28 % and 21.43 % respectively. Thus the viability percentage was recorded to be 85 % and 78.57 %. In those concentrations of extract shoot length, root length and seedling length were inhibited by 17.76 % in 75 % extract solution and 22.69 % in undiluted (100 %) extract; and 22.63 % in 7 5% extract and 25.07 % in 100 % extract solution respectively. All the SVI, RVI and SDVI were reduced notably by different strength of the solution and the lowest value of indices were recorded in highest concentration (100%) of extract and was followed by 75 % of extract solution. In undiluted (100 %) extract vigour indices were calculated to be 186.37 in shoot, 127.57 in root and 313.93 in seedling, in respect of 299.00 %, 210.63 % and 509.63 % in shoot, root and seedling vigour indices under the control. Biomass production was also reduced by the Sal extract in *Oxalis corniculata*. Maximum level of inhibition was recorded to be 30.70 % in 75 % of extract solution.

Effects of Jarul [*Lagerstroemia speciosa* (L.) Pers. of Lythraceae]: Another widely planted tree, Jarul was also tested against the herbs mentioned earlier and the result is represented in Table 13 in Annexure IIB. Germination percentage was found to be at least (41.67 %) in *O. gratissimum* in case of 100 % extract solution and the inhibitory effect was recorded to be 48.08 % (Figure 6.9.22).

In case of *Senna occidentalis* percentage of inhibition of seed germination was recorded to be 26.92 % in highest concentration of extract that resulted into the lowest percentage of viability (73.08 %). Shoot, root and seedling length were least affected even by the highest concentration of extract by 8.70 %, 8.80 % and 8.48 % respectively (Figure 6.9.21). Shoot vigour, root vigour and seedling vigour indices (SVI, RVI, SDVI) were calculated to be lowest in undiluted (100%) extract solution with calculated value of 347.64, 131.83 and 479.47 respectively (Figure 6.9.26). Effect on the shoot-root ratio was not prominent. But the biomass production was reduced by 27.39 % in 50 % concentration of leaf extract of Jarul tree.

Shoot length, root length and seedling length inhibition was gradually increased with the increase of concentration of leaf extract and were calculated to be 33.62%, 36.33% and 83.48% in case of 100% extract concentration in respective order in case of *O. gratissimum*. Other concentration of leaf extract were also found to exert inhibitory effects on seedling length with calculated values of 77.31% in 25%, 79.52% in 50% and 82.14% in 75% whereas in control solution, inhibition was found to be 48% (Figure 6.9.22). Shoot, root and seedling vigour was also affected and reduced (Figure 6.9.27). Biomass production was inhibited by the extract solution but the relation with the gradient of concentration was not clear.

Andrographis paniculata was not affected remarkably by the extract of Jarul leaf (Figures 6.9.23 & 6.9.28). Lowest percentage of seed germination was found in highest concentration of extract with 66.67 % germination. Highest degree of inhibition in percentage of germination was 28.57 % in the undiluted (100 %) extract solution of jarul leaf and it was quite low in respect of other species of test plants. Viability percentage was quite high (71.43 %). Shoot length of *A. paniculata* was stimulated to a very minor extent. Inhibition of root length was not more than 19.36 % even in highest concentration of extract. Thus the inhibition of seedling length was negligible. Shoot, root and seedling vigour indices (SVI, RVI, SDVI) were reduced to some extent. Though the shoot length was stimulated and root length was inhibited in a very lesser extent, the shoot-root ratio was increased up to 2.16 from 1.59 in control. Production of fresh weight was reduced and inhibition percentage was recorded to be up to 29.02 % in highest concentration of extract solution.

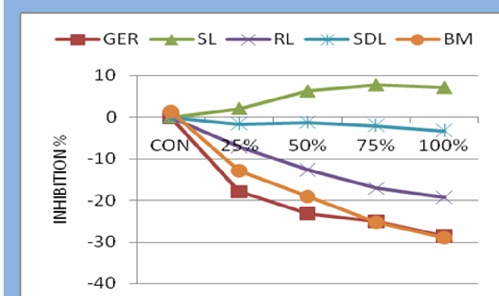

Figure 6.9.23. Effect of Jarul leaf extract on germination, shoot length, root length, seedling length and biomass of *Andrographis paniculata*

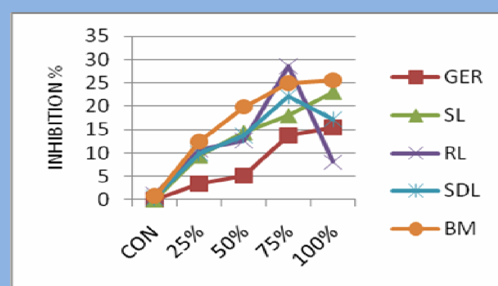

Figure 6.9.24. Effect of Jarul leaf extract on germination, shoot length, root length, seedling length and biomass of *Plumbago zeylanica*

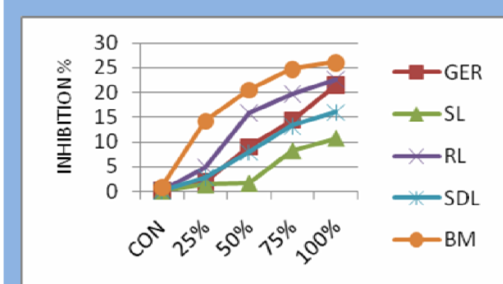

Figure 6.9.25. Effect of Jarul leaf extract on germination, shoot length, root length, seedling length and biomass of *Oxalis corniculata*

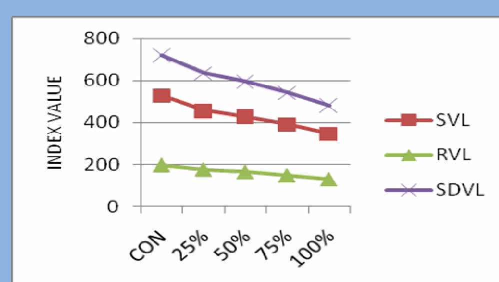

Figure 6.9.26. Effect of Jarul leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Senna occidentalis*

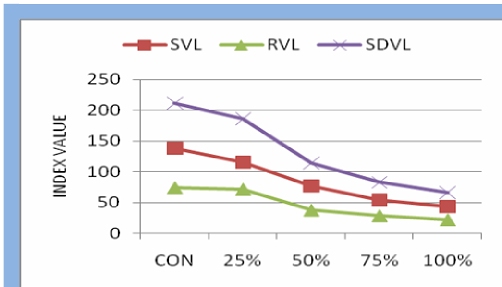

Figure 6.9.27. Effect of Jarul leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Ocimum gratissimum*

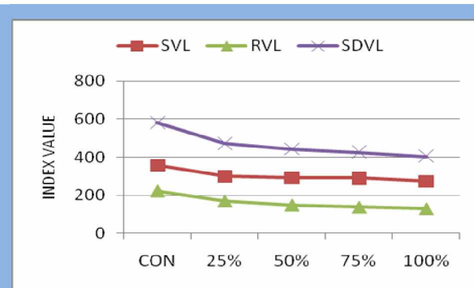

Figure 6.9.28. Effect of Jarul leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Andrographis paniculata*

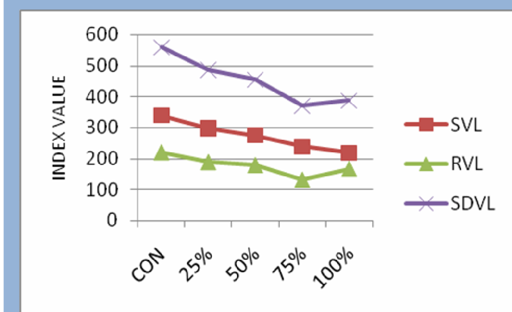

Figure 6.9.29. Effect of Jarul leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Plumbago zeylanica*

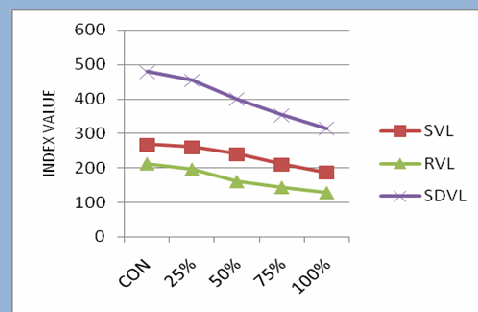

Figure 6.9.30. Effect of Jarul leaf extract on shoot vigour index, root vigour index and seedling vigour index of *Oxalis corniculata*

It has been mentioned earlier that the inhibition percentage of seed germination was very less in case of *Oxalis corniculata*. Higher concentration of extract (75 % and 100 %) showed only some impact on the seed germination and viability percentage of this cosmopolitan species with high ecological amplitude. Here, the shoot length inhibition was recorded to be 8.23 % and 10.78 % in 75 % and 100 % of extract concentrations; root length inhibition by 19.70 % and 22.69 % were recorded in 75 % and 100 % of extract concentration; and 13.24 % and 15.94 % of seedling length inhibition were found against 75 % and 100 % extract of Jarul leaf (Figure 6.9.25). The shoot, root and seedling vigour indices (SVI, RVI, SDVI) were also reduced at different concentrations of the extract. Shoot-root ratio was increased gradually along with the increased concentration of leaf extract and maximum value of the ratio was recorded to be 1.56 when trated with undiluted i.e. 100 % of the extract concentration, whereas in control it was calculated to 1.33. Production of fresh biomass was affected in the same manner and highest degree of inhibition of biomass was recorded in highest concentration of extract (Figure 6.9.30).

Figure 6(i). Working in forest and finding NTFPs: **a.** *Dioscorea pentaphylla* **b-d.** During field work; **e.** *Baccurea ramiflora;* **f.** Flower of *Oroxylum indicum*

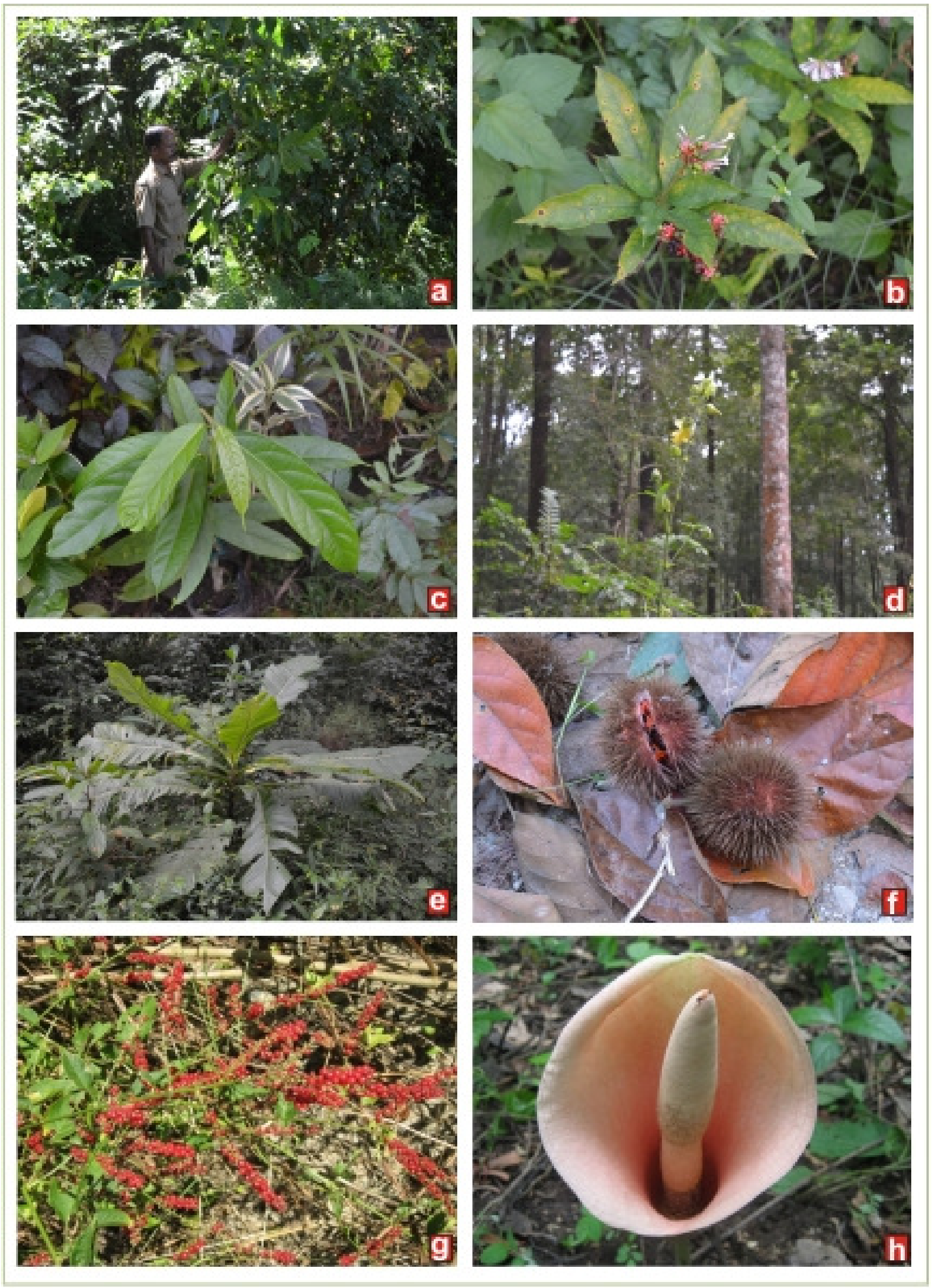

Figure 6(ii). Rare and useful plants: **a.** *Gynocardia odorata* **b.** *Rauvolfia serpentina;* **c.** *Gynocardia odorata* seedling; **d.** *Abelmoschus moschatus;* **e.** *Dillenia pentagyna;* **f.** *Sloanea sterculacea*; (fruit) **g.** *Deeringia amaranthoides;* h. *Amorphophallus* sp.

Figure 6(iii). Threats to the forest and biodiversity: **a.** Fire damaged forest floor; **b.** Illegal cutting pit spotted in forest; **c.** Collection of fire wood

Figure 6(iv). Threats to the forest and biodiversity: **a.** Stump of a sal tree after Illegal felling; **b.** Rail road through the forest; **c.** Road for patrolling

Figure 6(v). Structural difference between plantation and natural forest: **a.** View of natural (left) and plantation forest (right); **b.** Forest floor of natural vegetation; **c.** Ground cover vegetation in teak plantation

Figure 6(vi). Some NTFPs : **a-c** Edible fungus; **d.** Ornamental fungus; **e.** *Dioscorea* tuber; **f.** *Helminthostachys zeylanica*- An edible but rare fern

Discussion

7.1. VEGETATION STRUCTURE AND COMMUNITY ANALYSIS

The association of species growing together in a particular habitat is known as community and analysis of community is an important basis for studying vegetation and to understand its function (Warger & Morrel, 1978). Not only that the vegetation characterization is the primary and most important step in framing conservation goal. Different plantations and natural vegetations of Terai-Duars region of west Bengal have been analysed and thereby a quantitative data have been derived.

The vegetation of Terai and Duars region of West Bengal are very rich in phytodiversity and covers all major groups of plants (Chatterjee, 1940; Das 1986; Kadir, 2001; Das, 1996, 2011). Comparison of different plantations with natural forests revealed a huge difference. Difference in the numerical strength of different taxa of plantation and natural forest were noted and has been presented in Figure 7.1.1. Thus natural vegetation of this belt appeared much more diverse and rich in floral elements than the plantations. All the three layers – tree, shrub and herb layers were populated by higher number of species, family and genera in natural vegetation. Natural forests harboured 446 species, 312 genera and 97 families whereas in plantation the number of species genera and family were 280, 197 and 77 in respective order. From all the plantations only 62.78%, 61.54% and 79.38% of species, genus and families of plant that were growing in natural vegetations were recorded. The superiority of natural forest over the plantations was observed in all the three sites (Figure 7.1.2, 7.1.3, 7.1.4). Differences in number of species occurred in natural forest and plantation was highest in Lataguri site and was measured to be 36.56% and was followed by NRVK site (27.05%) and Sevoke site (25.45%) respectively. Differences in number of genera between natural forest and plantation were 77.17%, 26.99% and 24.11% in Sevoke, NRVK and Lataguri site respectively.

Seasonal variation of occurrences of different taxa i.e. family genus and species were also notable in both the plantation and natural forest and the variations have been represented in Table 7.1.5, 7.1.6, 7.1.7 & 7.1.8. In most of the cases, winter vegetation was less diverse and poor in both plantation and natural forest. Accumulation of thick layer of litter, dry weather and very less or no rainfall at all might be the reasons behind that poorness of winter vegetation (mainly the herbaceous vegetation). Maximum number of species genus and families were recorded in Postmonsoon season in all the plantation and natural vegetation and sites. Favourable conditions during the monsoon specifically the monsoon shower led to the development of this luxurious growth of vegetation although logged water adversely affected the vegetation in some lowland during monsoon rain. But when the plantation was compared with the natural vegetation under same ecological and environmental conditions in the same site, higher magnitude of difference were noted in plantation than the natural forest and that can be explained from the view point of better stability of natural forest than the plantations throughout the year. The tree layers were more or less similar in both natural and plantation forest throughout the year except some minor changes. Whenever the changes were noted, were due to some anthropogenic activities mainly like unauthorized felling, human induced fire etc. Differences were also noted in case of family representing highest number of species. Thus the different types of plantation differed from the natural vegetations in respect of species content and compositions along with the dominant families showing highest number of families, their seasonal variations and in the pattern of variations.

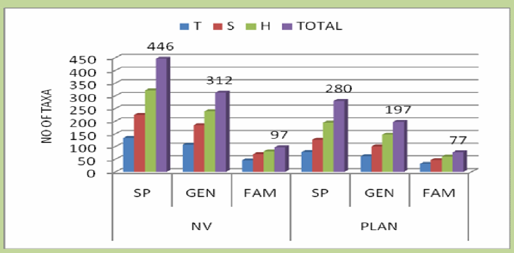

Figure 7.1.1. Number of taxa in different layer of vegetaion in Natural forests and plantation in Terai & Duars Region

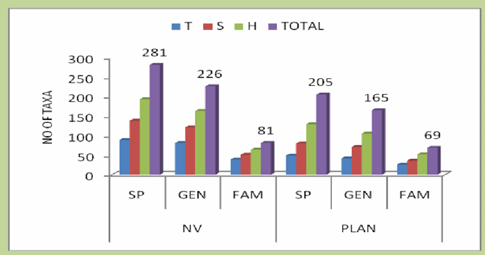

Figure 7.1.2. Number of taxa in different layer of vegetaion in Natural forests and plantation in NRVK site

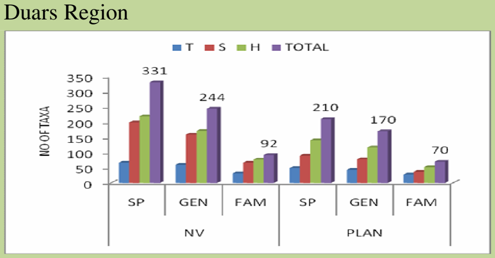

Figure 7.1.3. Number of taxa in different layer of vegetaion in Natural forests and plantation in Lataguri site

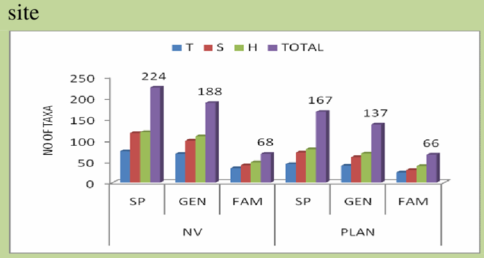

Figure 7.1.4. Number of taxa in different layer of vegetaion in Natural forests and plantation in Sevoke site

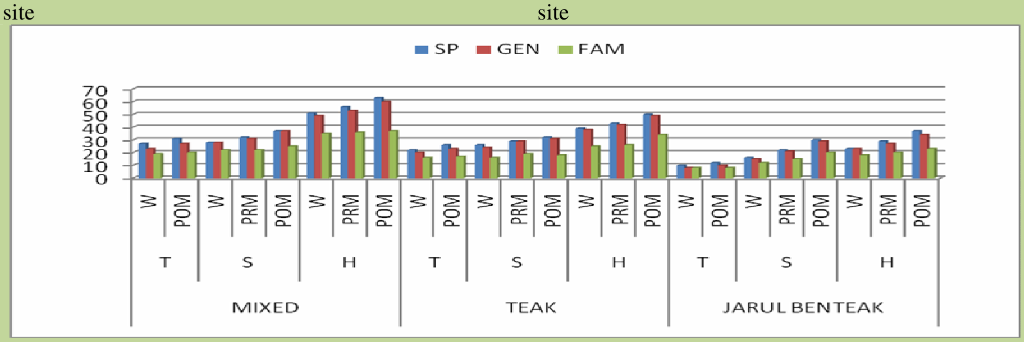

Figure 7.1.5. Seasonal variation of different taxa in various plantations of NRVK site

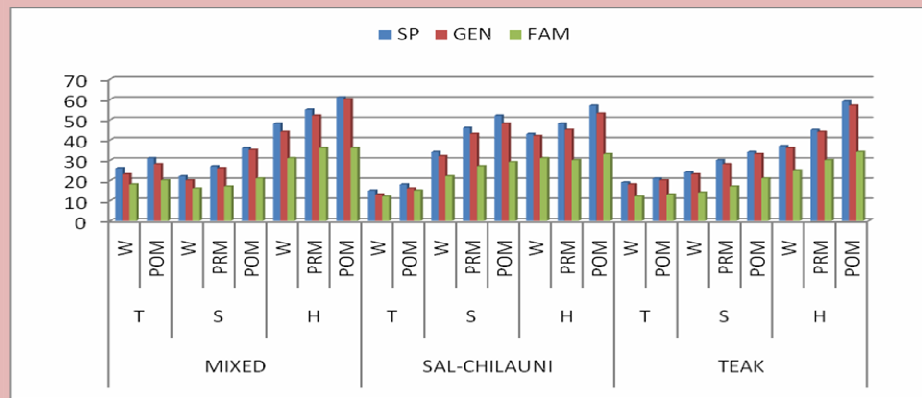

Figure 7.1.6. Seasonal variation in number of species, genera and families in different plantation of Lataguri site

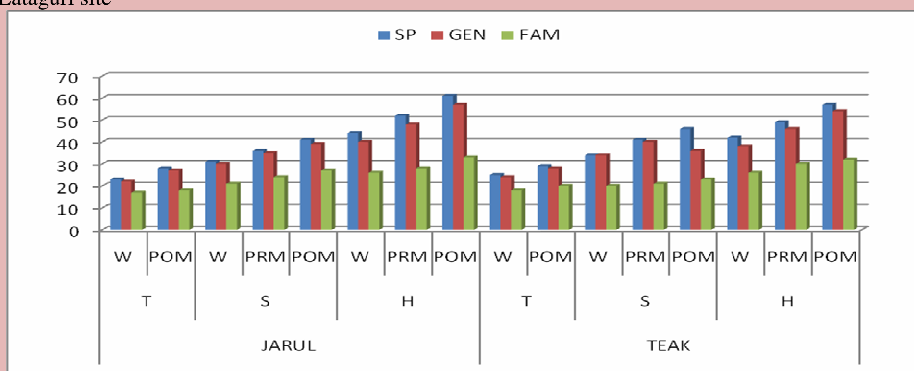

Figure 7.1.7. Seasonal variation of different taxa in different plantation of Sevoke site

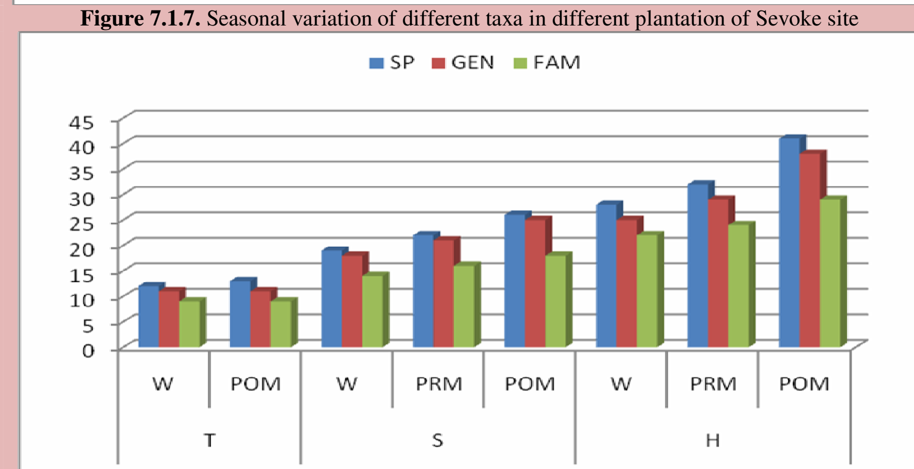

Figure 7.1.8. Seasonal variation of different taxa in Jarul plantation in Satali

7.1A. PHYTOSOCIOLOGY

Phytosociology is a branch of vegetation science which deals with plant communities, their composition and development, and the relationships between the species within them. Its principal goals are the delimitation and characterization of vegetation types based on the complete floristic composition (Dengler, 2017).

Phytosociological studies are essential for protecting the natural plant communities and biodiversity as well as understanding the changes experienced in the past and continuing on into the future (Mishra *et al.* 2012). In the present study phytosociological data were collected from natural vegetation and different plantations of Terai and Duars region of West Bengal. Analysis of processed data revealed the characteristic features of the vegetations (both plantations and natural vegetations). Comparison of different plantations with natural vegetation expressed differences in species richness, species diversity, concentration of dominance and seasonal variations of different vegetation layers were also noted differentially in different sites and types of plantation and natural forests.

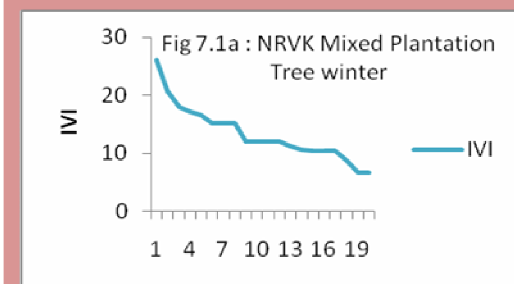

Figure 7.1a. Dominance diversity curve of tree layer of mixed plantation in winter in NRVK site

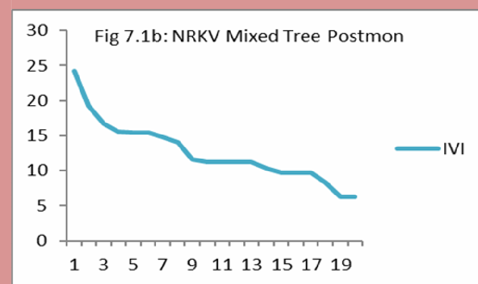

Figure 7.1b. Dominance diversity curve of tree layer of mixed plantation in Postmonsoon in NRVK site

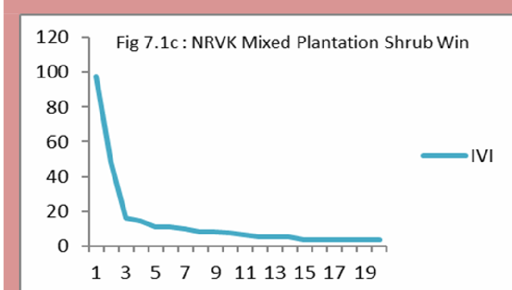

Figure 7.1c. Dominance diversity curve of Shrub layer of mixed plantation in winter in NRVK site

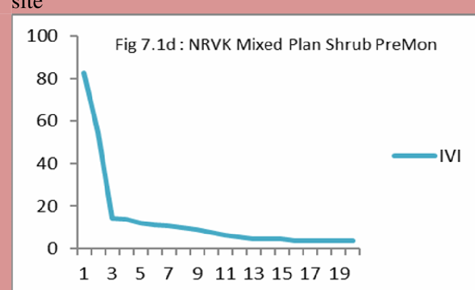

Figure 7.1d. Dominance diversity curve of Shrub layer of mixed plantation in pre monsoon in NRVK site

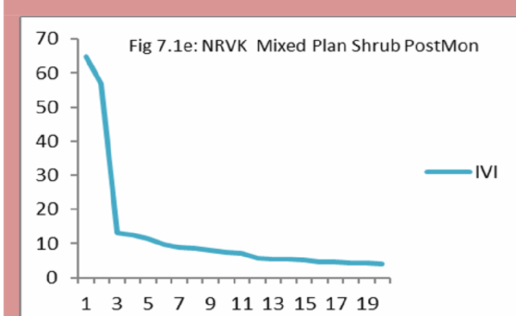

Figure 7.1e. Dominance diversity curve of Shrub layer of mixed plantation in post monsoon in NRVK site

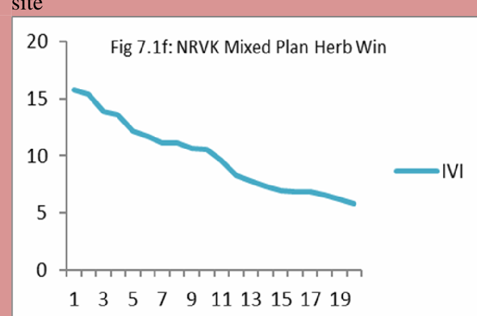

Figure 7.1f. Dominance diversity curve of Herb layer of mixed plantation in winter in NRVK site

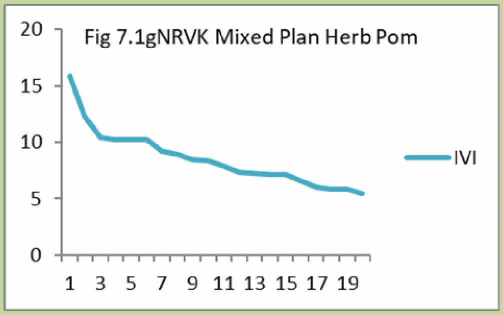

Figure 7.1g. Dominance diversity curve of Herb layer of mixed plantation in post monsoon in NRVK site

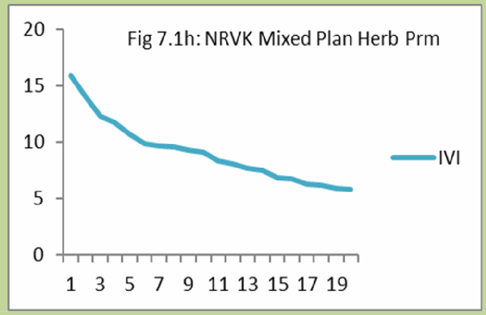

Figure 7.1h. Dominance diversity curve of Herb layer of mixed plantation in pre monsoon in NRVK site

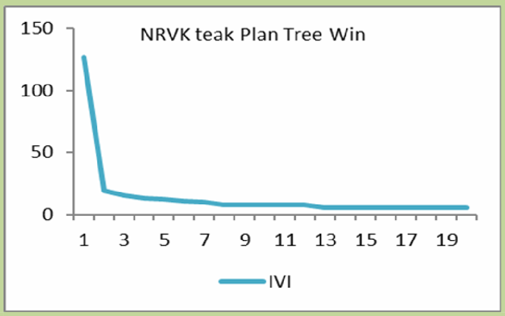

Figure 7.1i. Dominance diversity curve of Tree layer of Teak plantation in winter in NRVK site

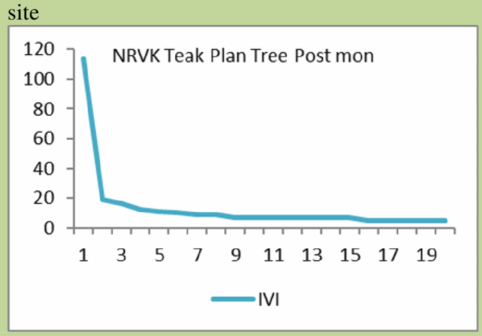

Figure 7.1j. Dominance diversity curve of Tree layer of Teak plantation in post monsoon in NRVK site

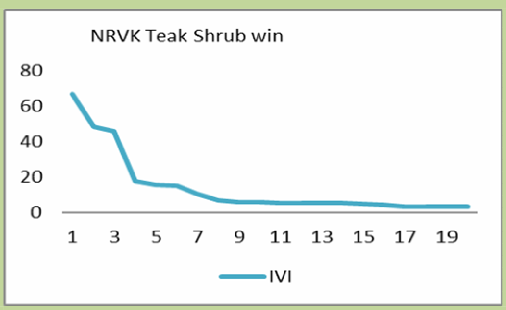

Figure 7.1k. Dominance diversity curve of Shrub layer of Teak plantation in winter in NRVK site

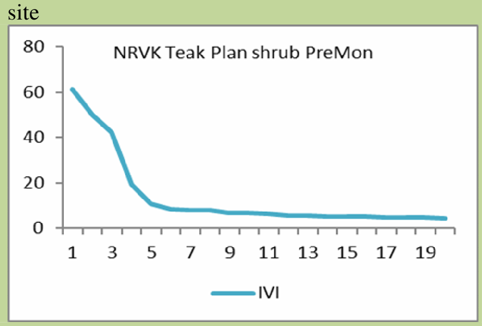

Figure 7.1l. Dominance diversity curve of Shrub layer of Teak plantation in pre monsoon in NRVK site

Mixed Plantation: Tree layer in NRVK mixed plantation in both winter and post-monsoon seasons were more or less similar in species composition. The vegetations were heterogeneous assemblage of numerous species and that was evident from nearly smooth running dominance diversity curve drawn on the basis of IVI value (Figure 7.1a & 1b).

Shrub layer showed more or less similar type of dominance pattern in all the seasonal vegetations but the vegetations were quite homogeneous or uniform and that was indicated by steeper dominance diversity curve (Figure 7.1c, d, e). Figure 7.1f, g & h revealed that the herbaceous vegetation of mixed plantation in NRVK site was heterogeneous type of assemblage of numerous species without true dominance by a single species. Detectable seasonal changes in vegetation were observed in post monsoon season which added little steepness to the dominance diversity curve (Figure 7.1g).

Teak Plantation: Tree layer of teak plantation was uniform or homogeneous growth of teak and maximum degree of dominance was shown by teak in both the winter and post-monsoon seasons and was very uniform in both the seasons. The association of top 20 species has been shown in Figure 7.1i & j. Steepness of the dominance diversity curve expressed the weaker association among them. Shrub and herb layer also showed same type of trend (Figure 7.1k & l) as in mixed plantation but the only difference is in the magnitude of dominancy of predominant species or of the predominant group of species.

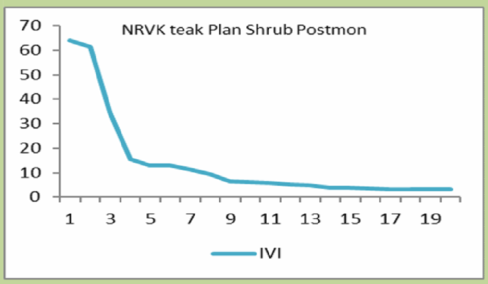

Figure 7.1m. Dominance diversity curve of Shrub layer of Teak plantation in post monsoon in NRVK site

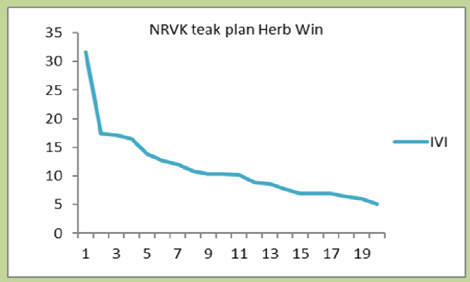

Figure 7.1n. Dominance diversity curve of Herb layer of Teak plantation in winter in NRVK site

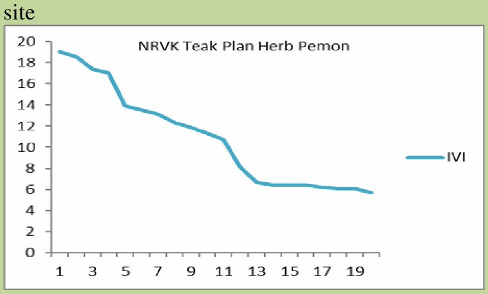

Figure 7.1o. Dominance diversity curve of Herb layer of Teak plantation in pre monsoon in NRVK site

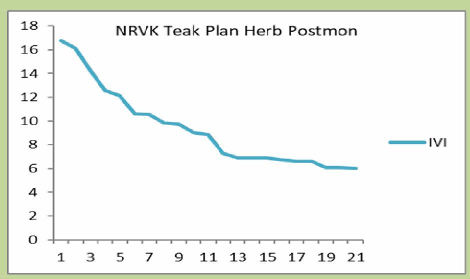

Figure 7.1p. Dominance diversity curve of Herb layer of Teak plantation in post monsoon in NRVK site

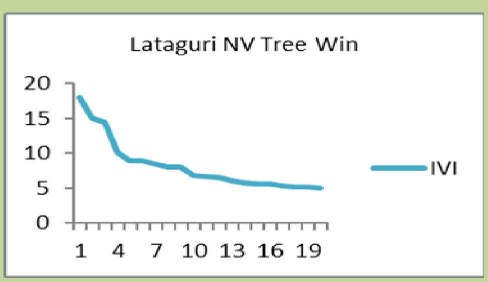

Figure 7.1q. Dominance diversity curve of Tree layer of Natural vegetation in winter in Lataguri site

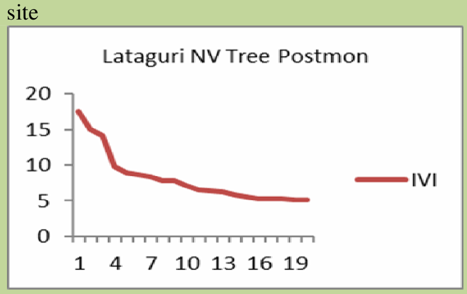

Figure 7.1r. Dominance diversity curve of Tree layer of Natural vegetation in post monsoon in NRVK site

Jarul Benteak plantation: Jarul Benteak plantations in NRVK site also exhibited same type of features of its different layers of vegetation in different seasons. In mixed plantation of Lataguri site the situation was little different from the other plantations. Tree layer in both winter and post-monsoon were quite diverse and dominance diversity curve revealed better association of component tree species than in other type of plantations. Shrub and herb layer were also different in to some extent. It was more diverse than the monoclonal plantation like teak or jarul-Benteak or sal-chilauni plantation. But all the tree shrub and herb layers were less diversified than the natural forests. Similar types of findings were noted in plantations of Sevoke site. Thus the general trend in different types of plantations in all the three sites were traced as less diverse tree layers (except mixed plantation) with minimum alliance among the associated species, lower to moderately diversified shrub layer with some seasonal changes especially in post monsoon season; and moderately diverse herb layer with higher degree of seasonal variation.

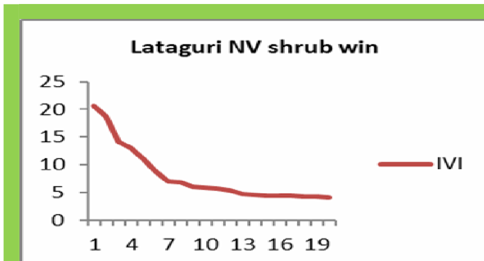

Figure 7.1s. Dominance diversity curve of Shrub layer of Natural vegetation in winter in Lataguri site

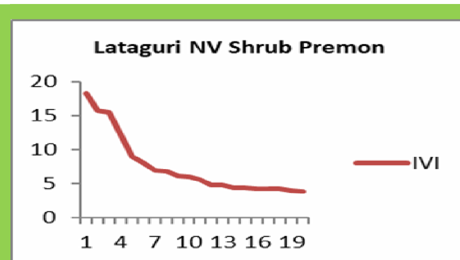

Figure 7.1t. Dominance diversity curve of Shrub layer of Natural vegetation in pre monsoon in Lataguri site

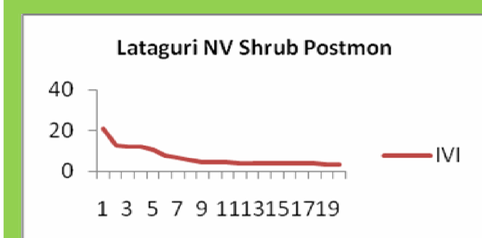

Figure 7.1u. Dominance diversity curve of Shrub layer of Natural vegetation in post monsoon in Lataguri site

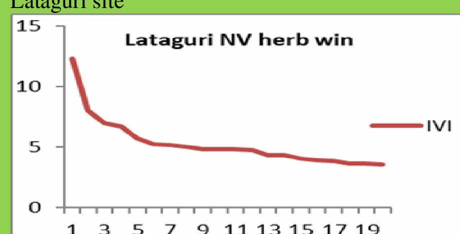

Figure 7.1v. Dominance diversity curve of Herb layer of natural vegetation in winter in Lataguri site

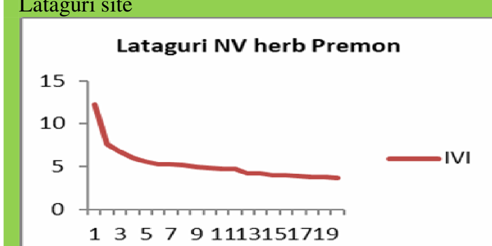

Figure 7.1w. Dominance diversity curve of Herb layer of Natural vegetation in pre monsoon in Lataguri site

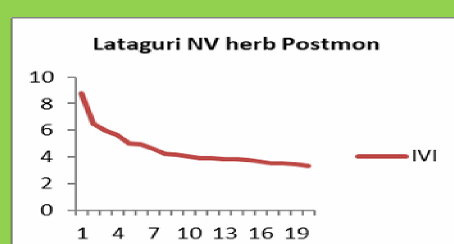

Figure 7.1x. Dominance diversity curve of Herb layer of Natural vegetation in post monsoon in Lataguri site

Seasonal variations were found mainly in post monsoon period when the dominance pattern got rapid change due to luxurious growth of pre-dominant herbs in the plantation floor. In natural vegetation all the tree shrub and herb layers were much more diverse than the plantations and the seasonal variation of different layer of vegetation were found to be symmetric. The dominant species with co-dominant one or co-dominant group of species were found to be well associated. General trend of the natural vegetation in other 2 sites were similar but only difference was in dominant species and /or dominant group of species, and in magnitude of dominancy.

7.2. BIODIVERSITY INDICES

Determination of different diversity indices for both the plantations and natural forests and their analysis revealed the actual picture of vegetation structure, diversity and dominance pattern, richness of the vegetation and the association of constituent species of the plant community.

Natural Vegetation

Lataguri Site: In natural vegetation of Lataguri site all the tree shrub and herb layers were diverse enough and were established by higher value of Shannon-Weiner index of species diversity. The layer wise comparison of vegetation revealed the superiority of herb layer over trees and shrubs. But, the winter shrubby community was the exception where maximum diversity was found (Figure 7.2.1).

Regarding the magnitude of dominancy of most abundant and predominant species, tree layer were with lower value of Simpson index or the concentration of dominance (Figure 7.2.2) that meant the tree layer was a heterogeneous assemblage of component species. It also indirectly indicated the higher diversity of tree layer. Higher value of Menhinick's index in case of tree layer (Figure 7.2.3) also supported the richness of the tree layer.

NRVK site: In NRVK site highest diversity was found in case of herb layer and then in tree layer. Shrub layer was least diverse (Figure 7.2.4). Concentration of dominance was highest in shrub layer which implied the high magnitude of dominant species. In herb layer lower value of concentration of dominance and moderately high value of Menhinick's index revealed richness of the herb layer (Figure 7.2.5).

Sevoke site: In Sevoke site tree layer in both winter and post monsoon season were rich in species diversity with lower concentration of dominance (lesser magnitude of dominancy of predominant species or group of species) and richness of species content as revealed by Menhinick's index of species richness (Figure 7.2.6 & 7.2.7). Thus the natural vegetation in all three sites were rich in species content, with less magnitude of dominance (heterogeneous community) and widely diversified.

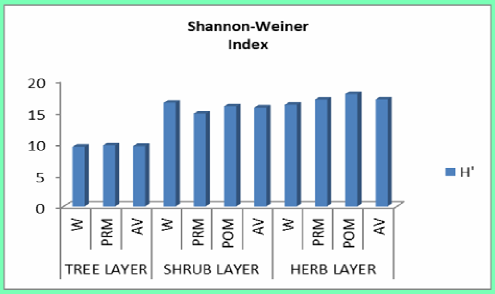

Figure 7.2.1. Shannon-Weiner Index of natural vegetation in Lataguri site

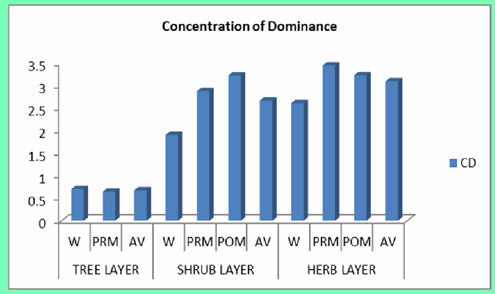

Figure 7.2.2. Concentration of Dominance of natural forest in Lataguri site

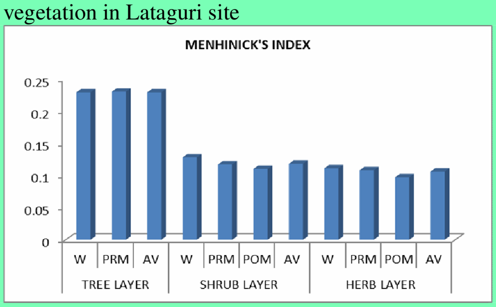

Figure 7.2.3. Menhinick's Index of natural forest in Lataguri site

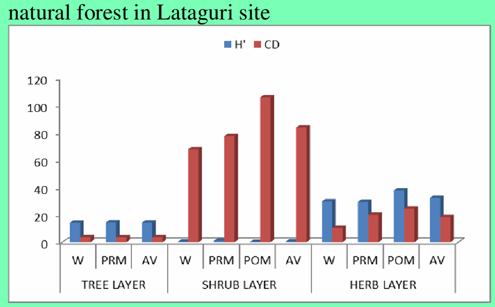

Figure 7.2.4. Shannon-Weiner Index & Concentration of Dominance of natural vegetation in NRVK site

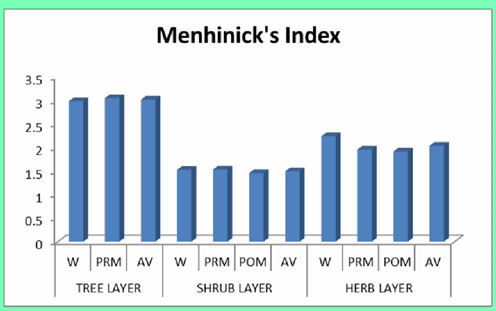

Figure 7.2.5. Menhinick's Index of natural forest in NRVK site

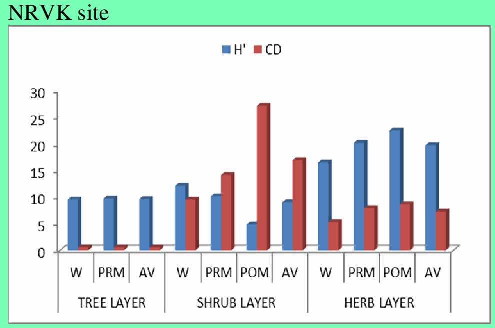

Figure 7.2.6. Shannon-Weiner Index & Concentration of Dominance of natural vegetation in Sevoke site

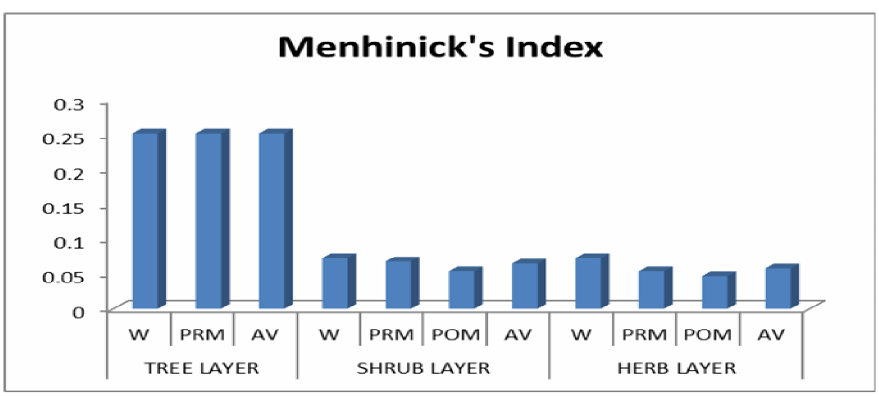

Figure 7.2.7. Menhinick's Index of natural forest in Sevoke site

***Plantation*:**

***NRVK Site*:** Determination of different diversity indices for different plantation, revealed Jarul – Benteak plantation (mainly the tree and shrub layers) as least diverse community, with higher concentration of dominance and moderate richness of species contents (Figure 7.2.8, 7.2.9 & 7.2.10). In other two types of plantation studied - mixed plantation and teak plantation the situation was more or less similar. But the herb layer was little more diverse.

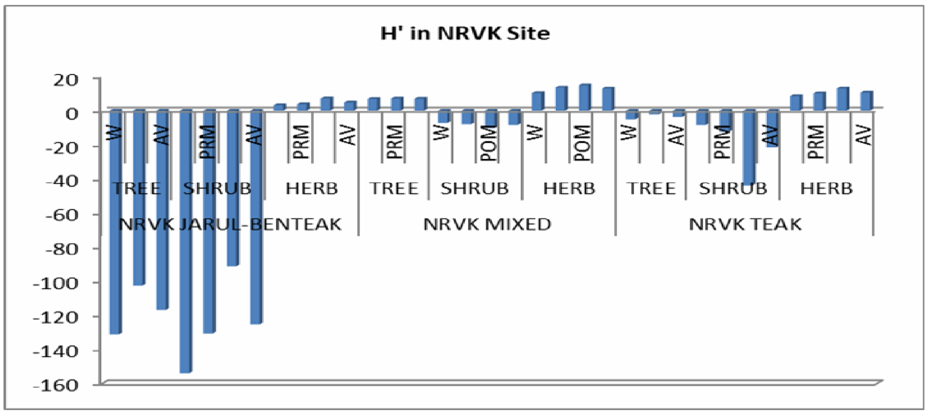

Figure 7.2.8. Shannon-Weiner Index of plantation in NRVK site

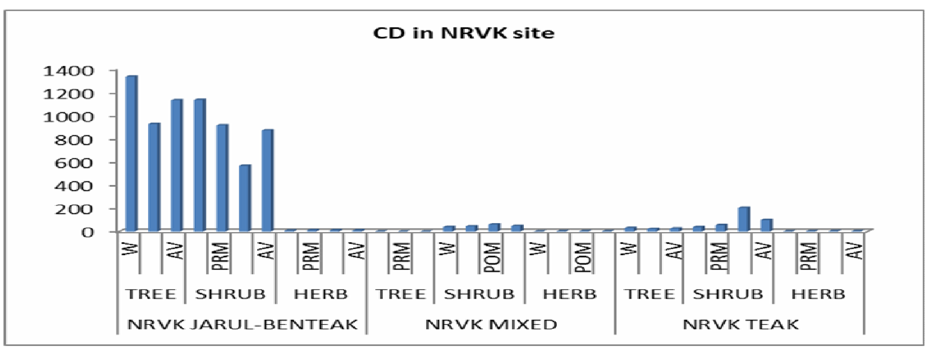

Figure 7.2.9. Concentration of Dominance of different plantations in NRVK site

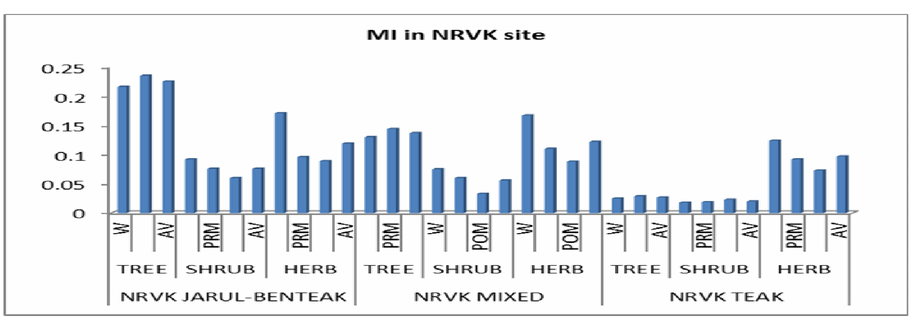

Figure 7.2.10. Menhinick's Index of plantations in NRVK site

Lataguri site: Figures 7.2.11, 7.2.12 & 7.2.13 summarised the main features of plantations in Lataguri site. Mixed plantation showed diversified shrub layer, less diverse tree or canopy layer and moderately diverse herb layer. Sal-chilauni plantation showed more or less similar type of tree, shrub and herb community with low to moderate species diversity, less concentration and moderate richness of species contents. Teak plantation in this site showed lowest diversity, highest concentration of dominance and lower richness of species contents in tree and shrub layer. But herb layer exhibited diversified species contents, lower concentration of dominance and moderately rich species composition. The situation was little different from the *Teak* plantations in other sites.

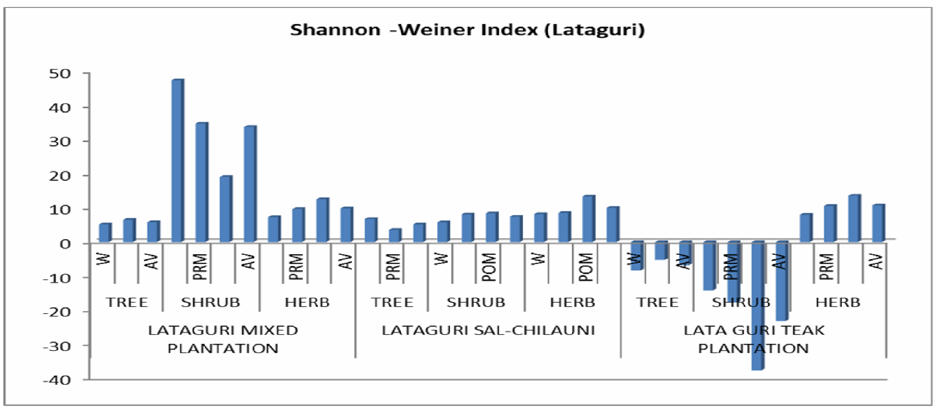

Figure 7.2.11 Shannon-Weiner Index of plantation in Lataguri site

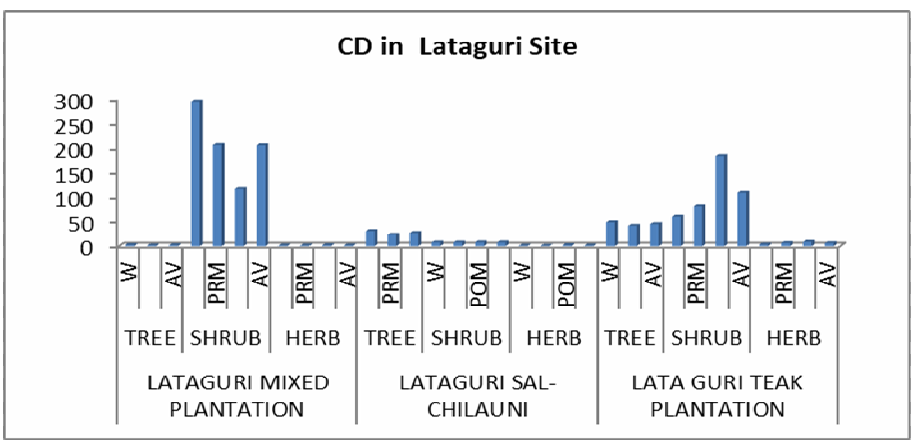

Figure 7.2.12. Concentration of Dominance of plantation in Lataguri site

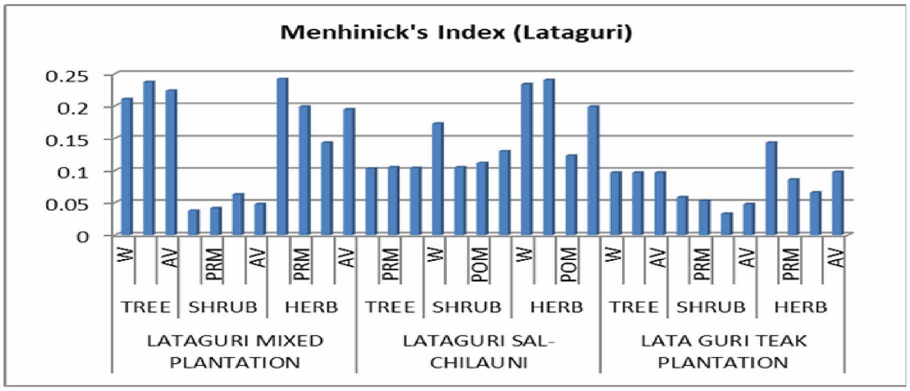

Figure 7.2.13. Menhinick's Index of plantations in Lataguri site

Sevoke site: Figures 7.2.14, 7.2.15 & 7.2.16 represent the biodiversity indices of different plantations in Sevoke site. Tree and shrub layers in both jarul and teak plantations were less diverse than herb layer as well as than the natural vegetation in the same area. But the herb layers were quite diverse and rich but not as in natural vegetation. Concentration of dominance was higher in tree and shrub layer that indicated the unevenness of the vegetation.

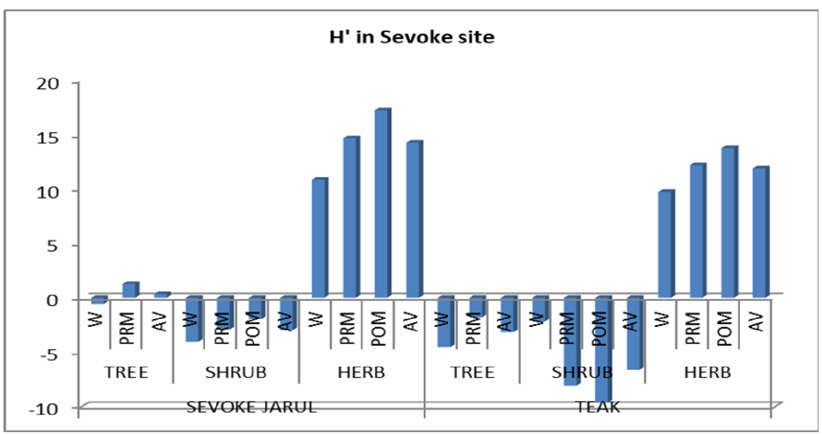

Figure 7.2.14. Shannon-Weiner Index of plantation in Sevoke site

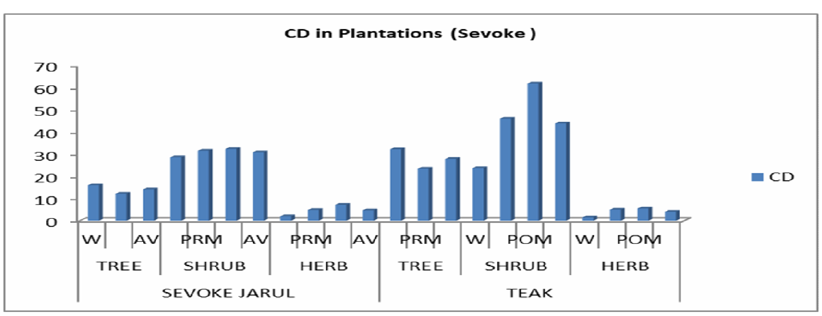

Figure 7.2.15. Concentration of Dominance of plantation in Sevoke site

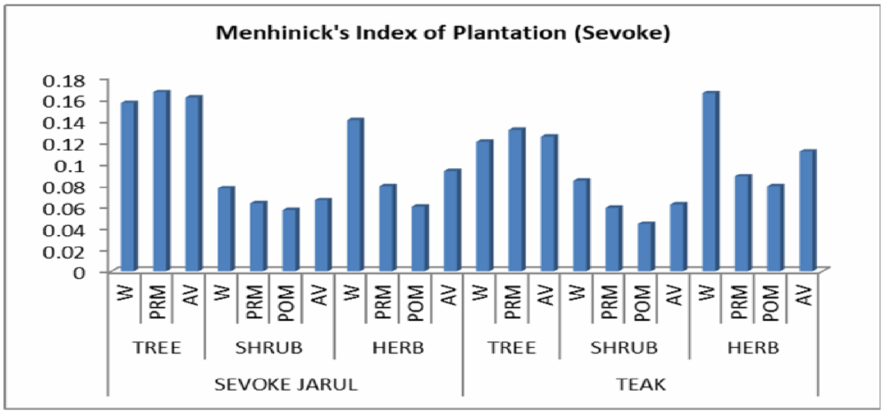

Figure 7.2.16. Menhinick's Index of plantation in Sevoke site

Similarity index: Figure 7.2.17, 7.2.18 & 7.2.19 revealed the measure of similarity and differences (Sorensen similarity indices) between different plantations and natural vegetation in different sites. Similarity was measured layer wise. Tree and herb layer of mixed plantation in Lataguri site, was more or less similar with that of natural vegetation whereas the other plantations differed from the natural forest. Jarul-Benteak plantation in NRVK site showed lesser similarity and higher differences. Teak plantation in the same site showed little higher similarity value in tree layer than the other layer of vegetation and also from other plantation as well. That may be due to the young age of teak plantation at that site. In Sevoke site also teak plantation showed some similarity in herb layer, shrub layer and tree layer but the similarity values were not more than 40%. Jarul plantation in Satali showed higher differences in all the three layers of vegetations.

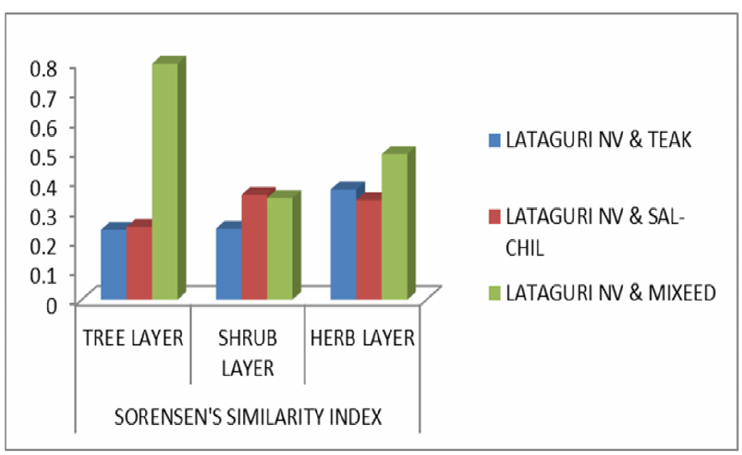

Figure 7.2.17. Sorensen's Similarity Index between natural vegetation & plantation in Lataguri site.

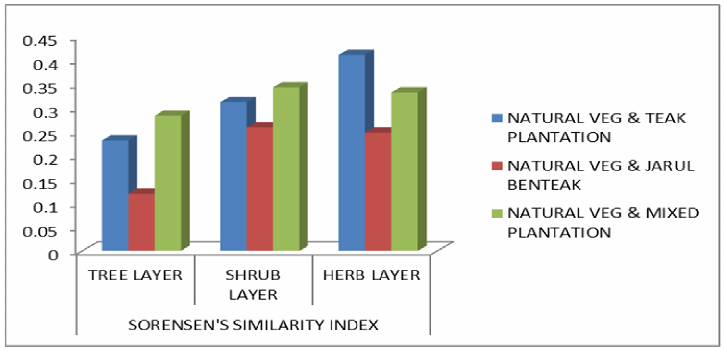

Figure 7.2.18. Sorensen's Similarity Index between natural vegetation & plantation in NRVK site.

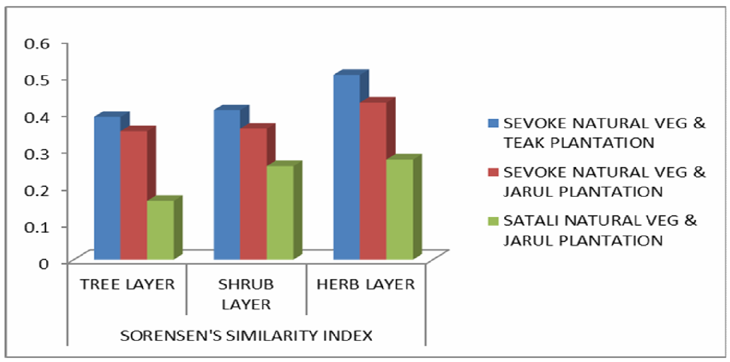

Figure 7.2.19. Sorensen's Similarity Index between natural vegetation & plantation in Sevoke and Satali site.

7.3. IMPACT OF AGGRESSIVE EXOTIC WEEDS

Impact of aggressive and exotic weeds on native biodiversity and ecosystem is already established (Carlton, 2003; Boot *et al.* 2003; Raghubanshi *et al.* 2005). In the present study, phytosociological attributes, different diversity indices for the vegetation of invaded and non invaded area, and their comparison outlined impacts of some exotic alien weed on the plant diversity of study area. Invaded area was inhabitated by lesser number of species, genera and families than the non-invaded area. As both the invaded and non invaded area were situated under same types of environmental conditions, it may be inferred that the difference in number of taxa (Species, genus and family) of invaded and non invaded area was due to the invasion of those exotic elements. Difference was also found in family distribution pattern and their frequency. But it has little correlation with invasion of alien weeds.

In shrub layer of non invaded area *Clerodendrum infortunatum* dominated the community with IVI value of 26.69 and relative diversity of 13.41. But differences in IVI value of dominant species and the species following the dominant one were less. There was a association *Coffea benghalensis*, *Triumfetta rhomboidea*, *Urea lobata*, *Mikania micrantha* etc with the dominant one. Dominance diversity curve of those species appeared smooth and it indicated the stability of the associated species in the community. But in invaded shrub layer where *Mimosa invisa* became dominant species with index value 61.43 and RD of 35.74. The high differences of IVI values of dominant species with others associated ones are the reason behind the steeper dominance diversity curve that indicated to the unstable situation of the community. Thus the invasion of *Mimosa invisa* disturbed the stable associated of species in native ecosystem.

In herb layer of non invaded area also number of species recorded was highest than the invaded area and thus the invasion of exotic *Mimosa*, affected the herbaceous layer also. It seemed to be happened due to the dense mat forming nature of young *Mimosa* plants. In herb layer of non invaded area *Ageratum conyzoides* was the dominant species. And it was associated with *Chromolaena odorata*, *Sida acuta*, *Diplazium esculenta*, *Clerodendrum infortunatum* etc. Smoothness of the dominance diversity curve of the species associated to the dominant one revealed the stability of their association. The invaded herb community was uniform and homogeneous.

Dominant diversity Indies also indicated the bad impact of those noxious weeds. Higher value of species diversity index or Shannon-Weiner index in non-invaded area was the indicator of higher species diversity in that site and it was farther established by the lesser value of concentration of dominance (Simpson's index). That meant in the non invaded area dominance of the species (mainly the predominant species) was less intense. Species richness index or Menhinick's index by it higher value revealed the species richness of non invaded native land use area. The situation was just opposite in the invaded area – i.e. species diversity was less, concentration of dominance was high and poor in species richness. Thus the invasion of exotic weeds resulted in the low species diversity, high dominance and poor species richness. This two type of vegetation i.e. vegetation in invaded and non invaded areas was different by 30% revealed by 0.70 of Sorensen's similarity index.

Invasion of *Parthenium* also caused same types of modification to the local plant community. Its invasion affected occurrences of species family and genera in invaded area. Steep dominance diversity curve revealed the higher magnitude of dominancy of the predominant species in invaded area whereas smoother one in case of non-invaded area revealed lower magnitude of dominancy of associated species in non invaded areas. Different biodiversity indices indicated the impact of *Parthenium* on local flora and floral community. Its invasion reduced the species diversity and richness in invaded area and increased the uniformity of community i.e. higher concentration of dominance was found.

Thus the invasive alien species exerted adverse effect on the plant diversity of Terai-Duars region. They reduced diversity of species and species richness and made the community uniform or homogeneous and replaced the native or local species by the huge aggression of non-native ones, alter the association of species in invaded area and ultimately disturb the stability of the ecosystem of this area. Similar type of impact was also reported by some other workers (Holway *et al*. 2002; Carlton, 2003, Raizada *et al*. 2008).

7.4. ABOVEGROUND HERBACEOUS BIOMASS PRODUCTION

Above ground biomass is an important and useful measure for assessing changes in forest structure (Brown *et al*. 1999). Comparision of Natural forest with plantations in respect of above ground herbaceous biomass production revealed that Natural vegetation (NV) produced higher amount of above ground herbaceous biomass than plantations (Figure 7.4.1). Both, in plantation and natural vegetation Maximum amount of biomass was harvested during the post monsoon period and notable difference was found in the amount of living and litter part of AGHB. The difference of litter and living biomass gradually reduced and became least during post monsoon period. Dry winter, low moisture content in the surface soil and leaf fall from deciduous tree species seemed to be the reasons for the production of high litter content during the winter. Favourable temperature, high precipitations during monsoon and addition of nutrients due to the degraded biomass in surface soil, lead to rapid flash of herb layer that ultimately contributed to the production of maximum amount of living part of AGHB. It was mentioned earlier that the degradation pattern of litter masses on the floor of plantations (teak and Sal-chilauni plantation) and natural forests both, in NRVK and Lataguri sites, as well as the biomass turnover, followed the same trends. But the differences were in the rates and their magnitudes.

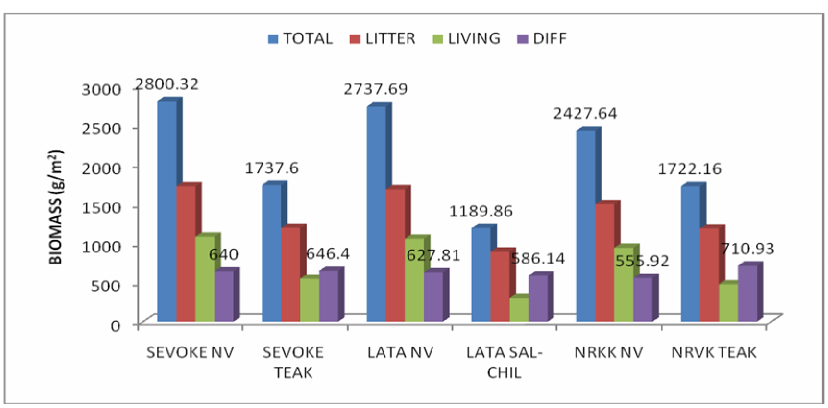

Figure 7.4.1. AGHB production under different plantations and natural vegetation (NV)

The differences in living and litter parts of AGHB were quite high under teak plantation than that of natural vegetation. Fallen leaves from teak plant during winter formed a dense carpet on the floor of plantation that prevented both, the upward and downwards penetration by the germinating seeds and seedlings of herbaceous species and ultimately reduced the production of living parts of AGHB. On the other hand slow rate of degradation of litter components lead to build up the huge difference in between litter and living parts of biomass and finally the total AGHB also.

The biomass and productivity in any ecosystem are governed by climatic and edaphic factors (Das et al. 2008). In the present study, growth of herbaceous vegetations under different land use pattern – natural vegetation, sal-chilauni plantation and teak plantation, were accelerated by the monsoon shower and AGHB production reached at peak during the post monsoon seasons reflecting better growth conditions, whereas in winter seasons the biomass production was lowest due to dry winter and low sunlight intensity. When the AGHB was splitted into living and litter contents and their production and degradation pattern were studied, litter part of AGHB showed the opposite trend of the living parts as well as the total AGHB production. Litter content were highest during winter and lowest during the post monsoon period. Large amount of above ground dead materials actually prevented the living part of AGHB during winter. That made the differences between litter contents and living parts of AGHB. This type of finding was corroborated by previous report also (Cornet, 1981; Das, 2008; Castro & Freitas, 2008; Facelli & Pickett, 1991; Grime, 2001). Present study also revealed that biomass (AGHB) production was comparatively higher in natural forests than that of tree plantations, and spatial variations of AGHB were found in different sites of Terai – Duars belt and that were governed by the climatic, edaphic, and biotic factors of the particular sites. Under natural vegetations, there were a balance between the rates of accumulation/degradation of litter contents and the production of living part of AGHB and that was indicated by the smaller differences in between living and litter parts. Thus the natural vegetations were in an ecologically balanced and stable condition but the plantations were somewhat different. The teak plantations were less efficient in the production of above ground herbaceous biomass than the natural vegetations. Terai region produced more AGHB than the Duars. AGHB production was influenced by the favourable conditions during monsoon, especially by the monsoon shower. As under the influences of same sort of climatic, edaphic and biotic factors, plantations produced lesser amount of AGHB than that of natural vegetation, it can be concluded that plantation had a negative impact on the above ground herbaceous biomass production – especially the teak plantation under which suppression of AGHB production was highest. This type of suppression is due to the accumulation of large amount of above ground dead material (Castro & Freitas, 2008), low rate of degradation due to low moisture contents in soil and lower microbial activity (Cornet, 1981).

7.5. RARE, ENDEMIC AND THREATENED ELEMENTS

Indian phytochorian is renowned for its relict species content (Sharma, 2000). Darjeeling Himalaya which is an important part of Himalaya Biodiversity Hotspot of conservation, is rich in endemic floral elements (Nayar, 1996; Das, 2004) as well as in other category of threatened plants (Nayar & Sastry 1987, 1988. 1990; Rao, 1994). Being located at the foot of Himalaya and contiguous with the Darjeeling Himalaya, Terai and Duars region also apeared to be populated by a number of endemics and other category of threatened plants (Das, 2011). Out of the total recorded plant of RET category 22 were endemic to the Darjeeling Himalayan region or Eastern Himalaya region. As the present study was not a purely florist work, extensive study of the floral elements were not done. Only the elements encounter during the present survey, were considered for determination of RET elements.

Uncontrolled increase in anthropogenic activity that led to the destruction and fragmentation of vegetations and invasion of exotic aggressive species were detected to be the major threats to the flora and vegetation of upper and lower past of Darjeeling Himalaya (Das, 1995, 2004). Similar types of threats were also applicable in the study area also. In addition to that, burning of forest floor to facilitate illegal poaching, excessive collection of NTFPs, medicinal plants, grazing in forest floor etc were some other worst from of threats to the flora, vegetation and ecosystem of the study area. Presently replacement of natural forest by economically potent exotic species and their huge plantation has also started to threaten the plant wealth and diverse vegetation of this belt.

7.6. NON TIMBER FOREST PRODUCES AND MEDICINAL PLANTS

NTFPs which play important role in poverty alleviation, has been a part of conservation strategy of forest cover in close association with human population (Sarkar, 2014). Collection of NTFPs by the forest department, involvement of rural and tribal people for harvesting them from forest, their marketing and household uses, led to the development of a strong relationship between the man and forest. In present study, a good number of plants were found to have commercial importance (Table 7.1). Economic potential of those plants (NTFPs) were not assessed in the present study, but reported by Sarkar (2014) for Buxa Tiger Reserve. Most of the commercially important NTFPs were collected as Medicinal plants which are marketed by the department of forest either in crude condition or after processing or both crude and processed. Few of the most important commercially harvested and marketed NTFPs of this region were fruits of *Phyllanthus emblica,* fruits of *Piper* *longum*, *Terminalia arjuna*, *T. belliria*, *T. Chebula*, *Thysanolaena latifolia* etc. Recording of 319 species of NTFPs as medicinal plant indicated the dominancy of medicinal herbs and trees among the non-wood product. Many of them were also collected by the rural healer personally. Thus dependency of rural, tribal and fringe population were revealed and implies the relationship between the non-wood product (or the Forest department) and the fringe population and their knowledge system related to the forest resources. Dependency of the rural and tribal population on NTFPs was quite high in case of remote location of human settlement. Specially, the dependency for medicinal plants was notable and their excessive collection became a threat to their population (Das, 2011).

Rural markets in fringe areas were the meeting ground of the local villagers. They were found to sell and buy numerous products from the forests such as different vegetables – tender fronds of *Diplazium esculenta* locally known as *Dhekiaa,* leaves and petioles *of Alocasia fallax, leaves of Centella asiatica, Amorphophallus bulbifer* etc; different wild fruits, tuber of *Dioscorea spp*., different edible fungus locally known as *Cheu* and some other plant materials. Thus different NTFPs not only fulfil the household demand of the fringe people but play role vital in their income sources.

Another aspect of collection of NTFPs from the natural forest, mainly the collection of fire wood by the rural population, which was ignored by the forest department, appeared to be most frequent one. As the dead and decaying wood has important implication in the forest ecosystem, removing them by the rural population in excessive amount might have some effects on the health of natural forest. *Helminthostachys zeylania*, an endangered fern, tender frond of which is used as vegetables are collected exclusively from the forest floor and thus its population appeared to be under threat to.

Table 7.1. Some of the important marketable NTFPs

Sl No.	Botanical Names	Local Name	Habit	Uses
1	*Acorus calamus* L. [Acoraceae]	Bocho	H	Medicinal,
2	*Aegle marmelos* (L.) Corrêa [Rutaceae]	Bel	T	Food, Medicine, Religious
3	*Ailanthus integrifolia* Lam. [Simaroubaceae]	Gokul	T	Dhup and Ornamental
4	*Alstonia scholaris* (L.) R. Br. [Apocynaceae]	Chatian	T	Medicinal, decotative
5	*Asparagus racemosus* Willd. [Asparagaceae]	Satamuli	CL	Medicinal
6	*Baccaurea ramiflora* Lour. [Phyllanthaceae]	Kusum	T	Edible, Medicinal
7	*Bombax ceiba* L. [Malvaceae]	Simal	T	Medicinal, fibre
8	*Canarium sikkimense* King [Burseraceae]	Gokul dhup	T	Medicinal, Dhuna
9	*Cassia fistula* L. [Leguminosae]	Sonalu	T	Medicinal, Fodder
10	*Cheilocostus speciosus* (J.Koenig) C. D. Specht [Costaceae]	Bet larang	CL	Cordage, Rope

Sl No.	Botanical Names	Local Name	Habit	Uses
11	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm.	Telpat	T	Spice, Medicinal
12	*Curcuma aromatica* Salisb. [Zingiberaceae]	Kala halud	H	Medicinal, aromatic
13	*Cymbopogon flexuosus* (Nees *ex* Steud.) W.Watson. [Poaceae]	Lebu ghass	H	Mosquto repellent
14	*Dillenia indica* L. [Dilleniaceae]	Chalta	T	Edible, Fodder
15	*Diplazium esculentum* (Retz.) Sw. [Athyriaceae]	Dheki	Fern	Edible, Medicinal
16	*Phyllanthus emblica* L. [Phyllanthaceae]	Aamla	T	Edible, Medicinal
17	*Murraya paniculata* (L.) Jack [Rutaceae]	Kamini	S	Ornamental
18	*Oroxylum indicum* (L.) Kurz [Bignoniaceae]	Totala	T	Edible, Fodder
19	*Piper longum* L. [Piperaceae]	Pipla	CL	Edible
20	*Piper nigrum* L. [Piperaceae]	Pipla	CL	Spice
21	*Pterygota alata* (Roxb.) R.Br.	Labsi	T	Ornamental
22	*Ricinus communis* L. [Euphorbiaceae]	Reri	S	Oil, Edible
23	*Bombax ceiba* L. [Malvaceae]	Simul	T	Fibre and fodder
24	*Sapindus rarak* DC. [Sapindasceae]	Ritha	T	Detergent
25	*Tamarindus indica* L. [Leguminosae]	Tetul	T	Edible
26	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. [Combretaceae]	Arjun	T	Medicinal, ornamental
27	*Terminalia bellirica* (Gaertn.) Roxb. [Combretaceae]	Bagera	T	Edible and Medicinal
28	*Terminalia chebula* Retz. [Combretaceae]	Harra	T	Edible, Medicinal
29	*Thysanolaena latifolia* (Roxb. *ex* Hornem.) Honda [Poaceae]	Jharu	H	Broom
30	*Tinospora sinensis* (Lour.) Merr. [Menispermaceae]	Gurus	CL	Medicinal, Fodder
31	*Ziziphus jujuba* f. lageniformis (Nakai) Kitag. [Rhamnaceae]	Boer	T	Edible, Fodder and Medicinal
32	*Ziziphus oenopolia* (L.) Mill. [Rhamnaceae]	Choti boer	S	Edible

7.7. ETHNOBOTANICAL KNOWLEDGE

A good number of plants have been found to be traditionally used by rural and aboriginals of this area and the diversity of uses were also notable. Similar type of findings was also reported by Das *et al*. (2007), Ghosh & Das (2007) and Sarkar (2011). Close observation to plants under different category of use, indicated the dominancy of family Leguminosae. It represented highest number of species under edible plants, fodder, ethno-veterinary, ethno-medicinal and decorative elements with 6, 8, 11, 12 and 5 species respectively. The second frequent family was Lauraceae. Though all the habit groups were found to be used, tree dominated over the other habit classes. Under the category of ethno-veterinary plants herbs were dominant one (Figure 7.7.1). Fruit was the mostly used parts under the category of edible plants and was followed by leaves, shoot, frond, rhizome, tuber, whole plants etc (Figure 7.7.2). Twigs and leaves were mostly used as fodder (Figure 7.7.3). Figure 7.7.4 represents the diversity of different plant part used medicinally. In most of cases more than one parts of a single plant were recorded and 31 such plant were found. In other cases only a single part was used for their medicinal properties. Leaves of 16 of plants, bark, fruits, twigs, rhizomes and roots of 11, 9, 12, 6, 5 species respectively were used to heal different ailments. Decorative elements were other important category of traditionally used plants. Fruits were mostly used as decorative elements (Figure 7.7.5). During the data collection on traditional knowledge and ethno-botany it was found that most of the medicinal plants were collected either from natural forest or fringe areas. As because of the poorness of plantation floor in diversity of required plant materials, collectors didn't preferred plantations if there was natural forest nearby. But for the fodder collector plantations were the first preference.

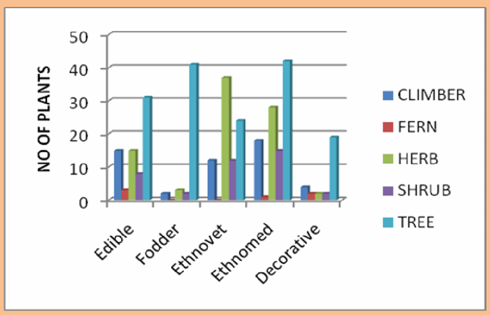

Figure 7.7.1. Distribution of recorded plants in different habit class

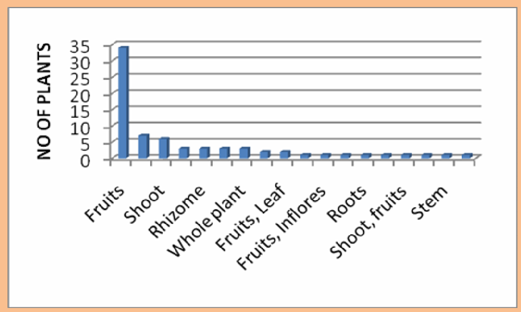

Figure 7.7.2. Diversity of plant parts used as food

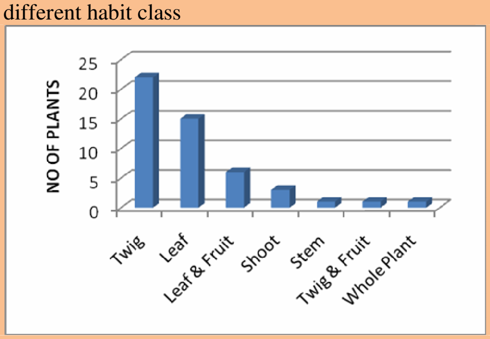

Figure 7.7.3. Diversity of plant parts used as fodder

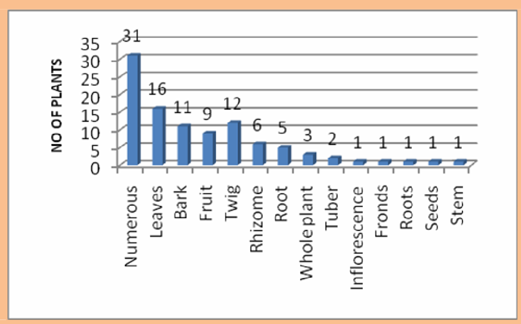

Figure 7.7.4. Diversity of plant parts used as medicines

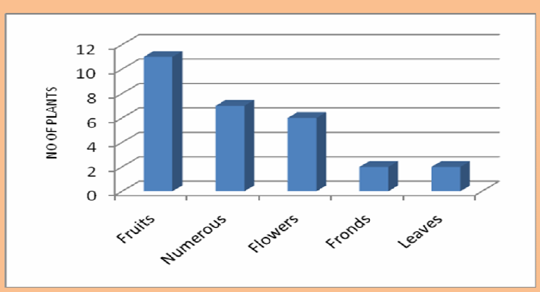

Figure 7.7.5. Diversity of plant parts used as decorative materials

The fringe villagers and tribal group were very much known about the traditional uses of plants, the forest resources and their availability. That might be developed due to their dependency on forest resources, which in turn had evolved due to the remoteness of their habitation and inaccessibility to the modern life-supports system (Sarkar, 2014) or simply for their daily life requirement. Interrelationship between the traditional knowledge system prevailed in rural and tribal population and NTFPs was also realized as the knowledgeable tribal people were preferred by the concerned authority as collector of NTFPs. Bothe the aboriginals and the rural populations were aware enough about the depletion of plant resources and in several cases they were found to grow the useful plants in their house hold garden or in kitchen garden. This tendency was more prominent among the traditional healers or the *ojhaas*. Their religious believe was also associated with the forest resources (Sarkar, 2011)**.**

7.8. IMPACT OF PLANTATIONS ON SOIL

Compassion of soil samples from different plantations and natural forest, showed some differences in its physical and chemical properties. Soil of mixed plantation was more or less similar with that of natural forest in respect of p^H. But Teak and Sal-chilauni plantations showed lesser p^H value of both top and sub soil. The difference was much more in Sal-chilauni plantation that meant soil of Sal-chilauni plantation was more acidic than the natural vegetation and even than other plantations. In all the plantation and natural vegetation, top soil showed more acidic nature than the sub soil (Figure 7.8.1) but in Sal-chilauni plantation the situation was just reverse (more acidic sub soil). Differences in p^H or acidity of top and sub soil were more or less similar in all the plantation except in mixed plantation where the differences was very less (0.037) while in other case it was 0.095 – 0.1. Regarding moisture content, soil of mixed plantation and sal-chilauni plantation was with higher moisture contents than the natural vegetation and the teak plantation showed similarity with the natural vegetation. Difference between water content of top and sub soil was highest in teak plantation (1.17%) and then in mixed plantation (1.10%) and the least in natural vegetation (0.31%).

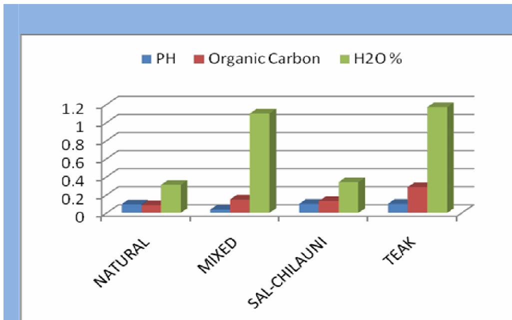

Figure **7.8.1.** Difference of p^H, Organic Carbon content and H_2O in top and sub soil

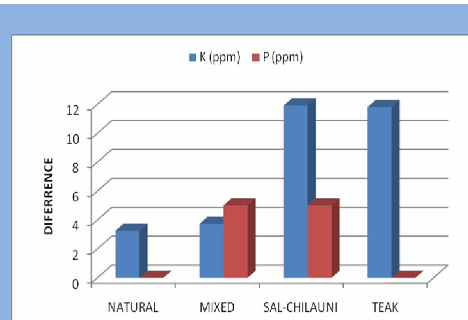

Figure **7.8.2.** Difference of Potassium and Phosphorus contents in top and sub soil

Teak plantation showed highest amount of organic carbon content in its top and sub soil and the difference was also higher than the other plantations and the natural vegetation. Difference of Organic Carbon contents between top and sub soil in teak plantation was highest measuring 0.285. In mixed and sal-chilauni plantation, that difference was slightly higher than the natural vegetation. In all plantations – mixed plantation, natural vegetation and teak plantation higher potassium content was found in top soil in comparison to sub soil, but the difference was highest in teak plantation (11.8 ppm). Sal-chilauni plantation also led to make a difference in potassium content between of top and sub soil but the sub soil was with higher potassium content and the trend was just opposite to the natural vegetation and other two types of plantation studied (Figure 7.8.2). Thus sal-chilauni and teak plantation deviated from natural forest in respect of potassium content. Phosphorus contents in both top and sub soil of plantation was reduced than the natural forest. In addition to that remarkable difference in top and sub soil phosphorus contents were found in mixed plantation and sal-chilauni plantation whereas in teak plantation and natural forest phosphorus contents was same in both top and sub layer of soil. So the plantations deviated from natural forest in respect of either phosphorus contents, or in difference of P contents in top and sub soil.

So in general, the soils of different plantations differed from that of natural vegetation in one or more aspects (Figure 7.8.3). Sal-chilauni plantation differed in lower value of pH (more acidic soil), higher moisture contents, lower potassium content and phosphorous contents and in texture of soil. Mixed plantation was different from the natural forest in respect of higher moisture content, lower potassium content and lower phosphorous contents. Soil of the teak plantation on the other hand deviated from the natural forest regarding lower pH contents or more acidic soil (top soil was too much acidic than the sub soil), higher organic carbon content, higher difference in potassium contents between top and sub soil, and in texture as the soil in teak plantation was classified as clay. Table 7.2 and 7.3 summarized the differences in different parameters in top and sub soil and differences between plantation and natural forest soil.

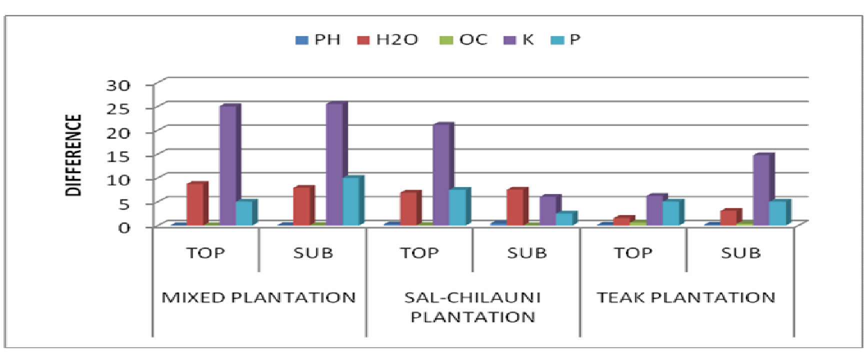

Figure 7.8.3. Comparion of different properties of plantations and natural forest

Table 7.2. Difference of P^H and of different nutrient contents in top and sub soil of natural forests and plantations

Vegetation Type	Difference Between Top And Sub Soil In				
	pH	Organic Carbon	H_2o %	Potassium Contents (Ppm)	Phosphorus (Ppm)
Natural	0.095	0.085	0.310	3.250	0
Mixed	0.037	0.148	1.100	3.725	5
Sal-Chilauni	0.100	0.130	0.340	11.900	5
Teak	0.100	0.285	1.170	11.800	0

Table 7.3. Difference of various soil parameters of Natural vegetation and plantations

Vegetation Type	Soil Layer	p^H	H_2O (%)	Organic Carbon	Potassium Contents (Ppm)	Phosphorus (Ppm)
Mixed Plantation	Top	0.018	8.7	0.0075	25.025	5
	Sub	0.04	7.91	0.055	25.5	10
Sal-Chilauni Plantation	Top	0.235	6.87	0.045	21.15	7.5
	Sub	0.43	7.52	0	6	2.5
Teak Plantation	Top	0.135	1.56	0.57	6.2	5
	Sub	0.13	3.04	0.37	14.75	5

7.9. ALLELOPATHIC EFFECTS

From the studies on three regularly planted angiospermic species of trees in the Terai-Duars region of West Bengal it is realized that *Tectona grandis*, an exotic from Myanmar region, exerted maximum effects on the randomly selected common herbs of this area, namely *Senna occidentalis, Ocimum gratissimum, Plumbago zeylanica, Oxalis corniculata* and *Andrographis paniculata.* And, the experiments also exposed that two other species under allelopathic evaluation are also having some degree of effects on these local species of plants. Extract of Sal affected the germination of *Ocimum gratisimum* and *A. paniculata*. Maximum level of inhibition of seedling mass was noted in *O. Gratisimum*. Jarul showed less inhibitory effects on the test herbs. Different chemical constituents such as nor-triterpene, dammarenolic acid, asiatic acid, dipterocarpol, triterpenic acid, tannic acid and phenolic content are present in Sal may be responsible for the allelopathic effects.

Allelopathy acts by addition of phototoxic substances to the environment and most of them inhibits germination and growths and are termed as allelochemicals (Whittaker & Feney 1971). Different phenolic acids such as salicylic acid, p-hydroxy benzoic acid, chlorogenic acid, tannic acid, caffeic acid, vanillic acid have been reported to occur in teak that are responsible for inhibitory or effects on other plants (Tripathi *et al*. 1999).

Of the selected herbs, *Ocimum gratissimum* is not a natural member of Terai-Duars vegetation but have naturalized in some regions especially around the forest villages. It is one highly aromatic plant and the present evaluation showed that it responded almost similarly like other species in the test. Similarly, the alkaloid content of *Andrographis paniculata and Senna occidentalis* are quite high. But their alkaloids could not resist the effects. *Oxalis corniculata* is one cosmopolitan species and grows in wide diversity of habitat conditions. This species was also affected, may be little less adversely. Out of the three tree-species under assessment, *Lagerstroemia* was with least effects and different test herbs also responded differentially to the extracts of different tree species.

7.10. PRESENT STATUS OF CONSERVATION

Once, the entire Terai-Duars belt of West Bengal was covered by dense forests. But introduction of tea, rapid extension of its cultivation, initiation of plantation, construction of road and rails, development of tourism industry and some other activities started to degrade the rich vegetation of this region (Das, 2011; Choudhury, 2015). And now the vegetation and ecosystem of Terai-Duars region is under severe threats. Followings are the main form of threats –

- Establishment of tea gardens and its rapid expansion
- Rapid extension of human settlement
- Cattle grazing in the natural vegetation
- Both legal and illegal extraction of timber in excess
- Fragmentations of ecosystems
- Initiation and expansion of tree plantation mainly the momoclonal plantation and rapid removal of natural forests
- Uncontrolled tourism to the reserve forests and protected areas
- Excessive collection of NTFPs, Medicinal Plants etc
- Removal of dead log for fuel wood

7.11. NOTES ON FUTURISTIC CONSERVATION STRATEGIES

Terai-Duars belt of west Bengal is concentrated in its relic contents and other category of threatened plants. On the other hand a huge pressure is being exerted on the vegetation and is increasing every day. So this unique belt of vegetation deserves very special conservational attention. The conservation strategies may be as follows:

- Creation of new plantations of introduced non-native species should be restricted.
- Monoclonal plantation should be avoided and if required a number of native species should be used to raise the plantation.
- At any cost natural forest should not be replaced with any type of plantations.
- Different cultural practice in plantation areas should be planned in such a way so that it exerts minimum or no strain on nearby natural forests.
- Unnecessary burning of forest floor in plantations and/or natural vegetation should be banned.
- Strict regulation to be strictly applied to prevent the unauthorized entry into the protected forests
- Grazing in the natural forest should be banned
- Collection of different type of NTFPs from the natural forests and even from the marginal areas should be controlled
- Rare species may be propagated by in vivo or in vitro method to increase their population very carefully.
- Tourism industry should be effectively managed, environment friendly initiative should be taken and tourist should be well aware of their activities in the natural forests
- No cultivation should be allowed inside the protected areas and already escaped species should be controlled immediately
- Emphasis should be laid on protection of the whole ecosystem instead of some rare species
- Creation of proper awareness among the common people especially among the fringe people should be emphasized.

CONCLUSION

Through the present work it was tried to evaluate the status of biodiversity in the plantations and Natural forest and the influences of the exotic and highly invasive weeds in the Terai-Duars region of West Bengal, located at the feet of the Eastern Himalaya.

All the experiments like Phytosociological analysis, Soil status, Allelopathy, etc. and the analysis of the results are indicating the highly degradable status of biodiversity status in the plantations.

The allelopathic investigation was also revealed that the effects of all species used in plantations are not equally virulent. So, the allelopathic evaluation of all the species selected for plantation may go through stringent allelopathic tests, small lab based experiments to wider field tests.

The status of biodiversity is much better in all senses in natural forests. Even the forest-floor biomass production is also significantly high and all these are the indications of a healthy ecosystem formation in natural vegetation. On the other hand trees in plantations are fast growing and are economically much attractive.

Experiments on the invasion of troublesome exotic weeds proved their too much dominance and destructive effects on the native vegetation endangering the existence of local species, including important ones.

The effects of vegetation changes on the climate and the biological diversity has attracted not only the scientists but the common people with sensible understanding with the future of the biosphere are expressing their serious concern over the man-induced artificial changes in the vegetation structure. It is now realized that the vegetation changes and degradations will not only lead to the extinction of species at much faster rate but will also make the earth un-inhabitable in near future.

However, the eastern part of the great Himalayas (i.e. the Eastern Himalaya) and its adjoining regions, including Terai and Duars are well known for the pristine vegetation with extremely rich status of biodiversity. But, the region is not escaped from the general trend of population explosion in Asiatic countries. Increase in human population is directly linked to the destruction in the form of developing new and new settlement areas, road and rail links, industrialization, etc. and that is always in an accelerating state.

So, it is now the utmost urgent situation that needs to be addressed just now. We need to take some important decisions if we are really serious to mitigate the effects of highly degraded vegetation, round the world, so that the biosphere may be saved:

1. It is needed to ensure that there should have absolute protection to save the existing vegetation
2. Establishment of new industries in locations far away from the natural forests
3. Strict vigilance over the nature and method of release of industrial effluents
4. All steps need to be taken to improve the environmental conditions
5. At this moment the extraction of natural resources, including the vegetative ones, is far beyond the sustainable limit and such extraction is now much above the desirable limit
6. Timber and innumerable other NTFPs are unavoidable resources for the sustenance of human life and their amount of extraction is proportional to the increase of human population
7. The plantation of selected species, mainly the timber yielding ones, affects natural vegetation so there is plenty of scope to redesign the plantations and the selection of species
8. As far as possible exotics, and also the conifers, may be avoided. Better to select the local broad-leaved species with minimum or no allelopathic effects
9. Spacing between two plants and two rows in plantations must be increased to accommodate the species of other habit groups, i.e. herbs, shrubs, climbers, etc.
10. Species supports local animals as habitat and/or food-providers are to be selected for plantation
11. Forest floor weed clearing should be minimum or may be avoided if possible
12. Plantations will gradually decrease the fertility of the soil and that, in turn, will decrease also the yield of the plantations
13. Protected Areas may be treated as truly protected and their commercialization needs to be avoided or at least minimized. This may affect the treasury turn-over but any such loss is much less than the survival of the biosphere that can’t be priced
14. Rules and regulations related to the protection of all types of vegetation must be stricter and need to be seriously implemented with ‘no exception’
15. Researches related to biodiversity conservation *in situ*, their evaluation and better conservation strategies need to be given more stress than the almost fully equipment and chemical based investigation proposals
16. With all possibilities we need to reduce our dependence from both, the natural vegetation and from the industries
17. All developmental programs should consider the conservation as their first priority.

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ANNEXURE - I

[Tables of Phytosociological Data]

Table 1. Phytosociological data of winter tree layer of mixed plantation in NRVK site

SL. No.	SPECIES	RF	RD	RA	IVI
1	*Neolamarckia cadamba* (Roxb.) Bosser	4.29	11.20	10.62	26.11
2	*Shorea robusta* Gaertn.	5.71	8.80	6.26	20.77
3	*Terminalia bellirica* (Gaertn.) Roxb.	5.71	7.20	5.12	18.04
4	*Lagerstroemia speciosa* (L.) Pers.	7.14	6.40	3.64	17.18
5	*Terminali alata* Wall.	5.71	6.40	4.55	16.67
6	*Bauhinia acuminata* L.	4.29	5.60	5.31	15.20
7	*Cratevare ligiosa* G.Forst.	4.29	5.60	5.31	15.20
8	*Leea macrophylla* Roxb. *ex* Hornem.	4.29	5.60	5.31	15.20
9	*Aphanamixis polystachya* (Wall.) R.Parker	4.29	4.00	3.79	12.08
10	*Magnolia champaca* (L.) Baill. *ex* Pierre	4.29	4.00	3.79	12.08
11	*Oroxylum indicum* (L.) Kurz	4.29	4.00	3.79	12.08
12	*Lagerstroemia parviflora* Roxb.	4.29	4.00	3.79	12.08
13	*Tectona grandis* L.f.	5.71	3.20	2.28	11.19
14	*Casearia glomerata* Roxb.	2.86	3.20	4.55	10.61
15	*Dillenia indica* L.	4.29	3.20	3.03	10.52
16	*Gmelinaar borea* Roxb.	4.29	3.20	3.03	10.52
17	*Litsea glutinosa* (Lour.) C.B.Rob.	4.29	3.20	3.03	10.52
18	*Tetrameles nudiflora* R.Br.	4.29	2.40	2.28	8.96
19	*Schima wallichii* (DC.) Korth.	2.86	1.60	2.28	6.73
20	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	2.86	1.60	2.28	6.73
21	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn.	1.43	0.80	2.28	4.50
22	*Dipterocarpus retusus* Blume	1.43	0.80	2.28	4.50
23	*Garuga floribunda* Decne.	1.43	0.80	2.28	4.50
24	*Dipterocarpus turbinatus* C.F.Gaertn	1.43	0.80	2.28	4.50
25	*Bischofia javanica* Blume	1.43	0.80	2.28	4.50
26	*Duabanga grandiflora* (DC.) Walp.	1.43	0.80	2.28	4.50
27	*Wrightia arborea* (Dennst.) Mabb.	1.43	0.80	2.28	4.50

Table 2. Phytosociological data of Post-monsoon tree layer of mixed plantation in NRVK site

SL. No.	SPECIES	RF	RD	RA	IVI
1	*Neolamarckia cadamba* (Roxb.) Bosser	3.95	10.61	9.68	24.23
2	*Shorea robusta* Gaertn.	5.26	8.33	5.70	19.30
3	*Terminalia bellirica* (Gaertn.) Roxb.	5.26	6.82	4.66	16.75
4	*Leea macrophylla* Roxb. *ex* Hornem.	3.95	6.06	5.53	15.54
5	*Crateva religiosa* G.Forst.	5.26	6.06	4.15	15.47
6	*Terminalia alata* Wall.	5.26	6.06	4.15	15.47
7	*Lagerstroemia reginae* Roxb.	6.58	5.30	2.90	14.78
8	*Bauhinia acuminata* L.	3.95	5.30	4.84	14.09
9	*Casearia vareca* Roxb.	2.63	3.79	5.18	11.60
10	*Aphanamixis polystachya* (Wall.) R.Parker	3.95	3.79	3.46	11.19
11	*Magnolia champaca* (L.) Baill. *ex* Pierre.	3.95	3.79	3.46	11.19
12	*Oroxylum indicum* (L.) Kurz	3.95	3.79	3.46	11.19
13	*Lagerstroemia parviflora* Roxb.	3.95	3.79	3.46	11.19
14	*Tectona grandis* L.f.	5.26	3.03	2.07	10.37
15	*Gmelina arborea* Roxb.	3.95	3.03	2.76	9.74
16	*Litsea glutinosa* (Lour.) C.B.Rob.	3.95	3.03	2.76	9.74

SL. No.	SPECIES	RF	RD	RA	IVI
17	*Dillenia indica* L.	3.95	3.03	2.76	9.74
18	*Tetrameles nudiflora* R. Br.	3.95	2.27	2.07	8.29
19	*Antidesma montanum* Blume	2.63	1.52	2.07	6.22
20	*Schima wallichii* (DC.) Korth.	2.63	1.52	2.07	6.22
21	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	2.63	1.52	2.07	6.22
22	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn.	1.32	0.76	2.07	4.15
23	*Erythrina stricta* Roxb.	1.32	0.76	2.07	4.15
24	*Artocarpus chama* Buch.-Ham.	1.32	0.76	2.07	4.15
25	*Dipterocarpus retusus* Blume	1.32	0.76	2.07	4.15
26	*Garuga floribunda* Decne.	1.32	0.76	2.07	4.15
27	*Dipterocarpus turbinatus* C.F.Gaertn	1.32	0.76	2.07	4.15
28	*Bischofia javanica* Blume	1.32	0.76	2.07	4.15
29	*Duabanga grandiflora* (DC.) Walp.	1.32	0.76	2.07	4.15
30	*Actinodaphneo bovata* (Nees) Blume	1.32	0.76	2.07	4.15
31	*Wrightia arborea* (Dennst.) Mabb.	1.32	0.76	2.07	4.15

Table 3. Phytosociological data of winter shrub layer of mixed plantation in NRVK site

SL. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	11.29	53.80	32.67	97.75
2	*Clerodendrum infortunatum* L.	8.06	21.45	18.24	47.75
3	*Litsea glutinosa* (Lour.) C.B.Rob.	9.68	3.63	2.57	15.88
4	*Morinda angustifolia* Roxb.	9.68	2.64	1.87	14.19
5	*Chromolaena odorata* (L.) R.M.King & H.Rob.	6.45	2.31	2.45	11.22
6	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem.& Schult	6.45	2.31	2.45	11.22
7	*Solanum aculeatissimum* Jacq.	4.84	1.98	2.81	9.62
8	*Urena lobata* L.	3.23	1.65	3.51	8.38
9	*Ixora athroantha* Bremek.	4.84	1.32	1.87	8.03
10	*Croton roxburghii* Wall.	3.23	1.32	2.81	7.35
11	*Clausena excavate* Burm.f.	3.23	0.99	2.10	6.32
12	*Maesa chisia* Buch.-Ham. *ex* D. Don	3.23	0.66	1.40	5.29
13	*Albizia lucidior* (Steud.) I.C.Nielsen	1.61	0.66	2.81	5.08
14	*Dioscorea bulbifera* L.	1.61	0.66	2.81	5.08
15	*Acacia pennata* (L.) Willd.	1.61	0.33	1.40	3.35
16	*Caesalpinia cucullata* Roxb.	1.61	0.33	1.40	3.35
17	*Casearia glomerata* Roxb.	1.61	0.33	1.40	3.35
18	*Magnolia champaca* (L.) Baill. *ex* Pierre.	1.61	0.33	1.40	3.35
19	*Gouania leptostachya* DC.	1.61	0.33	1.40	3.35
20	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	1.61	0.33	1.40	3.35
21	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook.f. & Thomson	1.61	0.33	1.40	3.35
22	*Leea guineensis* G. Don	1.61	0.33	1.40	3.35
23	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.61	0.33	1.40	3.35
24	*Oroxylum indicum* (L.) Kurz	1.61	0.33	1.40	3.35
25	*Pueraria sikkimensis* Prain	1.61	0.33	1.40	3.35
26	*Actinodaphne bovata* (Nees) Blume	1.61	0.33	1.40	3.35
27	*Shorea robusta* Gaertn.	1.61	0.33	1.40	3.35
28	*Streblus asper* Lour.	1.61	0.33	1.40	3.35

Table 4. Phytosociological data of Pre-monsoon shrub layer of mixed plantation in NRVK site

SL.No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	6.59	43.20	32.80	82.60
2	*Clerodendrum infortunatum* L.	6.59	27.21	20.66	54.46
3	*Litsea glutinosa* (Lour.) C.B.Rob.	7.69	4.06	2.64	14.39
4	*Morinda angustifolia* Roxb.	9.89	2.63	1.33	13.84
5	*Chromolaena odorata* (L.) R.M.King & H.Rob..	7.69	2.63	1.71	12.03
6	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult	7.69	2.15	1.40	11.24

SL.No.	SPECIES	RF	RD	RA	IVI
7	*Solanum aculeatissimum* Jacq.	5.49	2.63	2.39	10.51
8	*Ixora athroantha* Bremek.	6.59	1.91	1.45	9.95
9	*Urena lobata* L.	4.40	2.15	2.45	8.99
10	*Baliospermum solanifolium* (Burm.) Suresh	3.30	1.67	2.54	7.50
11	*Clausena excavata* Burm.f.	3.30	1.19	1.81	6.30
12	*Dioscorea bulbifera* L.	2.20	0.95	2.17	5.33
13	*Caesalpinia cucullata* Roxb.	2.20	0.72	1.63	4.54
14	*Pueraria sikkimensis* Prain	2.20	0.72	1.63	4.54
15	*Dioscorea pubera* Blume	2.20	0.72	1.63	4.54
16	*Albizia lucidior* (Steud.) I.C.Nielsen	2.20	0.48	1.09	3.76
17	*Maesa chisia* Buch.-Ham. *ex* D. Don	2.20	0.48	1.09	3.76
18	*Mikania micrantha* Kunth	2.20	0.48	1.09	3.76
19	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	1.10	0.48	2.17	3.75
20	*Leea guineensis* G. Don	1.10	0.48	2.17	3.75
21	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.10	0.48	2.17	3.75
22	*Acacia pennata* (L.) Willd.	1.10	0.24	1.09	2.43
23	*Casearia glomerata* Roxb.	1.10	0.24	1.09	2.43
24	*Magnolia champaca* (L.) Baill. *ex* Pierre.	1.10	0.24	1.09	2.43
25	*Gouania leptostachya* DC.	1.10	0.24	1.09	2.43
26	*Grewia asiatica* L.	1.10	0.24	1.09	2.43
27	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	1.10	0.24	1.09	2.43
28	*Oroxylum indicum* (L.) Kurz	1.10	0.24	1.09	2.43
29	*Stereospermum tetragonum* DC.	1.10	0.24	1.09	2.43
30	*Actinodaphneo bovata* (Nees) Blume	1.10	0.24	1.09	2.43
31	*Shorea robusta* Gaertn.	1.10	0.24	1.09	2.43
32	*Streblus asper* Lour.	1.10	0.24	1.09	2.43

Table 5. Phytosociological data of Post-monsoon shrub layer of mixed plantation in NRVK site

SL.No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	6.92	35.38	22.49	64.79
2	*Clerodendrum infortunatum* L.	6.15	29.56	21.14	56.86
3	*Morinda angustifolia* Roxb.	6.92	3.72	2.36	13.00
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	6.15	3.72	2.66	12.53
5	*Litsea glutinosa* (Lour.) C.B.Rob.	6.15	3.07	2.19	11.42
6	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult	3.85	2.75	3.14	9.73
7	*Solanum khasianum* C.B. Clarke	4.62	2.10	2.00	8.72
8	*Urena lobata* L.	3.85	2.26	2.59	8.70
9	*Ixora athroantha* Bremek	4.62	1.78	1.69	8.09
10	*Clausena excavata* Burm.f.	4.62	1.45	1.39	7.46
11	*Baliospermum solanifolium* (Burm.) Suresh.	1.54	1.45	4.16	7.15
12	*Dioscorea bulbifera* L.	3.08	1.13	1.62	5.82
13	*Dioscorea pubera* Blume	3.85	0.81	0.92	5.58
14	*Mikania micrantha* Kunth	3.08	0.97	1.39	5.43
15	*Pueraria sikkimensis* Prain	3.08	0.81	1.16	5.04
16	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.31	0.81	1.54	4.66
17	*Caesalpinia cucullata* Roxb.	2.31	0.81	1.54	4.66
18	*Maesa chisia* Buch.-Ham. *ex* D. Don	2.31	0.65	1.23	4.19
19	*Albizia lucidior* (Steud.) I.C.Nielsen	2.31	0.65	1.23	4.19
20	*Dendrocnide sinuata* (Blume) Chew	1.54	0.65	1.85	4.03
21	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	2.31	0.48	0.92	3.72
22	*Casearia glomerata* Roxb.	2.31	0.48	0.92	3.72
23	*Leea guineensis* G. Don	1.54	0.48	1.39	3.41
24	*Vallaris solanacea* (Roth) Kuntze	0.77	0.32	1.85	2.94
25	*Streblus asper* Lour.	0.77	0.32	1.85	2.94
26	*Stereospermum tetragonum* DC.	0.77	0.32	1.85	2.94

SL.No	SPECIES	RF	RD	RA	IVI
27	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.77	0.32	1.85	2.94
28	*Gouania leptostachya* DC.	0.77	0.32	1.85	2.94
29	*Acacia pennata* (L.) Willd.	0.77	0.32	1.85	2.94
30	*Shorea robusta* Gaertn.	1.54	0.32	0.92	2.79
31	*Actinodaphneo bovata* (Nees) Blume	1.54	0.32	0.92	2.79
32	*Oroxylum indicum* (L.) Kurz	1.54	0.32	0.92	2.79
33	*Mussaenda roxburghii* Hook.f	1.54	0.32	0.92	2.79
34	*Michelia champaca* L.	1.54	0.32	0.92	2.79
35	*Wattakaka volubilis* (L. f.) Stapf	0.77	0.16	0.92	1.85
36	*Grewia asiatica* L.	0.77	0.16	0.92	1.85
37	*Aristolochia tagala* Cham.	0.77	0.16	0.92	1.85

Table 6. Phytosociological data of winter herb layer of mixed plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Eupatorium odoratum* L.	5.56	7.38	2.89	15.83
2	*Chloranthus elatior* Link	5.56	7.05	2.76	15.36
3	*Mikania micrantha* Kunth	4.17	6.38	3.33	13.87
4	*Diplazium esculentum* (Retz.) Sw.	4.86	6.04	2.71	13.61
5	*Coffea benghalensis* B.Heyne *ex* Schult.	3.47	5.37	3.37	12.21
6	*Dryopteris sikkimensis* (Bedd.) Kuntze	6.25	4.03	1.40	11.68
7	*Piper mullesua* Buch.-Ham. *ex* D. Don	3.47	4.70	2.95	11.12
8	*Commelina suffruticosa* Blume	3.47	4.70	2.95	11.12
9	*Oplismenus burmannii* (J. Presl) Hier. *ex* Peter	4.86	4.03	1.80	10.69
10	*Cyperus compressus* L.	2.78	4.36	3.42	10.56
11	*Pupalia lappacea* (L.) Juss.	2.08	3.69	3.86	9.63
12	*Synedrella nodiflora* (L.) Gaertn.	2.08	3.02	3.16	8.26
13	*Gouania leptostachya* DC.	3.47	2.68	1.68	7.84
14	*Lygodium flexuosum* (L.) Sw.	3.47	2.35	1.47	7.29
15	*Lepidagath is incurva* Buch.-Ham. *ex* D. Don	2.78	2.35	1.84	6.97
16	*Digitaria ciliaris* (Retz.) Koeler	2.08	2.35	2.46	6.89
17	*Impatiens trilobata* Colebr.	2.08	2.35	2.46	6.89
18	*Ageratum conyzoides* (L.) L.	1.39	2.01	3.16	6.56
19	*Blumea lacera* (Burm. f.) DC.	2.08	2.01	2.10	6.20
20	*Morinda angustifolia* Roxb.	2.78	1.68	1.32	5.77
21	*Phrynium pubinerve* Blume	0.69	1.01	3.16	4.86
22	*Floscopa scandens* Lour.	0.69	1.01	3.16	4.86
23	*Tectaria gemmifera* (Fée) Alston	0.69	1.01	3.16	4.86
24	*Piper betleoides* C.DC.	1.39	1.34	2.10	4.84
25	*Lindernia ciliata* (Colsm.) Pennell	1.39	1.34	2.10	4.84
26	*Ardisia solanacea* (Poir.) Roxb.	1.39	1.01	1.58	3.97
27	*Helminthostachys zeylanica* (L.) Hook.	1.39	1.01	1.58	3.97
28	*Tetrastigma serrulatum* (Roxb.) Planch.	1.39	1.01	1.58	3.97
29	*Molineria capitulata* (Lour.) Herb.	0.69	0.67	2.10	3.47
30	*Phyllanthus emblica* L.	0.69	0.67	2.10	3.47
31	*Phlogacanthus thyrsiflorus* Nees	0.69	0.67	2.10	3.47
32	*Thelypteris nudata* (Roxb.) C.V. Morton.	0.69	0.67	2.10	3.47
33	*Rungia himalayensis* C.B.Clarke	0.69	0.67	2.10	3.47
34	*Sauropus compressus* Müll.Arg.	0.69	0.67	2.10	3.47
35	*Hylodesmum laxum* (DC.) H.Ohashi & R.R.Mill.	1.39	0.67	1.05	3.11
36	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.39	0.67	1.05	3.11
37	*Oxalis debilis* var. *corymbosa* (DC.) Lourteig.	1.39	0.67	1.05	3.11
38	*Pericampylus glaucus* (Lam.) Merr.	1.39	0.67	1.05	3.11
39	*Persicaria chinensis* (L.) H. Gross	1.39	0.67	1.05	3.11
40	*Pteris semipinnata* L.	1.39	0.67	1.05	3.11
41	*Smilax zeylanica* L.	1.39	0.67	1.05	3.11
42	*Tetrastigma dubium* (Lawson) Planch.	1.39	0.67	1.05	3.11
43	*Cyanthillium cinereum* (L.) H.Rob..	1.39	0.67	1.05	3.11
44	*Aristolochia tagala* Cham.	0.69	0.34	1.05	2.08

Sl. No.	SPECIES	RF	RD	RA	IVI
45	*Cryptolepis sinensis* (Lour.) Merr.	0.69	0.34	1.05	2.08
46	*Phaius tankervilleae* (Banks) Blume	0.69	0.34	1.05	2.08
47	*Merremia hirta* (L.) Merr.	0.69	0.34	1.05	2.08
48	*Sterculia villosa* Roxb.	0.69	0.34	1.05	2.08
49	*Peristrophe bicalyculata* (Retz.) Nees	0.69	0.34	1.05	2.08
50	*Dillenia pentagyna* Roxb.	0.69	0.34	1.05	2.08
51	*Vallaris solanacea* (Roth) Kuntze	0.69	0.34	1.05	2.08

Table 7. Phytosociological data of Pre-monsoon herb layer of mixed plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Mikania micrantha* Kunth	6.4	7.2	2.3	15.9
2	*Dryopteris simasakii* (H. Itô) Sa. Kurata	4.4	6.7	3.1	14.1
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	4.8	5.3	2.2	12.3
4	*Chloranthus elatior* Link	4.8	5.0	2.1	11.8
5	*Pupalia lappacea* (L.) Juss.	3.2	4.6	2.9	10.7
6	*Oplismenus burmanni* (Retz.) P.Beauv.	3.2	4.1	2.6	9.9
7	*Coffea benghalensis* B.Heyne *ex* Schult.	3.6	3.9	2.2	9.7
8	*Ageratum conyzoides* (L.) L.	3.2	3.9	2.5	9.6
9	*Synedrella nodiflora* (L.) Gaertn.	2.8	3.8	2.7	9.3
10	*Diplazium esculentum* (Retz.) Sw.	3.2	3.6	2.3	9.1
11	*Lygodium flexuosum* (L.) Sw.	4.0	2.9	1.5	8.4
12	*Commelina suffruticosa* Blume	2.4	3.1	2.6	8.1
13	*Piper mullesua* Buch.-Ham. ex D. Don	3.2	2.7	1.7	7.7
14	*Persicaria chinensis* (L.) H. Gross	2.8	2.7	2.0	7.5
15	*Cynodon dactylon* (L.) Pers.	2.8	2.4	1.7	6.9
16	*Blumea lacera* (Burm.f.) DC.	2.0	2.4	2.4	6.8
17	*Gouania leptostachya* DC.	2.8	2.1	1.5	6.3
18	*Thelypteris nudata* (Roxb.) C.V. Morton	1.6	2.1	2.6	6.2
19	*Lindernia ciliata* (Colsm.) Pennell	1.6	1.9	2.4	5.9
20	*Cyperus compressus* L.	2.0	1.9	1.9	5.8
21	*Rungia himalayensis* C.B.Clarke	1.2	1.5	2.6	5.3
22	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	2.0	1.5	1.5	5.1
23	*Piper betleoides* C.DC.	1.6	1.5	1.9	5.1
24	*Morinda angustifolia* Roxb.	1.6	1.5	1.9	5.1
25	*Phyllanthus urinaria* L.	1.2	1.4	2.3	4.9
26	*Piper chuvya* Miq.	1.2	1.4	2.3	4.9
27	*Phrynium pubinerve* Blume	0.8	1.0	2.6	4.4
28	*Helminthostachys zeylanica* (L.) Hook.	1.2	1.2	2.0	4.4
29	*Pteris semipinnata* L.	2.0	1.2	1.2	4.4
30	*Floscopa scandens* Lour.	1.6	1.2	1.5	4.3
31	*Peristrophe bicalyculata* (Retz.) Nees	0.8	0.9	2.2	3.8
32	*Tetrastigma serrulatum* (Roxb.) Planch.	0.8	0.9	2.2	3.8
33	*Tectaria gemmifera* (Fée) Alston	0.8	0.9	2.2	3.8
34	*Ardisia solanacea* (Poir.) Roxb.	1.2	0.9	1.4	3.5
35	*Molineria capitulata* (Lour.) Herb.	1.2	0.9	1.4	3.5
36	*Digitaria ciliaris* (Retz.) Koeler	1.2	0.9	1.4	3.5
37	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.2	0.9	1.4	3.5
38	*Oxalis debilis* var. corymbosa (DC.) Lourteig.	1.2	0.9	1.4	3.5
39	*Phlogacanthus thyrsiflorus* Nees	0.8	0.7	1.7	3.2
40	*Pericampylus glaucus* (Lam.) Merr.	1.2	0.7	1.1	3.0
41	*Tetrastigma dubium* (Lawson) Planch.	1.2	0.7	1.1	3.0
42	*Cyanthillium cinereum* (L.) H.Rob..	1.2	0.7	1.1	3.0
43	*Hylodesmum laxum* (DC.) H.Ohashi & R.R.Mill.	0.8	0.5	1.3	2.6
44	*Impatiens trilobata* Colebr.	0.8	0.5	1.3	2.6
45	*Merremia hirta* (L.) Merr.	0.8	0.5	1.3	2.6
46	*Smilax zeylanica* L.	0.8	0.5	1.3	2.6
47	*Cryptolepis sinensis* (Lour.) Merr.	0.4	0.3	1.7	2.5
48	*Dillenia pentagyna* Roxb.	0.4	0.3	1.7	2.5
49	*Vallaris solanacea* (Roth) Kuntze	0.4	0.3	1.7	2.5

Sl. No.	SPECIES	RF	RD	RA	IVI
50	*Phaius tankervilleae* (Banks) Blume	0.8	0.3	0.9	2.0
51	*Sauropus compressus* Müll.Arg.	0.8	0.3	0.9	2.0
52	*Aristolochia tagala* Cham.	0.4	0.2	0.9	1.4
53	*Bauhinia acuminata* L.	0.4	0.2	0.9	1.4
54	*Jasminum laurifolium* Roxb. *ex* Hornem.	0.4	0.2	0.9	1.4
55	*Momordica dioica* Roxb. *ex* Willd.	0.4	0.2	0.9	1.4
56	*Paederia foetida* L.	0.4	0.2	0.9	1.4

Table 8. Phytosociological data of Post-monsoon herb layer of mixed plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Dryopteris sikkimensis* (Bedd.) Kuntze	4.91	8.03	2.94	15.88
2	*Diplazium esculentum* (Retz.) Sw.	3.86	5.77	2.69	12.33
3	*Mikania micrantha* Kunth	4.21	4.37	1.87	10.44
4	*Chloranthus elatior* Link	3.86	4.37	2.04	10.26
5	*Coffea benghalensis* B.Heyne *ex* Schult.	3.16	4.51	2.57	10.24
6	*Impatiens trilobata* Colebr.	2.81	4.51	2.89	10.21
7	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	2.11	3.80	3.25	9.16
8	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	3.16	3.66	2.09	8.91
9	*Commelina suffruticosa* Blume	3.16	3.38	1.93	8.47
10	*Pupalia lappacea* (L.) Juss.	2.46	3.38	2.48	8.32
11	*Chromolaena odorata* (L.) R.M.King & H.Rob.	2.81	3.10	1.99	7.89
12	*Piper mullesua* Buch.-Ham. *ex* D. Don	3.16	2.68	1.53	7.36
13	*Cyperus compressus* L.	2.81	2.68	1.72	7.20
14	*Piper chuvya* Miq.	1.40	2.54	3.25	7.19
15	*Oplismenus burmanni* (Retz.) P.Beauv.	1.75	2.68	2.75	7.18
16	*Lygodium flexuosum* (L.) Sw.	2.11	2.39	2.05	6.55
17	*Phrynium pubinerve* Blume	1.05	1.83	3.13	6.02
18	*Digitaria ciliaris* (Retz.) Koeler	2.81	1.83	1.17	5.81
19	*Gouania leptostachya* DC.	2.81	1.83	1.17	5.81
20	*Cynodon dactylon* (L.) Pers.	2.11	1.83	1.57	5.50
21	*Tetrastigma serrulatum* (Roxb.) Planch.	2.46	1.69	1.24	5.39
22	*Persicaria chinensis* (L.) H.Gross	1.05	1.55	2.65	5.25
23	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	2.11	1.55	1.33	4.98
24	*Tetrastigma dubium* (Lawson) Planch.	1.05	1.27	2.17	4.49
25	*Piper betleoides* C.DC.	1.40	1.27	1.63	4.30
26	*Peristrophe bicalyculata* (Retz.) Nees	1.05	1.13	1.93	4.11
27	*Synedrella nodiflora* (L.) Gaertn.	1.05	1.13	1.93	4.11
28	*Ageratum conyzoides* (L.) L.	1.75	1.13	1.16	4.04
29	*Ichnocarpu sfrutescens* (L.) W.T.Aiton	1.40	1.13	1.45	3.98
30	*Helminthostachys zeylanica* (L.) Hook.	1.75	0.99	1.01	3.75
31	*Thelypteris nudata* (Roxb.) C.V. Morton	1.75	0.99	1.01	3.75
32	*Lindernia ciliata* (Colsm.) Pennell	1.05	0.99	1.69	3.73
33	*Cyanthillium cinereum* (L.) H.Rob.	1.05	0.99	1.69	3.73
34	*Tectaria gemmifera* (Fée) Alston	1.40	0.99	1.27	3.65
35	*Blumea lacera* (Burm.f.) DC.	1.40	0.85	1.08	3.33
36	*Morinda angustifolia* Roxb.	1.40	0.85	1.08	3.33
37	*Oxalis debilis* var. corymbosa (DC.) Lourteig.	1.40	0.85	1.08	3.33
38	*Rungia himalayensis* C.B.Clarke	0.70	0.70	1.81	3.21
39	*Smilax zeylanica* L.	1.05	0.70	1.21	2.96
40	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	1.05	0.70	1.21	2.96
41	*Bauhinia variegata* L.	0.70	0.56	1.45	2.71
42	*Molineria capitulata* (Lour.) Herb.	0.70	0.56	1.45	2.71
43	*Floscopa scandens* Lour.	0.70	0.56	1.45	2.71
44	*Phaius tankervilleae* (Banks) Blume	1.05	0.56	0.96	2.58
45	*Merremia hirta* (L.) Merr.	1.05	0.56	0.96	2.58
46	*Pteris semipinnata* L.	1.05	0.56	0.96	2.58
47	*Ardisia solanacea* (Poir.) Roxb.	0.70	0.42	1.08	2.21
48	*Kaempferia rotunda* L.	0.70	0.42	1.08	2.21

Sl. No.	SPECIES	RF	RD	RA	IVI
49	*Merremia hirta* (L.) Merr.	0.70	0.42	1.08	2.21
50	*Ophioglossum lanceolatum* (Luerss.) Prantl.	0.70	0.42	1.08	2.21
51	*Pericampylus glaucus* (Lam.) Merr.	0.70	0.42	1.08	2.21
52	*Phyllanthus emblica* L.	0.70	0.42	1.08	2.21
53	*Sauropus compressus* Müll.Arg.	0.70	0.42	1.08	2.21
54	*Vallaris solanacea* (Roth) Kuntze	0.70	0.42	1.08	2.21
55	*Desmodium laxum* (DC.) H.Ohashi & R.R.Mill.	1.05	0.42	0.72	2.20
56	*Acacia pennata* (L.) Willd.	0.35	0.28	1.45	2.08
57	*Aristolochia tagala* Cham.	0.35	0.28	1.45	2.08
58	*Cryptolepis sinensis* (Lour.) Merr.	0.35	0.28	1.45	2.08
59	*Momordica dioica* Roxb. *ex* Willd.	0.35	0.28	1.45	2.08
60	*Jasminum laurifolium* Roxb. *ex* Hornem.	0.70	0.28	0.72	1.71
61	*Paederia foetida* L.	0.70	0.28	0.72	1.71
62	*Phlogacanthus thyrsiflorus* Nees	0.70	0.28	0.72	1.71
63	*Dillenia pentagyna* Roxb.	0.70	0.28	0.72	1.71

Table 9. Phytosociological data of winter tree layer of teak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Tectona grandis* L.f.	19.23	72.19	35.16	126.58
2	*Lagerstroemia speciosa* (L.) Pers.	11.54	4.14	3.36	19.04
3	*Croton caudatus* Geiseler	7.69	3.55	4.32	15.57
4	*Magnolia pterocarpa* Roxb.	7.69	2.37	2.88	12.94
5	*Terminalia alata* D.Dietr.	5.77	2.37	3.84	11.98
6	*Lagerstroemia parviflora* Roxb.	5.77	1.78	2.88	10.43
7	*Casearia vareca* Roxb.	3.85	1.78	4.32	9.94
8	*Schima wallichii* Choisy	3.85	1.18	2.88	7.91
9	*Dalbergia stipulacea* Roxb.	3.85	1.18	2.88	7.91
10	*Gmelina arborea* Roxb.	3.85	1.18	2.88	7.91
11	*Wrightia arborea* (Dennst.) Mabb.	3.85	1.18	2.88	7.91
12	*Syzygium cumini* (L.) Skeels	3.85	1.18	2.88	7.91
13	*Antidesma bunius* (L.) Spreng.	1.92	0.59	2.88	5.40
14	*Terminalia bellirica* (Gaertn.) Roxb.	1.92	0.59	2.88	5.40
15	*Callicarpa arborea* Roxb.	1.92	0.59	2.88	5.40
16	*Neolamarckia cadamba* (Roxb.) Bosser	1.92	0.59	2.88	5.40
17	*Careya arborea* Roxb.	1.92	0.59	2.88	5.40
18	*Holarrhena pubescens* Wall. *ex* G.Don	1.92	0.59	2.88	5.40
19	*Swietenia mahagoni* (L.) Jacq.	1.92	0.59	2.88	5.40
20	*Stereospermum tetragonum* DC.	1.92	0.59	2.88	5.40
21	*Shorea robusta* Gaertn.	1.92	0.59	2.88	5.40
22	*Toona ciliata* M.Roem.	1.92	0.59	2.88	5.40

Table 10. Phytosociological data of Post-monsoon tree layer of teak plantation in NRVK site

Sl. No	SPECIES	RF	RD	RA	IVI
1	*Tectona grandis* L.f.	15.38	66.85	31.73	113.96
2	*Croton caudatus* Geiseler	10.77	4.97	3.37	19.11
3	*Lagerstroemia* (Lamarck) Willd.	9.23	3.87	3.06	16.16
4	*Casearia vareca* Roxb.	6.15	2.76	3.28	12.19
5	*Magnolia pterocarpa* Roxb.	6.15	2.21	2.62	10.99
6	*Terminalia alata* Wall.	4.62	2.21	3.50	10.32
7	*Antidesma bunius* (L.) Spreng.	4.62	1.66	2.62	8.90
8	*Lagerstroemia parviflora* Roxb.	4.62	1.66	2.62	8.90
9	*Schima Wallichii* Choisy	3.08	1.10	2.62	6.80
10	*Dalbergia stipulacea* Roxb.	3.08	1.10	2.62	6.80
11	*Gmelina arborea* Roxb.	3.08	1.10	2.62	6.80
12	*Neolamarckia cadamba* (Roxb.) Bosser	3.08	1.10	2.62	6.80
13	*Wrightia arborea* (Dennst.) Mabb.	3.08	1.10	2.62	6.80
14	*Syzygium cumini* (L.) Skeels	3.08	1.10	2.62	6.80
15	*Toona ciliata* M.Roem.	3.08	1.10	2.62	6.80

Sl. No.	SPECIES	RF	RD	RA	IVI
16	*Terminalia bellirica* (Gaertn.) Roxb.	1.54	0.55	2.62	4.71
17	*Erythrina stricta* Roxb.	1.54	0.55	2.62	4.71
18	*Callicarpa arborea* Roxb.	1.54	0.55	2.62	4.71
19	*Careya arborea* Roxb.	1.54	0.55	2.62	4.71
20	*Holarrhena pubescens* Wall. *ex* G.Don	1.54	0.55	2.62	4.71
21	*Swietenia mahagoni* (L.) Jacq	1.54	0.55	2.62	4.71
22	*Stereospermum tetragonum* DC.	1.54	0.55	2.62	4.71
23	*Premna barbata* Wall. *ex* Schauer	1.54	0.55	2.62	4.71
24	*Shorea robusta* Gaertn.	1.54	0.55	2.62	4.71
25	*Dalbergia sissoo* DC.	1.54	0.55	2.62	4.71
26	*Ziziphus jujuba* Mill.	1.54	0.55	2.62	4.71

Table 11. Phytosociological data of winter shrub layer of teak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	14.89	35.94	16.40	67.24
2	*Clerodendrum infortunatum* L.	7.45	21.45	19.58	48.47
3	*Morinda angustifolia* Roxb.	19.15	19.71	7.00	45.86
4	*Clausena excavata* Burm f.	8.51	4.93	3.94	17.37
5	*Triumfetta rhomboidea* Jacq.	2.13	3.19	10.19	15.50
6	*Chromolaena odorata* (L.) R.M.King & H.Rob.	6.38	4.06	4.32	14.76
7	*Maesa indica* (Roxb.) A.DC	6.38	2.03	2.16	10.57
8	*Urena lobata* L.	2.13	1.16	3.70	6.99
9	*Pueraria sikkimensis* Prain	3.19	0.87	1.85	5.91
10	*Combretum decandrum* Jacq.	4.26	0.58	0.93	5.76
11	*Smilax zeylanica* L.	1.06	0.58	3.70	5.35
12	*Uncaria scandens* (Sm.) Hutch.	1.06	0.58	3.70	5.35
13	*Lagerstroemia reginae* Roxb.	3.19	0.58	1.23	5.01
14	*Dillenia pentagyna* Roxb.	3.19	0.58	1.23	5.01
15	*Leea guineensis* G. Don	2.13	0.58	1.85	4.56
16	*Mussaenda roxburghii* Hook.f.	3.19	0.29	0.62	4.10
17	*Tectona grandis* L. f.	2.13	0.29	0.93	3.34
18	*Acacia pennata* (L.) Willd.	1.06	0.29	1.85	3.21
19	*Antidesma bunius* (L.) Spreng.	1.06	0.29	1.85	3.21
20	*Clerodendrum indicum* (L.) Kuntze	1.06	0.29	1.85	3.21
21	*Litsea monopetala* (Roxb.) Pers.	1.06	0.29	1.85	3.21
22	*Mallotus philippensis* (Lam.) Müll.Arg.	1.06	0.29	1.85	3.21
23	*Shorea robusta* Gaertn.	1.06	0.29	1.85	3.21
24	*Sauropus compressus* Müll.Arg.	1.06	0.29	1.85	3.21
25	*Sida acuta* Burm.f.	1.06	0.29	1.85	3.21
26	*Lagerstroemia parviflora* Roxb.	1.06	0.29	1.85	3.21

Table 12. Phytosociological data of Pre-monsoon shrub layer of teak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	12.84	31.81	16.67	61.33
2	*Clerodendrum infortunatum* L.	11.93	24.32	13.73	49.98
3	*Morinda angustifolia* Roxb.	12.84	19.33	10.14	42.31
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	8.26	6.03	4.92	19.20
5	*Maesa indica* (Roxb.) A. DC.	2.75	2.29	5.59	10.63
6	*Triumfetta rhomboidea* Jacq.	2.75	1.66	4.07	8.48
7	*Urena lobata* L.	3.67	1.46	2.67	7.80
8	*Sida acuta* Burm.f.	2.75	1.46	3.56	7.77
9	*Combretum decandrum* Jacq.	3.67	1.04	1.91	6.62
10	*Pueraria sikkimensis* Prain	3.67	1.04	1.91	6.62
11	*Litsea monopetala* (Roxb.) Pers	2.75	1.04	2.54	6.33
12	*Desmodium laxiflorum* DC.	2.75	0.83	2.03	5.62
13	*Sauropus compressus* Müll.Arg.	2.75	0.83	2.03	5.62
14	*Macaranga denticulata* (Blume) Müll.Arg.	2.75	0.62	1.53	4.90

Sl. No.	SPECIES	RF	RD	RA	IVI
15	*Smilax zeylanica* L.	2.75	0.62	1.53	4.90
16	*Dillenia pentagyna* Roxb.	2.75	0.62	1.53	4.90
17	*Antidesma bunius* (L.) Spreng.	1.83	0.62	2.29	4.75
18	*Ardisia solanacea* (Poir.) Roxb.	1.83	0.62	2.29	4.75
19	*Leea guineensis* G. Don	1.83	0.62	2.29	4.75
20	*Lagerstroemia speciosa* (L.) Pers.	0.92	0.42	3.05	4.38
21	*Acacia pennata* (L.) Willd.	1.83	0.42	1.53	3.78
22	*Mallotus philippensis* (Lam.) Müll.Arg.	1.83	0.42	1.53	3.78
23	*Mussaenda roxburghii* Hook.f.	1.83	0.42	1.53	3.78
24	*Streblus asper* Lour.	1.83	0.42	1.53	3.78
25	*Bombax ceiba* L.	0.92	0.21	1.53	2.65
26	*Sorindeia madagascariensis* Thouars ex DC.	0.92	0.21	1.53	2.65
27	*Ficus hispida* L.f.	0.92	0.21	1.53	2.65
28	*Ilex godajam* Colebr. *ex* Hook.f.	0.92	0.21	1.53	2.65
29	*Stereospermum tetragonum* DC.	0.92	0.21	1.53	2.65

Table 13. Phytosociological data of Post-monsoon shrub layer of teak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L.	11.97	32.33	19.61	63.91
2	*Coffea benghalensis* B.Heyne *ex* Schult.	11.97	30.87	18.72	61.57
3	*Morinda angustifolia* Roxb.	10.56	14.24	9.79	34.59
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	5.63	4.37	5.63	15.63
5	*Clausena excavata* Burm.f.	5.63	3.22	4.15	13.01
6	*Baliospermum solanifolium* (Burm.) Suresh.	4.93	3.22	4.75	12.90
7	*Maesa indica* (Roxb.) A.DC.	6.34	2.39	2.74	11.47
8	*Urena lobata* L.	4.93	1.77	2.60	9.30
9	*Leea guineensis* G.Don	3.52	0.94	1.93	6.39
10	*Pueraria sikkimensis* Prain	2.82	0.94	2.41	6.16
11	*Sauropus compressus* Müll.Arg.	3.52	0.73	1.50	5.75
12	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	2.82	0.62	1.61	5.05
13	*Macaranga denticulata* (Blume) Müll.Arg.	2.82	0.52	1.34	4.68
14	*Acacia pennata* (L.) Willd.	2.11	0.42	1.43	3.96
15	*Glycosmis pentaphylla* (Retz.) DC.	2.11	0.42	1.43	3.96
16	*Lagerstroemia speciosa* (L.) Pers.	2.11	0.31	1.07	3.50
17	*Asparagus racemosus* Willd.	1.41	0.31	1.61	3.33
18	*Barleria cristata* L.	1.41	0.31	1.61	3.33
19	*Mallotus philippensis* (Lam.) Müll.Arg.	1.41	0.31	1.61	3.33
20	*Bridelia stipularis* (L.) Blume	0.70	0.21	2.14	3.06
21	*Bombax ceiba* L.	1.41	0.21	1.07	2.69
22	*Litsea monopetala* (Roxb.) Pers.	1.41	0.21	1.07	2.69
23	*Shorea robusta* Gaertn.	1.41	0.21	1.07	2.69
24	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	1.41	0.10	0.54	2.05
25	*Terminalia bellirica* (Gaertn.) Roxb.	0.70	0.10	1.07	1.88
26	*Dalbergia pinnata* (Lour.) Prain	0.70	0.10	1.07	1.88
27	*Premna bengalensis* C.B.Clarke	0.70	0.10	1.07	1.88
28	*Grewia asiatica* L.	0.70	0.10	1.07	1.88
29	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.70	0.10	1.07	1.88
30	*Phyllanthus urinaria* L.	0.70	0.10	1.07	1.88
31	*Lagerstroemia parviflora* Roxb.	0.70	0.10	1.07	1.88
32	*Oroxylum indicum* (L.) Kurz	0.70	0.10	1.07	1.88

Table 14. Phytosociological data of winter herb layer of teak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Oplismenus burmannii* (J. Presl) Hier. *ex* Peter	13.01	15.35	3.26	31.63
2	*Coffea benghalensis* B.Heyne *ex* Schult.	5.48	7.88	3.98	17.34
3	*Mikania micrantha* Kunth	7.53	7.05	2.59	17.18

Sl. No.	SPECIES	RF	RD	RA	IVI
4	*Lygodium flexuosum* (L.) Sw.	8.22	6.22	2.09	16.54
5	*Dryopteris sikkimensis* (Bedd.) Kuntze	4.11	5.81	3.91	13.83
6	*Piper betleoides* C.DC.	4.79	4.98	2.87	12.65
7	*Phyllanthus emblica* L.	4.79	4.56	2.63	11.99
8	*Chromolaena odorata* (L.) R.M.King & H.Rob.	2.05	3.73	5.03	10.82
9	*Commelina diffusa* Burm.f.	4.11	3.73	2.51	10.36
10	*Rungia pectinata* (L.) Nees	4.11	3.73	2.51	10.36
11	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	3.42	3.73	3.02	10.17
12	*Diplazium esculentum* (Retz.) Sw.	2.05	2.90	3.91	8.87
13	*Curculigo recurvata* W.T.Aiton	3.42	2.90	2.35	8.67
14	*Dioscorea pentaphylla* L.	2.74	2.49	2.51	7.74
15	*Chlorophytum arundinaceum* Baker	2.05	2.07	2.79	6.92
16	*Pouzolzia hirta* Blume *ex* Hassk.	2.05	2.07	2.79	6.92
17	*Gouania leptostachya* DC.	2.74	2.07	2.09	6.91
18	*Axonopus compressus* (Sw.) P.Beauv.	1.37	1.66	3.35	6.38
19	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.05	1.66	2.23	5.95
20	*Elephantopus scaber* L.	1.37	1.24	2.51	5.13
21	*Persicaria chinensis* (L.) H.Gross	1.37	1.24	2.51	5.13
22	*Sauropus compressus* Müll.Arg.	1.37	1.24	2.51	5.13
23	*Sida acuta* Burm.f.	1.37	1.24	2.51	5.13
24	*Hedyotis scandens* Roxb.	0.68	0.83	3.35	4.87
25	*Helminthostachys zeylanica* (L.) Hook.	0.68	0.83	3.35	4.87
26	*Pteris biaurita* L.	0.68	0.83	3.35	4.87
27	*Vernonia cinerea* (L.) Less.	0.68	0.83	3.35	4.87
28	*Cissampelos pareira* L.	1.37	0.83	1.68	3.88
29	*Cheilocostus speciosus* (J.Koenig) C.D.Specht.	1.37	0.83	1.68	3.88
30	*Piper peepuloides* Wall.	1.37	0.83	1.68	3.88
31	*Stephania japonica* (Thunb.) Miers	1.37	0.83	1.68	3.88
32	*Toona ciliata* M.Roem.	1.37	0.83	1.68	3.88
33	*Acacia pennata* (L.) Willd.	0.68	0.41	1.68	2.78
34	*Curcuma zedoaria* (Christm.) Roscoe	0.68	0.41	1.68	2.78
35	*Desmodium laxiflorum* DC.	0.68	0.41	1.68	2.78
36	*Wrightia arborea* (Dennst.) Mabb.	0.68	0.41	1.68	2.78
37	*Merremia hirta* (L.) Merr	0.68	0.41	1.68	2.78
38	*Psychotria erratica* Hook.f.	0.68	0.41	1.68	2.78
39	*Tetrastigma campylocarpum* (Kurz) Planch.	0.68	0.41	1.68	2.78

Table 15. Phytosociological data of Pre-monsoon herb layer of teak plantation in NRVK site

Sl .No.	SPECIES	RF	RD	RA	IVI
1	*Chromolaena odorata* (L.) R.M.King & H.Rob.	8.41	8.18	2.43	19.02
2	*Coffea benghalensis* B.Heyne *ex* Schult.	6.54	8.70	3.32	18.55
3	*Oplismenus burmanni* (Retz.) P.Beauv..	8.88	6.65	1.87	17.40
4	*Mikania micrantha* Kunth	7.48	7.16	2.39	17.03
5	*Diplazium esculentum* (Retz.) Sw.	2.80	5.88	5.24	13.92
6	*Dryopteris sikkimensis* (Bedd.) Kuntze	3.74	5.88	3.93	13.55
7	*Dioscorea pentaphylla* L.	5.14	5.37	2.61	13.12
8	*Commelina diffusa* Burm.f.	5.14	4.86	2.36	12.36
9	*Piper betleoides* C.DC.	3.74	4.86	3.24	11.84
10	*Lygodium flexuosum* (L.) Sw.	4.67	4.35	2.32	11.34
11	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	4.21	4.09	2.43	10.73
12	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.34	2.81	3.00	8.15
13	*Helminthostachys zeylanica* (L.) Hook.	2.80	2.05	1.82	6.67
14	*Axonopus compressus* (Sw.) P.Beauv.	1.40	1.79	3.19	6.38
15	*Digitaria ciliaris* (Retz.) Koeler	1.40	1.79	3.19	6.38
16	*Piper peepuloides* Wall.	1.40	1.79	3.19	6.38
17	*Gouania leptostachya* DC.	2.80	1.79	1.59	6.19
18	*Cyperus pangorei* Rottb.	1.87	1.79	2.39	6.05

Sl. No.	SPECIES	RF	RD	RA	IVI
19	*Phyllanthus emblica* L.	1.87	1.79	2.39	6.05
20	*Synedrella nodiflora* (L.) Gaertn.	1.40	1.53	2.73	5.67
21	*Globba andersonii* C.B.Clarke *ex* Baker	1.87	1.53	2.05	5.45
22	*Impatiens trilobata* Colebr.	1.40	1.28	2.28	4.96
23	*Ophiopogon intermedius* D.Don.	1.40	1.28	2.28	4.96
24	*Sida acuta* Burm.f.	1.40	1.28	2.28	4.96
25	*Triumfetta rhomboidea* Jacq.	0.93	1.02	2.73	4.69
26	*Cheilocostus speciosus* (J.Koenig) C.D.Specht.	1.40	1.02	1.82	4.25
27	*Morinda angustifolia* Roxb.	1.40	1.02	1.82	4.25
28	*Stephania japonica* (Thunb.) Miers	1.40	1.02	1.82	4.25
29	*Goniothalamus sesquipedalis* (Wall.) Hook.f. & Thomson	0.93	0.77	2.05	3.75
30	*Thelypteris nudata* (Roxb.) C.V. Morton	0.93	0.77	2.05	3.75
31	*Blumea lacera* (Burm.f.) DC.	0.47	0.51	2.73	3.71
32	*Desmodium laxiflorum* DC.	0.47	0.51	2.73	3.71
33	*Elephantopus scaber* L.	0.47	0.51	2.73	3.71
34	*Peristrophe bicalyculata* (Retz.) Nees	0.47	0.51	2.73	3.71
35	*Cissampelos pareira* L.	0.93	0.51	1.37	2.81
36	*Baliospermum solanifolium* (Burm.) Suresh	0.93	0.51	1.37	2.81
37	*Curculigo recurvata* W.T.Aiton	0.93	0.51	1.37	2.81
38	*Floscopa scandens* Lour.	0.93	0.51	1.37	2.81
39	*Nelsonia canescens* (Lam.) Spreng.	0.93	0.51	1.37	2.81
40	*Sauropus compressus* Müll.Arg.	0.93	0.51	1.37	2.81
41	*Leea guineensis* G. Don	0.47	0.26	1.37	2.09
42	*Paederia foetida* L.	0.47	0.26	1.37	2.09
43	*Tinospora sinensis* (Lour.) Merr.	0.47	0.26	1.37	2.09

Table 16. Phytosociological data of Post-monsoon herb layer of teak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	7.17	7.43	2.19	16.80
2	*Mikania micrantha* Kunth	7.17	6.90	2.04	16.11
3	*Diplazium esculentum* (Retz.) Sw.	2.95	6.55	4.69	14.19
4	*Oplismenus burmanni* (Retz.) P.Beauv.	2.53	5.49	4.58	12.60
5	*Lygodium flexuosum* (L.) Sw.	5.91	4.60	1.65	12.16
6	*Dioscorea pentaphylla* L.	2.11	4.25	4.26	10.62
7	*Commelina diffusa* Burm.f.	4.64	4.07	1.86	10.57
8	*Piper betleoides* C.DC.	3.80	3.89	2.17	9.86
9	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	3.38	3.89	2.44	9.71
10	*Ichnocarpus frutescens* (L.) W.T.Aiton	4.64	3.01	1.37	9.02
11	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.38	3.36	2.11	8.85
12	*Chlorophytum arundinaceum* Baker	1.69	2.48	3.11	7.27
13	*Clerodendrum infortunatum* L.	1.69	2.30	2.88	6.87
14	*Phyllanthus emblica* L.	1.69	2.30	2.88	6.87
15	*Synedrella nodiflora* (L.) Gaertn.	1.69	2.30	2.88	6.87
16	*Cyperus pangorei* Rottb.	2.11	2.30	2.31	6.72
17	*Gouania leptostachya* DC.	2.95	2.12	1.52	6.60
18	*Helminthostachys zeylanica* (L.) Hook.	2.95	2.12	1.52	6.60
19	*Axonopus compressus* (Sw.) P.Beauv.	1.69	1.95	2.44	6.07
20	*Dryopteris sikkimensis* (Bedd.) Kuntze	1.69	1.95	2.44	6.07
21	*Thelypteris nudata* (Roxb.) C.V. Morton	2.11	1.95	1.95	6.01
22	*Digitaria ciliaris* (Retz.) Koeler	1.27	1.59	2.66	5.52
23	*Pipe peepuloides* Wall.	2.11	1.59	1.60	5.30
24	*Urena lobata* L.	1.69	1.59	2.00	5.28
25	*Selaginella sp*	0.84	1.24	3.11	5.19
26	*Desmodium laxiflorum* DC.	2.11	1.42	1.42	4.95
27	*Morinda angustifolia* Roxb.	1.69	1.42	1.77	4.88
28	*Blumea lacera* (Burm. f.) DC.	1.27	1.24	2.07	4.57
29	*Carex indica* L.	1.27	1.24	2.07	4.57
30	*Biophytum sensitivum* (L.) DC.	0.84	1.06	2.66	4.57
31	*Hedyotis scandens* Roxb.	1.69	1.24	1.55	4.48

Sl. No.	SPECIES	RF	RD	RA	IVI
32	*Lindernia ciliata* (Colsm.) Pennell	1.69	1.24	1.55	4.48
33	*Molineria capitulata* (Lour.) Herb.	1.27	1.06	1.77	4.10
34	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	0.84	0.88	2.22	3.95
35	*Floscopa scandens* Lour.	0.84	0.88	2.22	3.95
36	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.27	0.88	1.48	3.63
37	*Goniothalamus sesquipedalis* (Wall.) Hook.f. & Thomson	1.27	0.71	1.18	3.16
38	*Maesa chisia* Buch.-Ham. *ex* D. Don	1.27	0.71	1.18	3.16
39	*Leea guineensis* G. Don	0.84	0.53	1.33	2.71
40	*Merremia hirta* (L.) Merr.	0.84	0.53	1.33	2.71
41	*Persicaria chinensis* (L.) H. Gross	0.84	0.53	1.33	2.71
42	*Pouzolzia hirta* Blume *ex* Hassk.	0.84	0.53	1.33	2.71
43	*Mimosa pudica* L.	0.42	0.35	1.77	2.55
44	*Rungia pectinata* (L.) Nees	0.42	0.35	1.77	2.55
45	*Acacia pennata* (L.) Willd.	0.84	0.35	0.89	2.09
46	*Antidesma bunius* (L.) Spreng.	0.84	0.35	0.89	2.09
47	*Pueraria sikkimensis* Prain	0.84	0.35	0.89	2.09
48	*Stephania japonica* (Thunb.) Miers	0.84	0.35	0.89	2.09
49	*Cyanthillium cinereum* (L.) H.Rob.	0.84	0.35	0.89	2.09
50	*Ilex godajam* Colebr. *ex* Hook.f.	0.42	0.18	0.89	1.49

Table 17. Phytosociological data of winter tree layer of Jarul beanteak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia speciosa* (L.) Pers.	25.81	89.43	79.62	194.86
2	*Lagerstroemia microcarpa* Hance	25.81	6.39	5.69	37.88
3	*Leea macrophylla* Roxb.*ex* Hornem.	16.13	1.72	2.45	20.30
4	*Alangium chinense* (Lour.) Harms	6.45	0.49	1.75	8.69
5	*Stereospermum tetragonum* DC.	6.45	0.49	1.75	8.69
6	*Premna bengalensis* C.B.Clarke	6.45	0.49	1.75	8.69
7	*Magnolia champaca* (L.) Baill. *ex* Pierre.	3.23	0.25	1.75	5.22
8	*Croton caudatus* Geiseler	3.23	0.25	1.75	5.22
9	*Lagerstroemia parviflora* Roxb.	3.23	0.25	1.75	5.22
10	*Callicarpa arborea* Roxb.	3.23	0.25	1.75	5.22

Table 18. Phytosociological data of post monsoon tree layer of jarul beanteak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia microcarpa* Hance	23.53	6.31	5.43	35.27
2	*Lagerstroemia speciosa* (L.) Pers.	23.53	88.35	76.02	187.90
3	*Leea macrophylla* Roxb. *ex* Hornem.	14.71	1.94	2.67	19.32
4	*Alangium chinense* (Lour.) Harms	5.88	0.49	1.67	8.04
5	*Stereospermum colais* (Buch.-Ham. *ex* Dillwyn) Mabb.	5.88	0.49	1.67	8.04
6	*Michelia champaca* L.	2.94	0.24	1.67	4.85
7	*Premna bengalensis* C.B.Clarke	5.88	0.49	1.67	8.04
8	*Croton caudatus* Geiseler	5.88	0.73	2.51	9.12
9	*Lagerstroemia parviflora* Roxb.	2.94	0.24	1.67	4.85
10	*Litsea glutinosa* (Lour.) C.B.Rob.	2.94	0.24	1.67	4.85
11	*Sterculia villosa* Roxb.	2.94	0.24	1.67	4.85
12	*Callicarpa arborea* Roxb.	2.94	0.24	1.67	4.85

Table 19. Phytosociological data of winter shrub layer of Jarul beanteak plantation in NRVK site

SL.No	SPECIES	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L.	13.10	43.46	37.12	93.68
2	*Coffea benghalensis* B.Heyne *ex* Schult.	11.90	37.04	34.80	83.74
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	14.29	8.26	6.46	29.01
4	*Sida acuta* Burm.f.	10.71	2.52	2.63	15.87
5	*Clausena excavata* Burm.f.	7.14	2.41	3.77	13.32

SL.NO	SPECIES	RF	RD	RA	IVI
6	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	9.52	1.49	1.75	12.77
7	*Solanum aculeatissimum* Jacq.	7.14	2.18	3.41	12.73
8	*Albizia lucidior* (Steud.) I.C.Nielsen	5.95	0.57	1.08	7.60
9	*Glycosmis pentaphylla* (Retz.) DC.	4.76	0.46	1.08	6.30
10	*Urena lobata* L.	3.57	0.46	1.44	5.47
11	*Leea guineensis* G.Don	3.57	0.34	1.08	4.99
12	*Litsea monopetala* (Roxb.) Pers.	2.38	0.23	1.08	3.69
13	*Sida rhombifolia* L.	2.38	0.23	1.08	3.69
14	*Sterculia villosa* Roxb.	1.19	0.11	1.08	2.38
15	*Sauropus compressus* Müll. Arg.	1.19	0.11	1.08	2.38
16	*Torenia ciliata* Hook.f.	1.19	0.11	1.08	2.38

Table 20. Phytosociological data of Pre-monsoon shrub layer of Jarul beanteak plantation in NRVK site

Sl. no.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	12.04	44.13	36.04	92.20
2	*Clerodendrum infortunatum* L.	12.04	35.66	29.13	76.83
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	12.96	7.69	5.83	26.48
4	*Sida acuta* Burm.f.	8.33	2.85	3.36	14.54
5	*Clausena excavata* Burm.f.	6.48	2.07	3.14	11.70
6	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	7.41	1.81	2.41	11.63
7	*Solanum aculeatissimum* Jacq.	5.56	1.99	3.51	11.06
8	*Albizia lucidior* (Steud.) I.C.Nielsen	6.48	0.60	0.92	8.00
9	*Glycosmis cymosa* (Kurz) V.Naray.	3.70	0.52	1.38	5.60
10	*Urena lobata* L.	3.70	0.43	1.15	5.28
11	*Mikania micrantha* Kunth	2.78	0.35	1.22	4.35
12	*Leea guineensis* G. Don	2.78	0.26	0.92	3.95
13	*Litsea glutinosa* (Lour.) C.B.Rob.	2.78	0.26	0.92	3.95
14	*Sauropus compressus* Müll.Arg.	2.78	0.26	0.92	3.95
15	*Elephantopus scaber* L.	1.85	0.17	0.92	2.94
16	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.85	0.17	0.92	2.94
17	*Triumfetta rhomboidea* Jacq.	1.85	0.17	0.92	2.94
18	*Sida rhombifolia* L.	0.93	0.17	1.83	2.93
19	*Torenia ciliata* Hook.f.	0.93	0.17	1.83	2.93
20	*Sterculia villosa* Roxb.	0.93	0.09	0.92	1.93
21	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.93	0.09	0.92	1.93
22	*Tinospora sinensis* (Lour.) Merr.	0.93	0.09	0.92	1.93

Table 21. Phytosociological data of Post-monsoon shrub layer of Jarul beanteak plantation in NRVK site

Sl. no.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	10.95	40.73	28.79	80.47
2	*Clerodendrum infortunatum* L.	10.22	36.76	27.84	74.82
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	10.22	7.17	5.43	22.81
4	*Sida acuta* Burm.f.	8.03	2.65	2.55	13.23
5	*Solanum aculeatissimum* Jacq.	3.65	2.41	5.12	11.18
6	*Clausena excavata* Burm.f.	5.11	2.10	3.18	10.40
7	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	5.11	1.79	2.71	9.61
8	*Mikania micrantha* Kunth	5.84	0.86	1.14	7.83
9	*Albizia lucidior* (Steud.) I.C.Nielsen	5.11	0.62	0.94	6.68
10	*Glycosmis cyanocarpa* var. *cymosa* Kurz	4.38	0.55	0.96	5.89
11	*Urena lobata* L.	2.92	0.47	1.24	4.63
12	Litsea glutinosa (Lour.) C.B.Rob	2.19	0.31	1.10	3.60
13	*Maesa indica* (Roxb.) A. DC.	2.19	0.31	1.10	3.60
14	*Sauropus compressus* Müll.Arg.	2.19	0.31	1.10	3.60

Sl. No.	SPECIES	RF	RD	RA	IVI
15	*Triumfetta rhomboidea* Jacq.	2.19	0.31	1.10	3.60
16	*Dendrocnide sinuata* (Blume) Chew	1.46	0.31	1.65	3.42
17	*Leea guineensis* G. Don	2.19	0.23	0.83	3.25
18	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.19	0.23	0.83	3.25
19	*Croton caudatus* Geiseler	1.46	0.23	1.24	2.93
20	*Elephantopus scaber* L.	1.46	0.23	1.24	2.93
21	*Morinda angustifolia* Roxb.	1.46	0.23	1.24	2.93
22	*Sida rhombifolia* L.	1.46	0.23	1.24	2.93
23	*Dioscorea bulbifera* L.	0.73	0.16	1.65	2.54
24	*Casearia vareca* Roxb.	1.46	0.16	0.83	2.44
25	*Lagerstroemia microcarpa* Hance	1.46	0.16	0.83	2.44
26	*Streblus asper* Lour.	1.46	0.16	0.83	2.44
27	*Mussaenda roxburghii* Hook.f.	0.73	0.08	0.83	1.63
28	*Sterculia villosa* Roxb.	0.73	0.08	0.83	1.63
29	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.73	0.08	0.83	1.63
30	*Tinospora sinensis* (Lour.) Merr.	0.73	0.08	0.83	1.63

Table 22. Phytosociological data of winter herb layer of Jarul beanteak plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Ageratum houstonianum* Mill.	8.18	11.89	7.80	27.88
2	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.82	1.62	4.79	8.23
3	*Axonopus compressus* (Sw.) P.Beauv.	5.45	4.86	4.79	15.11
4	*Dioscorea pubera* Blume	0.91	0.54	3.19	4.64
5	*Diplazium esculentum* (Retz.) Sw.	2.73	2.70	5.32	10.75
6	*Drymaria cordata* (L.) Willd. *ex* Schult.	0.91	0.54	3.19	4.64
7	*Dryopteris sikkimensis* (Bedd.) Kuntze	3.64	3.24	4.79	11.67
8	*Elephantopus scaber* L.	1.82	1.08	3.19	6.09
9	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.82	1.08	3.19	6.09
10	*Ichnocarpus frutescens* (L.) W.T.Aiton	0.91	0.54	3.19	4.64
11	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	3.64	3.24	4.79	11.67
12	*Merremia vitifolia* (Burm.f.) Hallier f.	0.91	0.54	3.19	4.64
13	*Mikania micrantha* Kunth	19.09	18.38	5.17	42.64
14	*Mimosa pudica* L.	2.73	2.70	5.32	10.75
15	*Naravelia zeylanica* (L.) DC.	1.82	1.08	3.19	6.09
16	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.82	1.08	3.19	6.09
17	*Oplismenus burmanni* (Retz.) P.Beauv.	6.36	8.65	7.30	22.31
18	*Persicaria chinensis* (L.) H. Gross	8.18	6.49	4.26	18.92
19	*Phyllanthus niruri* L.	2.73	1.62	3.19	7.54
20	*Piper peepuloides* Wall.	4.55	2.70	3.19	10.44
21	*Pupalia lappacea* (L.) Juss.	17.27	23.78	7.39	48.45
22	*Smilax zeylanica* L.	0.91	0.54	3.19	4.64
23	*Synedrella nodiflora* (L.) Gaertn.	1.82	1.08	3.19	6.09

Table 23. Phytosociological data of Pre-monsoon herb layer of Jarul beanteak plantation in NRVK site

Sl. No	SPECIES	RF	RD	RA	IVI
1	*Piper betleoides* C.DC.	12.65	18.10	6.20	36.95
2	*Mikania micrantha* Kunth	13.86	15.24	4.77	33.86
3	*Ageratum houstonianum* Mill.	8.43	10.16	5.22	23.81
4	*Spermacoce alata* Aubl.	7.23	9.21	5.52	21.96
5	*Persicaria chinensis* (L.) H. Gross	7.83	8.57	4.74	21.15
6	*Oplismenus compositus* (L.) P.Beauv.	5.42	6.67	5.33	17.42
7	*Axonopus compressus* (Sw.) P.Beauv.	5.42	4.13	3.30	12.85
8	*Oxalis corniculata* L.	4.82	3.81	3.43	12.06

Sl. No.	SPECIES	RF	RD	RA	IVI
9	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	3.01	2.54	3.66	9.21
10	*Piper peepuloides* Wall.	3.01	2.54	3.66	9.21
11	*Setaria palmifolia* (J.Koenig) Stapf	3.01	2.54	3.66	9.21
12	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.41	2.22	4.00	8.63
13	*Diplazium esculentum* (Retz.) Sw.	3.01	1.90	2.74	7.66
14	*Mimosa pudica* L.	1.81	1.59	3.81	7.20
15	*Oxalis debilis* var. corymbosa (DC.) Lourteig.	0.60	0.63	4.57	5.81
16	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.20	0.95	3.43	5.58
17	*Elephantopus scaber* L.	1.20	0.95	3.43	5.58
18	*Synedrella nodiflora* (L.) Gaertn.	1.20	0.95	3.43	5.58
19	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.81	0.95	2.28	5.04
20	*Phyllanthus urinaria* L.	1.81	0.95	2.28	5.04
21	*Acmella calva* (DC.) R.K.Jansen	1.81	0.95	2.28	5.04
22	*Aristolochia tagala* Cham.	1.20	0.63	2.28	4.12
23	*Drymaria cordata* (L.) Willd. *ex* Schult.	1.20	0.63	2.28	4.12
24	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.20	0.63	2.28	4.12
25	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.20	0.63	2.28	4.12
26	*Merremia vitifolia* (Burm. f.) Hallier f.	1.20	0.63	2.28	4.12
27	*Naravelia zeylanica* (L.) DC.	1.20	0.63	2.28	4.12
28	*Dioscorea pubera* Blume	0.60	0.32	2.28	3.20
29	*Smilax zeylanica* L.	0.60	0.32	2.28	3.20

Table 24. Phytosociological data of Post-monsoon herb layer of Jarul beanteak plantation in NRVK site

Sl. No	SPECIES	RF	RD	RA	IVI
1	*Pupalia lappacea* (L.) Juss.	9.24	12.25	4.01	25.50
2	*Mikania micrantha* Kunth	11.34	10.47	2.79	24.61
3	*Ageratum houstonianum* Mill.	5.88	8.50	4.37	18.75
4	*Spermacoce alata* Aubl.	5.04	7.51	4.50	17.06
5	*Oplismenus compositus* (L.) P.Beauv.	5.88	6.32	3.25	15.46
6	*Persicaria chinensis* (L.) H. Gross	4.62	5.73	3.75	14.10
7	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	2.94	4.15	4.27	11.36
8	*Axonopus compressus* (Sw.) P.Beauv.	3.78	3.75	3.00	10.54
9	*Lygodium flexuosum* (L.) Sw.	3.36	3.75	3.38	10.49
10	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.10	3.36	4.84	10.30
11	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	2.52	3.36	4.03	9.91
12	*Oxalis corniculata* L.	4.62	3.16	2.07	9.85
13	*Imperata cylindrica* (L.) Raeusch.	3.78	3.36	2.69	9.83
14	*Setaria palmifolia* (J.Koenig) Stapf	1.26	2.17	5.21	8.65
15	*Diplazium esculentum* (Retz.) Sw.	2.94	2.17	2.23	7.35
16	*Piper peepuloides* Wall.	2.94	1.78	1.83	6.55
17	*Commelina diffusa* Burm.f.	2.10	1.78	2.56	6.44
18	*Setaria plicata* (Lam.) T.Cooke	2.52	1.78	2.13	6.43
19	*Synedrella nodiflora* (L.) Gaertn.	2.10	1.38	1.99	5.48
20	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	0.84	0.99	3.56	5.38
21	*Dioscorea pubera* Blume	0.42	0.59	4.27	5.28
22	*Desmodium oblongum* Benth.	1.68	1.19	2.13	5.00
23	*Mimosa pudica* L.	1.68	1.19	2.13	5.00
24	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.68	1.19	2.13	5.00
25	*Acmella calva* (DC.) R.K.Jansen	1.68	0.99	1.78	4.45
26	*Elephantopus scaber* L.	1.26	0.79	1.90	3.95
27	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.68	0.79	1.42	3.89
28	*Phyllanthus urinaria* L.	1.68	0.79	1.42	3.89
29	*Oxalis debilis* var. *corymbosa* (DC.) Lourteig.	0.42	0.40	2.84	3.66

Sl. No.	SPECIES	RF	RD	RA	IVI
30	*Drymaria cordata* (L.) Willd. *ex* Schult.	0.84	0.59	2.13	3.57
31	*Merremia vitifolia* (Burm. f.) Hallier f.	0.84	0.59	2.13	3.57
32	*Shorea robusta* Gaertn.	0.84	0.59	2.13	3.57
33	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.26	0.59	1.42	3.28
34	*Naravelia zeylanica* (L.) DC.	1.26	0.59	1.42	3.28
35	*Vernonia cinerea* (L.) Less.	1.26	0.59	1.42	3.28
36	*Aristolochia tagala* Cham.	0.84	0.40	1.42	2.66
37	*Smilax zeylanica* L.	0.84	0.40	1.42	2.66

Table 25. Phytosociological data of winter tree layer of mixed plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Neolamarckia cadamba* (Roxb.) Bosser	8.77	18.70	10.59	38.06
2	*Leeamacrophylla* Roxb. *ex* Hornem.	10.53	18.70	8.83	38.05
3	*Terminalia alata* Wall.	7.02	13.01	9.21	29.24
4	*Terminalia bellirica* (Gaertn.) Roxb.	5.26	8.13	7.67	21.07
5	*Bauhinia variegata* L.	3.51	5.69	8.06	17.26
6	*Casearia vareca* Roxb.	8.77	4.07	2.30	15.14
7	*Aphanamixis polystachya* (Wall.) R.Parker	5.26	4.07	3.84	13.17
8	*Crateva religiosa* G.Forst.	3.51	3.25	4.60	11.37
9	*Lagerstroemia speciosa* (L.) Pers.	3.51	3.25	4.60	11.37
10	*Antidesma bunius* (L.) Spreng.	5.26	2.44	2.30	10.00
11	*Oroxylum indicum* (L.) Kurz.	3.51	2.44	3.45	9.40
12	*Callicarpa arborea* Roxb.	3.51	1.63	2.30	7.44
13	*Tetrameles nudiflora* R.Br.	3.51	1.63	2.30	7.44
14	*Shorea robusta* Gaertn.	3.51	1.63	2.30	7.44
15	*Lagerstroemia parviflora* Roxb.	3.51	1.63	2.30	7.44
16	*Tectona grandis* L.f.	3.51	1.63	2.30	7.44
17	*Alangium alpinum* (C.B.Clarke) W.W.Sm. & Cave	1.75	0.81	2.30	4.87
18	*Elaeocarpus lanceifolius* Roxb.	1.75	0.81	2.30	4.87
19	*Garuga floribunda* Decne.	1.75	0.81	2.30	4.87
20	*Gmelina arborea* Roxb.	1.75	0.81	2.30	4.87
21	*Dipterocarpus turbinatus* C.F.Gaertn	1.75	0.81	2.30	4.87
22	*Dipterocarpus retusus* Blume	1.75	0.81	2.30	4.87
23	*Litsea monopetala* (Roxb.) Pers.	1.75	0.81	2.30	4.87
24	*Chisocheton cumingianus* subsp. *balansae* (C.DC.) Mabb.	1.75	0.81	2.30	4.87
25	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	1.75	0.81	2.30	4.87
26	*Toona ciliata* M.Roem.	1.75	0.81	2.30	4.87

Table 26. Phytosociological data of Post-monsoon tree layer of mixed plantation in Lataguri site

Sl .No	SPECIES	RF	RD	RA	IVI
1	*Neolamarckia cadamba* (Roxb.) Bosser	5.88	17.56	11.00	34.44
2	*Terminalia alata* Roth	5.88	12.21	7.65	25.75
3	*Terminalia bellirica* (Gaertn.) Roxb.	4.71	7.63	5.98	18.32
4	*Casearia vareca* Roxb.	8.24	6.87	3.07	18.18
5	*Crateva religiosa* G.Forst.	9.41	6.11	2.39	17.91
6	*Lagerstroemia speciosa* (L.) Pers.	5.88	5.34	3.35	14.57
7	*Bauhinia acuminata* L.	3.53	5.34	5.58	14.45
8	*Aphanamixis polystachya* (Wall.) R.Parker	4.71	4.58	3.59	12.87
9	*Antidesma bunius* (L.) Spreng.	3.53	2.29	2.39	8.21
10	*Litsea monopetala* (Roxb.) Pers.	3.53	2.29	2.39	8.21
11	*Streblus asper* Lour.	3.53	2.29	2.39	8.21
12	*Oroxylum indicum* (L.) Kurz	3.53	2.29	2.39	8.21
13	*Callicarpa arborea* Roxb.	3.53	2.29	2.39	8.21
14	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	3.53	2.29	2.39	8.21
15	*Gmelina arborea* Roxb.	1.18	1.53	4.78	7.49

Sl. No	SPECIES	RF	RD	RA	IVI
16	*Alangium alpinum* (C.B.Clarke) W.W.Sm. & Cave	2.35	1.53	2.39	6.27
17	*Magnolia pterocarpa* Roxb.	2.35	1.53	2.39	6.27
18	*Tetrameles nudiflora* R.Br.	2.35	1.53	2.39	6.27
19	*Shorea robusta* Gaertn.	2.35	1.53	2.39	6.27
20	*Lagerstroemia parviflora* Roxb.	2.35	1.53	2.39	6.27
21	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	2.35	1.53	2.39	6.27
22	*Tectona grandis* L.f.	2.35	1.53	2.39	6.27
23	*Toona ciliata* M.Roem.	2.35	1.53	2.39	6.27
24	*Cassia fistula* L.	2.35	1.53	2.39	6.27
25	*Elaeocarpus lanceifolius* Roxb.	1.18	0.76	2.39	4.33
26	*Dalbergia stipulacea* Roxb.	1.18	0.76	2.39	4.33
27	*Garuga floribunda* Decne.	1.18	0.76	2.39	4.33
28	*Dipterocarpus turbinatus* C.F.Gaertn	1.18	0.76	2.39	4.33
29	*Ailanthus integrifolia* Lam.	1.18	0.76	2.39	4.33
30	*Dipterocarpus retusus* Blume	1.18	0.76	2.39	4.33
31	*Chisocheton cumingianus* subsp. *balansae* (C.DC.) Mabb.	1.18	0.76	2.39	4.33

Table 27. Phytosociological data of winter shrub layer of mixed plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	12.86	63.48	43.48	119.82
2	*Clerodendrum infortunatum* L.	12.86	15.65	10.72	39.23
3	*Morinda angustifolia* Roxb.	8.57	3.83	3.93	16.33
4	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	7.14	3.13	3.86	14.13
5	*Maesa chisia* Buch.-Ham. *ex* D. Don	7.14	1.91	2.36	11.41
6	*Litsea glutinosa* (Lour.) C.B.Rob.	5.71	2.09	3.22	11.02
7	*Chromolaena odorata* (L.) R.M.King & H.Rob.	5.71	1.74	2.68	10.13
8	*Solanum aculeatissimum* Jacq.	1.43	1.04	6.43	8.90
9	*Litsea monopetala* (Roxb.) Pers.	4.29	1.39	2.86	8.54
10	*Actinodaphne obovata* (Nees) Blume	5.71	0.87	1.34	7.92
11	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	5.71	0.70	1.07	7.48
12	*Litsea glutinosa* (Lour.) C.B.Rob.	1.43	0.70	4.29	6.41
13	*Albizia lucidior* (Steud.) I.C.Nielsen	4.29	0.70	1.43	6.41
14	*Clausena excavata* Burm.f.	2.86	0.70	2.14	5.70
15	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	2.86	0.52	1.61	4.99
16	*Leea aequata* L.	2.86	0.35	1.07	4.28
17	*Toona ciliata* M.Roem.	1.43	0.35	2.14	3.92
18	*Caesalpinia cucullata* Roxb.	1.43	0.17	1.07	2.67
19	*Casearia vareca* Roxb.	1.43	0.17	1.07	2.67
20	*Croton caudatus* Geiseler	1.43	0.17	1.07	2.67
21	*Oroxylum indicum* (L.) Kurz	1.43	0.17	1.07	2.67
22	*Streblus asper* Lour.	1.43	0.17	1.07	2.67

Table 28. Phytosociological data of Pre-monsoon shrub layer of mixed plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	9.01	57.79	40.85	107.64
2	*Clerodendrum infortunatum* L.	6.31	16.04	16.20	38.55
3	*Morinda angustifolia* Roxb.	7.21	4.05	3.58	14.84
4	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	6.31	3.27	3.30	12.88
5	*Litsea glutinosa* (Lour.) C.B.Rob.	6.31	2.49	2.52	11.31
6	*Chromolaena odorata* (L.) R.M.King & H.Rob.	5.41	2.65	3.12	11.17
7	*Maesa chisia* Buch.-Ham. *ex* D. Don	6.31	1.87	1.89	10.06
8	*Litsea monopetala* (Roxb.) Pers.	5.41	1.25	1.47	8.12

Sl. No.	SPECIES	RF	RD	RA	IVI
9	*Mikania micrantha* Kunth	4.50	1.09	1.54	7.14
10	*Actinodaphne obovata* (Nees) Blume	4.50	0.93	1.32	6.76
11	*Solanum aculeatissimum* Jacq.	2.70	1.09	2.57	6.36
12	*Clausena excavata* Burm.f.	3.60	0.93	1.65	6.19
13	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	3.60	0.62	1.10	5.33
14	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	3.60	0.62	1.10	5.33
15	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	2.70	0.62	1.47	4.79
16	*Albizia lucidior* (Steud.) I.C.Nielsen	2.70	0.62	1.47	4.79
17	*Croton caudatus* Geiseler	2.70	0.47	1.10	4.27
18	*Toona ciliata* M.Roem.	2.70	0.47	1.10	4.27
19	*Ardisia solanacea* (Poir.) Roxb.	1.80	0.47	1.65	3.92
20	*Casearia vareca* Roxb.	1.80	0.47	1.65	3.92
21	*Streblus asper* Lour.	1.80	0.47	1.65	3.92
22	*Oroxylum indicum* (L.) Kurz	0.90	0.31	2.20	3.41
23	*Pueraria sikkimensis* Prain	1.80	0.31	1.10	3.21
24	*Caesalpinia cucullata* Roxb.	1.80	0.31	1.10	3.21
25	*Leea aequata* L.	1.80	0.31	1.10	3.21
26	*Mussaenda roxburghii* Hook. f.	1.80	0.31	1.10	3.21
27	*Cassia fistula* L.	0.90	0.16	1.10	2.16

Table 29. Phytosociological data of Post-monsoon shrub layer of mixed plantation in Lataguri site

Sl No	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	7.58	55.29	36.11	98.97
2	*Clerodendrum infortunatum* L.	5.30	15.35	14.32	34.97
3	*Morinda angustifolia* Roxb.	6.06	3.87	3.16	13.10
4	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult	5.30	3.13	2.92	11.35
5	*Litsea glutinosa* (Lour.) C.B.Rob.	5.30	2.38	2.22	9.91
6	*Chromolaena odorata* (L.) R.M.King & H.Rob.	4.55	2.53	2.76	9.84
7	*Maesa chisia* Buch.-Ham. *ex* D. Don	5.30	1.79	1.67	8.76
8	*Litsea monopetala* (Roxb.) Pers.	4.55	1.19	1.30	7.04
9	*Mikania micrantha* Kunth	3.79	1.04	1.36	6.19
10	*Actinodaphne obovata* (Nees) Blume	3.79	0.89	1.17	5.85
11	*Sida acuta* Burm.f.	3.03	1.04	1.70	5.78
12	*Solanum aculeatissimum* Jacq.	2.27	1.04	2.27	5.59
13	*Clausena excavata* Burm.f.	3.03	0.89	1.46	5.38
14	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.27	0.75	1.62	4.64
15	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	3.03	0.60	0.97	4.60
16	*Natsiatum herpeticum* Buch.-Ham. ex Arn.	3.03	0.60	0.97	4.60
17	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	2.27	0.60	1.30	4.17
18	*Albizia lucidior* (Steud.) I.C.Nielsen	2.27	0.60	1.30	4.17
19	*Croton caudatus* Geiseler	2.27	0.45	0.97	3.69
20	*Toona ciliata* M.Roem.	2.27	0.45	0.97	3.69
21	*Smilax zeylanica* L.	2.27	0.45	0.97	3.69
22	*Cryptolepis sinensis* (Lour.) Merr.	1.52	0.45	1.46	3.42
23	*Acacia pennata* (L.) Willd.	1.52	0.45	1.46	3.42
24	*Ardisia solanacea* (Poir.) Roxb.	1.52	0.45	1.46	3.42
25	*Casearia vareca* Roxb.	1.52	0.45	1.46	3.42
26	*Streblus asper* Lour.	1.52	0.45	1.46	3.42
27	*Sauropus compressus* Müll.Arg.	1.52	0.45	1.46	3.42
28	*Oroxylum indicum* (L.) Kurz	0.76	0.30	1.95	3.00
29	*Grewia eriocarpa* Juss.	1.52	0.30	0.97	2.79
30	*Pueraria sikkimensis* Prain	1.52	0.30	0.97	2.79
31	*Caesalpinia cucullata* Roxb.	1.52	0.30	0.97	2.79
32	*Leea guineensis* G. Don	1.52	0.30	0.97	2.79

Sl. No.	SPECIES	RF	RD	RA	IVI
33	*Mussaenda roxburghii* Hook.f.	1.52	0.30	0.97	2.79
34	*Vallaris solanacea* (Roth) Kuntze	1.52	0.30	0.97	2.79
35	*Aristolochia tagala* Cham.	0.76	0.15	0.97	1.88
36	*Cassia fistula* L.	0.76	0.15	0.97	1.88

Table 30. Phytosociological data of winter herb layer of mixed plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Dryopteris sikkimensis* (Bedd.) Kuntze	10.57	17.68	3.99	32.24
2	*Pupalia atropurpurea* (Lam.) Moq.	7.32	10.10	3.29	20.71
3	*Mikania micrantha* Kunth	9.76	8.59	2.10	20.44
4	*Diplazium esculentum* (Retz.) Sw.	6.50	7.07	2.59	16.17
5	*Piper chuvya* Miq.	4.88	7.58	3.71	16.16
6	*Coffea benghalensis* B.Heyne *ex* Schult.	2.44	4.04	3.95	10.43
7	*Oplismenus burmanni* (Retz.) P.Beauv.	3.25	3.54	2.59	9.38
8	*Gouania leptostachya* DC.	6.50	2.02	0.74	9.27
9	*Oxalis corniculata* L.	4.07	3.03	1.78	8.87
10	*Persicaria chinensis* (L.) H. Gross	3.25	2.53	1.85	7.63
11	*Ichnocarpus frutescens* (L.)W.T. Aiton	2.44	2.53	2.47	7.44
12	*Borreria alata* (Aubl.) DC.	0.81	1.52	4.45	6.78
13	*Lepidagathis incurva* Buch-Ham *ex* D. Don	0.81	1.52	4.45	6.78
14	*Imperata cylindrica* (L.) Raeusch.	1.63	2.02	2.97	6.61
15	*Piper peepuloides* Roxb.	2.44	2.02	1.98	6.44
16	*Vallaris solanacea* (Roth) Kuntze	2.44	1.52	1.48	5.44
17	*Kyllinga nemoralis* (J.R. & G Forster) Dandy *ex* Hutchinson & Dalziel	1.63	1.52	2.22	5.37
18	*Maesa chisia* Buch.-Ham. *ex* D. Don	1.63	1.52	2.22	5.37
19	*Synedrella nodiflora* (L.) Gaertn.	1.63	1.52	2.22	5.37
20	*Impatiens trilobata* Colebr.	0.81	1.01	2.97	4.79
21	*Oxalis corymbosa* DC.	0.81	1.01	2.97	4.79
22	*Pronephrium nudatum* (Roxb.) Holttum	0.81	1.01	2.97	4.79
23	*Rungia himalayensis* C.B.Clarke	0.81	1.01	2.97	4.79
24	*Ageratum houstonianum* Mill.	1.63	1.01	1.48	4.12
25	*Desmodium oblongum* Benth.	1.63	1.01	1.48	4.12
26	*Pteris biaurita* L.	1.63	1.01	1.48	4.12
27	*Acacia pennata* (L.) Willd.	0.81	0.51	1.48	2.80
28	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	0.81	0.51	1.48	2.80
29	*Aristolochia tagala* Cham.	0.81	0.51	1.48	2.80
30	*Athyrium sp*	0.81	0.51	1.48	2.80
31	*Piper betleoides* C. DC.	0.81	0.51	1.48	2.80
32	*Clausena excavata* Burm.f.	0.81	0.51	1.48	2.80
33	*Chlorophytum arundinaceum* Baker	0.81	0.51	1.48	2.80
34	*Cryptolepis dubia* (Burm.f.) M.R.Almeida	0.81	0.51	1.48	2.80
35	*Grewia asiatica* L.	0.81	0.51	1.48	2.80
36	*Merremia hirta* (L.) Merr.	0.81	0.51	1.48	2.80
37	*Lindenbergia titensis* Sikdar & Maiti	0.81	0.51	1.48	2.80
38	*Morinda angustifolia* Roxb.	0.81	0.51	1.48	2.80
39	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	0.81	0.51	1.48	2.80
40	*Pericampylus glaucus* (Lam.) Merr.	0.81	0.51	1.48	2.80
41	*Peristrophe bicalyculata* (Retz.) Nees	0.81	0.51	1.48	2.80
42	*Sauropus compressus* Mull.Arg.	0.81	0.51	1.48	2.80
43	*Setaria palmifolia* (J.Koenig) Stapf	0.81	0.51	1.48	2.80
44	*Sida acuta* Burm.f.	0.81	0.51	1.48	2.80
45	*Smilax zeylanica* L.	0.81	0.51	1.48	2.80
46	*Tetrastigma serrulatum* (Roxb.) Planch	0.81	0.51	1.48	2.80
47	*Tectaria gemmifera* (Fée) Alston	0.81	0.51	1.48	2.80
48	*Tetrastigma dubium* (Lawson) Planch.	0.81	0.51	1.48	2.80

Table 31. Phytosociological data of Pre-monsoon herb layer of mixed plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Dryopteris sikkimensis* (Bedd.) Kuntze	9.87	13.77	2.78	26.42
2	*Mikania micrantha* Kunth	7.24	6.88	1.90	16.02
3	*Pupalia atropurpurea* (Lam.) Moq.	5.26	7.61	2.88	15.75
4	*Diplazium esculentum* (Retz.) Sw.	5.92	6.16	2.07	14.15
5	*Piper chuvya* Miq.	4.61	5.80	2.51	12.91
6	*Oplismenus burmanni* (Retz.) P.Beauv.	3.29	3.99	2.42	9.69
7	*Coffea benghalensis* B.Heyne *ex* Schult.	2.63	3.26	2.47	8.36
8	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.97	2.54	2.56	7.07
9	*Oxalis corniculata* L.	2.63	2.17	1.65	6.45
10	*Piper peepuloides* Wall.	2.63	2.17	1.65	6.45
11	*Borreria alata* Aubl.	1.97	2.17	2.20	6.34
12	*Kyllinga nemoralis* (J.R. & G Forster) Dandy *ex* Hutch. & Dalziel	1.32	1.81	2.74	5.87
13	*Persicaria chinensis* (L.) H. Gross	2.63	1.81	1.37	5.82
14	*Ageratum conyzoides* (L.) L.	1.97	1.81	1.83	5.61
15	*Gouania leptostachya* DC.	1.97	1.81	1.83	5.61
16	*Setaria palmifolia* (J. Konig) Stapf	1.97	1.81	1.83	5.61
17	*Rungia himalayensis* C.B.Clarke	0.66	1.09	3.29	5.04
18	*Athyrium sp*	1.32	1.45	2.20	4.96
19	*Cyperus compressus* L.	1.32	1.45	2.20	4.96
20	*Imperata cylindrica* (L.) Raeusch.	1.32	1.45	2.20	4.96
21	*Synedrella nodiflora* (L.) Gaertn.	1.32	1.45	2.20	4.96
22	*Vallaris solanacea* (Roth) Kuntze	1.97	1.09	1.10	4.16
23	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	1.32	1.09	1.65	4.05
24	*Piper betleoides* C. DC.	1.32	1.09	1.65	4.05
25	*Clausena excavata* Burm.f.	1.32	1.09	1.65	4.05
26	*Chlorophytum arundinaceum* Baker	1.32	1.09	1.65	4.05
27	*Hydrocotyle sibthorpioides* Lam.	1.32	1.09	1.65	4.05
28	*Impatiens trilobata* Colebr.	1.32	1.09	1.65	4.05
29	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.32	1.09	1.65	4.05
30	*Maesa chisia* Buch.-Ham. *ex* D. Don	1.32	1.09	1.65	4.05
31	*Morinda angustifolia* Roxb.	1.32	1.09	1.65	4.05
32	*Polycarpon prostratum* (Forssk.) Asch. & Schweinf.	1.32	1.09	1.65	4.05
33	*Thelypteris nudata* (Roxb.) C.V. Morton	1.32	1.09	1.65	4.05
34	*Smilax zeylanica* L.	1.32	1.09	1.65	4.05
35	*Tectaria gemmifera* (Fée) Alston	1.32	1.09	1.65	4.05
36	*Acacia pennata* (L.) Willd.	0.66	0.72	2.20	3.58
37	*Cryptolepis dubia* (Burm.f.)M.R. Almeida	0.66	0.72	2.20	3.58
38	*Curcuma aromatica* Salisb.	0.66	0.72	2.20	3.58
39	*Globba andersonii* C.B.Clarke *ex* Baker	0.66	0.72	2.20	3.58
40	*Merremia hirta* (L.) Merr.	0.66	0.72	2.20	3.58
41	*Ophioglossum lanceolatum* (Luerss.) Prantl	0.66	0.72	2.20	3.58
42	*Pericampylus glaucus* (Lam.) Merr.	0.66	0.72	2.20	3.58
43	*Setaria plicata* (Lam.) T.Cooke	0.66	0.72	2.20	3.58
44	*Hylodesmum laxum* (DC.) H.Ohashi & R.R.Mill	1.32	0.72	1.10	3.14
45	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.32	0.72	1.10	3.14
46	*Pteris biaurita* L.	1.32	0.72	1.10	3.14
47	*Sauropus compressus* Müll.Arg.	1.32	0.72	1.10	3.14
48	*Sida acuta* Burm.f.	1.32	0.72	1.10	3.14
49	*Torenia diffusa* Roxb.	1.32	0.72	1.10	3.14
50	*Aristolochia tagala* Cham	0.66	0.36	1.10	2.12
51	*Grewia asiatica* L.	0.66	0.36	1.10	2.12
52	*Lindenbergia titensis* Sikdar & Maiti	0.66	0.36	1.10	2.12
53	*Peristrophe bicalyculata* (Retz.) Nees	0.66	0.36	1.10	2.12
54	*Tetrastigma serrulatum* (Roxb.) Planch.	0.66	0.36	1.10	2.12
55	*Tetrastigma dubium* (Lawson) Planch.	0.66	0.36	1.10	2.12

Table 32. Phytosociological data of Post-monsoon herb layer of mixed plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Dryopteris sikkimensis* (Bedd.) Kuntze	7.41	9.15	2.20	18.77
2	*Pupalia lappacea* (L.) Juss.	4.17	7.75	3.31	15.23
3	*Diplazium esculentum* (Retz.) Sw.	5.56	5.63	1.81	13.00
4	*Coffea benghalensis* B.Heyne *ex* Schult.	5.09	5.40	1.89	12.38
5	*Mikania micrantha* Kunth	4.17	4.93	2.11	11.21
6	*Piper chuvya* Miq.	2.31	4.46	3.44	10.21
7	*Oplismenus burmanni* (Retz.) P.Beauv.	1.85	3.05	2.94	7.84
8	*Borreria alata* Aubl.	1.85	2.58	2.49	6.92
9	*Synedrella nodiflora* (L.) Gaertn.	2.31	2.11	1.63	6.05
10	*Ageratum conyzoides* (L.) L.	1.85	2.11	2.03	6.00
11	*Setaria palmifolia* (J. Koenig) Stapf.	1.85	2.11	2.03	6.00
12	*Persicaria chinensis* (L.) H. Gross	1.39	1.88	2.41	5.68
13	*Tectaria gemmifera* (Fée) Alston	1.39	1.88	2.41	5.68
14	*Piper peepuloides* Wall.	2.31	1.88	1.45	5.64
15	*Ichnocarpus frutescens* (L.) W.T. Aiton	1.85	1.88	1.81	5.54
16	*Chlorophytum arundinaceum* Baker	2.31	1.64	1.27	5.22
17	*Oxalis corniculata* L.	2.31	1.64	1.27	5.22
18	*Athyrium sp*	1.39	1.64	2.11	5.14
19	*Cyperus pangorei* Rottb.	1.85	1.64	1.58	5.08
20	*Axonopus compressus* (Sw.) P.Beauv.	0.93	1.41	2.71	5.05
21	*Imperata cylindrica* (L.) Raeusch.	0.93	1.41	2.71	5.05
22	*Kyllinga nemoralis* (J.R. & G Forster) Dandy *ex* Hutch. & Dalziel	0.93	1.41	2.71	5.05
23	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f	1.39	1.41	1.81	4.61
24	*Globba andersonii* C.B.Clarke *ex* Baker	1.39	1.41	1.81	4.61
25	*Clausena excavata* Burm.f.	1.85	1.17	1.13	4.16
26	*Sida acuta* Burm.f.	1.85	1.17	1.13	4.16
27	*Piper betleoides* C.DC.	1.39	1.17	1.51	4.07
28	*Gouania leptostachya* DC.	1.39	1.17	1.51	4.07
29	*Impatiens trilobata* Colebr.	1.39	1.17	1.51	4.07
30	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.39	1.17	1.51	4.07
31	*Tetrastigma serrulatum* (Roxb.) Planch.	1.39	1.17	1.51	4.07
32	*Torenia diffusa* Roxb.	1.39	1.17	1.51	4.07
33	*Vallaris solanacea* (Roth) Kuntze	1.85	0.94	0.90	3.69
34	*Hydrocotyle sibthorpioides* Lam.	0.93	0.94	1.81	3.67
35	*Maesa chisia* Buch.-Ham. *ex* D. Don	0.93	0.94	1.81	3.67
36	*Acacia pinnata* Link	0.93	0.94	1.81	3.67
37	*Rungia adnata* (J.B.Imlay) B.Hansen	0.93	0.94	1.81	3.67
38	*Lindernia crustacea* (L.) F.Muell.	0.93	0.94	1.81	3.67
39	*Morinda angustifolia* Roxb.	1.39	0.94	1.21	3.53
40	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.39	0.94	1.21	3.53
41	*Polycarpon prostratum* (Forssk.) Asch. & Schweinf.	1.39	0.94	1.21	3.53
42	*Thelypteris nudata* (Roxb.) C.V. Morton	1.39	0.94	1.21	3.53
43	*Youngia japonica* (L.) DC.	1.39	0.94	1.21	3.53
44	*Desmodium oblongum* Benth.	1.39	0.70	0.90	3.00
45	*Pericampylus glaucus* (Lam.) Merr.	1.39	0.70	0.90	3.00
46	*Sauropus compressus* Mull.Arg.	1.39	0.70	0.90	3.00
47	*Acacia pennata* (L.) Willd	0.93	0.70	1.36	2.99
48	*Cryptolepis sinensis* (Lour.) Merr.	0.93	0.70	1.36	2.99
49	*Curcuma aromatica* Salisb.	0.93	0.70	1.36	2.99
50	*Smilax zeylanica* L.	0.93	0.70	1.36	2.99
51	*Tetrastigma dubium* (Lawson) Planch.	0.93	0.70	1.36	2.99
52	*Typhonium trilobatum* (L.) Schott.	0.93	0.70	1.36	2.99
53	*Merremia hirta* (L.) Merr.	0.46	0.47	1.81	2.74
54	*Pteris biaurita* L.	0.46	0.47	1.81	2.74

Sl. No.	SPECIES	RF	RD	RA	IVI
55	*Amorphophallus bulbifer* (Roxb.) Blume	0.93	0.47	0.90	2.30
56	*Drymaria cordata* subsp. *diandra* (Blume) J.A.Duke.	0.93	0.47	0.90	2.30
57	*Grewia eriocarpa* Juss.	0.93	0.47	0.90	2.30
58	*Peristrophe bicalyculata* (Retz.) Nees	0.93	0.47	0.90	2.30
59	*Aristolochia tagala* Cham.	0.46	0.23	0.90	1.60
60	*Lindenbergia titensis* Sikdar & Maiti	0.46	0.23	0.90	1.60
61	*Mussaenda roxburghii* Hook. f.	0.46	0.23	0.90	1.60

Table 33. Phytosociological data of winter tree layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Schima wallichii* Choisy	20.41	48.97	27.88	97.25
2	*Shorea robusta* Gaertn.	20.41	28.97	16.49	65.87
3	*Syzygium cumini* (L.) Skeels	12.24	4.83	4.58	21.65
4	*Lagerstroemia parviflora* Roxb.	8.16	2.76	3.93	14.85
5	*Terminalia alata* Roth	6.12	2.07	3.93	12.12
6	*Wrightia arborea* (Dennst.) Mabb.	4.08	2.07	5.89	12.04
7	*Tectona grandis* L.f.	4.08	2.07	5.89	12.04
8	*Premna barbata* Wall. *ex* Schauer	4.08	1.38	3.93	9.39
9	*Lagerstroemia reginae* Roxb.	4.08	1.38	3.93	9.39
10	*Leea macrophylla* Roxb. *ex* Hornem.	4.08	1.38	3.93	9.39
11	*Turpinia affinis* Merr. & L.M. Perry	4.08	1.38	3.93	9.39
12	*Sterculia villosa* Roxb.	2.04	0.69	3.93	6.66
13	*Alangium alpinum* (C.B.Clarke) W.W.Sm. & Cave	2.04	0.69	3.93	6.66
14	*Antidesma montanum* Blume	2.04	0.69	3.93	6.66
15	*Terminalia bellirica* (Gaertn.) Roxb.	2.04	0.69	3.93	6.66

Table 34. Phytosociological data of Post-monsoon tree layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Schima wallichii* Choisy	16.67	41.52	21.93	80.12
2	*Shorea robusta* Gaertn.	16.67	27.49	14.52	58.67
3	*Syzygium cumini* (L.) Skeels	11.67	6.43	4.85	22.95
4	*Leea macrophylla* Roxb. *ex* Hornem.	6.67	3.51	4.63	14.81
5	*Tectona grandis* L.f.	5.00	3.51	6.18	14.69
6	*Lagerstroemia parviflora* Roxb.	6.67	2.34	3.09	12.09
7	*Terminalia alata* Roth	5.00	1.75	3.09	9.84
8	*Alangium chinense* (Lour.) Harms	3.33	1.75	4.63	9.72
9	*Sterculia villosa* Roxb.	3.33	1.75	4.63	9.72
10	*Wrightia arborea* (Dennst.) Mabb.	3.33	1.75	4.63	9.72
11	*Antidesma montanum* Blume	1.67	1.17	6.18	9.01
12	*Magnolia pterocarpa* Roxb.	3.33	1.17	3.09	7.59
13	*Lagerstroemia speciosa* (L.) Pers.	3.33	1.17	3.09	7.59
14	*Premna barbata* Wall. *ex* Schauer	3.33	1.17	3.09	7.59
15	*Streblus asper* Lour.	3.33	1.17	3.09	7.59
16	*Turpinia pomifera* (Roxb.) DC.	3.33	1.17	3.09	7.59
17	*Terminalia bellirica* (Gaertn.) Roxb.	1.67	0.58	3.09	5.34
18	*Callicarpa arborea* Roxb.	1.67	0.58	3.09	5.34

Table 35. Phytosociological data of winter shrub layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne ex Schult.	7.37	23.35	12.12	42.84
2	*Clerodendrum infortunatum* L.	12.63	18.27	5.53	36.44
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	8.42	9.64	4.38	22.45
4	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult	9.47	7.11	2.87	19.45

Sl. No.	SPECIES	RF	RD	RA	IVI
5	*Maesa chisia* Buch.-Ham. *ex* D. Don	4.21	4.57	4.15	12.93
6	*Melastoma malabathricum* L.	4.21	3.55	3.23	10.99
7	*Syzygium cumini* (L.) Skeels	5.26	3.05	2.21	10.52
8	*Ardisia solanacea* (Poir.) Roxb.	3.16	3.05	3.69	9.89
9	*Antidesma montanum* Blume	2.11	2.54	4.61	9.26
10	*Sauropus compressus* Müll.Arg.	1.05	1.52	5.53	8.11
11	*Leea guineensis* G. Don	3.16	1.52	1.84	6.53
12	*Litsea glutinosa* (Lour.) C.B.Rob.	3.16	1.52	1.84	6.53
13	*Schima wallichii* Choisy	2.11	1.52	2.77	6.40
14	*Glycosmis pentaphylla* (Retz.) DC.	2.11	1.52	2.77	6.40
15	*Pueraria sikkimensis* Prain	2.11	1.52	2.77	6.40
16	*Smilax zeylanica* L.	2.11	1.52	2.77	6.40
17	*Acalypha spiciflora* Burm.f.	1.05	1.02	3.69	5.76
18	*Mikania micrantha* Kunth	1.05	1.02	3.69	5.76
19	*Caesalpinia cucullata* Roxb.	2.11	1.02	1.84	4.97
20	*Baliospermum solanifolium* (Burm.) Suresh	2.11	1.02	1.84	4.97
21	*Casearia vareca* Roxb.	2.11	1.02	1.84	4.97
22	*Lagerstroemia reginae* Roxb.	2.11	1.02	1.84	4.97
23	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook.f. & Thomson	2.11	1.02	1.84	4.97
24	*Shorea robusta* Gaertn.	2.11	1.02	1.84	4.97
25	*Lagerstroemia parviflora* Roxb.	2.11	1.02	1.84	4.97
26	*Mallotus philippensis* (Lam.) Müll.Arg.	2.11	1.02	1.84	4.97
27	*Casearia glomerata* Roxb.	1.05	0.51	1.84	3.41
28	*Sorindeia madagascariensis* Thouars *ex* DC.	1.05	0.51	1.84	3.41
29	*Urena lobata* L.	1.05	0.51	1.84	3.41
30	*Holarrhena pubescens* Wall. *ex* G.Don	1.05	0.51	1.84	3.41
31	*Stereospermum tetragonum* DC.	1.05	0.51	1.84	3.41
32	*Turpinia pomifera* (Roxb.) DC.	1.05	0.51	1.84	3.41
33	*Triumfetta rhomboidea* Jacq.	1.05	0.51	1.84	3.41
34	*Ziziphus jujuba* Mill.	1.05	0.51	1.84	3.41

Table 36. Phytosociological data of Pre-monsoon shrub layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L.	8.48	20.00	6.46	34.94
2	*Coffea benghalensis* B.Heyne *ex* Schult.	6.67	14.32	5.88	26.87
3	*Mikania micrantha* Kunth	3.03	8.18	7.40	18.61
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	5.45	5.91	2.97	14.33
5	*Shorea robusta* Gaertn.	6.67	4.32	1.77	12.76
6	*Melastoma malabathricum* L.	4.85	4.32	2.44	11.61
7	*Croton caudatus* Geiseler	1.21	2.95	6.68	10.84
8	*Lagerstroemia parviflora* Roxb.	4.24	2.95	1.91	9.10
9	*Maesa chisia* Buch.-Ham. *ex* D. Don	3.03	2.50	2.26	7.79
10	*Ardisia solanacea* (Poir.) Roxb.	2.42	2.05	2.31	6.78
11	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	2.42	1.82	2.05	6.30
12	*Syzygium cumini* (L.) Skeels	2.42	1.59	1.80	5.81
13	*Antidesma montanum* Blume	1.82	1.59	2.40	5.81
14	*Urena lobata* L.	1.82	1.59	2.40	5.81
15	*Paederia foetida* L.	1.82	1.59	2.40	5.81
16	*Dalbergia pinnata* (Lour.) Prain	1.21	1.36	3.08	5.66
17	*Dendrocnide sinuata* (Blume) Chew	3.03	1.36	1.23	5.63
18	*Lagerstroemia speciosa* (L.) Pers.	3.03	1.36	1.23	5.63
19	*Leea guineensis* G. Don	3.03	1.36	1.23	5.63
20	*Tetrastigma serrulatum* (Roxb.) Planch.	1.82	1.36	2.05	5.24

Sl. No.	SPECIES	RF	RD	RA	IVI
21	*Casearia glomerata* Roxb.	1.21	1.14	2.57	4.92
22	*Dioscorea pentaphylla* L.	1.21	1.14	2.57	4.92
23	*Baliospermum solanifolium* (Burm.) Suresh	2.42	1.14	1.28	4.84
24	*Litsea glutinosa* (Lour.) C.B.Rob.	2.42	1.14	1.28	4.84
25	*Glycosmis pentaphylla* (Retz.) DC.	1.82	1.14	1.71	4.67
26	*Sauropus compressus* Müll.Arg.	1.21	0.91	2.05	4.18
27	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	1.21	0.91	2.05	4.18
28	*Caesalpinia cucullata* Roxb.	1.82	0.91	1.37	4.10
29	*Casearia vareca* Roxb.	1.82	0.68	1.03	3.53
30	*Schima wallichii* Choisy	1.82	0.68	1.03	3.53
31	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.21	0.68	1.54	3.43
32	*Sorindeia madagascariensis* Thouars *ex* DC.	1.21	0.68	1.54	3.43
33	*Gouania leptostachya* DC.	1.21	0.68	1.54	3.43
34	*Holarrhena pubescens* Wall. *ex* G.Don	1.21	0.68	1.54	3.43
35	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	1.21	0.68	1.54	3.43
36	*Morinda angustifolia* Roxb.	1.21	0.68	1.54	3.43
37	*Smilax zeylanica* L.	1.21	0.68	1.54	3.43
38	*Piper betleoides* C.DC.	0.61	0.45	2.05	3.11
39	*Triumfetta rhomboidea* Jacq.	0.61	0.45	2.05	3.11
40	*Ziziphus jujuba* Mill.	0.61	0.45	2.05	3.11
41	*Mallotus philippensis* (Lam.) Müll.Arg.	1.21	0.45	1.03	2.69
42	*Callicarpa arborea* Roxb.	0.61	0.23	1.03	1.86
43	*Mussaenda roxburghii* Hook.f.	0.61	0.23	1.03	1.86
44	*Pueraria sikkimensis* Prain	0.61	0.23	1.03	1.86
45	*Streblus asper* Lour.	0.61	0.23	1.03	1.86
46	*Turpinia pomifera* (Roxb.) DC.	0.61	0.23	1.03	1.86

Table 37. Phytosociological data of Post-monsoon shrub layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L.	7.69	25.54	8.25	41.48
2	*Coffea benghalensis* B.Heyne *ex* Schult.	4.98	12.23	6.11	23.32
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	6.33	5.58	2.19	14.10
4	*Mikania micrantha* Kunth	5.88	4.72	1.99	12.60
5	*Melastoma malabathricum* L.	4.52	4.08	2.24	10.84
6	*Croton caudatus* Geiselar	3.62	3.65	2.50	9.77
7	*Dendrocnide sinuata* (Blume) Chew	3.17	3.00	2.36	8.53
8	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	3.62	2.58	1.77	7.96
9	*Maesa chisia* Buch.-Ham. *ex* D. Don	4.07	2.36	1.44	7.87
10	*Shorea robusta* Gaertn.	3.17	1.93	1.52	6.61
11	*Dioscorea bulbifera* L.	2.71	1.93	1.77	6.41
12	*Syzygium cumini* (L.) Skeels	2.26	1.72	1.89	5.86
13	*Ardisia solanacea* (Poir.) Roxb.	1.36	1.50	2.75	5.61
14	*Morinda angustifolia* Roxb.	2.26	1.50	1.65	5.41
15	*Smilax zeylanica* L.	2.26	1.50	1.65	5.41
16	*Tetrastigma serrulatum* (Roxb.) Planch.	1.81	1.50	2.06	5.37
17	*Glycosmis pentaphylla* (Retz.) DC.	2.26	1.29	1.41	4.96
18	*Antidesma montanum* Blume	0.90	1.07	2.95	4.92
19	*Acalypha spiciflora* Burm.f.	0.45	0.64	3.54	4.63
20	*Sauropus compressus* Müll.Arg.	0.45	0.64	3.54	4.63
21	*Leea guineensis* G. Don	2.26	1.07	1.18	4.51
22	*Paederia foetida* L.	1.36	1.07	1.96	4.39
23	*Lagerstroemia parviflora* Roxb.	1.36	1.07	1.96	4.39

Sl. No.	SPECIES	RF	RD	RA	IVI
24	*Triumfetta rhomboidea* Jacq.	1.36	1.07	1.96	4.39
25	*Casearia vareca* Roxb.	1.81	1.07	1.47	4.36
26	*Schima wallichii* Choisy	1.81	1.07	1.47	4.36
27	*Piper betleoides* C.DC.	1.81	1.07	1.47	4.36
28	*Pueraria sikkimensis* Prain	0.90	0.86	2.36	4.12
29	*Mussaenda roxburghii* Hook.f.	1.81	0.86	1.18	3.85
30	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.36	0.86	1.57	3.79
31	*Litsea glutinosa* (Lour.) C.B.Rob.	1.36	0.86	1.57	3.79
32	*Sorindeia madagascariensis* Thouars *ex* DC.	0.90	0.64	1.77	3.32
33	*Dalbergia pinnata* (Lour.) Prain	0.90	0.64	1.77	3.32
34	*Lagerstroemia speciosa* (L.) Pers.	0.90	0.64	1.77	3.32
35	*Holarrhena pubescens* Wall. *ex* G.Don	0.90	0.64	1.77	3.32
36	*Sabia paniculata* Edgew. *ex* Hook.f. & Thomson	0.45	0.43	2.36	3.24
37	*Dioscorea pentaphylla* L.	1.36	0.64	1.18	3.18
38	*Urena lobata* L.	1.36	0.64	1.18	3.18
39	*Gouania leptostachya* DC.	1.36	0.64	1.18	3.18
40	*Urtica dioica* L.	1.36	0.64	1.18	3.18
41	*Abrus pulchellus* Thwaites	0.90	0.43	1.18	2.51
42	*Caesalpinia cucullata* Roxb.	0.90	0.43	1.18	2.51
43	*Baliospermum solanifolium* (Burm.) Suresh	0.90	0.43	1.18	2.51
44	*Polyalthia simiarum* (Hook.f. & Thomson) Hook f. & Thomson	0.90	0.43	1.18	2.51
45	*Stereospermum tetragonum* DC.	0.90	0.43	1.18	2.51
46	*Mallotus philippensis* (Lam.) Müll.Arg.	0.90	0.43	1.18	2.51
47	*Streblus asper* Lour.	0.90	0.43	1.18	2.51
48	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.90	0.43	1.18	2.51
49	*Ziziphus jujuba* Mill.	0.90	0.43	1.18	2.51
50	*Casearia glomerata* Roxb.	0.45	0.21	1.18	1.85
51	*Callicarpa arborea* Roxb.	0.45	0.21	1.18	1.85
52	*Turpinia pomifera* (Roxb.) DC.	0.45	0.21	1.18	1.85

Table 38. Phytosociological data of winter herb layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Mikania micrantha* Kunth	7.69	8.15	2.63	18.48
2	*Coffea benghalensis* B.Heyne *ex* Schult.	5.98	8.70	3.61	18.29
3	*Chloranthus elatior* Link	2.56	7.07	6.85	16.48
4	*Ichnocarpus frutescens* (L.) W.T.Aiton	7.69	5.98	1.93	15.60
5	*Lygodium flexuosum* (L.) Sw.	7.69	5.98	1.93	15.60
6	*Kyllinga nemoralis* (J.R. & G Forster) Dandy *ex* Hutch. & Dalziel	2.56	5.43	5.27	13.27
7	*Imperata cylindrica* (L.) Raeusch.	4.27	4.89	2.84	12.01
8	*Dryopteris sikkimensis* (Bedd.) Kuntze	4.27	4.35	2.53	11.15
9	*Elephantopus scaber* L.	4.27	3.80	2.21	10.29
10	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	2.56	3.80	3.69	10.06
11	*Oplismenus burmanni* (Retz.) P.Beauv.	3.42	3.26	2.37	9.05
12	*Gouania leptostachya* DC.	4.27	2.72	1.58	8.57
13	*Clerodendrum infortunatum* L.	1.71	2.72	3.95	8.38
14	*Diplazium esculentum* (Retz.) Sw.	3.42	2.72	1.98	8.11
15	*Blumea lacera* (Burm.f.) DC.	2.56	2.72	2.63	7.92
16	*Pupalia atropurpurea* (Lam.) Moq.	2.56	2.72	2.63	7.92
17	*Ageratum conyzoides* (L.) L.	1.71	2.17	3.16	7.04
18	*Thelypteris nudata* (Roxb.) C.V. Morton	2.56	1.63	1.58	5.77
19	*Shorea robusta* Gaertn.	2.56	1.63	1.58	5.77
20	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.71	1.63	2.37	5.71
21	*Cyperus compressus* L.	1.71	1.63	2.37	5.71

Sl. No.	SPECIES	RF	RD	RA	IVI
22	*Sauropus compressus* Mull.Arg.	1.71	1.63	2.37	5.71
23	*Barleria cristata* L.	0.85	1.09	3.16	5.10
24	*Commelina diffusa* Burm.f.	0.85	1.09	3.16	5.10
25	*Setaria plicata* (Lam.) T.Cooke	0.85	1.09	3.16	5.10
26	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.71	1.09	1.58	4.38
27	*Phyllanthus urinaria* L.	1.71	1.09	1.58	4.38
28	*Smilax zeylanica* L.	1.71	1.09	1.58	4.38
29	*Clausena excavata* Burm.f.	0.85	0.54	1.58	2.98
30	*Dioscorea pubera* Blume	0.85	0.54	1.58	2.98
31	*Desmodium williamsii* H.Ohashi	0.85	0.54	1.58	2.98
32	*Merremia hirta* (L.) Merr.	0.85	0.54	1.58	2.98
33	*Persea glaucecens* (Nees) Wight	0.85	0.54	1.58	2.98
34	*Morinda angustifolia* Roxb.	0.85	0.54	1.58	2.98
35	*Ophiopogon intermedius* D.Don	0.85	0.54	1.58	2.98
36	*Persicaria chinensis* (L.) H. Gross	0.85	0.54	1.58	2.98
37	*Pueraria phaseoloides* (Roxb.) Benth.	0.85	0.54	1.58	2.98
38	*Piper betleoides* C.DC.	0.85	0.54	1.58	2.98
39	*Stereospermum tetragonum* DC.	0.85	0.54	1.58	2.98
40	*Pericampylus glaucus* (Lam.) Merr.	0.85	0.54	1.58	2.98
41	*Piper peepuloides* Wall.	0.85	0.54	1.58	2.98
42	*Tetrastigma campylocarpum* (Kurz) Planch.	0.85	0.54	1.58	2.98
43	*Cyanthillium cinereum* (L.) H.Rob.	0.85	0.54	1.58	2.98

Table 39. Phytosociological data of Pre-monsoon herb layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Mikania micrantha* Kunth	6.06	8.50	3.19	17.75
2	*Coffea benghalensis* B.Heyne *ex* Schult.	5.30	7.50	3.21	16.02
3	*Lygodium flexuosum* (L.) Sw.	6.82	5.50	1.83	14.15
4	*Ichnocarpus frutescens* (L.) W.T.Aiton	5.30	6.00	2.57	13.87
5	*Imperata cylindrica* (L.) Raeusch.	4.55	5.50	2.75	12.79
6	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	2.27	5.00	5.00	12.27
7	*Gouania leptostachya* DC.	4.55	4.50	2.25	11.29
8	*Oplismenus burmanni* (Retz.) P.Beauv..	4.55	4.50	2.25	11.29
9	*Chloranthus elatior* Link	4.55	4.00	2.00	10.54
10	*Diplazium esculentum* (Retz.) Sw.	3.79	4.00	2.40	10.19
11	*Elephantopus scaber* L.	3.79	3.50	2.10	9.39
12	*Clerodendrum infortunatum* L.	3.03	3.50	2.62	9.15
13	*Pronephrium nudatum* (Roxb.) Holttum	3.03	3.50	2.62	9.15
14	*Cyperus compressus* L.	1.52	2.00	3.00	6.51
15	*Dryopteris sikkimensis* (Bedd.) Kuntze	1.52	2.00	3.00	6.51
16	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	2.27	2.00	2.00	6.27
17	*Blumea lacera* (Burm. f.) DC.	2.27	2.00	2.00	6.27
18	*Pupalia lappacea* (L.) Juss.	2.27	2.00	2.00	6.27
19	*Sauropus compressus* Müll.Arg.	2.27	1.50	1.50	5.27
20	*Ageratum conyzoides* (L.) L.	1.52	1.50	2.25	5.26
21	*Commelina diffusa* Burm.f.	0.76	1.00	3.00	4.76
22	*Leea aequata* L.	0.76	1.00	3.00	4.76
23	*Piper hamiltonii* C.DC.	0.76	1.00	3.00	4.76
24	*Setaria plicata* (Lam.) T.Cooke	0.76	1.00	3.00	4.76
25	*Tectaria gemmifera* (Fée) Alston	0.76	1.00	3.00	4.76
26	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.52	1.00	1.50	4.01
27	*Spermacoce alata* Aubl.	1.52	1.00	1.50	4.01

Sl. No.	SPECIES	RF	RD	RA	IVI
28	*Piper chuvya* Miq.	1.52	1.00	1.50	4.01
29	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.52	1.00	1.50	4.01
30	*Persicaria chinensis* (L.) H. Gross	1.52	1.00	1.50	4.01
31	*Pueraria phaseoloides* (Roxb.) Benth.	1.52	1.00	1.50	4.01
32	*Phyllanthus emblica* L.	1.52	1.00	1.50	4.01
33	*Smilax zeylanica* L.	1.52	1.00	1.50	4.01
34	*Tetrastigma planicaule* (Hook. f.) Gagnep.	1.52	1.00	1.50	4.01
35	*Cyanthillium cinereum* (L.) H.Rob.	1.52	1.00	1.50	4.01
36	*Barleria cristata* L.	0.76	0.50	1.50	2.76
37	*Clausena excavata* Burm.f.	0.76	0.50	1.50	2.76
38	*Dioscorea pubera* Blume	0.76	0.50	1.50	2.76
39	*Hylodesmum laxum* (DC.) H.Ohashi & R.R.Mill.	0.76	0.50	1.50	2.76
40	*Gomphostemma ovatum* Wall. *ex* Benth.	0.76	0.50	1.50	2.76
41	*Morinda citrifolia* L.	0.76	0.50	1.50	2.76
42	*Ophiopogon intermedius* D.Don	0.76	0.50	1.50	2.76
43	*Piper betleoides* C.DC.	0.76	0.50	1.50	2.76
44	*Pericampylus glaucus* (Lam.) Merr.	0.76	0.50	1.50	2.76
45	*Shorea robusta* Gaertn.	0.76	0.50	1.50	2.76
46	*Tetrastigma campylocarpum* (Kurz) Planch.	0.76	0.50	1.50	2.76
47	*Dillenia pentagyna* Roxb.	0.76	0.50	1.50	2.76
48	*Toona ciliata* M.Roem.	0.76	0.50	1.50	2.76

Table 40. Phytosociological data of Post-monsoon herb layer of sal-chilauni plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Imperata cylindrica* (L.) Raeusch.	4.38	6.24	2.72	13.33
2	*Oplismenus burmanni* (Retz.) P.Beauv.	4.38	5.59	2.44	12.41
3	*Mikania micrantha* Kunth	4.01	4.95	2.35	11.31
4	*Elephantopus scaber* L.	4.74	4.52	1.82	11.08
5	*Kyllinga nemoralis* (J.R. & G Forster) Dandy *ex* Hutch. & Dalziel	4.38	4.52	1.97	10.86
6	*Coffea benghalensis* B.Heyne *ex* Schult.	2.19	4.52	3.94	10.64
7	*Spermacoce alata* Aubl.	2.55	4.52	3.37	10.44
8	*Chloranthus elatior* Link	2.55	3.87	2.89	9.32
9	*Lygodium flexuosum* (L.) Sw.	3.28	3.44	2.00	8.72
10	*Ageratum conyzoides* (L.) L.	2.55	3.44	2.57	8.57
11	*Ichnocarpus frutescens* (L.) W.T.Aiton	3.65	2.58	1.35	7.58
12	*Rotheca serrata* (L.) Steane & Mabb.	2.19	2.80	2.44	7.42
13	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.19	2.80	2.44	7.42
14	*Gouania leptostachya* DC.	2.92	2.37	1.55	6.83
15	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	2.55	2.37	1.77	6.69
16	*Cyperus compressus* L.	1.46	1.94	2.53	5.93
17	*Setaria plicata* (Lam.) T.Cooke	1.46	1.94	2.53	5.93
18	*Diplazium esculentum* (Retz.) Sw.	2.19	1.94	1.69	5.81
19	*Thelypteris nudata* (Roxb.) C.V. Morton	1.82	1.72	1.80	5.34
20	*Pupalia lappacea* (L.) Juss.	1.82	1.72	1.80	5.34
21	*Shorea robusta* Gaertn.	2.19	1.51	1.31	5.01
22	*Blumea lacera* (Burm.f.) DC.	1.82	1.51	1.57	4.90
23	*Persicaria chinensis* (L.) H. Gross	1.82	1.51	1.57	4.90
24	*Tectaria gemmifera* (Fée) Alston	1.82	1.51	1.57	4.90
25	*Dendrocnide sinuata* (Blume) Chew	1.82	1.51	1.57	4.90
26	*Cyanthillium cinereum* (L.) H.Rob.	1.82	1.51	1.57	4.90
27	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.82	1.29	1.35	4.46
28	*Sauropus compressus* Mull.Arg.	1.82	1.29	1.35	4.46

Sl. No.	SPECIES	RF	RD	RA	IVI
29	*Commelina diffusa* Burm.f.	1.46	1.29	1.69	4.44
30	*Phyllanthus emblica* L.	1.09	1.08	1.87	4.04
31	*Setaria palmifolia* (J.Koenig) Stapf	1.09	1.08	1.87	4.04
32	*Ophiopogon intermedius* D.Don	1.46	1.08	1.41	3.94
33	*Pueraria phaseoloides* (Roxb.) Benth.	1.46	1.08	1.41	3.94
34	*Barleria cristata* L.	0.73	0.86	2.25	3.84
35	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.73	0.86	2.25	3.84
36	*Dioscorea pubera* Blume	1.09	0.86	1.50	3.45
37	*Piper betleoides* C.DC.	1.09	0.86	1.50	3.45
38	*Smilax zeylanica* L.	1.09	0.86	1.50	3.45
39	*Tetrastigma planicaule* (Hook. f.) Gagnep.	1.09	0.86	1.50	3.45
40	*Toona ciliata* M.Roem.	1.09	0.86	1.50	3.45
41	*Piper peepuloides* Wall.	0.73	0.65	1.69	3.06
42	*Digitaria ciliaris* (Retz.) Koeler	0.36	0.43	2.25	3.04
43	*Gomphostemma ovatum* Wall. *ex* Benth.	0.36	0.43	2.25	3.04
44	*Piper chuvya* Miq.	1.09	0.65	1.12	2.86
45	*Hylodesmum laxum* (DC.) H.Ohashi & R.R.Mill.	1.09	0.65	1.12	2.86
46	*Merremia hirta* (L.) Merr.	1.09	0.65	1.12	2.86
47	*Leea aequata* L.	1.09	0.65	1.12	2.86
48	*Morinda angustifolia* Roxb.	1.09	0.65	1.12	2.86
49	*Stereospermum tetragonum* DC.	1.09	0.65	1.12	2.86
50	*Tetrastigma campylocarpum* (Kurz) Planch.	1.09	0.65	1.12	2.86
51	*Clausena excavata* Burm.f.	0.73	0.43	1.12	2.28
52	*Gmelina arborea* Roxb.	0.73	0.43	1.12	2.28
53	*Machilus glaucescens* (Nees) Wight	0.73	0.43	1.12	2.28
54	*Pericampylus glaucus* (Lam.) Merr.	0.73	0.43	1.12	2.28
55	*Dillenia pentagyna* Roxb.	0.73	0.43	1.12	2.28
56	*Streblus asper* Lour.	0.73	0.43	1.12	2.28
57	*Solanum aculeatissimum* Jacq.	0.73	0.43	1.12	2.28

Table 41. Phytosociological data of winter tree layer of teak plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Tectona grandis* L.f.	14.71	66.84	40.35	121.89
2	*Gmelina arborea* Roxb.	10.29	3.57	3.08	16.95
3	*Croton caudatus* Geiseler	7.35	4.08	4.93	16.36
4	*Pueraria sikkimensis* Prain	7.35	4.08	4.93	16.36
5	*Casearia vareca* Roxb.	8.82	3.57	3.59	15.99
6	*Magnolia lanuginosa* (Wall.) Figlar & Noot.	8.82	3.06	3.08	14.96
7	*Terminalia bellirica* (Gaertn.) Roxb.	5.88	2.04	3.08	11.00
8	*Dalbergia stipulacea* Roxb.	4.41	1.53	3.08	9.02
9	*Neolamarckia cadamba* (Roxb.) Bosser	4.41	1.53	3.08	9.02
10	*Holarrhena pubescens* Wall. *ex* G.Don	4.41	1.53	3.08	9.02
11	*Syzygium cumini* (L.) Skeels	4.41	1.53	3.08	9.02
12	*Callicarpa arborea* Roxb.	2.94	1.02	3.08	7.04
13	*Morinda angustifolia* Roxb.	2.94	1.02	3.08	7.04
14	*Carya alba* (L.) Nutt. *ex* Elliott	2.94	1.02	3.08	7.04
15	*Terminalia alata* Roth	2.94	1.02	3.08	7.04
16	*Toona ciliata* M.Roem.	2.94	1.02	3.08	7.04
17	*Antidesma bunius* (L.) Spreng.	1.47	0.51	3.08	5.06
18	*Rhamnus napalensis* (Wall.) M.A. Lawson	1.47	0.51	3.08	5.06
19	*Wrightia arborea* (Dennst.) Mabb.	1.47	0.51	3.08	5.06

Table 42. Phytosociological data of Post-monsoon tree layer of teak plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Tectona grandis* L.f.	12.99	61.86	36.87	111.72
2	*Pueraria sikkimensis* Prain	7.79	6.05	6.01	19.84
3	*Croton caudatus* Geiseler	9.09	5.12	4.36	18.56
4	*Gmelina arborea* Roxb.	10.39	3.72	2.77	16.88
5	*Casearia vareca* Roxb.	9.09	4.19	3.56	16.84
6	*Magnolia lanuginosa* (Wall.) Figlar & Noot.	7.79	2.79	2.77	13.35
7	*Neolamarckia cadamba* (Roxb.) Bosser	5.19	2.33	3.47	10.99
8	*Terminalia bellirica* (Gaertn.) Roxb.	5.19	1.86	2.77	9.83
9	*Antidesma bunius* (L.) Spreng.	2.60	1.40	4.16	8.15
10	*Dalbergia stipulacea* Roxb.	3.90	1.40	2.77	8.06
11	*Morinda angustifolia* Roxb.	3.90	1.40	2.77	8.06
12	*Holarrhena pubescens* Wall. *ex* G.Don	3.90	1.40	2.77	8.06
13	*Syzygium cumini* (L.) Skeels	3.90	1.40	2.77	8.06
14	*Callicarpa arborea* Roxb.	2.60	0.93	2.77	6.30
15	*Carya alba* (L.) Nutt. *ex* Elliott	2.60	0.93	2.77	6.30
16	*Terminalia alata* Roth	2.60	0.93	2.77	6.30
17	*Toona ciliata* M.Roem.	2.60	0.93	2.77	6.30
18	*Rhamnus napalensis* (Wall.) M.A. Lawson	1.30	0.47	2.77	4.54
19	*Alstonia scholaris* (L.) R. Br.	1.30	0.47	2.77	4.54
20	*Ficus benjamina* L.	1.30	0.47	2.77	4.54
21	*Wrightia arborea* (Dennst.) Mabb.	1.30	0.47	2.77	4.54

Table 43. Phytosociological data of winter shrub layer of teak plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	12.26	33.66	18.16	64.08
2	*Clerodendrum infortunatum* L.	12.26	23.59	12.72	48.57
3	*Morinda angustifolia* Roxb.	16.98	17.44	6.80	41.22
4	*Maesa chisia* Buch.-Ham. *ex* D. Don	5.66	5.16	6.03	16.85
5	*Chromolaena odorata* (L.) R.M.King & H.Rob.	6.60	4.67	4.68	15.95
6	*Urena lobata* L.	0.94	1.72	12.06	14.72
7	*Mussaenda roxburghii* Hook.f.	6.60	3.93	3.94	14.47
8	*Clausena excavata* Burm.f.	10.38	0.25	0.16	10.78
9	*Pueraria sikkimensis* Prain	3.77	1.23	2.15	7.16
10	*Combretum album* Pers.	2.83	1.23	2.87	6.93
11	*Phyllanthus emblica* L.	2.83	1.23	2.87	6.93
12	*Tectona grandis* L.f	2.83	0.74	1.72	5.29
13	*Antidesma bunius* (L.) Spreng.	1.89	0.74	2.58	5.21
14	*Leea guineensis* G. Don	1.89	0.74	2.58	5.21
15	*Litsea glutinosa* (Lour.) C.B.Rob.	0.94	0.49	3.45	4.88
16	*Smilax zeylanica* L.	0.94	0.49	3.45	4.88
17	*Lagerstroemia reginae* Roxb.	1.89	0.49	1.72	4.10
18	*Mallotus philippensis* (Lam.) Müll.Arg.	1.89	0.49	1.72	4.10
19	*Uncaria scandens* (Sm.) Hutch.	1.89	0.49	1.72	4.10
20	*Acacia pennata* (L.) Willd.	0.94	0.25	1.72	2.91
21	*Clerodendrum indicum* (L.) Kuntze	0.94	0.25	1.72	2.91
22	*Sauropus compressus* Müll.Arg.	0.94	0.25	1.72	2.91
23	*Sida acuta* Burm.f.	0.94	0.25	1.72	2.91
24	*Triumfetta rhomboidea* Jacq.	0.94	0.25	1.72	2.91

Table 44. Phytosociological data of Pre-monsoon shrub layer of teak plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	13.46	38.84	17.94	70.24
2	*Clerodendrum infortunatum* L.	10.26	22.32	13.53	46.11
3	*Morinda angustifolia* Roxb.	14.10	15.11	6.66	35.88
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	8.33	4.92	3.67	16.93
5	*Maesa chisia* Buch.-Ham. *ex* D.Don	4.49	2.11	2.92	9.52
6	*Urena lobata* L.	3.85	1.93	3.13	8.90
7	*Triumfetta tomentosa* Bojer *ex* Bouton	3.21	1.93	3.75	8.89
8	*Sorindeia madagascariensis* Thouars *ex* DC.	7.05	0.18	0.15	7.38
9	*Combretum decandrum* Jacq.	3.21	1.23	2.39	6.82
10	*Sauropus compressus* Müll.Arg.	3.21	1.23	2.39	6.82
11	*Pueraria sikkimensis* Prain	2.56	1.23	2.98	6.78
12	*Desmodium oblongum* Benth.	0.64	0.53	5.11	6.28
13	*Ardisia solanacea* (Poir.) Roxb.	2.56	1.05	2.56	6.18
14	*Smilax zeylanica* L.	2.56	1.05	2.56	6.18
15	*Antidesmabunius* (L.) Spreng.	2.56	0.88	2.13	5.57
16	*Clausena excavata* Burm.f.	1.28	0.70	3.41	5.39
17	*Leea guineensis* G. Don	2.56	0.70	1.70	4.97
18	*Sida acuta* Burm.f.	1.28	0.53	2.56	4.37
19	*Lagerstroemia speciosa* (L.) Pers.	1.92	0.53	1.70	4.15
20	*Litsea glutinosa* (Lour.) C.B.Rob.	1.92	0.53	1.70	4.15
21	*Mussaenda roxburghii* Hook.f.	1.92	0.53	1.70	4.15
22	*Macaranga denticulata* (Blume) Müll.Arg.	1.28	0.35	1.70	3.34
23	*Mallotus philippensis* (Lam.) Müll.Arg.	1.28	0.35	1.70	3.34
24	*Acacia pennata* (L.) Willd.	0.64	0.18	1.70	2.52
25	*Clerodendrum indicum* (L.) Kuntze	0.64	0.18	1.70	2.52
26	*Ficus hispida* L.f.	0.64	0.18	1.70	2.52
27	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.64	0.18	1.70	2.52
28	*Streblus asper* Lour.	0.64	0.18	1.70	2.52
29	*Lagerstroemia parviflora* Roxb.	0.64	0.18	1.70	2.52
30	*Tectona grandis* L. f.	0.64	0.18	1.70	2.52

Table 45. Phytosociological data of Post-monsoon shrub layer of teak plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne ex Schult.	8.38	35.88	25.08	69.34
2	*Clerodendrum infortunatum* L.	8.90	22.45	14.77	46.12
3	*Morinda angustifolia* Roxb.	8.38	14.12	9.87	32.36
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	7.33	5.10	4.07	16.50
5	*Urena lobata* L.	4.19	3.14	4.39	11.71
6	*Clausena excavata* Burm.f.	4.19	1.86	2.60	8.66
7	*Maesa indica* (Roxb.) A. DC.	4.19	1.86	2.60	8.66
8	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	4.71	1.67	2.07	8.45
9	*Baliospermum solanifolium* (Burm.) Suresh	4.71	1.08	1.34	7.13
10	*Sauropus compressus* Müll.Arg.	3.66	1.27	2.04	6.98
11	*Phyllanthus urinaria* L.	2.62	1.27	2.85	6.74
12	*Leea guineensis* G. Don	3.66	1.08	1.72	6.47
13	*Pueraria sikkimensis* Prain	3.66	1.08	1.72	6.47
14	*Glycosmis pentaphylla* (Retz.) DC.	2.62	1.18	2.63	6.43
15	*Antidesma bunius* (L.) Spreng.	4.19	0.88	1.23	6.30
16	*Uncaria scandens* (Sm.) Hutch.	2.09	0.88	2.47	5.44
17	*Triumfetta tomentosa* Bojer *ex* Bouton	1.57	0.78	2.92	5.28
18	*Litsea monopetala* (Roxb.) Pers.	2.09	0.49	1.37	3.95
19	*Lagerstroemia reginae* Roxb.	2.09	0.39	1.10	3.58
20	*Mallotus philippensis* (Lam.) Müll.Arg.	2.09	0.39	1.10	3.58

Sl. No.	SPECIES	RF	RD	RA	IVI
21	*Smilax zeylanica* L.	2.09	0.39	1.10	3.58
22	*Barleria cristata* L.	1.05	0.29	1.64	2.99
23	*Streblus asper* Lour.	1.05	0.29	1.64	2.99
24	*Acacia pennata* (L.) Willd.	1.57	0.29	1.10	2.96
25	*Grewia asiatica* L.	1.57	0.29	1.10	2.96
26	*Macaranga denticulata* (Blume) Müll.Arg.	1.57	0.29	1.10	2.96
27	*Asparagus racemosus* Willd.	0.52	0.20	2.19	2.91
28	*Oroxylum indicum* (L.) Kurz	0.52	0.20	2.19	2.91
29	*Bridelia retusa* (L.) A.Juss.	1.05	0.20	1.10	2.34
30	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	1.05	0.20	1.10	2.34
31	*Lagerstroemia parviflora* Roxb.	1.05	0.20	1.10	2.34
32	*Terminalia bellirica* (Gaertn.) Roxb.	0.52	0.10	1.10	1.72
33	*Micromelum integerrimum* (Buch.-Ham. ex DC.) Wight & Arn. *ex* M. Roem.	0.52	0.10	1.10	1.72
34	*Shorea robusta* Gaertn.	0.52	0.10	1.10	1.72

Table 46. Phytosociological data of winter herb layer of teak plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Chromolaena odorata* (L.) R.M.King & H.Rob.	11.43	12.40	3.52	27.35
2	*Oplismenus burmanni* (Retz.) P.Beauv.	6.43	12.40	6.25	25.08
3	*Clerodendrum infortunatum* L.	6.43	8.14	4.10	18.67
4	*Mikania micrantha* Kunth	6.43	8.14	4.10	18.67
5	*Lygodium flexuosum* (L.) Sw.	6.43	6.98	3.52	16.92
6	*Coffea benghalensis* B.Heyne *ex* Schult.	5.71	6.59	3.73	16.04
7	*Rungia pectinata* (L.) Nees	4.29	3.49	2.64	10.41
8	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	2.86	3.49	3.95	10.30
9	*Dioscorea bulbifera* L.	3.57	3.10	2.81	9.48
10	*Phyllanthus emblica* L.	2.86	3.10	3.52	9.47
11	*Stephania japonica* (Thunb.) Miers	4.29	2.71	2.05	9.05
12	*Piper betleoides* C.DC.	2.14	2.71	4.10	8.96
13	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.86	2.71	3.08	8.65
14	*Morinda angustifolia* Roxb.	3.57	2.33	2.11	8.01
15	*Pouzolzia hirta* Blume *ex* Hassk.	2.14	1.94	2.93	7.01
16	*Diplazium esculentum* (Retz.) Sw.	2.86	1.94	2.20	6.99
17	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	1.43	1.55	3.52	6.49
18	*Molineria capitulata* (Lour.) Herb.	2.14	1.55	2.34	6.04
19	*Cyperus pangorei* Rottb.	2.14	1.55	2.34	6.04
20	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.14	1.55	2.34	6.04
21	*Leea guineensis* G. Don	2.14	1.55	2.34	6.04
22	*Biophytum sensitivum* (L.) DC.	1.43	1.16	2.64	5.23
23	*Chlorophytum arundinaceum* Baker	1.43	1.16	2.64	5.23
24	*Piper peepuloides* Wall.	1.43	1.16	2.64	5.23
25	*Pteris biaurita* L.	0.71	0.78	3.52	5.00
26	*Cissus repens* Lam.	1.43	0.78	1.76	3.96
27	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	1.43	0.78	1.76	3.96
28	*Gouania leptostachya* DC.	1.43	0.78	1.76	3.96
29	*Ageratum houstonianum* Mill.	0.71	0.39	1.76	2.86
30	*Desmodium laxiflorum* DC.	0.71	0.39	1.76	2.86
31	*Elephantopus scaber* L.	0.71	0.39	1.76	2.86
32	*Hedyotis scandens* Roxb.	0.71	0.39	1.76	2.86
33	*Holarrhena pubescens* Wall. *ex* G.Don	0.71	0.39	1.76	2.86
34	*Merremia hirta* (L.) Merr.	0.71	0.39	1.76	2.86
35	*Psychotria erratica* Hook.f.	0.71	0.39	1.76	2.86
36	*Tetrastigma dubium* (Lawson) Planch.	0.71	0.39	1.76	2.86
37	*Cyanthillium cinereum* (L.) H.Rob.	0.71	0.39	1.76	2.86

Table 47. Phytosociological data of Pre-monsoon herb layer of teak plantation in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L.	13.11	8.22	1.51	22.85
2	*Coffea benghalensis* B.Heyne *ex* Schult.	7.79	9.75	3.01	20.55
3	*Oplismenus burmanni* (Retz.) P.Beauv.	3.28	7.07	5.19	15.55
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	6.97	5.93	2.05	14.94
5	*Mikania micrantha* Kunth	5.33	6.50	2.94	14.77
6	*Synedrella nodiflora* (L.) Gaertn.	3.28	6.50	4.77	14.55
7	*Diplazium esculentum* (Retz.) Sw.	3.69	4.21	2.75	10.64
8	*Piper betleoides* C.DC.	4.10	4.02	2.36	10.47
9	*Lygodium flexuosum* (L.) Sw.	3.28	4.02	2.95	10.24
10	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.87	3.63	3.05	9.55
11	*Imperata cylindrica* (L.) Raeusch.	2.05	3.25	3.82	9.12
12	*Commelina diffusa* Burm.f.	3.28	3.06	2.25	8.58
13	*Lepidagathis incurva* Buch.-Ham. *ex* D.Don	2.05	2.49	2.92	7.45
14	*Phyllanthus urinaria* L.	2.46	2.10	2.06	6.62
15	*Pronephrium nudatum* (Roxb.) Holttum	2.46	2.10	2.06	6.62
16	*Dioscorea bulbifera* L.	1.64	1.72	2.53	5.89
17	*Helminthostachys zeylanica* (L.) Hook.	1.64	1.72	2.53	5.89
18	*Cyperus pangorei* Rottb.	2.05	1.72	2.02	5.79
19	*Lindernia ciliata* (Colsm.) Pennell	1.23	1.53	2.99	5.75
20	*Gouania leptostachya* DC.	2.05	1.53	1.80	5.38
21	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.23	1.34	2.62	5.19
22	*Blumea lacera* (Burm.f.) DC.	1.64	1.34	1.97	4.94
23	*Sauropus compressus* Müll.Arg.	1.64	1.34	1.97	4.94
24	*Torenia diffusa* Roxb.	1.64	1.34	1.97	4.94
25	*Biophytum sensitivum* (L.) DC.	0.82	0.96	2.81	4.58
26	*Digitaria ciliaris* (Retz.) Koeler	1.64	1.15	1.68	4.47
27	*Carex indica* L.	0.41	0.57	3.37	4.35
28	*Gomphostemma ovatum* Wall. *ex* Benth.	1.23	0.96	1.87	4.06
29	*Hedyotis scandens* Roxb.	1.23	0.96	1.87	4.06
30	*Piper peepuloides* Wall.	1.23	0.96	1.87	4.06
31	*Rungia pectinata* (L.) Nees	0.82	0.76	2.25	3.83
32	*Chlorophytum arundinaceum* Baker	1.23	0.76	1.50	3.49
33	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	1.23	0.76	1.50	3.49
34	*Merremia hirta* (L.) Merr.	1.23	0.76	1.50	3.49
35	*Curculigo orchioides* Gaertn.	0.82	0.57	1.68	3.08
36	*Desmodium laxiflorum* DC.	0.82	0.57	1.68	3.08
37	*Urena lobata* L.	0.82	0.57	1.68	3.08
38	*Mimosa pudica* L.	0.82	0.57	1.68	3.08
39	*Pouzolzia hirta* Blume *ex* Hassk.	0.82	0.57	1.68	3.08
40	*Stephania Japonica* (Thunb.) Miers	0.82	0.57	1.68	3.08
41	*Litsea monopetala* (Roxb.) Pers.	0.82	0.38	1.12	2.33
42	*Maesa indica* (Roxb.) A.DC.	0.82	0.38	1.12	2.33
43	*Streblus asper* Lour.	0.82	0.38	1.12	2.33
44	*Antidesma bunius* (L.) Spreng.	0.41	0.19	1.12	1.72
45	*Bombax ceiba* L.	0.41	0.19	1.12	1.72

Table 48. Phytosociological data of Post-monsoon herb layer of teak plantation in Lataguri site

Sl.No.	SPECIES	RF	RD	RA	IVI
1	*Piper betleoides* C.DC.	4.72	9.15	3.90	17.77
2	*Coffea benghalensis* B.Heyne *ex* Schult.	3.33	7.03	4.24	14.61
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	5.28	6.03	2.30	13.60
4	*Mikania micrantha* Kunth	4.44	6.25	2.83	13.52

Sl.No.	SPECIES	RF	RD	RA	IVI
5	*Oplismenus burmanni* (Retz.) P.Beauv.	4.72	4.80	2.04	11.57
6	*Spermacoce alata* Aubl.	2.22	4.58	4.14	10.94
7	*Lygodium flexuosum* (L.) Sw.	2.22	4.13	3.74	10.09
8	*Blumea lacera* (Burm.f.) DC.	2.22	3.57	3.23	9.03
9	*Phyllanthus emblica* L.	4.44	3.01	1.36	8.82
10	*Synedrella nodiflora* (L.) Gaertn.	1.94	3.24	3.35	8.53
11	*Cyperus compressus* L.	3.33	2.46	1.48	7.27
12	*Commelina diffusa* Burm.f.	2.50	2.57	2.07	7.13
13	*Dryopteris sikkimensis* (Bedd.) Kuntze	1.94	2.46	2.54	6.94
14	*Ageratum conyzoides* (L.) L.	2.22	2.46	2.22	6.90
15	*Globba andersonii* C.B.Clarke *ex* Baker	2.50	2.34	1.89	6.73
16	*Lepidagathis incurve* Buch.-Ham. *ex* D. Don	2.50	2.23	1.80	6.53
17	*Dioscorea bulbifera* L.	2.22	2.12	1.92	6.26
18	*Impatiens trilobata* Colebr.	1.39	1.90	2.75	6.03
19	*Helminthostachys zeylanica* (L.) Hook.	2.50	1.79	1.44	5.72
20	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	2.50	1.79	1.44	5.72
21	*Piper peepuloides* Wall.	1.11	1.34	2.43	4.88
22	*Gouania leptostachya* DC.	1.39	1.34	1.94	4.67
23	*Morinda angustifolia* Roxb.	1.94	1.23	1.27	4.44
24	*Dioscorea pentaphylla* L.	1.94	1.23	1.27	4.44
25	*Axonopus compressus* (Sw.) P.Beauv.	1.67	1.23	1.48	4.38
26	*Desmodium laxum* DC.	1.67	1.00	1.21	3.88
27	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	1.67	1.00	1.21	3.88
28	*Sida acuta* Burm.f.	1.39	1.00	1.46	3.85
29	*Leea guineensis* G. Don	1.94	0.89	0.92	3.76
30	*Croton persimilis* Müll.Arg.	1.67	0.89	1.08	3.64
31	*Selaginella sp*	1.11	0.89	1.62	3.62
32	*Floscopa scandens* Lour.	0.83	0.78	1.89	3.50
33	*Biophytum sensitivum* (L.) DC.	1.11	0.78	1.41	3.31
34	*Cissampelos pareira* L.	1.11	0.78	1.41	3.31
35	*Cheilocostus speciosus* (J.Koenig) C.D.Specht.	1.11	0.78	1.41	3.31
36	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.11	0.78	1.41	3.31
37	*Girardinia diversifolia* (Link) Friis	1.39	0.78	1.13	3.30
38	*Stephania glabra* (Roxb.) Miers	1.39	0.67	0.97	3.03
39	*Deeringia amaranthoides* (Lam.) Merr.	1.11	0.67	1.21	2.99
40	*Nelsonia canescens* (Lam.) Spreng.	1.11	0.67	1.21	2.99
41	*Schoenoxiphium sparteum* (Wahlenb.) C.B.Clarke.	0.83	0.56	1.35	2.74
42	*Curculigo orchioides* Gaertn.	0.83	0.56	1.35	2.74
43	*Peristrophe bicalyculata* (Retz.) Nees	0.83	0.56	1.35	2.74
44	*Triumfetta rhomboidea* Jacq.	0.83	0.56	1.35	2.74
45	*Cyanthillium cinereum* (L.) H.Rob.	0.83	0.56	1.35	2.74
46	*Shorea robusta* Gaertn.	1.11	0.56	1.01	2.68
47	*Ophiopogon wallichianus* (Kunth) Hook.f.	0.56	0.45	1.62	2.62
48	*Sauropus compressus* Müll.Arg.	0.83	0.45	1.08	2.36
49	*Cissus repens* Lam.	0.56	0.33	1.21	2.10
50	*Gomphostemma ovatum* Wall. *ex* Benth.	0.56	0.33	1.21	2.10
51	*Smilax zeylanica* L.	0.56	0.33	1.21	2.10
52	*Tetrastigma campylocarpum* (Kurz) Planch.	0.56	0.33	1.21	2.10
53	*Vallaris solanacea* (Roth) Kuntze	0.56	0.33	1.21	2.10
54	*Tinospora sinensis* (Lour.) Merr.	0.83	0.33	0.81	1.98
55	*Toona ciliata* M.Roem.	0.83	0.33	0.81	1.98
56	*Antidesma bunius* (L.) Spreng.	0.56	0.22	0.81	1.59
57	*Paederia foetida* L.	0.56	0.22	0.81	1.59
58	*Premna barbata* Wall. *ex* Schauer	0.56	0.22	0.81	1.59
59	*Sterculia villosa* Roxb.	0.28	0.11	0.81	1.20

Table 49. Phytosociological data of winter tree layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia speciosa* (L.) Pers.	15.38	61.90	29.84	107.13
2	*Callicarpa arborea* Roxb.	7.69	6.12	5.90	19.72
3	*Tectona grandis* L.f.	7.69	4.08	3.93	15.71
4	*Croton caudatus* Geiseler	3.85	2.72	5.25	11.81
5	*Artocarpus chama* Buch.-Ham.	5.77	2.04	2.62	10.43
6	*Lagerstroemia parviflora* Roxb.	5.77	2.04	2.62	10.43
7	*Careya arborea* Roxb.	3.85	2.04	3.93	9.82
8	*Dalbergia stipulacea* Roxb.	3.85	2.04	3.93	9.82
9	*Premna mucronata* Roxb.	1.92	1.36	5.25	8.53
10	*Schima wallichii* (DC.) Korth.	3.85	1.36	2.62	7.83
11	*Terminalia chebula* Retz.	3.85	1.36	2.62	7.83
12	*Pterospermum acerifolium* (L.) Willd.	3.85	1.36	2.62	7.83
13	*Lannea coromandelica* (Houtt.) Merr.	3.85	1.36	2.62	7.83
14	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC.	3.85	1.36	2.62	7.83
15	*Persea glaucescens* (Nees) D.G. Long	3.85	1.36	2.62	7.83
16	*Wrightia arborea* (Dennst.) Mabb.	3.85	1.36	2.62	7.83
17	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	3.85	1.36	2.62	7.83
18	*Leea macrophylla* Roxb. *ex* Hornem.	3.85	1.36	2.62	7.83
19	*Bauhinia variegata* L.	1.92	0.68	2.62	5.23
20	*Holarrhena pubescens* Wall. *ex* G.Don	1.92	0.68	2.62	5.23
21	*Sterculia villosa* Roxb.	1.92	0.68	2.62	5.23
22	*Shorea robusta* Gaertn.	1.92	0.68	2.62	5.23
23	*Mallotus repandus* (Willd.) Müll.Arg.	1.92	0.68	2.62	5.23

Table 50. Phytosociological data of Post-monsoon tree layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia speciosa* (L.) Pers.	12.12	56.80	25.94	94.86
2	*Callicarpa arborea* Roxb.	9.09	5.92	3.60	18.61
3	*Croton caudatus* Geiseler	7.58	4.73	3.46	15.77
4	*Pueraria sikkimensis* Prain	6.06	2.96	2.70	11.72
5	*Tectona grandis* L.f.	6.06	2.96	2.70	11.72
6	*Careya arborea* Roxb.	1.52	1.78	6.48	9.77
7	*Artocarpus chama* Buch.-Ham.	4.55	1.78	2.16	8.48
8	*Grewia asiatica* L.	4.55	1.78	2.16	8.48
9	*Lagerstroemia parviflora* Roxb.	4.55	1.78	2.16	8.48
10	*Dalbergia stipulacea* Roxb.	3.03	1.78	3.24	8.05
11	*Lannea coromandelica* (Houtt.) Merr.	1.52	1.18	4.32	7.02
12	*Persea glaucescens* (Nees) D.G. Long	1.52	1.18	4.32	7.02
13	*Leea macrophylla* Roxb. *ex* Hornem.	1.52	1.18	4.32	7.02
14	*Antidesma montanum* Blume	3.03	1.18	2.16	6.38
15	*Schima wallichii* (DC.) Korth.	3.03	1.18	2.16	6.38
16	*Premna mollissima* Roth	3.03	1.18	2.16	6.38
17	*Terminalia chebula* Retz.	3.03	1.18	2.16	6.38
18	*Bauhinia variegata* L.	3.03	1.18	2.16	6.38
19	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC.	3.03	1.18	2.16	6.38
20	*Aglaia spectabilis* (Miq.) S.S.Jain & S. Bennet	3.03	1.18	2.16	6.38
21	*Sterculia villosa* Roxb.	3.03	1.18	2.16	6.38
22	*Mallotus repandus* (Willd.) Müll.Arg..	3.03	1.18	2.16	6.38
23	*Alangium chinense* (Lour.) Harms	1.52	0.59	2.16	4.27
24	*Pterospermum acerifolium* (L.) Willd.	1.52	0.59	2.16	4.27
25	*Wrightia arborea* (Dennst.) Mabb.	1.52	0.59	2.16	4.27
26	*Holarrhena pubescens* Wall. *ex* G.Don	1.52	0.59	2.16	4.27
27	*Shorea robusta* Gaertn.	1.52	0.59	2.16	4.27
28	*Magnolia champaca* (L.) Baill. *ex* Pierre.	1.52	0.59	2.16	4.27

Table 51. Phytosociological data of winter shrub layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	13.01	26.24	11.09	50.34
2	*Clerodendrum infortunatum* L.	11.38	25.99	12.56	49.93
3	*Urena lobata* L.	5.69	14.11	13.64	33.44
4	*Triumfetta rhomboidea* Jacq.	9.76	7.67	4.33	21.76
5	*Chromolaena odorata* (L.) R.M.King & H.Rob.	13.01	5.69	2.41	21.11
6	*Pueraria sikkimensis* Prain	5.69	2.97	2.87	11.53
7	*Sida acuta* Burm.f.	4.07	2.23	3.01	9.31
8	*Girardinia diversifolia* (Link) Friis	1.63	1.49	5.02	8.13
9	*Mikania micrantha* Kunth	2.44	1.73	3.91	8.08
10	*Barleria cristata* L.	3.25	1.24	2.09	6.58
11	*Maesa indica* (Roxb.) A. DC.	2.44	1.24	2.79	6.47
12	*Litsea glutinosa* (Lour.) C.B.Rob.	2.44	0.99	2.23	5.66
13	*Morinda angustifolia* Roxb.	2.44	0.99	2.23	5.66
14	*Bauhinia vahlii* Wight & Arn.	1.63	0.74	2.51	4.88
15	*Melastoma malabathricum* L.	1.63	0.74	2.51	4.88
16	*Capparis acutifolia* Sweet	2.44	0.74	1.67	4.86
17	*Solanum khasianum* C.B. Clarke	2.44	0.74	1.67	4.86
18	*Careya arborea* Roxb.	1.63	0.50	1.67	3.80
19	*Leea aequata* L.	1.63	0.50	1.67	3.80
20	*Smilax zeylanica* L.	1.63	0.50	1.67	3.80
21	*Vallaris solanacea* (Roth) Kuntze	1.63	0.50	1.67	3.80
22	*Acacia pennata* (L.) Willd.	0.81	0.25	1.67	2.74
23	*Aristolochia tagala* Cham.	0.81	0.25	1.67	2.74
24	*Combretum album* Pers.	0.81	0.25	1.67	2.74
25	*Crateva religiosa* G. Forst.	0.81	0.25	1.67	2.74
26	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.81	0.25	1.67	2.74
27	*Grewia asiatica* L.	0.81	0.25	1.67	2.74
28	*Lagerstroemia speciosa* (L.) Pers.	0.81	0.25	1.67	2.74
29	*Sabia lanceolata* Colebr.	0.81	0.25	1.67	2.74
30	*Sida rhombifolia* L.	0.81	0.25	1.67	2.74
31	*Syzygium cumini* (L.) Skeels	0.81	0.25	1.67	2.74

Table 52. Phytosociological data of Pre-monsoon shrub layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	8.99	23.12	11.54	43.65
2	*Clerodendrum infortunatum* L.	7.87	20.49	11.69	40.05
3	*Urena lobata* L.	6.18	12.08	8.78	27.04
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	8.99	7.18	3.58	19.75
5	*Triumfetta rhomboidea* Jacq.	5.06	6.83	6.06	17.95
6	*Morinda angustifolia* Roxb.	5.06	4.03	3.58	12.66
7	*Sida acuta* Burm.f.	4.49	2.98	2.97	10.44
8	*Mikania micrantha* Kunth	5.06	2.80	2.49	10.35
9	*Girardinia diversifolia* (Link) Friis	2.81	2.28	3.64	8.72
10	*Melastoma malabathricum* L.	4.49	1.93	1.92	8.34
11	*Pueraria sikkimensis* Prain	4.49	1.93	1.92	8.34
12	*Barleria cristata* L.	2.25	1.40	2.80	6.45
13	*Solanum aculeatissimum* Jacq.	2.25	1.40	2.80	6.45
14	*Maesa indica* (Roxb.) A.DC.	2.81	1.23	1.96	5.99
15	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.25	1.05	2.10	5.40
16	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.69	0.88	2.33	4.89
17	*Smilax zeylanica* L.	2.25	0.70	1.40	4.35
18	*Vallaris solanacea* (Roth) Kuntze	2.25	0.70	1.40	4.35
19	*Leea aequata* L.	1.69	0.70	1.87	4.25
20	*Antidesma montanum* Blume	1.12	0.53	2.10	3.75

Sl. No.	SPECIES	RF	RD	RA	IVI
21	*Ardisia solanacea* (Poir.) Roxb.	1.12	0.53	2.10	3.75
22	*Combretum decandrum* Jacq.	1.69	0.53	1.40	3.61
23	*Litsea glutinosa* (Lour.) C.B.Rob.	1.69	0.53	1.40	3.61
24	*Acacia pennata* (L.) Willd.	1.12	0.35	1.40	2.87
25	*Tinospora sinensis* (Lour.) Merr.	1.12	0.35	1.40	2.87
26	*Aristolochia tagala* Cham.	1.12	0.35	1.40	2.87
27	*Capparis acutifolia* Sweet	1.12	0.35	1.40	2.87
28	*Crateva religiosa* G.Forst.	1.12	0.35	1.40	2.87
29	*Grewia asiatica* L.	1.12	0.35	1.40	2.87
30	*Lagerstroemia reginae* Roxb.	1.12	0.35	1.40	2.87
31	*Careya arborea* Roxb.	1.12	0.35	1.40	2.87
32	*Sabia lanceolata* Colebr.	1.12	0.35	1.40	2.87
33	*Sida rhombifolia* L.	1.12	0.35	1.40	2.87
34	*Syzygium cumini* (L.) Skeels	1.12	0.35	1.40	2.87
35	*Senna alata* (L.) Roxb.	0.56	0.18	1.40	2.14
36	*Bauhinia vahlii* Wight & Arn.	0.56	0.18	1.40	2.14

Table 53. Phytosociological data of Post-monsoon shrub layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	6.94	20.36	11.08	38.38
2	*Clerodendrum infortunatum* L.	6.48	18.69	10.89	36.06
3	*Urena lobata* L.	6.02	10.88	6.83	23.73
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	6.94	7.95	4.32	19.22
5	*Triumfetta rhomboidea* Jacq.	5.56	6.00	4.08	15.63
6	*Mikania micrantha* Kunth	5.09	4.46	3.31	12.87
7	*Morinda angustifolia* Roxb.	6.02	4.04	2.54	12.60
8	*Melastoma malabathricum* L.	4.17	3.21	2.91	10.28
9	*Sida acuta* Burm.f.	4.17	2.65	2.40	9.22
10	*Girardinia diversifolia* (Link) Friis	4.17	2.37	2.15	8.69
11	*Pueraria sikkimensis* Prain	3.24	1.95	2.28	7.47
12	*Solanum aculeatissimum* Jacq.	2.31	1.81	2.96	7.09
13	*Maesa indica* (Roxb.) A.DC.	3.24	1.53	1.79	6.56
14	*Barleria cristata* L.	2.78	1.26	1.71	5.74
15	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.31	1.12	1.82	5.25
16	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	2.31	0.98	1.59	4.88
17	*Vallaris solanacea* (Roth) Kuntze	2.31	0.98	1.59	4.88
18	*Capparis acutifolia* Sweet	1.85	0.84	1.71	4.40
19	*Ardisia solanacea* (Poir.) Roxb.	1.85	0.70	1.42	3.97
20	*Leea aequata* L.	1.85	0.70	1.42	3.97
21	*Litsea glutinosa* (Lour.) C.B.Rob.	1.85	0.70	1.42	3.97
22	*Antidesma montanum* Blume	1.39	0.56	1.52	3.46
23	*Crateva religiosa* G.Forst.	1.39	0.56	1.52	3.46
24	*Clerodendrum indicum* (L.) Kuntze	0.93	0.42	1.71	3.05
25	*Murraya koenigii* (L.) Spreng.	0.93	0.42	1.71	3.05
26	*Smilax zeylanica* L.	0.93	0.42	1.71	3.05
27	*Acacia pennata* (L.) Willd.	0.46	0.28	2.28	3.02
28	*Bauhinia vahlii* Wight & Arn.	0.46	0.28	2.28	3.02
29	*Senna alata* (L.) Roxb.	0.46	0.28	2.28	3.02
30	*Careya arborea* Roxb.	0.46	0.28	2.28	3.02
31	*Combretum album* Pers.	1.39	0.42	1.14	2.95
32	*Grewia asiatica* L.	1.39	0.42	1.14	2.95
33	*Sabia lanceolata* Colebr.	1.39	0.42	1.14	2.95
34	*Aristolochia tagala* Cham.	0.93	0.28	1.14	2.34
35	*Clausena excavata* Burm.f.	0.93	0.28	1.14	2.34
36	*Lagerstroemia speciosa* (L.) Pers.	0.93	0.28	1.14	2.34

Sl. No.	SPECIES	RF	RD	RA	IVI
37	*Sida rhombifolia* L.	0.93	0.28	1.14	2.34
38	*Syzygium cumini* (L.) Skeels	0.93	0.28	1.14	2.34
39	*Tinospora sinensis* (Lour.) Merr.	0.93	0.28	1.14	2.34
40	*Trichosanthes tricuspidata* Lour.	0.93	0.28	1.14	2.34
41	*Melia azedarach* L.	0.46	0.14	1.14	1.74

Table 54. Phytosociological data of winter herb layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Pupalia lappacea* (L.) Juss.	6.82	10.48	3.68	20.97
2	*Setaria palmifolia* (J.Koenig) Stapf	5.30	6.98	3.15	15.44
3	*Oplismenus burmannii* f. *cristata* (J. Presl) Hier. *ex* Peter	4.55	6.98	3.68	15.21
4	*Cyperus pangorei* Rottb.	5.30	5.40	2.44	13.14
5	*Lygodium flexuosum* (L.) Sw.	6.06	3.49	1.38	10.93
6	*Ageratum conyzoides* (L.) L.	3.03	4.13	3.26	10.42
7	*Commelina suffruticosa* Blume	3.03	4.13	3.26	10.42
8	*Pronephrium nudatum* (Roxb.) Holttum	3.03	3.81	3.01	9.85
9	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.27	3.17	3.34	8.79
10	*Curculigo orchioides* Gaertn.	3.03	2.86	2.26	8.14
11	*Peristrophe bicalyculata* (Retz.) Nees	3.03	2.86	2.26	8.14
12	*Piper peepuloides* Wall.	2.27	2.86	3.01	8.14
13	*Dioscorea deltoidea* Wall. *ex* Griseb.	3.79	2.54	1.60	7.93
14	*Diplazium esculentum* (Retz.) Sw.	3.79	2.54	1.60	7.93
15	*Ophiopogon intermedius* D.Don	2.27	2.54	2.67	7.49
16	*Carex indica* L.	2.27	2.22	2.34	6.83
17	*Globba andersonii* C.B.Clarke *ex* Baker	2.27	2.22	2.34	6.83
18	*Pteris biaurita* L.	2.27	1.90	2.01	6.18
19	*Dioscorea pentaphylla* L.	2.27	1.90	2.01	6.18
20	*Axonopus compressus* (Sw.) P.Beauv.	0.76	1.27	4.01	6.04
21	*Ichnocarpus frutescens* (L.) W.T.Aiton	3.03	1.59	1.25	5.87
22	*Barleria cristata* L.	1.52	1.59	2.51	5.61
23	*Gouania leptostachya* DC.	1.52	1.59	2.51	5.61
24	*Curcuma zedoaria* (Christm.) Roscoe	1.52	1.59	2.51	5.61
25	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	1.52	1.59	2.51	5.61
26	*Piper chuvya* Miq.	2.27	1.59	1.67	5.53
27	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	2.27	1.59	1.67	5.53
28	*Achyranthes bidentata* Blume	1.52	1.27	2.01	4.79
29	*Torenia sp*	1.52	1.27	2.01	4.79
30	*Gomphostemma ovatum* Wall. *ex* Benth.	1.52	1.27	2.01	4.79
31	*Tetrastigma planicaule* (Hook.f.) Gagnep.	1.52	1.27	2.01	4.79
32	*Persicaria chinensis* (L.) H.Gross	0.76	0.95	3.01	4.72
33	*Phaulopsis imbricata* (Forssk.) Sweet	0.76	0.95	3.01	4.72
34	*Rungia himalayensis* C.B.Clarke	0.76	0.95	3.01	4.72
35	*Blumea lacera* (Burm. f.) DC.	1.52	0.95	1.50	3.97
36	*Mimosa pudica* L.	1.52	0.95	1.50	3.97
37	*Pericampylus glaucus* (Lam.) Merr.	1.52	0.95	1.50	3.97
38	*Tetrastigma campylocarpum* (Kurz) Planch.	1.52	0.95	1.50	3.97
39	*Senna occidentalis* (L.) Link	0.76	0.63	2.01	3.40
40	*Deeringia amaranthoides* (Lam.) Merr.	0.76	0.63	2.01	3.40
41	*Phyllanthus emblica* L.	0.76	0.63	2.01	3.40
42	*Amorphophallus bulbifer* (Roxb.) Blume	0.76	0.32	1.00	2.08
43	*Floscopa scandens* Lour.	0.76	0.32	1.00	2.08
44	*Tetrastigma dubium* (Lawson) Planch.	0.76	0.32	1.00	2.08

Table 55. Phytosociological data of Pre-monsoon herb layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Rungia himalayensis* C.B.Clarke	0.59	5.31	13.83	19.73
2	*Pupalia lappacea* (L.) Juss.	7.10	5.01	1.09	13.19
3	*Persicaria chinensis* (L.) H. Gross	0.59	3.49	9.09	13.17
4	*Oplismenus burmanni* (Retz.) P.Beauv.	3.55	6.22	2.70	12.47
5	*Diplazium esculentum* (Retz.) Sw.	5.33	5.31	1.54	12.17
6	*Ageratum conyzoides* (L.) L.	5.33	4.86	1.40	11.59
7	*Lygodium flexuosum* (L.) Sw.	4.73	4.86	1.58	11.17
8	*Cyperus pangorei* Rottb.	5.33	3.49	1.01	9.83
9	*Dryopteris sikkimensis* (Bedd.) Kuntze	4.14	3.49	1.30	8.93
10	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.78	3.19	2.77	7.73
11	*Commelina suffruticosa* Blume	2.37	3.19	2.07	7.63
12	*Setaria palmifolia* (J. Konig) Stapf.	4.73	2.12	0.69	7.55
13	*Dioscorea bulbifera* L.	4.14	2.43	0.90	7.47
14	*Axonopus compressus* (Sw.) P.Beauv.	0.59	1.82	4.74	7.15
15	*Thelypteris nudata* (Roxb.) C.V. Morton.	2.37	2.73	1.78	6.88
16	*Piper peepuloides* Roxb.	1.78	2.28	1.98	6.03
17	*Polycarpon prostratum* (Forssk.) Asch. & Schweinf.	1.18	1.97	2.57	5.72
18	*Achyranthes bidentata* Blume	1.18	1.82	2.37	5.37
19	*Globba andersonii* C.B.Clarke *ex* Baker	1.78	1.82	1.58	5.18
20	*Curculigo orchioides* Gaertn.	2.37	1.67	1.09	5.12
21	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	1.18	1.67	2.17	5.03
22	*Phaulopsis imbricata* (Forssk.) Sweet	0.59	1.21	3.16	4.97
23	*Phyllanthus emblica* L.	0.59	1.21	3.16	4.97
24	*Hedychium sp*	1.78	1.67	1.45	4.89
25	Ophiopogon wallichianus (Kunth) Hook.f.	1.78	1.67	1.45	4.89
26	*Gouania leptostachya* DC.	1.18	1.52	1.98	4.68
27	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.37	1.37	0.89	4.62
28	*Peristrophe bicalyculata* (Retz.) Nees	2.37	1.21	0.79	4.37
29	*Hydrocotyle sibthorpioides* Lam.	1.18	1.37	1.78	4.33
30	*Torenia sp*	1.18	1.37	1.78	4.33
31	*Carex indica* L.	1.78	1.37	1.19	4.33
32	*Dioscorea pentaphylla* L.	1.78	1.37	1.19	4.33
33	*Oxalis corniculata* L.	1.78	1.21	1.05	4.04
34	*Pteris biaurita* L.	1.78	1.21	1.05	4.04
35	*Barleria cristata* L.	1.18	1.21	1.58	3.98
36	*Curcuma zedoaria* (Christm.) Roscoe	1.18	1.21	1.58	3.98
37	*Piper chuvya* Miq.	1.78	1.06	0.92	3.76
38	*Abrus pulchellus* Thwaites	1.18	1.06	1.38	3.63
39	*Tetrastigma planicaule* (Hook. f.) Gagnep.	1.18	1.06	1.38	3.63
40	*Typhonium trilobatum* (L.) Schott	1.18	1.06	1.38	3.63
41	*Gomphostemma ovatum* Wall. *ex* Benth.	1.18	0.91	1.19	3.28
42	*Mimosa pudica* L.	1.18	0.91	1.19	3.28
43	*Blumea lacera* (Burm.f.) DC.	1.18	0.76	0.99	2.93
44	*Tetrastigma campylocarpum (*Kurz) Planch.	1.18	0.76	0.99	2.93
45	*Senna occidentalis* (L.) Link	0.59	0.61	1.58	2.78
46	*Deeringia amaranthoides* (Lam.) Merr.	0.59	0.61	1.58	2.78
47	*Pericampylus glaucus* (Lam.) Merr.	1.18	0.61	0.79	2.58
48	*Floscopa scandens* Lour.	0.59	0.46	1.19	2.23
49	*Amorphophallus bulbifer* (Roxb.) Blume	0.59	0.30	0.79	1.69
50	*Mimosa himalayana* Gamble	0.59	0.30	0.79	1.69
51	*Pothos scandens* L.	0.59	0.30	0.79	1.69
52	*Tetrastigma dubium* (Lawson) Planch.	0.59	0.30	0.79	1.69

Table 56. Phytosociological data of Post-monsoon herb layer of jarul plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Diplazium esculentum* (Retz.) Sw.	2.64	5.53	3.64	11.81
2	*Dryopteris sikkimensis* (Bedd.) Kuntze	3.52	4.84	2.39	10.74
3	*Rungia himalayensis* C.B.Clarke	3.52	4.54	2.24	10.30
4	*Oplismenus burmanni* (Retz.) P.Beauv.	2.64	4.24	2.79	9.68
5	*Synedrella nodiflora* (L.) Gaertn.	3.23	3.65	1.97	8.85
6	*Persicaria chinensis* (L.) H. Gross	2.05	3.65	3.09	8.80
7	*Pupalia lappacea* (L.) Juss.	2.05	3.65	3.09	8.80
8	*Ageratum conyzoides* (L.) L.	3.23	3.36	1.81	8.39
9	*Cyperus pangorei* Rottb.	2.35	3.36	2.49	8.19
10	*Lygodium flexuosum* (L.) Sw.	2.64	3.16	2.08	7.88
11	*Commelina suffruticosa* Blume	2.05	2.86	2.42	7.34
12	*Curculigo orchioides* Gaertn.	1.76	2.76	2.73	7.25
13	*Dioscorea deltoidea* Wall. *ex* Griseb.	1.76	2.76	2.73	7.25
14	*Setaria palmifolia* (J. Koenig) Stapf.	3.81	2.17	0.99	6.97
15	*Gouania leptostachya* DC.	2.64	2.27	1.49	6.40
16	*Achyranthes bidentata* Blume	2.05	2.17	1.84	6.06
17	*Mimosa himalayana* Gamble	0.59	1.38	4.09	6.06
18	*Carex indica* L.	1.76	2.07	2.05	5.88
19	*Axonopus compressus* (Sw.) P.Beauv.	2.35	1.97	1.46	5.78
20	*Polycarpon prostratum* (Forssk.) Asch. & Schweinf.	2.64	1.88	1.23	5.75
21	*Hydrocotyle sibthorpioides* Lam.	1.47	1.88	2.22	5.56
22	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	2.05	1.68	1.42	5.15
23	*Pteris biaurita* L.	2.35	1.58	1.17	5.09
24	Oxalis corniculata L.	1.17	1.58	2.34	5.09
25	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	2.05	1.58	1.34	4.97
26	Tectaria coadunata (J. Sm.) C. Chr.	2.35	1.38	1.02	4.75
27	*Blumea lacera* (Burm.f.) DC.	1.47	1.48	1.75	4.70
28	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.35	1.28	0.95	4.58
29	*Piper peepuloides* Roxb.	1.76	1.38	1.36	4.51
30	*Curcuma zedoaria* (Christm.) Roscoe	1.47	1.38	1.64	4.49
31	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	2.05	1.28	1.09	4.42
32	*Thelypteris nudata* (Roxb.) C.V. Morton.	1.47	1.28	1.52	4.27
33	*Hedychium sp*	1.17	1.18	1.75	4.11
34	*Torenia sp*	1.17	1.18	1.75	4.11
35	*Globba andersonii* C.B.Clarke *ex* Baker	1.47	1.18	1.40	4.05
36	*Gomphostemma ovatum* Wall. *ex* Benth.	1.17	1.09	1.61	3.87
37	*Mimosa pudica* L.	1.17	1.09	1.61	3.87
38	*Phyllanthus emblica* L.	0.88	0.89	1.75	3.52
39	*Tetrastigma planicaule* (Hook. f.) Gagnep.	0.88	0.89	1.75	3.52
40	*Typhonium trilobatum* (L.) Schott	1.47	0.89	1.05	3.41
41	*Piper chuvy*a Miq.	1.17	0.89	1.32	3.38
42	*Phaulopsis imbricata* (Forssk.) Sweet	0.59	0.69	2.05	3.32
43	*Ophiopogon intermedius* D.Don	1.47	0.79	0.94	3.19
44	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.47	0.79	0.94	3.19
45	*Thunbergia fragrans* Roxb.	1.76	0.69	0.68	3.13
46	*Dioscorea pentaphylla* L.	1.17	0.79	1.17	3.13
47	*Barleria cristata* L.	0.88	0.69	1.36	2.94
48	*Tetrastigma campylocarpum* (Kurz) Planch.	0.88	0.69	1.36	2.94
49	*Senna occidentalis* (L.) Link	1.17	0.69	1.02	2.89
50	*Deeringia amaranthoides* (Lam.) Merr.	0.59	0.49	1.46	2.54
51	*Peristrophe bicalyculata* (Retz.) Nees	0.59	0.49	1.46	2.54
52	*Homalomena rubescens* (Roxb.) Kunth	0.59	0.49	1.46	2.54
53	*Uvaria hamiltonii* Hook f. & Thomson	1.17	0.49	0.73	2.40
54	*Abrus pulchellus* Thwaites	0.88	0.49	0.97	2.35
55	*Pericampylus glaucus* (Lam.) Merr.	0.88	0.49	0.97	2.35

Sl. No.	SPECIES	RF	RD	RA	IVI
56	*Floscopa scandens* Lour.	0.59	0.39	1.17	2.15
57	*Toona ciliata* M.Roem.	0.88	0.30	0.58	1.76
58	*Sterculia villosa* Roxb.	0.88	0.30	0.58	1.76
59	*Amorphophallus bulbifer* (Roxb.) Blume	0.59	0.30	0.88	1.76
60	*Pothos scandens* L.	0.59	0.30	0.88	1.76
61	*Tetrastigma dubium* (Lawson) Planch.	0.59	0.30	0.88	1.76

Table 57. Phytosociological data of winter tree layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Tectona grandis* L.f.	14.71	68.27	35.15	118.12
2	*Pueraria sikkimensis* Prain	8.82	4.33	3.71	16.86
3	*Bauhinia variegate* L.	7.35	2.88	2.97	13.21
4	*Careya arborea* Roxb.	7.35	2.40	2.48	12.23
5	*Alangium alpinum* (C.B.Clarke) W.W.Sm. & Cave	4.41	1.92	3.30	9.64
6	*Crateva religiosa* G.Forst.	4.41	1.92	3.30	9.64
7	*Litsea glutinosa* (Lour.) C.B.Rob.	4.41	1.92	3.30	9.64
8	*Callicarpa arborea* Roxb.	4.41	1.44	2.48	8.33
9	*Lagerstroemia speciosa* (L.) Pers.	4.41	1.44	2.48	8.33
10	*Casearia glomerata* Roxb.	2.94	1.44	3.71	8.10
11	*Dillenia indica* L.	2.94	0.96	2.48	6.38
12	*Michelia champaca* L.	2.94	0.96	2.48	6.38
13	*Gmelina arborea* Roxb.	2.94	0.96	2.48	6.38
14	*Syzygium cumini* (L.) Skeels	2.94	0.96	2.48	6.38
15	*Lannea coromandelica* (Houtt.) Merr.	2.94	0.96	2.48	6.38
16	*Morinda angustifolia* Roxb.	2.94	0.96	2.48	6.38
17	*Sterculia villosa* Roxb.	2.94	0.96	2.48	6.38
18	*Mallotus nudiflorus* (L.) Kulju & Welzen	2.94	0.96	2.48	6.38
19	*Albizia chinensis* (Osbeck) Merr.	2.94	0.96	2.48	6.38
20	*Toona ciliata* M.Roem.	2.94	0.96	2.48	6.38
21	*Terminalia bellirica* (Gaertn.) Roxb.	1.47	0.48	2.48	4.43
22	*Chukrasia tabularis* A.Juss.	1.47	0.48	2.48	4.43
23	*Premna bengalensis* C.B.Clarke	1.47	0.48	2.48	4.43
24	*Shorea robusta* Gaertn.	1.47	0.48	2.48	4.43
25	*Lagerstroemia parviflora* Roxb.	1.47	0.48	2.48	4.43

Table 58. Phytosociological data of Post-monsoon tree layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Tectona grandis* L.f.	13.51	62.61	29.66	105.78
2	*Pueraria sikkimensis* Prain	6.76	5.86	5.55	18.16
3	*Bauhinia variegate* L.	6.76	2.70	2.56	12.02
4	*Crateva religiosa* G.Forst.	5.41	2.70	3.20	11.31
5	*Callicarpa arborea* Roxb.	5.41	2.25	2.67	10.32
6	*Careya arborea* Roxb.	5.41	2.25	2.67	10.32
7	*Casearia glomerata* Roxb.	4.05	2.25	3.56	9.86
8	*Litsea glutinosa* (Lour.) C.B.Rob.	4.05	2.25	3.56	9.86
9	*Alangium alpinum* (C.B.Clarke) W.W.Sm. & Cave	4.05	1.80	2.84	8.70
10	*Lagerstroemia speciosa* (L.) Pers.	4.05	1.35	2.13	7.54
11	*Lannea coromandelica* (Houtt.) Merr.	2.70	1.35	3.20	7.25
12	*Dillenia indica* L.	2.70	0.90	2.13	5.74
13	*Magnolia champaca* (L.) Baill. *ex* Pierre	2.70	0.90	2.13	5.74
14	*Gmelina arborea* Roxb.	2.70	0.90	2.13	5.74
15	*Syzygium cumini* (L.) Skeels	2.70	0.90	2.13	5.74
16	*Morinda angustifolia* Roxb.	2.70	0.90	2.13	5.74

Sl. No.	SPECIES	RF	RD	RA	IVI
17	*Sterculia villosa* Roxb.	2.70	0.90	2.13	5.74
18	*Mallotus nudiflorus* (L.) Kulju & Welzen	2.70	0.90	2.13	5.74
19	*Premna bengalensis* C.B.Clarke	2.70	0.90	2.13	5.74
20	*Albizia chinensis* (Osbeck) Merr.	2.70	0.90	2.13	5.74
21	*Toona ciliata* M.Roem.	2.70	0.90	2.13	5.74
22	*Terminalia bellirica* (Gaertn.) Roxb.	1.35	0.45	2.13	3.94
23	*Chukrasia tabularis* A.Juss.	1.35	0.45	2.13	3.94
24	*Dalbergia stipulacea* Roxb.	1.35	0.45	2.13	3.94
25	*Shorea robusta* Gaertn.	1.35	0.45	2.13	3.94
26	*Streblus asper* Lour.	1.35	0.45	2.13	3.94
27	*Lagerstroemia parviflora* Roxb.	1.35	0.45	2.13	3.94
28	*Mallotus philippensis* (Lam.) Müll.Arg.	1.35	0.45	2.13	3.94
29	*Ziziphus rubiginosa* D.G.Long & Rae	1.35	0.45	2.13	3.94

Table 59. Phytosociological data of winter shrub layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	12.12	26.11	11.16	49.39
2	*Clerodendrum infortunatum* L.	10.61	25.86	12.63	49.10
3	*Urena lobata* L.	5.30	14.04	13.72	33.06
4	*Triumfetta rhomboidea* Jacq.	9.09	7.64	4.35	21.08
5	*Chromolaena odorata* (L.) R.K. King & H. Rob.	12.12	5.67	2.42	20.21
6	*Pueraria sikkimensis* Prain	5.30	2.96	2.89	11.15
7	*Sida acuta* Burm.f.	3.79	2.22	3.03	9.04
8	*Bridelia glauca* Blume	3.79	1.72	2.36	7.87
9	*Barleria cristata* L.	3.03	1.23	2.11	6.37
10	*Casearia glomerata* Roxb.	3.03	1.23	2.11	6.37
11	*Litsea panamanja* (Buch.-Ham. *ex* Nees) Hook. f.	2.27	0.99	2.25	5.50
12	*Morinda angustifolia* Roxb.	2.27	0.99	2.25	5.50
13	*Ardisia solanacea* (Poir.) Roxb.	1.52	0.74	2.53	4.78
14	*Melastoma malabathricum* L.	1.52	0.74	2.53	4.78
15	*Capparis acutifolia* Sweet	2.27	0.74	1.68	4.70
16	*Bauhinia vahlii* Wight & Arn.	1.52	0.49	1.68	3.69
17	*Ixora athroantha* Bremek.	1.52	0.49	1.68	3.69
18	*Sabia paniculata* Edgew. *ex* Hook. f. & Thomson	1.52	0.49	1.68	3.69
19	*Careya arborea* Roxb.	1.52	0.49	1.68	3.69
20	*Leea macrophylla* Roxb. *ex* Hornem.	1.52	0.49	1.68	3.69
21	*Psychotria erratica* Hook.f.	1.52	0.49	1.68	3.69
22	*Girardinia diversifolia* (Link) Friis	1.52	0.49	1.68	3.69
23	*Smilax ovalifolia* Roxb. *ex* D.Don	1.52	0.49	1.68	3.69
24	*Tectona grandis* L.f.	1.52	0.49	1.68	3.69
25	*Vallaris solanacea* (Roth) Kuntze	1.52	0.49	1.68	3.69
26	*Crateva religiosa* G.Forst.	0.76	0.25	1.68	2.69
27	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.76	0.25	1.68	2.69
28	*Grewia asiatica* L.	0.76	0.25	1.68	2.69
29	*Lagerstroemia speciosa* (L.) Pers.	0.76	0.25	1.68	2.69
30	*Macaranga denticulata* (Blume) Mull.Arg.	0.76	0.25	1.68	2.69
31	*Sterculia villosa* Roxb.	0.76	0.25	1.68	2.69
32	*Phyllanthus urinaria* L.	0.76	0.25	1.68	2.69
33	*Meliosma simplicifolia* (Roxb.) Walp.	0.76	0.25	1.68	2.69
34	*Syzygium cumini* (L.) Skeels	0.76	0.25	1.68	2.69

Table 60. Phytosociological data of Pre-monsoon shrub layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	10.13	26.90	12.61	49.63
2	*Urena lobata* L.	6.96	20.46	13.95	41.37
3	*Clerodendrum infortunatum* L.	10.76	18.31	8.08	37.15
4	*Triumfetta rhomboidea* Jacq.	3.80	7.30	9.12	20.22
5	*Chromolaena odorata* (L.) R.M.King & H.Rob.	4.43	4.86	5.21	14.51
6	*Pueraria sikkimensis* Prain	5.70	3.29	2.74	11.73
7	*Morinda angustifolia* Roxb.	3.16	2.43	3.65	9.25
8	*Bridelia sikkimensis* Gehrmann	4.43	1.57	1.69	7.69
9	*Sida acuta* Burm.f.	2.53	1.57	2.95	7.06
10	*Litsea glutinosa* (Lour.) C.B.Rob.	3.80	1.00	1.25	6.05
11	*Casearia glomerata* Roxb.	3.16	1.14	1.72	6.03
12	*Melastoma malabathricum* L.	3.16	1.00	1.50	5.67
13	*Capparis acutifolia* Sweet	2.53	0.72	1.34	4.59
14	*Barleria cristata* L.	1.90	0.72	1.79	4.40
15	*Ardisia solanacea* (Poir.) Roxb.	1.90	0.57	1.43	3.90
16	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.90	0.57	1.43	3.90
17	*Leea guineense* G.Don	1.90	0.57	1.43	3.90
18	*Tectona grandis* L.f.	1.90	0.57	1.43	3.90
19	*Vallaris solanacea* (Roth) Kuntze	1.90	0.57	1.43	3.90
20	*Ixora athroantha* Bremek.	1.90	0.43	1.07	3.40
21	*Careya arborea* Roxb.	1.90	0.43	1.07	3.40
22	*Macaranga denticulata* (Blume) Müll.Arg.	1.90	0.43	1.07	3.40
23	*Smilax ovalifolia* Roxb. *ex* D.Don	1.90	0.43	1.07	3.40
24	*Bauhinia vahlii* Wight & Arn.	1.27	0.43	1.61	3.31
25	*Gomphostemma ovatum* Wall. *ex* Benth.	1.27	0.43	1.61	3.31
26	*Sauropus androgynus* (L.) Merr.	1.27	0.43	1.61	3.31
27	*Clausena excavata* Burm.f.	1.27	0.29	1.07	2.63
28	*Lagerstroemia speciosa* (L.) Pers.	1.27	0.29	1.07	2.63
29	*Sabia paniculata* Edgew. *ex* Hook. f. & Thomson	1.27	0.29	1.07	2.63
30	*Murraya paniculata* (L.) Jack.	1.27	0.29	1.07	2.63
31	*Syzygium cumini* (L.) Skeels	1.27	0.29	1.07	2.63
32	*Albizia lucidior* (Steud.) I.C.Nielsen	0.63	0.14	1.07	1.85
33	*Acacia pennata* (L.) Willd.	0.63	0.14	1.07	1.85
34	Cleidion spiciflorum (Burm.f.) Merr.	0.63	0.14	1.07	1.85
35	*Crateva religiosa* G.Forst.	0.63	0.14	1.07	1.85
36	*Dalbergia stipulacea* Roxb.	0.63	0.14	1.07	1.85
37	*Grewia eriocarpa* Juss.	0.63	0.14	1.07	1.85
38	*Sterculia villosa* Roxb.	0.63	0.14	1.07	1.85
39	*Psychotria erratica* Hook.f.	0.63	0.14	1.07	1.85
40	*Stereospermum tetragonum* DC.	0.63	0.14	1.07	1.85
41	*Dalbergia latifolia* Roxb.	0.63	0.14	1.07	1.85

Table 61. Phytosociological data of Post-monsoon shrub layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L.	7.12	20.00	10.03	37.15
2	*Coffea benghalensis* B.Heyne *ex* Schult.	6.74	19.24	10.19	36.17
3	*Urena lobata* L.	5.99	16.78	9.99	32.76
4	*Triumfetta rhomboidea* Jacq.	2.62	6.45	8.78	17.84
5	*Chromolaena odorata* (L.) R.M.King & H.Rob.	4.12	6.45	5.58	16.15
6	*Pueraria sikkimensis* Prain	4.12	3.22	2.79	10.13
7	*Morinda angustifolia* Roxb.	2.25	2.18	3.46	7.89
8	*Litsea glutinosa* (Lour.) C.B.Rob.	3.37	1.99	2.11	7.47

Sl. No.	SPECIES	RF	RD	RA	IVI
9	*Sida acuta* Burm.f.	2.62	1.71	2.32	6.65
10	*Clausena excavata* Burm.f.	3.37	1.52	1.61	6.49
11	*Bridelia sikkimensis* Gehrm.	2.62	1.52	2.06	6.20
12	*Melastoma malabathricum* L.	3.37	1.33	1.41	6.10
13	*Phlogacanthus thyrsiformis* (Roxb. ex Hardw.) Mabb.	2.62	1.33	1.81	5.76
14	*Capparis acutifolia* Sweet	3.00	1.23	1.47	5.70
15	*Casearia glomerata* Roxb.	2.62	1.04	1.42	5.08
16	*Leea macrophylla* Roxb. *ex* Hornem.	2.62	0.85	1.16	4.64
17	*Flemingia sp.*	2.25	0.85	1.36	4.46
18	*Mallotus philippensis* (Lam.) Müll.Arg.	2.62	0.76	1.03	4.41
19	*Girardinia diversifolia* (Link) Friis	2.25	0.76	1.20	4.21
20	*Sabia paniculata* Edgew. *ex* Hook. f. & Thomson	2.62	0.66	0.90	4.19
21	*Barleria cristata* L.	1.87	0.76	1.45	4.08
22	*Gomphostemma ovatum* Wall. *ex* Benth.	1.87	0.76	1.45	4.08
23	*Macaranga denticulata* (Blume) Müll.Arg.	1.87	0.66	1.26	3.80
24	*Vallaris solanacea* (Roth) Kuntze	1.87	0.66	1.26	3.80
25	*Ardisia solanacea* (Poir.) Roxb.	1.50	0.66	1.58	3.74
26	*Sauropus androgynus* (L.) Merr.	1.50	0.66	1.58	3.74
27	*Careya arborea* Roxb.	1.87	0.57	1.08	3.53
28	*Smilax ovalifolia* Roxb. *ex* D.Don	1.50	0.57	1.36	3.42
29	*Bauhinia vahlii* Wight & Arn.	1.87	0.47	0.90	3.25
30	*Tectona grandis* L.f.	1.50	0.47	1.13	3.10
31	*Psychotria erratica* Hook.f.	0.75	0.38	1.81	2.93
32	*Ixora athroantha* Bremek.	1.50	0.38	0.90	2.78
33	*Murraya paniculata* (L.) Jack.	0.75	0.28	1.36	2.39
34	*Phyllanthus urinaria* L.	0.75	0.28	1.36	2.39
35	*Acacia pennata* (L.) Willd.	1.12	0.28	0.90	2.31
36	*Acalypha spiciflora* Burm.f.	1.12	0.28	0.90	2.31
37	*Crateva religiosa* G.Forst.	1.12	0.28	0.90	2.31
38	*Grewia eriocarpa* Juss.	1.12	0.28	0.90	2.31
39	*Lagerstroemia speciosa* (L.) Pers.	1.12	0.28	0.90	2.31
40	*Albizia lucidior* (Steud.) I.C.Nielsen	0.75	0.19	0.90	1.84
41	*Dalbergia stipulacea* Roxb.	0.75	0.19	0.90	1.84
42	*Actinodaphne obovata* (Nees) Blume	0.75	0.19	0.90	1.84
43	*Stereospermum tetragonum* DC.	0.75	0.19	0.90	1.84
44	*Syzygium cumini* (L.) Skeels	0.75	0.19	0.90	1.84
45	*Sterculia villosa* Roxb.	0.37	0.09	0.90	1.37
46	*Toona ciliata* M.Roem.	0.37	0.09	0.90	1.37

Table 62. Phytosociological data of winter herb layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Setaria palmifolia* (J. Koenig) Stapf	4.17	10.24	5.57	19.97
2	*Oplismenus burmanni* (Retz.) P.Beauv.	13.89	5.12	0.84	19.84
3	*Pupalia lappacea* (L.) Juss.	5.56	8.27	3.37	17.20
4	*Commelina diffusa* Burm.f.	4.86	5.51	2.57	12.94
5	*Ichnocarpus frutescens* (L.) W.T.Aiton	5.56	5.12	2.09	12.76
6	*Thelypteris nudata* (Roxb.) C.V. Morton.	5.56	5.12	2.09	12.76
7	*Dryopteris sikkimensis* (Bedd.) Kuntze	4.17	3.94	2.14	10.25
8	*Carex indica* L.	2.08	3.54	3.85	9.48
9	*Tetrastigma campylocarpum* (Kurz) Planch.	3.47	3.54	2.31	9.33
10	*Diplazium esculentum* (Retz.) Sw.	2.78	3.54	2.89	9.21
11	*Mikania micrantha* Kunth	2.78	3.54	2.89	9.21
12	*Peristrophe bicalyculata* (Retz.) Nees	5.56	2.36	0.96	8.88
13	*Lygodium flexuosum* (L.) Sw.	2.08	2.76	3.00	7.84
14	*Piper peepuloides* Roxb.	2.78	2.76	2.25	7.78

Sl. No.	SPECIES	RF	RD	RA	IVI
15	*Lepidagathis incurva* Buch.-Ham. *ex* D.Don	1.39	2.36	3.85	7.61
16	*Piper chuvya* Miq.	2.78	2.36	1.93	7.07
17	*Ageratum conyzoides* (L.) L.	2.08	2.36	2.57	7.02
18	*Cyperus compressus* L.	2.08	2.36	2.57	7.02
19	*Phaulopsis imbricata* (Forssk.) Sweet	2.08	2.36	2.57	7.02
20	*Rungia himalayensis* C.B.Clarke	2.08	2.36	2.57	7.02
21	*Curculigo orchioides* Gaertn.	2.08	1.97	2.14	6.19
22	*Ophiopogon intermedius* D.Don	0.69	1.18	3.85	5.73
23	*Dioscorea belophylla* (Prain) Voigt *ex* Haines	1.39	1.57	2.57	5.53
24	*Persicaria chinensis* (L.) H. Gross	1.39	1.57	2.57	5.53
25	*Phyllanthus emblica* L.	1.39	1.57	2.57	5.53
26	*Gouania leptostachya* DC.	2.08	1.18	1.28	4.55
27	*Axonopus compressus* (Sw.) P.Beauv.	1.39	1.18	1.93	4.50
28	*Floscopa scandens* Lour.	1.39	1.18	1.93	4.50
29	*Achyranthes bidentata* Blume	0.69	0.79	2.57	4.05
30	*Gomphostemma ovatum* Wall. *ex* Benth.	0.69	0.79	2.57	4.05
31	*Pteris biaurita* L.	0.69	0.79	2.57	4.05
32	*Tetrastigma dubium* (Lawson) Planch.	0.69	0.79	2.57	4.05
33	*Tectaria gemmifera* (Fée) Alston	0.69	0.79	2.57	4.05
34	*Tetrastigma planicaule* (Hook. f.) Gagnep.	0.69	0.79	2.57	4.05
35	*Dioscorea pentaphylla* L.	0.69	0.79	2.57	4.05
36	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.69	0.79	2.57	4.05
37	*Pericampylus glaucus* (Lam.) Merr.	1.39	0.79	1.28	3.46
38	*Barleria cristata* L.	0.69	0.39	1.28	2.37
39	*Deeringia amaranthoides* (Lam.) Merr.	0.69	0.39	1.28	2.37
40	*Ficus pumila* L.	0.69	0.39	1.28	2.37
41	*Pothos scandens* L.	0.69	0.39	1.28	2.37
42	*Thunbergia fragrans* Roxb.	0.69	0.39	1.28	2.37

Table 63. Phytosociological data of Pre-monsoon herb layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Oplismenus burmanni* (Retz.) P.Beauv.	1.48	9.19	13.23	23.90
2	*Setaria palmifolia* (J.Koenig) Stapf	4.43	7.75	3.72	15.90
3	*Pupalia lappacea* (L.) Juss.	3.94	6.67	3.60	14.21
4	*Thelypteris nudata* (Roxb.) C.V. Morton.	5.42	4.32	1.70	11.44
5	*Commelina diffusa* Burm.f.	5.42	4.14	1.63	11.19
6	*Ichnocarpus frutescens* (L.) W.T.Aiton	4.43	4.32	2.08	10.83
7	*Mikania micrantha* Kunth	2.96	4.14	2.98	10.08
8	*Diplazium esculentum* (Retz.) Sw.	2.46	3.96	3.42	9.85
9	*Synedrella nodiflora* (L.) Gaertn.	3.45	3.42	2.11	8.98
10	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	5.42	2.34	0.92	8.68
11	*Peristrophe bicalyculata* (Retz.) Nees	2.96	3.24	2.33	8.53
12	*Dryopteris sikkimensis* (Bedd.) Kuntze	1.97	3.06	3.31	8.34
13	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.97	3.06	3.31	8.34
14	*Ageratum conyzoides* (L.) L.	2.46	3.06	2.65	8.17
15	*Carex indica* L.	3.94	2.70	1.46	8.10
16	*Rungia himalayensis* C.B.Clarke	1.48	2.52	3.63	7.63
17	*Cyperus compressus* L.	3.94	2.34	1.26	7.55
18	*Tetrastigma planicaule* (Hook. f.) Gagnep.	2.46	2.34	2.02	6.83
19	*Piper peepuloides* Wall.	2.96	2.16	1.56	6.67
20	*Lygodium flexuosum* (L.) Sw.	1.97	2.16	2.33	6.47
21	*Tetrastigma campylocarpum* (Kurz) Planch.	1.97	1.80	1.95	5.72
22	*Phaulopsis imbricata* (Forssk.) Sweet	1.48	1.62	2.33	5.43
23	*Piper chuvya* Miq.	2.46	1.44	1.25	5.15
24	*Dioscorea belophylla* (Prain) Voigt *ex* Haines	1.97	1.44	1.56	4.97

Sl. No.	SPECIES	RF	RD	RA	IVI
25	*Curculigo orchioides* Gaertn.	1.97	1.26	1.36	4.59
26	*Gouania leptostachya* DC.	1.97	1.26	1.36	4.59
27	*Persicaria chinensis* (L.) H. Gross	1.97	1.26	1.36	4.59
28	*Ophiopogon wallichianus* (Kunth) Hook.f.	1.48	1.26	1.82	4.56
29	*Phyllanthus emblica* L.	1.48	1.26	1.82	4.56
30	*Axonopus compressus* (Sw.) P.Beauv.	1.48	1.08	1.56	4.12
31	*Pteris biaurita* L.	1.48	1.08	1.56	4.12
32	*Tectaria gemmifera* (Fée) Alston	0.49	0.54	2.33	3.37
33	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.99	0.72	1.56	3.26
34	*Gomphostemma ovatum* Wall. *ex* Benth.	1.48	0.72	1.04	3.24
35	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.48	0.72	1.04	3.24
36	*Pericampylus glaucus* (Lam.) Merr.	1.48	0.72	1.04	3.24
37	*Tetrastigma dubium* (Lawson) Planch.	1.48	0.72	1.04	3.24
38	*Homalomena rubescens* (Roxb.) Kunth	0.99	0.54	1.17	2.69
39	*Pothos scandens* L.	0.99	0.54	1.17	2.69
40	*Achyranthes bidentata* Blume	0.49	0.36	1.56	2.41
41	*Barleria cristata* L.	0.49	0.36	1.56	2.41
42	*Deeringia amaranthoides* (Lam.) Merr.	0.49	0.36	1.56	2.41
43	*Ficus pumila* L.	0.49	0.36	1.56	2.41
44	*Ophioglossum sp*	0.49	0.36	1.56	2.41
45	*Pueraria phaseoloides* (Roxb.) Benth.	0.49	0.36	1.56	2.41
46	*Thunbergia fragrans* Roxb.	0.99	0.36	0.78	2.12
47	*Abrus pulchellus* Thwaites	0.49	0.18	0.78	1.45
48	*Jasminum dispermum* Wall.	0.49	0.18	0.78	1.45
49	*Leucas grandis* Vatke	0.49	0.18	0.78	1.45

Table 64. Phytosociological data of Post-monsoon herb layer of teak plantation in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Oplismenus burmanni* (Retz.) P.Beauv.	9.05	5.97	1.03	16.05
2	*Mikania micrantha* Kunth	0.45	3.33	11.46	15.24
3	*Dioscorea bulbifera* L.	4.07	7.36	2.81	14.24
4	*Commelina suffruticosa* Blume	4.07	6.39	2.44	12.90
5	*Synedrella nodiflora* (L.) Gaertn.	4.52	5.83	2.01	12.36
6	*Lygodium flexuosum* (L.) Sw.	0.45	2.64	9.07	12.16
7	*Ageratum conyzoides* (L.) L.	3.62	5.28	2.27	11.17
8	*Thelypteris nudata* (Roxb.) C.V. Morton.	4.07	4.58	1.75	10.41
9	*Pupalia lappacea* (L.) Juss.	4.07	4.44	1.70	10.21
10	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	4.98	3.33	1.04	9.35
11	*Peristrophe bicalyculata* (Retz.) Nees	3.62	2.92	1.25	7.79
12	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.26	3.19	2.20	7.65
13	*Ichnocarpus frutescens* (L.) W.T.Aiton	3.62	2.64	1.13	7.39
14	*Persicaria chinensis* (L.) H. Gross	0.90	2.36	4.06	7.32
15	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	1.81	2.92	2.51	7.23
16	*Tetrastigma planicaule* (Hook. f.) Gagnep.	2.71	2.36	1.35	6.43
17	*Axonopus compressus* (Sw.) P.Beauv.	1.81	2.36	2.03	6.20
18	*Diplazium esculentum* (Retz.) Sw.	2.71	2.08	1.19	5.99
19	*Piper peepuloides* Wall.	1.81	2.08	1.79	5.68
20	*Ophiopogon intermedius* D.Don	0.45	1.11	3.82	5.38
21	*Phaulopsis imbricata* (Forssk.) Sweet	0.45	1.11	3.82	5.38
22	*Carex indica* L.	1.81	1.81	1.55	5.17
23	*Rungia himalayensis* C.B.Clarke	1.36	1.67	1.91	4.93
24	*Lepidagathis incurva* Buch.-Ham. *ex* D.Don	2.26	1.53	1.05	4.84
25	*Floscopa scandens* Lour.	0.45	0.83	2.86	4.15
26	*Phyllanthus emblica* L.	0.45	0.83	2.86	4.15
27	*Piper chuvya* Miq.	1.36	1.11	1.27	3.74

Sl. No.	SPECIES	RF	RD	RA	IVI
28	*Gouania leptostachya* DC.	1.36	1.11	1.27	3.74
29	*Homalomena rubescens* (Roxb.) Kunth	1.81	0.97	0.84	3.62
30	*Barleria cristata* L.	1.81	0.97	0.84	3.62
31	*Pericampylus glaucus* (Lam.) Merr.	0.90	0.97	1.67	3.55
32	*Pueraria phaseoloides* (Roxb.) Benth.	0.90	0.97	1.67	3.55
33	*Cyperus pangorei* Rottb.	1.36	0.97	1.11	3.44
34	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.36	0.97	1.11	3.44
35	*Tetrastigma campylocarpum* (Kurz) Planch.	0.90	0.83	1.43	3.17
36	*Cheilocostus speciosus* (J.Koenig) C.D.Specht.	1.36	0.83	0.95	3.15
37	*Tectaria gemmifera* (Fée) Alston	1.36	0.83	0.95	3.15
38	*Vallaris solanacea* (Roth) Kuntze	1.36	0.83	0.95	3.15
39	*Curculigo orchioides* Gaertn.	1.36	0.69	0.80	2.85
40	*Pothos scandens* L.	1.36	0.69	0.80	2.85
41	*Tetrastigma dubium* (Lawson) Planch.	1.36	0.69	0.80	2.85
42	*Setaria palmifolia* (J.Koenig) Stapf	1.36	0.56	0.64	2.55
43	*Pteris biaurita* L.	0.90	0.56	0.95	2.42
44	*Gomphostemma ovatum* Wall. *ex* Benth.	0.45	0.42	1.43	2.30
45	*Leucas grandis* Vatke	0.45	0.42	1.43	2.30
46	*Deeringia amaranthoides* (Lam.) Merr.	1.36	0.42	0.48	2.25
47	*Jasminum dispermum* Wall.	1.36	0.42	0.48	2.25
48	*Sauropus androgynus* (L.) Merr.	0.90	0.42	0.72	2.04
49	*Thunbergia fragrans* Roxb.	0.90	0.42	0.72	2.04
50	*Achyranthes bidentata* Blume	0.45	0.28	0.95	1.69
51	*Asparagus racemosus* Willd.	0.45	0.28	0.95	1.69
52	*Sterculia villosa* Roxb.	0.45	0.28	0.95	1.69
53	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.45	0.28	0.95	1.69
54	*Stereospermum tetragonum* DC.	0.90	0.28	0.48	1.66
55	*Toona ciliata* M.Roem.	0.90	0.28	0.48	1.66
56	*Antidesma montanum* Blume.	0.45	0.14	0.48	1.07
57	*Uvaria hamiltonii* Hook. f. & Thomson	0.45	0.14	0.48	1.07

Table 65. Phytosociological data of winter tree layer of jarul (satali) plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia speciosa* (L.) Pers.	13.51	62.39	50.25	126.15
2	*Litsea monopetala* (Roxb.) Pers.	13.51	8.26	6.65	28.42
3	*Albizia lucidior* (Steud.) I.C.Nielsen	10.81	5.50	5.54	21.86
4	*Crateva religiosa* G.Forst.	10.81	3.67	3.69	18.18
5	*Lagerstroemia parviflora* Roxb.	8.11	3.67	4.93	16.70
6	*Streblus asper* Lour.	8.11	3.67	4.93	16.70
7	*Ficus hispida* L.f.	8.11	2.75	3.69	14.55
8	*Albizia chinensis* (Osbeck) Merr.	8.11	2.75	3.69	14.55
9	*Tectona grandis* L.f.	5.41	2.75	5.54	13.70
10	*Phyllanthus emblica* L.	5.41	1.83	3.69	10.93
11	*Schima wallichii* (DC.) Korth.	5.41	1.83	3.69	10.93
12	*Magnolia pterocarpa* Roxb.	2.70	0.92	3.69	7.31

Table 66. Phytosociological data of Post-monsoon tree layer of jarul (satali) plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia speciosa* (L.) Pers.	12.82	59.84	47.74	120.40
2	*Litsea monopetala* (Roxb.) Pers.	12.82	8.20	6.54	27.56
3	*Albizia lucidior* (Steud.) I.C.Nielsen	12.82	5.74	4.58	23.14
4	*Crateva religiosa* G.Forst.	10.26	5.74	5.72	21.72
5	*Ficus hispida* L.f.	7.69	3.28	4.36	15.33

Sl. No.	SPECIES	RF	RD	RA	IVI
6	*Albizia chinensis* (Osbeck) Merr.	7.69	3.28	4.36	15.33
7	*Lagerstroemia parviflora* Roxb.	7.69	3.28	4.36	15.33
8	*Streblus asper* Lour.	7.69	3.28	4.36	15.33
9	*Tectona grandis* L.f.	5.13	2.46	4.90	12.49
10	*Phyllanthus emblica* L.	5.13	1.64	3.27	10.04
11	*Schima wallichii* (DC.) Korth.	5.13	1.64	3.27	10.04
12	*Magnolia pterocarpa* Roxb.	2.56	0.82	3.27	6.65
13	*Artocarpus lacucha* Buch.-Ham.	2.56	0.82	3.27	6.65

Table 67. Phytosociological data of winter shrub layer of jarul (satali) plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	15.79	64.41	43.06	123.26
2	*Clerodendrum infortunatum* L.	10.53	17.37	17.42	45.32
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	10.53	4.66	4.67	19.86
4	*Mikania micrantha* Kunth	10.53	2.54	2.55	15.62
5	*Dendrocnide sinuata* (Blume) Chew	5.26	1.69	3.40	10.36
6	*Dioscorea bulbifera* L.	5.26	1.27	2.55	9.08
7	*Solanum aculeatissimum* Jacq.	5.26	1.27	2.55	9.08
8	*Casearia glomerata* Roxb.	5.26	0.85	1.70	7.81
9	*Girardinia diversifolia* (Link) Friis	5.26	0.85	1.70	7.81
10	*Leea aequata* L.	2.63	0.85	3.40	6.88
11	*Maesa indica* (Roxb.) A.DC.	2.63	0.85	3.40	6.88
12	*Urena lobata* L.	2.63	0.42	1.70	4.76
13	*Ficus hispida* L.f.	2.63	0.42	1.70	4.76
14	*Gouania leptostachya* DC.	2.63	0.42	1.70	4.76
15	*Lagerstroemia speciosa* (L.) Pers.	2.63	0.42	1.70	4.76
16	*Litsea glutinosa* (Lour.) C.B.Rob.	2.63	0.42	1.70	4.76
17	*Murraya koenigii* (L.) Spreng.	2.63	0.42	1.70	4.76
18	*Streblus asper* Lour.	2.63	0.42	1.70	4.76
19	*Dioscorea pentaphylla* L.	2.63	0.42	1.70	4.76

Table 68. Phytosociological data of pre-monsoon shrub layer of jarul (satali) plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	8.96	50.52	33.95	93.43
2	*Clerodendrum infortunatum* L.	8.96	13.87	9.32	32.15
3	*Leea aequata* L.	13.43	9.42	4.22	27.08
4	*Eupatorium odoratum* L.	2.99	5.24	10.55	18.77
5	*Mikania micrantha* Kunth	10.45	2.88	1.66	14.99
6	*Dendrocnide sinuata* (Blume) Chew	2.99	3.93	7.92	14.83
7	*Solanum khasianum* C. B. Clarke	1.49	2.09	8.44	12.03
8	*Dioscorea bulbifera* L.	7.46	2.09	1.69	11.25
9	*Crateva religiosa* G.Forst.	5.97	1.31	1.32	8.60
10	*Ficus hispida* L.f.	5.97	1.05	1.06	8.07
11	*Gouania leptostachya* DC.	4.48	1.05	1.41	6.93
12	*Lagerstroemia reginae* Roxb.	4.48	0.79	1.06	6.32
13	*Girardinia diversifolia* (Link) Friis	1.49	0.79	3.17	5.44
14	*Urena lobata* L.	2.99	0.79	1.58	5.35
15	*Ardisia solanacea* (Poir.)Roxb.	2.99	0.52	1.06	4.56
16	*Casearia glomerata* Roxb.	2.99	0.52	1.06	4.56
17	*Albizia chinensis* (Osbeck) Merr.	2.99	0.52	1.06	4.56
18	*Dioscorea pentaphylla* L.	2.99	0.52	1.06	4.56
19	*Litsea glutinosa* (Lour.) C.B.Rob.	1.49	0.52	2.11	4.13

Sl. No.	SPECIES	RF	RD	RA	IVI
20	*Maesa indica* (Roxb.) A. DC.	1.49	0.52	2.11	4.13
21	*Murraya koenigii* (L.) Spreng.	1.49	0.52	2.11	4.13
22	*Streblus asper* Lour.	1.49	0.52	2.11	4.13

Table 69. Phytosociological data of Post-monsoon shrub layer of jarul (satali) plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	7.50	42.49	31.54	81.54
2	*Clerodendrum infortunatum* L.	6.67	13.74	11.47	31.88
3	*Leea aequata* L.	6.67	8.03	6.71	21.41
4	*Eupatorium odoratum* L.	6.67	7.19	6.00	19.86
5	*Dendrocnide sinuata* (Blume) Chew	5.83	4.44	4.24	14.51
6	*Mikania micrantha* Kunth	6.67	3.81	3.18	13.65
7	*Dioscorea bulbifera* L.	5.00	2.33	2.59	9.91
8	*Solanum khasianum* C. B. Clarke	5.00	2.33	2.59	9.91
9	*Crateva religiosa* G.Forst.	5.00	1.48	1.65	8.13
10	*Dioscorea pentaphylla* L.	4.17	1.48	1.98	7.62
11	*Ficus hispida* L.f.	4.17	1.27	1.69	7.13
12	*Girardinia diversifolia* (Link) Friis	3.33	1.27	2.12	6.72
13	*Gouania leptostachya* DC.	2.50	1.06	2.35	5.91
14	*Croton caudatus* Geiselar	3.33	0.85	1.41	5.59
15	*Urena lobata* L.	3.33	0.85	1.41	5.59
16	*Murraya koenigii* (L.) Spreng.	3.33	0.85	1.41	5.59
17	*Casearia glomerata* Roxb.	2.50	0.85	1.88	5.23
18	*Maesa indica* (Roxb.) A. DC	2.50	0.85	1.88	5.23
19	*Streblus asper* Lour.	2.50	0.85	1.88	5.23
20	*Lagerstroemia reginae* Roxb.	2.50	0.63	1.41	4.55
21	*Litsea glutinosa* (Lour.) C.B.Rob.	2.50	0.63	1.41	4.55
22	*Albizia chinensis* (Osbeck) Merr.	2.50	0.63	1.41	4.55
23	*Ardisia solanacea* (Poir.) Roxb.	1.67	0.63	2.12	4.42
24	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.67	0.63	2.12	4.42
25	*Tetrastigma serrulatum (*Roxb.) Planch.	1.67	0.63	2.12	4.42
26	*Stephania glabra* (Roxb.) Miers	0.83	0.21	1.41	2.46

Table 70. Phytosociological data of winter herb layer of jarul (satali) plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Diplazium esculentum* (Retz.) Sw.	17.95	20.57	4.81	43.34
2	*Dioscorea bulbifera* L.	11.11	11.00	4.16	26.28
3	*Gonostegia hirta* (Blume *ex* Hassk.) Miq.	8.55	10.05	4.94	23.53
4	*Oplismenus burmanni* (Retz.) P.Beauv.	5.13	8.61	7.05	20.79
5	*Pupalia Lappacea* (L.) Juss.	4.27	7.66	7.52	19.45
6	*Dioscorea pentaphylla* L.	5.13	6.70	5.49	17.31
7	*Dryopteris sparsa* (D.Don) Kuntze	6.84	5.26	3.23	15.33
8	*Mikania micrantha* Kunth	5.98	4.31	3.02	13.31
9	*Phyllanthus urinaria* L.	3.42	4.31	5.29	13.02
10	*Piper betleoides* C.DC.	5.13	3.35	2.74	11.22
11	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.71	1.91	4.70	8.33
12	*Typhonium trilobatum* (L.) Schott	2.56	1.91	3.14	7.61
13	*Gomphostemma ovatum* Wall. *ex* Benth.	2.56	1.91	3.14	7.61
14	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	2.56	1.91	3.14	7.61
15	*Athyrium sp*	0.85	0.96	4.70	6.51
16	*Ophioglossum lanceolatum* (Luerss.) Prantl	0.85	0.96	4.70	6.51
17	*Chloranthus elatior* Link	2.56	1.44	2.35	6.35

Sl. No.	SPECIES	RF	RD	RA	IVI
18	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.56	1.44	2.35	6.35
19	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.71	0.96	2.35	5.02
20	*Tectaria coadunata* C. Chr.	1.71	0.96	2.35	5.02
21	*Momordica charantia* L.	0.85	0.48	2.35	3.68
22	*Desmodium triflorum* (L.) DC.	0.85	0.48	2.35	3.68
23	*Deeringia amaranthoides* (Lam.) Merr.	0.85	0.48	2.35	3.68
24	*Desmodium laxiflorum* DC.	0.85	0.48	2.35	3.68
25	*Gouania leptostachya* DC.	0.85	0.48	2.35	3.68
26	*Merremia hirta* (L.) Merr.	0.85	0.48	2.35	3.68
27	*Merremia vitifolia* (Burm. f.) Hallier f.	0.85	0.48	2.35	3.68
28	*Tetrastigma dubium* (Lawson) Planch.	0.85	0.48	2.35	3.68

Table 71. Phytosociological data of Pre-monsoon herb layer of jarul (satali) plantation in NRVK site

SL NO	SPECIES	RF	RD	RA	IVI
1	*Diplazium esculentum* (Retz.) Sw.	14.50	16.27	4.18	34.95
2	*Dioscorea bulbifera* L.	9.92	13.86	5.20	28.98
3	*Borreria alata* (Aubl.) DC.	2.29	5.72	9.31	17.33
4	*Oplismenus burmanni* (Retz.) P.Beauv.	6.11	6.33	3.86	16.29
5	*Pouzolzia zeylanica* (L.) Benn.	6.11	6.33	3.86	16.29
6	*Pupalia lappacea* (L.) Juss.	4.58	6.33	5.15	16.05
7	*Dryopteris sparsa* (D. Don) Kuntze	6.87	4.82	2.61	14.30
8	*Dioscorea pentaphylla* L.	3.82	5.12	5.00	13.94
9	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	3.82	4.82	4.71	13.34
10	*Commelina diffusa* Burm.f.	4.58	3.92	3.19	11.68
11	*Typhonium trilobatum* (L.) Schott	2.29	3.31	5.39	10.99
12	*Mikania micrantha* Kunth	4.58	3.31	2.70	10.59
13	*Piper betleoides* C.DC.	3.82	3.01	2.94	9.77
14	*Phyllanthus urinaria* L.	4.58	2.71	2.21	9.50
15	*Synedrella nodiflora* (L.) Gaertn.	2.29	2.71	4.41	9.41
16	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.53	1.51	3.68	6.71
17	*Axonopus compressus* (Sw.) P.Beauv.	2.29	1.51	2.45	6.25
18	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.53	1.20	2.94	5.67
19	*Chloranthus elatior* Link	2.29	1.20	1.96	5.46
20	*Tectaria gemmifera* (Fée) Alston	1.53	0.90	2.21	4.64
21	*Globba racemosa* Sm.	0.76	0.60	2.94	4.31
22	*Helminthostachys zeylanica* (L.) Hook.	0.76	0.60	2.94	4.31
23	*Merremia hirta* (L.) Merr.	0.76	0.60	2.94	4.31
24	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.53	0.60	1.47	3.60
25	*Deeringia amaranthoides* (Lam.) Merr.	1.53	0.60	1.47	3.60
26	*Trichosanthes tricuspidata* Lour.	0.76	0.30	1.47	2.53
27	*Curculigo orchioides* Gaertn.	0.76	0.30	1.47	2.53
28	*Desmodium triflorum* (L.) DC.	0.76	0.30	1.47	2.53
29	*Desmodium laxiflorum* DC.	0.76	0.30	1.47	2.53
30	*Gouania leptostachya* DC.	0.76	0.30	1.47	2.53
31	*Merremia vitifolia* (Burm. f.) Hallier f.	0.76	0.30	1.47	2.53
32	*Tetrastigma dubium* (Lawson) Planch.	0.76	0.30	1.47	2.53

Table 72. Phytosociological data of Post-monsoon herb layer of jarul (satali) plantation in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Diplazium esculentum* (Retz.) Sw.	10.55	12.19	3.25	25.99
2	*Dioscorea bulbifera* L.	7.80	11.29	4.08	23.17
3	*Pouzolzia zeylanica* (L.) Benn.	4.13	5.73	3.91	13.78

Sl. No.	SPECIES	RF	RD	RA	IVI
4	*Chloranthus elatior* Link	3.67	5.56	4.27	13.49
5	*Oplismenus burmanni* (Retz.) P.Beauv.	5.05	4.66	2.60	12.31
6	*Pupalia lappacea* (L.) Juss.	3.21	4.66	4.09	11.96
7	*Borreria alata* (Aubl.) DC.	1.38	3.41	6.97	11.75
8	*Impatiens trilobata* Colebr.	5.05	4.30	2.40	11.75
9	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	5.96	3.76	1.78	11.50
10	*Mikania micrantha* Kunth	3.67	4.12	3.16	10.96
11	*Commelina diffusa* Burm.f.	2.75	3.76	3.85	10.37
12	*Dryopteris sparsa* (D. Don) Kuntze	5.05	3.41	1.90	10.35
13	*Dioscorea pentaphylla* L.	3.21	3.76	3.30	10.28
14	*Piper betleoides* C.DC.	3.21	3.23	2.83	9.27
15	*Typhonium trilobatum* (L.) Schott	2.29	2.87	3.52	8.68
16	*Phyllanthus urinaria* L.	3.67	2.51	1.93	8.11
17	*Alocasia fallax* Schott	2.29	2.51	3.08	7.88
18	*Youngia japonica* (L.) DC.	1.83	2.33	3.58	7.74
19	*Synedrella nodiflora* (L.) Gaertn.	2.29	1.97	2.42	6.69
20	*Gomphostemma ovatum* Wall. *ex* Benth.	1.38	1.61	3.30	6.29
21	*Axonopus compressus* (Sw.) P.Beauv.	2.29	1.43	1.76	5.49
22	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.29	1.25	1.54	5.09
23	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.83	1.08	1.65	4.56
24	*Deeringia amaranthoides* (Lam.) Merr.	1.38	0.90	1.83	4.11
25	*Tectaria gemmifera* (Fée) Alston	1.38	0.90	1.83	4.11
26	*Crassocephalum crepidioides* (Benth.) S.Moore	0.92	0.72	2.20	3.84
27	*Globba racemosa* Sm.	1.38	0.72	1.47	3.56
28	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	0.92	0.54	1.65	3.11
29	*Athyrium sp*	0.92	0.54	1.65	3.11
30	*Gouania leptostachya* DC.	0.92	0.54	1.65	3.11
31	*Oenanthe thomsonii* C.B.Clarke	0.92	0.54	1.65	3.11
32	*Tetrastigma dubium* (Lawson) Planch.	0.92	0.54	1.65	3.11
33	*Helminthostachys zeylanica* (L.) Hook.	0.46	0.36	2.20	3.02
34	*Merremia hirta* (L.) Merr.	0.46	0.36	2.20	3.02
35	*Ophioglossum lanceolatum* (Luerss.) Prantl	0.46	0.36	2.20	3.02
36	*Desmodium laxiflorum* DC.	0.92	0.36	1.10	2.38
37	*Merremia vitifolia* (Burm. f.) Hallier f.	0.92	0.36	1.10	2.38
38	*Solanum americanum* Mill.	0.92	0.36	1.10	2.38
39	*Momordica charantia* L.	0.46	0.18	1.10	1.74
40	*Curculigo orchioides* Gaertn.	0.46	0.18	1.10	1.74
41	*Desmodium triflorum* (L.) DC.	0.46	0.18	1.10	1.74

Table 73. Phytosociological data of tree layer of natural vegetation in winter in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Tabernaemontana Divaricata* (L.) R.Br. *Ex* Roem. & Schult.	6.044	9.759	2.180	17.983
2	*Dendrocnide Sinuata* (Blume) Chew	2.564	8.152	4.292	15.007
3	*Mallotus Nudiflorus* (L.) Kulju & Welzen	5.495	7.233	1.777	14.505
4	*Aphanamixis Polystachya* (Wall.) R.Parker	4.762	4.133	1.172	10.067
5	*Leea Guineensis* G.Don	3.480	3.904	1.514	8.898
6	*Litsea Monopetala* (Roxb.) Pers.	3.480	3.904	1.514	8.898
7	*Polyalthia Simiarum* (Buch.-Ham. *Ex* Hook. F. & Thomson) Benth. *Ex* Hook.F. & Thomson	4.396	3.100	0.952	8.447
8	*Casearia Vareca* Roxb.	2.381	3.559	2.018	7.958
9	*Ailanthus Integrifolia* Lam.	2.198	3.559	2.186	7.943
10	*Tetrameles Nudiflora* R.Br.	3.114	2.526	1.095	6.735
11	*Croton Caudatus* Geiseler	2.198	2.755	1.692	6.646
12	*Aglaia Spectabilis* (Miq.) S.S.Jain & S.Bennet	3.297	2.296	0.940	6.533

Sl. No.	SPECIES	RF	RD	RA	IVI
13	*Dysoxylum Excelsum* Blume	3.114	2.067	0.896	6.076
14	*Rhamnus Napalensis* (Wall.) M.A. Lawson	2.564	2.067	1.088	5.719
15	*Turpinia Pomifera* (Roxb.) DC.	2.747	1.952	0.959	5.658
16	*Shorea Robusta* Gaertn.	2.564	1.952	1.028	5.543
17	*Magnolia Pterocarpa* Roxb.	2.564	1.837	0.967	5.368
18	*Litsea Panamanja* (Buch.-Ham. Ex Nees) Hook.F.	1.832	1.952	1.439	5.222
19	*Lagerstroemia Hirsuta* (Lam.) Willd.	1.648	1.952	1.598	5.199
20	*Elaeocarpus Lanceolatus* Blume	1.465	1.837	1.692	4.995
21	*Casearia Glomerata* Roxb.	1.648	1.837	1.504	4.990
22	*Reevesia Wallichii* R.Br.	2.198	1.722	1.058	4.978
23	*Actinodaphne Obovata* (Nees) Blume	1.832	1.722	1.269	4.823
24	*Chisocheton Cumingianus (*C.DC.) Harms	0.733	1.263	2.327	4.323
25	*Stereospermum Tetragonum* DC.	2.015	1.263	0.846	4.124
26	*Murraya Paniculata* (L.) Jack	0.183	0.459	3.385	4.027
27	*Syzygium Formosum* (Wall) Masam.	1.832	1.263	0.931	4.025
28	*Mallotus Philippensis* (Lam.) Müll.Arg.	1.465	1.263	1.164	3.892
29	*Tetrastigma Planicaule* (Hook.F.) Gagnep.	1.282	1.033	1.088	3.403
30	*Cordia Myxa* L.	1.099	1.033	1.269	3.402
31	*Ilex Godajam* Colebr. *Ex* Hook.F.	1.099	1.033	1.269	3.402
32	*Terminalia Belirica* Wall.	1.099	0.804	0.987	2.890
33	*Bauhinia Acuminate* L.	1.099	0.689	0.846	2.634
34	*Albizia Lucidior* (Steud.) I.C.Nielsen	0.549	0.574	1.410	2.534
35	*Dysoxylum Gotadhora* (Buch.-Ham.) Mabb.	0.366	0.459	1.692	2.518
36	*Pterospermum Acerifolium* (L.) Willd.	0.366	0.459	1.692	2.518
37	*Flueggeac Virosa* (Roxb. *Ex* Willd.) Royle	0.916	0.574	0.846	2.336
38	*Vitex Peduncularis* Wall. *Ex* Schauer	0.916	0.574	0.846	2.336
39	*Morus Laevigata* Wall. Ex Brandis	0.549	0.459	1.128	2.137
40	*Sterculia Villosa* Roxb.	0.549	0.459	1.128	2.137
41	*Erythrina Stricta* Roxb.	0.183	0.230	1.692	2.105
42	*Albizia Chinensis* (Osbeck) Merr.	0.733	0.459	0.846	2.038
43	*Oroxylum Indicum* (L.) Kurz	0.733	0.459	0.846	2.038
44	*Pueraria Sikkimensis* Prain	0.733	0.459	0.846	2.038
45	*Wrightia Arborea* (Dennst.) Mabb.	0.733	0.459	0.846	2.038
46	*Miliusa Macrocarpa* Hook.F. & Thomson	0.366	0.344	1.269	1.980
47	*Sorindeia Madagascariensis* Thouars *Ex* DC.	0.366	0.344	1.269	1.980
48	*Alstonia Scholaris* (L.) R. Br.	0.549	0.344	0.846	1.740
49	*Baccaurea Ramiflora* Lour.	0.549	0.344	0.846	1.740
50	*Cassia Fistula* L.	0.549	0.344	0.846	1.740
51	*Dalbergia Latifolia* Roxb.	0.549	0.344	0.846	1.740
52	*Dillenia Pentagyna* Roxb	0.549	0.344	0.846	1.740
53	*Ficus Benjamina* L.	0.549	0.344	0.846	1.740
54	*Gmelina Arborea* Roxb.	0.549	0.344	0.846	1.740
55	*Schima Wallichii* Choisy	0.549	0.344	0.846	1.740
56	*Tectona Grandis* L.F.	0.549	0.344	0.846	1.740
57	*Toona Ciliata* M.Roem.	0.549	0.344	0.846	1.740
58	*Bombax Ceiba* L.	0.366	0.230	0.846	1.442
59	*Macaranga Denticulata* (Blume) Müll.Arg.	0.366	0.230	0.846	1.442
60	*Michelia Champaca* L.	0.366	0.230	0.846	1.442
61	*Phyllanthus Emblica* L.	0.366	0.230	0.846	1.442
62	*Premna Mollissima* Roth	0.366	0.230	0.846	1.442
63	*Pterygota Alata* (Roxb.) R.Br.	0.366	0.230	0.846	1.442
64	*Semecarpus Anacardium* L.F.	0.366	0.230	0.846	1.442
65	*Aesculus Assamica* Griff.	0.183	0.115	0.846	1.144
66	*Alangium Chinense* (Lour.) Harms	0.183	0.115	0.846	1.144
67	*Bauhinia Vahlii* Wight & Arn.	0.183	0.115	0.846	1.144
68	*Bridelia Retusa* (L.) A.Juss.	0.183	0.115	0.846	1.144

Sl. No.	SPECIES	RF	RD	RA	IVI
69	*Castanopsis Indica* (Roxb. Ex Lindl.) A.DC.	0.183	0.115	0.846	1.144
70	*Ceiba Pentandra* (L.) Gaertn.	0.183	0.115	0.846	1.144
71	*Chonemorpha Fragrans* (Moon) Alston	0.183	0.115	0.846	1.144
72	*Cinnamomum Bejolghota* (Buch.-Ham.) Sweet	0.183	0.115	0.846	1.144
73	*Combretum Decandrum* Jacq.	0.183	0.115	0.846	1.144
74	*Dalbergia Stipulacea* Roxb.	0.183	0.115	0.846	1.144
75	*Elaeagnus Infundibularis* Momiy	0.183	0.115	0.846	1.144
76	*Elaeocarpus Rugosus* Roxb. *Ex* G.Don	0.183	0.115	0.846	1.144
77	*Garuga Floribunda* Decne.	0.183	0.115	0.846	1.144
78	*Grewia Asiatica* L.	0.183	0.115	0.846	1.144
79	*Gynocardia Odorata* R.Br.	0.183	0.115	0.846	1.144
80	*Holarrhena Pubescens* Wall. *Ex* G.Don	0.183	0.115	0.846	1.144
81	*Meliosma Simplicifolia* (Roxb.) Walp.	0.183	0.115	0.846	1.144
82	*Morinda Angustifolia* Roxb.	0.183	0.115	0.846	1.144
83	*Neolamarckia Cadamba* (Roxb.) Bosser	0.183	0.115	0.846	1.144
84	*Persea Glaucescens* (Nees) D.G. Long	0.183	0.115	0.846	1.144
85	*Premna Bengalensis* C.B.Clarke	0.183	0.115	0.846	1.144
86	*Sapindus Rarak* DC.	0.183	0.115	0.846	1.144
87	*Sterculia Lanceifolia* Roxb.	0.183	0.115	0.846	1.144
88	*Streblus Asper* Lour.	0.183	0.115	0.846	1.144

Table 74. Phytosociological data of tree layer of natural vegetation in post monsoon in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	5.893	9.518	2.139	17.551
2	*Dendrocnide sinuata* (Blume) Chew	2.857	8.287	3.842	14.985
3	*Trewia nudiflora* L.	5.357	7.055	1.744	14.156
4	*Aphanamixis polystachya* (Wall.) R.Parker	4.643	4.031	1.150	9.824
5	*Leea guineensis* G. Don	3.214	4.031	1.661	8.907
6	*Litsea monopetala* (Roxb.) Pers.	3.393	3.807	1.486	8.687
7	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	4.286	3.135	0.969	8.390
8	*Casearia vareca* Roxb.	2.321	3.471	1.981	7.774
9	*Ailanthus integrifolia* Lam.	2.143	3.471	2.146	7.760
10	*Croton caudatus* Geiseler	2.500	3.024	1.602	7.125
11	*Tetrameles nudiflora* R.Br.	3.036	2.464	1.075	6.574
12	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	3.214	2.240	0.923	6.377
13	*Dysoxylum excelsum* Blume	3.214	2.128	0.877	6.219
14	*Rhamnus napalensis* (Wall.) M.A. Lawson	2.857	2.016	0.934	5.807
15	*Turpinia pomifera* (Roxb.) DC.	2.679	1.904	0.941	5.524
16	*Casearia glomerata* Roxb.	1.607	2.016	1.661	5.284
17	*Magnolia pterocarpa* Roxb.	2.500	1.792	0.949	5.241
18	*Shorea robusta* Gaertn.	2.500	1.792	0.949	5.241
19	*Litsea panamanja* (Buch.-Ham. ex Nees) Hook. f.	1.786	1.904	1.412	5.101
20	*Lagerstroemia hirsuta* (Lam.) Willd.	1.607	1.904	1.569	5.080
21	*Elaeocarpus grandiflorus* Sm.	1.429	1.792	1.661	4.882
22	*Reevesia wallichii* R.Br.	2.143	1.680	1.038	4.861
23	*Actinodaphne obovata* (Nees) Blume	1.786	1.680	1.246	4.711
24	*Chisocheton cumingianus* (C.DC.) Harms	0.714	1.232	2.284	4.230
25	*Stereospermum tetragonum* DC.	1.964	1.232	0.831	4.027
26	*Syzygium formosum* (Wall.) Masam.	1.786	1.232	0.914	3.931
27	*Mallotus philippensis* (Lam.) Müll.Arg.	1.429	1.232	1.142	3.802
28	*Tetrastigma planicaule* (Hook. f.) Gagnep.	1.250	1.008	1.068	3.326
29	*Cordia myxa* L.	1.071	1.008	1.246	3.325

Sl. No.	SPECIES	RF	RD	RA	IVI
30	*Ilex godajam* Colebr. *ex* Hook.f.	1.071	1.008	1.246	3.325
31	*Murraea exotica* L.	0.357	0.560	2.077	2.994
32	*Flueggea virosa* (Roxb. *ex* Willd.) Royle	1.071	0.784	0.969	2.824
33	*Terminalia bellirica* (Gaertn.) Roxb.	1.071	0.784	0.969	2.824
34	*Bauhinia acuminata* L.	1.071	0.672	0.831	2.574
35	*Albizia lucidior* (Steud.) I.C.Nielsen	0.536	0.560	1.384	2.480
36	*Dalbergia latifolia* Roxb.	0.357	0.448	1.661	2.466
37	*Pterospermum acerifolium* (L.) Willd.	0.357	0.448	1.661	2.466
38	*Vitex peduncularis* Wall. *ex* Schauer.	0.893	0.560	0.831	2.283
39	*Morus macroura* Miq.	0.536	0.448	1.107	2.091
40	*Sorindeia madagascariensis* Thouars *ex* DC.	0.536	0.448	1.107	2.091
41	*Sterculia villosa* Roxb.	0.536	0.448	1.107	2.091
42	*Erythrina stricta* Roxb.	0.179	0.224	1.661	2.064
43	*Albizia chinensis* (Osbeck) Merr.	0.714	0.448	0.831	1.993
44	*Oroxylum indicum* (L.) Kurz	0.714	0.448	0.831	1.993
45	*Pueraria sikkimensis* Prain	0.714	0.448	0.831	1.993
46	*Wrightia arborea* (Dennst.) Mabb.	0.714	0.448	0.831	1.993
47	*Dysoxylum excelsum* Blume	0.357	0.336	1.246	1.939
48	*Miliusa macrocarpa* Hook.f. & Thomson	0.357	0.336	1.246	1.939
49	*Pterygota alata* (Roxb.) R.Br.	0.357	0.336	1.246	1.939
50	*Alstonia scholaris* (L.) R. Br.	0.536	0.336	0.831	1.702
51	*Baccaurea ramiflora* Lour.	0.536	0.336	0.831	1.702
52	*Cassia fistula* L.	0.536	0.336	0.831	1.702
53	*Dillenia pentagyna* Roxb.	0.536	0.336	0.831	1.702
54	*Ficus benjamina* L.	0.536	0.336	0.831	1.702
55	*Gmelina arborea* Roxb.	0.536	0.336	0.831	1.702
56	*Schima wallichii* Choisy	0.536	0.336	0.831	1.702
57	*Tectona grandis* L.f.	0.536	0.336	0.831	1.702
58	*Toona ciliata* M.Roem.	0.536	0.336	0.831	1.702
59	*Alangium chinense* (Lour.) Harms.	0.357	0.224	0.831	1.412
60	*Bombax ceiba* L.	0.357	0.224	0.831	1.412
61	*Macaranga denticulata* (Blume) Müll.Arg.	0.357	0.224	0.831	1.412
62	*Magnolia champaca* (L.) Baill. *ex* Pierre.	0.357	0.224	0.831	1.412
63	*Morinda angustifolia* Roxb.	0.357	0.224	0.831	1.412
64	*Neolamarckia cadamba* (Roxb.) Bosser	0.357	0.224	0.831	1.412
65	*Phyllanthus emblica* L.	0.357	0.224	0.831	1.412
66	*Premna mollissima* Roth	0.357	0.224	0.831	1.412
67	*Semecarpus anacardium* L.f.	0.357	0.224	0.831	1.412
68	*Aesculus assamica* Griff.	0.179	0.112	0.831	1.121
69	*Bauhinia vahlii* Wight & Arn.	0.179	0.112	0.831	1.121
70	*Bischofia javanica* Blume	0.179	0.112	0.831	1.121
71	*Bridelia retusa* (L.) A.Juss.	0.179	0.112	0.831	1.121
72	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC.	0.179	0.112	0.831	1.121
73	*Ceiba pentandra* (L.) Gaertn.	0.179	0.112	0.831	1.121
74	*Chonemorpha fragrans* (Moon) Alston	0.179	0.112	0.831	1.121
75	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.179	0.112	0.831	1.121
76	*Combretum decandrum* Jacq.	0.179	0.112	0.831	1.121
77	*Dalbergia stipulacea* Roxb.	0.179	0.112	0.831	1.121
78	*Elaeagnus infundibularis* Momiy.	0.179	0.112	0.831	1.121
79	*Elaeocarpus rugosus* Roxb. *ex* G.Don	0.179	0.112	0.831	1.121
80	*Garuga floribunda* Decne.	0.179	0.112	0.831	1.121
81	*Grewia asiatica* L.	0.179	0.112	0.831	1.121
82	*Gynocardia odorata* R.Br.	0.179	0.112	0.831	1.121
83	*Holarrhena pubescens* Wall. *ex* G.Don	0.179	0.112	0.831	1.121
84	*Meliosma simplicifolia* (Roxb.) Walp.	0.179	0.112	0.831	1.121
85	*Machilus glaucescens* (Nees) Wight	0.179	0.112	0.831	1.121

Sl. No.	SPECIES	RF	RD	RA	IVI
86	*Premna bengalensis* C.B.Clarke	0.179	0.112	0.831	1.121
87	*Sapindus rarak* DC.	0.179	0.112	0.831	1.121
88	*Sterculia lanceifolia* Roxb.	0.179	0.112	0.831	1.121
89	*Streblus asper* Lour.	0.179	0.112	0.831	1.121
90	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn.	0.179	0.112	0.831	1.121
91	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.179	0.112	0.831	1.121

Table 75. Phytosociological data of shrub layer of natural vegetation in winter in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	3.836	12.104	4.674	20.615
2	*Clerodendrum infortunatum* L.	2.956	10.522	5.273	18.751
3	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	4.780	7.210	2.234	14.224
4	*Dendrocnide sinuata* (Blume) Chew	3.082	6.682	3.212	12.976
5	*Morinda angustifolia* Roxb.	3.270	5.363	2.429	11.063
6	*Mikania micrantha* Kunth	4.591	3.136	1.012	8.739
7	*Eupatorium odoratum* L.	2.138	2.843	1.969	6.951
8	*Piper peepuloides* Roxb.	2.075	2.755	1.966	6.797
9	*Urena lobata* L.	2.327	2.286	1.455	6.068
10	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.447	2.227	2.281	5.955
11	*Casearia vareca* Roxb.	2.013	2.140	1.575	5.727
12	*Glycosmis pentaphylla* (Retz.) DC.	2.642	1.788	1.003	5.432
13	*Ardisia solanacea* (Poir.) Roxb.	2.138	1.524	1.056	4.718
14	*Clausena excavata* Burm.f.	2.138	1.436	0.995	4.569
15	*Casearia glomerata* Roxb.	1.132	1.436	1.879	4.447
16	*Solanum khasianum* C.B. Clarke	0.377	0.821	3.221	4.419
17	*Sida acuta* Burm.f.	2.138	1.319	0.914	4.371
18	*Tetrastigma campylocarpum* (Kurz) Planch.	1.950	1.348	1.024	4.322
19	*Dioscorea bulbifera* L.	1.950	1.290	0.980	4.219
20	*Piper nigrum* L.	1.824	1.260	1.024	4.108
21	*Pueraria sikkimensis* Prain	1.824	1.260	1.024	4.108
22	*Maesa indica* (Roxb.) A. DC.	1.195	1.290	1.599	4.083
23	*Croton caudatus* Geiseler	2.075	1.114	0.795	3.984
24	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.950	1.143	0.868	3.961
25	*Lygodium flexuosum* (L.) Sw.	1.824	1.114	0.905	3.842
26	*Tetrastigma planicaule* (Hook. f.) Gagnep.	1.824	1.084	0.881	3.789
27	*Mussaenda roxburghii* Hook.f.	1.824	0.996	0.809	3.630
28	*Acacia pennata* (L.) Willd.	1.635	0.996	0.903	3.534
29	*Combretum decandrum* Jacq.	1.824	0.938	0.762	3.523
30	*Dalbergia stipulacea* Roxb.	1.635	0.909	0.823	3.367
31	*Sauropus quadrangularis* (Willd.) Müll.Arg.	1.447	0.909	0.930	3.286
32	*Caesalpinia cucullata* Roxb.	1.509	0.850	0.834	3.194
33	*Croton roxburghii* Wall.	1.384	0.850	0.910	3.144
34	*Litsea monopetala* (Roxb.) Pers.	1.572	0.791	0.746	3.109
35	*Gouania leptostachya* DC.	1.447	0.791	0.810	3.048
36	*Vallaris solanacea* (Roth) Kuntze	1.195	0.821	1.017	3.033
37	*Capparis multiflora* Hook.f. & Thomson	0.881	0.791	1.331	3.003
38	*Chonemorpha fragrans* (Moon) Alston	1.321	0.674	0.756	2.751
39	*Merremia vitifolia* (Burm. f.) Hallier f.	1.195	0.674	0.836	2.705
40	*Tetrastigma dubium* (Lawson) Planch.	0.881	0.645	1.085	2.610
41	*Murraya koenigii* (L.) Spreng.	1.006	0.645	0.949	2.600
42	*Litsea panamanja* (Buch.-Ham. *ex* Nees) Hook.f.	1.069	0.615	0.853	2.537
43	*Dioscorea pentaphylla* L.	0.881	0.615	1.035	2.531
44	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.006	0.615	0.906	2.528
45	*Zanthoxylum rhetsa* DC.	0.440	0.469	1.578	2.487
46	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.126	0.176	2.071	2.373
47	*Jasminum scandens* (Retz.) Vahl	1.006	0.498	0.733	2.238
48	*Paederia foetida* L.	0.818	0.498	0.903	2.219
49	*Ampelocissus barbata* (Wall.) Planch.	0.943	0.469	0.736	2.149
50	*Stephania japonica* (Thunb.) Miers	0.755	0.469	0.920	2.144
51	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.503	0.381	1.122	2.006

Sl. No.	SPECIES	RF	RD	RA	IVI
52	*Uncaria macrophylla* Wall.	0.755	0.410	0.805	1.970
53	*Ipomoea linifolia* Blume	0.566	0.381	0.997	1.944
54	*Eurya acuminate* DC.	0.692	0.381	0.816	1.889
55	*Macaranga denticulata* (Blume) Müll.Arg.	0.692	0.381	0.816	1.889
56	*Celastrus paniculatus* Willd.	0.692	0.352	0.753	1.797
57	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.692	0.352	0.753	1.797
58	*Wattakaka volubilis* (L. f.) Stapf	0.566	0.322	0.844	1.732
59	*Talauma hodgsonii* Hook.f. & Thomson	0.063	0.059	1.381	1.502
60	*Naravelia zeylanica* (L.) DC.	0.252	0.176	1.035	1.463
61	*Albizia lucidior* (Steud.) I.C.Nielsen	0.377	0.205	0.805	1.388
62	*Flacourtia jangomas* (Lour.) Raeusch.	0.377	0.205	0.805	1.388
63	*Phyllanthus emblica* L.	0.377	0.205	0.805	1.388
64	*Sterculia villosa* Roxb.	0.377	0.205	0.805	1.388
65	*Thunbergia fragrans* Roxb.	0.377	0.205	0.805	1.388
66	*Tinospora sinensis* (Lour.) Merr.	0.377	0.205	0.805	1.388
67	*Shorea robusta* Gaertn.	0.440	0.205	0.690	1.336
68	*Smilax ovalifolia* Roxb. *ex* D.Don	0.440	0.205	0.690	1.336
69	*Wrightia arborea* (Dennst.) Mabb.	0.314	0.176	0.828	1.319
70	*Aristolochia tagala* Cham.	0.126	0.088	1.035	1.249
71	*Mallotus philippensis* (Lam.) Müll.Arg.	0.377	0.176	0.690	1.244
72	*Dillenia indica* L.	0.314	0.147	0.690	1.151
73	*Actinodaphne obovata* (Nees) Blume	0.252	0.117	0.690	1.059
74	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.252	0.117	0.690	1.059
75	*Parthenocissus semicordata* (Wall.) Planch.	0.252	0.117	0.690	1.059
76	*Ailanthus integrifolia* Lam.	0.189	0.088	0.690	0.967
77	*Antidesma bunius* (L.) Spreng.	0.189	0.088	0.690	0.967
78	*Aphanamixis polystachya* (Wall.) R.Parker	0.189	0.088	0.690	0.967
79	*Michelia champaca* L.	0.189	0.088	0.690	0.967
80	*Oroxylum indicum* (L.) Kurz	0.189	0.088	0.690	0.967
81	*Ostodes paniculata* Blume	0.189	0.088	0.690	0.967
82	*Stereospermum tetragonum* DC.	0.189	0.088	0.690	0.967
83	*Zanonia indica* L.	0.189	0.088	0.690	0.967
84	*Bombax ceiba* L.	0.126	0.059	0.690	0.875
85	*Magnolia pterocarpa* Roxb.	0.126	0.059	0.690	0.875
86	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.126	0.059	0.690	0.875
87	*Premna bengalensis* C.B.Clarke	0.126	0.059	0.690	0.875
88	*Pterygota alata* (Roxb.) R.Br.	0.126	0.059	0.690	0.875
89	*Pterospermum acerifolium* (L.) Willd.	0.063	0.029	0.690	0.783

Table 76. Phytosociological data of shrub layer of natural vegetation in Pre-monsoon in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	3.632	10.775	3.929	18.337
2	*Clerodendrum cordatum* D.Don	2.972	8.814	3.928	15.714
3	*Dendrocnide sinuata* (Blume) Chew	3.160	8.702	3.647	15.508
4	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	3.396	6.335	2.470	12.201
5	*Tabernamantana divaricata* L.	2.877	4.238	1.951	9.066
6	*Mikania micrantha* Kunth	2.217	3.674	2.195	8.087
7	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	2.264	2.976	1.741	6.980
8	*Piper peepuloides* Roxb.	2.217	2.908	1.737	6.862
9	*Lygodium flexuosum* (L.) Sw.	2.972	2.187	0.975	6.133
10	*Tetrastigma planicaule* (Hook. f.) Gagnep.	3.113	2.051	0.873	6.037
11	*Leea guineensis* G. Don	2.594	2.006	1.024	5.625
12	*Ardisia solanacea* (Poir.) Roxb.	1.745	1.758	1.334	4.838
13	*Piper nigrum* L.	1.792	1.713	1.266	4.772
14	*Tetrastigma campylocarpum* (Kurz) Planch.	1.981	1.488	0.995	4.464
15	*Clausena excavata* Burm.f.	2.075	1.420	0.906	4.402
16	*Sauropus compressus* Müll.Arg.	1.934	1.420	0.973	4.327
17	*Pueraria sikkimensis* Prain	1.557	1.443	1.228	4.227
18	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.075	1.307	0.834	4.217
19	*Solanum khasianum* C.B. Clarke	0.613	1.060	2.288	3.961

Sl. No.	SPECIES	RF	RD	RA	IVI
20	*Dioscorea bulbifera* L.	1.745	1.195	0.907	3.847
21	*Combretum decandrum* Jacq.	1.604	1.105	0.912	3.621
22	*Acacia pennata* (L.) Willd.	1.792	1.037	0.766	3.596
23	*Merremia palmata* Hallier f.	1.698	1.037	0.809	3.544
24	*Croton caudatus* Geiseler	1.368	1.060	1.026	3.453
25	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.557	0.969	0.825	3.351
26	*Capparis multiflora* Hook. f.& Thomson	1.604	0.947	0.782	3.332
27	*Dalbergia stipulacea* Roxb.	1.557	0.834	0.710	3.100
28	*Vallaris solanacea* (Roth) Kuntze	1.509	0.812	0.712	3.033
29	*Tetrastigma dubium* (Lawson) Planch.	1.085	0.857	1.046	2.987
30	*Gouania leptostachya* DC.	1.368	0.812	0.786	2.965
31	*Litsea panamanja* (Buch.-Ham. *ex* Nees) Hook. f.	1.321	0.812	0.814	2.946
32	*Stephania glabra* (Roxb.) Miers	1.274	0.766	0.797	2.837
33	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	1.085	0.766	0.936	2.787
34	*Croton roxburghii* Wall.	1.038	0.766	0.978	2.782
35	*Glycosmis pentaphylla* (Retz.) DC.	1.132	0.744	0.870	2.746
36	*Chonemorpha fragrans* (Moon) Alston	1.321	0.699	0.701	2.720
37	*Caesalpinia cucullata* Roxb.	1.274	0.699	0.727	2.699
38	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	1.274	0.631	0.656	2.561
39	*Litsea monopetala* (Roxb.) Pers.	1.085	0.631	0.771	2.487
40	*Sorindeia madagascariensis* Thouars *ex* DC.	0.991	0.631	0.844	2.466
41	*Piper mullesua* Buch.-Ham. *ex* D. Don	0.519	0.518	1.323	2.361
42	*Piper chuvya* Miq.	0.613	0.541	1.169	2.323
43	*Paederia foetida* L.	0.802	0.541	0.894	2.236
44	*Dioscorea prazeri* Prain & Burkill	0.755	0.518	0.910	2.183
45	*Wattakaka volubilis* (L. f.) Stapf	0.802	0.518	0.856	2.177
46	*Ampelocissus barbata* (Wall.) Planch.	0.849	0.518	0.809	2.176
47	*Maesa indica* (Roxb.) A. DC.	0.849	0.518	0.809	2.176
48	*Smilax ovalifolia* Roxb. *ex* D.Don	0.849	0.518	0.809	2.176
49	*Jasminum scandens* (Retz.) Vahl	0.849	0.496	0.774	2.119
50	*Cyclea bicristata* (Griff.) Diels	0.802	0.496	0.819	2.117
51	*Debregeasia longifolia* (Burm.f.) Wedd.	0.755	0.473	0.831	2.059
52	*Meyna spinosa* Roxb. *ex* Link	0.755	0.473	0.831	2.059
53	*Celastrus paniculatus* Willd.	0.755	0.428	0.752	1.935
54	*Tetrastigma serrulatum* (Roxb.) Planch.	0.755	0.428	0.752	1.935
55	*Dioscorea pentaphylla* L.	0.566	0.406	0.949	1.921
56	*Ipomoea linifolia* Blume	0.613	0.406	0.876	1.895
57	*Pericampylus glaucus* (Lam.) Merr.	0.566	0.383	0.897	1.846
58	*Eurya acuminate* DC.	0.660	0.383	0.769	1.812
59	*Macaranga denticulata* (Blume) Müll.Arg.	0.755	0.383	0.673	1.810
60	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.708	0.383	0.717	1.808
61	*Antidesma bunius* (L.) Spreng.	0.660	0.361	0.723	1.744
62	*Randia dumetorum* (Retz.) Lam.	0.425	0.316	0.985	1.725
63	*Berchemia floribunda* (Wall.) Brongn.	0.519	0.338	0.863	1.720
64	*Zanthoxylum rhetsa* DC.	0.472	0.316	0.886	1.673
65	*Bridelia retusa* (L.) A.Juss.	0.425	0.293	0.914	1.632
66	*Pothos scandens* L.	0.519	0.293	0.748	1.560
67	*Trichosanthes tricuspidata* Lour.	0.566	0.293	0.686	1.545
68	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.472	0.271	0.760	1.502
69	*Zanonia indica* L.	0.283	0.203	0.949	1.435
70	*Aristolochia tagala* Cham.	0.330	0.203	0.814	1.347
71	*Sterculia villosa* Roxb.	0.330	0.203	0.814	1.347
72	*Shorea robusta* Gaertn.	0.283	0.180	0.844	1.307
73	*Bauhinia acuminata* L.	0.236	0.158	0.886	1.280
74	*Actinodaphne obovata* (Nees.) Blume	0.425	0.203	0.633	1.260
75	*Flacourtia jangomas* (Lour.) Raeusch.	0.330	0.180	0.723	1.234
76	*Naravelia zeylanica* (L.) DC.	0.330	0.180	0.723	1.234
77	*Cayratia japonica* (Thunb.) Gagnep.	0.283	0.158	0.738	1.179
78	*Persea glaucescens* (Nees) D.G. Long	0.283	0.158	0.738	1.179
79	*Premna bengalensis* C.B.Clarke	0.283	0.158	0.738	1.179
80	*Uncaria macrophylla* Wall.	0.283	0.158	0.738	1.179

Sl. No.	SPECIES	RF	RD	RA	IVI
81	*Ficus hispida* L.f.	0.236	0.135	0.760	1.131
82	*Alangium chinense* (Lour.) Harms.	0.330	0.158	0.633	1.121
83	*Clerodendrum serratum* (L.) Moon	0.094	0.068	0.949	1.111
84	*Vitex peduncularis* Wall. *ex* Schauer	0.094	0.068	0.949	1.111
85	*Syzygium cumini* (L.) Skeels	0.189	0.113	0.791	1.093
86	*Wrightia arborea* (Dennst.) Mabb.	0.189	0.113	0.791	1.093
87	*Turpinia pomifera* (Roxb.) DC.	0.142	0.090	0.844	1.076
88	*Dillenia indica* L.	0.283	0.135	0.633	1.051
89	*Aphanamixis polystachya* (Wall.) R.Parker	0.236	0.113	0.633	0.982
90	*Mallotus philippensis* (Lam.) Müll.Arg.	0.236	0.113	0.633	0.982
91	*Morus laevigata* Wall. *ex* Brandis	0.236	0.113	0.633	0.982
92	*Mallotus nudiflorus* (L.) Kulju & Welzen	0.236	0.113	0.633	0.982
93	*Holarrhena pubescens* Wall. *ex* G.Don	0.189	0.090	0.633	0.912
94	*Pterygota alata* (Roxb.) R.Br.	0.189	0.090	0.633	0.912
95	*Ailanthus integrifolia* Lam.	0.142	0.068	0.633	0.842
96	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.142	0.068	0.633	0.842
97	*Ficus pumila* L.	0.142	0.068	0.633	0.842
98	*Semecarpus anacardium* L.f.	0.142	0.068	0.633	0.842
99	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng	0.142	0.068	0.633	0.842
100	*Oroxylum indicum* (L.) Kurz	0.094	0.045	0.633	0.772
101	*Sloanea sterculiacea* (Benth.) Rehder & E.H. Wilson	0.094	0.045	0.633	0.772
102	*Alstonia scholaris* (L.) R. Br.	0.047	0.023	0.633	0.703

Table 77. Phytosociological data of shrub layer of natural vegetation in Post-monsoon in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	3.737	13.288	3.822	20.846
2	*Dendrocnide sinuata* (Blume) Chew	3.197	7.159	2.406	12.762
3	*Pueraria sikkimensis* Prain	0.154	1.528	10.657	12.339
4	*Clerodendrum infortunatum* L.	2.812	6.644	2.539	11.995
5	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	2.157	5.459	2.720	10.336
6	*Chromolaena odorata* (L.) R.M.King & H.Rob.	2.658	3.725	1.506	7.890
7	*Morinda angustifolia* Roxb.	1.772	3.193	1.937	6.902
8	*Leea guineensis* G. Don	1.425	2.438	1.838	5.701
9	*Litsea monopetala* (Roxb.) Pers.	2.350	1.682	0.770	4.802
10	*Ardisia solanacea* (Poir.) Roxb.	2.042	1.665	0.877	4.583
11	*Clausena excavata* Burm.f.	2.350	1.408	0.644	4.401
12	*Casearia glomerata* Roxb.	1.502	1.648	1.179	4.329
13	*Croton caudatus* Geiseler	2.003	1.425	0.765	4.193
14	*Tetrastigma planicaule* (Hook.f.) Gagnep.	1.810	1.494	0.887	4.191
15	*Dioscorea bulbifera* L.	1.965	1.391	0.761	4.116
16	*Dalbergia stipulacea* Roxb.	2.196	1.133	0.555	3.883
17	*Caesalpinia cucullata* Roxb.	1.772	1.305	0.791	3.868
18	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.849	1.270	0.738	3.858
19	*Sauropus compressus* Müll.Arg.	1.425	1.236	0.932	3.593
20	*Casearia vareca* Roxb.	0.886	1.219	1.479	3.583
21	*Acacia pennata* (L.) Willd.	1.695	1.150	0.729	3.574
22	*Sida acuta* Burm.f.	0.886	1.185	1.437	3.507
23	*Glycosmis pentaphylla* (Retz.) DC.	1.387	1.150	0.891	3.428
24	*Murraya paniculata* (L.) Jack	1.233	1.150	1.003	3.386
25	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.656	0.996	0.646	3.298
26	*Tetrastigma campylocarpum* (Kurz) Planch.	1.425	1.047	0.790	3.262
27	*Stephania glabra* (Roxb.) Miers	1.579	0.979	0.666	3.224
28	*Combretum decandrum* Jacq.	1.464	0.927	0.681	3.071
29	*Urena lobata* L.	1.502	0.910	0.651	3.063
30	*Solanum aculeatissimum* Jacq.	1.425	0.927	0.699	3.051
31	*Triumfetta rhomboidea* Jacq.	1.117	0.979	0.941	3.037
32	*Antidesma bunius* (L.) Spreng.	0.924	0.927	1.078	2.929
33	*Cyclea bicristata* (Griff.) Diels	1.464	0.807	0.592	2.863
34	*Gouania leptostachya* DC.	1.271	0.807	0.682	2.760
35	*Berchemia floribunda* (Wall.) Brongn.	1.425	0.738	0.557	2.720

Sl. No.	SPECIES	RF	RD	RA	IVI
36	*Maesa indica* (Roxb.) A.DC.	1.387	0.738	0.572	2.697
37	*Trichosanthes tricuspidata* Lour.	1.194	0.790	0.711	2.695
38	*Capparis multiflora* Hook.f. & Thomson	1.079	0.807	0.804	2.689
39	*Vallaris solanacea* (Roth) Kuntze	1.271	0.721	0.610	2.602
40	*Baliospermum solanifolium* (Burm.) Suresh	1.271	0.704	0.595	2.570
41	*Maesa chisia* Buch.-Ham. *ex* D. Don	0.655	0.652	1.071	2.378
42	*Smilax ovalifolia* Roxb. *ex* D.Don	0.693	0.652	1.011	2.357
43	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.462	0.567	1.317	2.346
44	*Paederia foetida* L.	0.886	0.635	0.771	2.292
45	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.616	0.584	1.018	2.218
46	*Bridelia retusa* (L.) A.Juss.	0.886	0.601	0.729	2.216
47	*Catunaregam spinosa* (Thunb.) Tirveng.	0.963	0.584	0.651	2.198
48	*Chonemorpha fragrans* (Moon) Alston	0.693	0.584	0.905	2.182
49	*Ampelocissus barbata* (Wall.) Planch.	0.847	0.584	0.740	2.171
50	*Debregeasia longifolia* (Burm.f.) Wedd.	0.809	0.584	0.775	2.168
51	*Sorindeia madagascariensis* Thouars *ex* DC.	0.655	0.567	0.930	2.151
52	*Smilax zeylanica* L.	0.886	0.532	0.646	2.064
53	*Dioscorea prazeri* Prain & Burkill	0.847	0.532	0.675	2.055
54	*Tetrastigma serrulatum* (Roxb.) Planch.	0.847	0.498	0.631	1.977
55	*Dregea volubilis* (L.f.) Benth. *ex* Hook.f.	0.847	0.464	0.588	1.899
56	*Acalypha spiciflora* Burm.f.	0.616	0.464	0.808	1.888
57	*Pothos scandens* L.	0.809	0.446	0.593	1.848
58	*Girardinia diversifolia* (Link) Friis	0.462	0.395	0.918	1.775
59	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.809	0.412	0.547	1.768
60	*Merremia hirta* (L.) Merr.	0.578	0.395	0.734	1.707
61	*Zanthoxylum rhetsa* DC.	0.732	0.395	0.580	1.707
62	*Crateva religiosa* G.Forst.	0.616	0.395	0.689	1.700
63	*Celastrus paniculatus* Willd.	0.655	0.395	0.648	1.698
64	*Mussaenda roxburghii* Hook.f.	0.655	0.395	0.648	1.698
65	*Dioscorea pentaphylla* L.	0.501	0.378	0.811	1.689
66	*Eurya acuminata* DC.	0.693	0.378	0.585	1.656
67	*Macaranga denticulata* (Blume) Müll.Arg.	0.655	0.378	0.620	1.652
68	*Cayratia japonica* (Thunb.) Gagnep.	0.693	0.361	0.559	1.613
69	*Naravelia zeylanica* (L.) DC.	0.424	0.326	0.827	1.577
70	*Sauropus quadrangularis* (Willd.) Müll.Arg.	0.347	0.292	0.905	1.543
71	*Miliusa roxburghiana* Hook.f. & Thomson	0.539	0.326	0.650	1.516
72	*Porana paniculata* Roxb.	0.501	0.309	0.663	1.473
73	*Zanonia indica* L.	0.616	0.309	0.539	1.464
74	*Jasminum scandens* (Retz.) Vahl	0.462	0.292	0.679	1.433
75	*Uvaria hamiltonii* Hook. f. & Thomson	0.539	0.292	0.582	1.413
76	*Grewia asiatica* L.	0.424	0.240	0.610	1.274
77	*Balakata baccata* (Roxb.) Esser.	0.347	0.223	0.692	1.262
78	*Uncaria macrophylla* Wall.	0.347	0.223	0.692	1.262
79	*Wrightia arborea* (Dennst.) Mabb.	0.347	0.223	0.692	1.262
80	*Phyllanthus emblica* L.	0.424	0.223	0.566	1.213
81	*Shorea robusta* Gaertn.	0.424	0.223	0.566	1.213
82	*Bauhinia acuminata* L.	0.501	0.223	0.479	1.203
83	*Bombax ceiba* L.	0.347	0.206	0.639	1.191
84	*Dillenia indica* L.	0.347	0.206	0.639	1.191
85	*Premna bengalensis* C.B.Clarke	0.347	0.206	0.639	1.191
86	*Mallotus repandus* (Willd.) Müll.Arg..	0.347	0.206	0.639	1.191
87	*Sloanea sterculiacea* (Benth.) Rehder & E.H. Wilson	0.385	0.206	0.575	1.166
88	*Flacourtia jangomas* (Lour.) Raeusch.	0.308	0.189	0.659	1.156
89	*Alangium chinense* (Lour.) Harms	0.424	0.206	0.523	1.152
90	*Actinodaphne obovata* (Nees) Blume	0.347	0.189	0.585	1.121
91	*Mallotus philippensis* (Lam.) Müll.Arg.	0.347	0.189	0.585	1.121
92	*Codariocalyx motorius* (Houtt.) H.Ohashi	0.154	0.120	0.838	1.112
93	*Holarrhena pubescens* Wall. *ex* G.Don	0.270	0.155	0.616	1.040
94	*Pterygota alata* (Roxb.) R.Br.	0.308	0.155	0.539	1.002
95	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.154	0.103	0.718	0.976
96	*Aristolochia tagala* Cham.	0.270	0.137	0.547	0.954

Sl. No.	SPECIES	RF	RD	RA	IVI
97	*Bauhinia vahlii* Wight & Arn.	0.308	0.137	0.479	0.924
98	*Syzygium cumini* (L.) Skeels	0.308	0.137	0.479	0.924
99	*Albizia lucidior* (Steud.) I.C.Nielsen	0.231	0.120	0.559	0.910
100	*Aphanamixis polystachya* (Wall.) R.Parker	0.231	0.120	0.559	0.910
101	*Sterculia villosa* Roxb.	0.270	0.120	0.479	0.869
102	*Toona ciliata* M.Roem.	0.154	0.086	0.599	0.839
103	*Ficus hispida* L.f.	0.116	0.069	0.639	0.823
104	*Vitex peduncularis* Wall. *ex* Schauer	0.116	0.069	0.639	0.823
105	*Magnolia champaca* (L.) Baill. *ex* Pierre	0.231	0.103	0.479	0.813
106	*Ficus pumila* L.	0.154	0.069	0.479	0.702
107	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.116	0.052	0.479	0.646
108	*Oroxylum indicum* (L.) Kurz	0.116	0.052	0.479	0.646
109	*Pterospermum acerifolium* (L.) Willd.	0.116	0.052	0.479	0.646
110	*Alstonia scholaris* (L.) R. Br.	0.077	0.034	0.479	0.590
111	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng	0.077	0.034	0.479	0.590

Table 78. Phytosociological data of herb layer of natural vegetation in winter in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Chloranthus elatior* Link	4.772	6.380	1.166	12.318
2	*Mikania micrantha* Kunth	2.084	4.198	1.756	8.039
3	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	2.798	3.174	0.989	6.960
4	*Phaulopsis imbricata* (Forssk.) Sweet	2.578	3.074	1.040	6.692
5	*Gomphostemma ovatum* Wall. *ex* Benth.	2.414	2.413	0.872	5.699
6	*Setaria palmifolia* (J.Koenig) Stapf	1.536	2.347	1.332	5.215
7	*Dryopteris sikkimensis* (Bedd.) Kuntze	1.865	2.281	1.066	5.212
8	*Clerodendrum infortunatum* L.	1.865	2.182	1.020	5.067
9	*Pteris biaurita* L.	0.768	1.917	2.177	4.862
10	*Diplazium esculentum* (Retz.) Sw.	1.481	2.116	1.245	4.842
11	*Thelypteris nudata* (Roxb.) C.V. Morton.	1.536	2.083	1.182	4.801
12	*Coffea benghalensis* B.Heyne *ex* Schult.	1.591	2.050	1.123	4.764
13	*Spermacoce ocymoides* Burm.f.	0.933	1.752	1.638	4.323
14	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	0.713	1.620	1.980	4.313
15	*Chromolaena odorata* (L.) R.M.King & H.Rob.	1.700	1.554	0.797	4.051
16	*Floscopa scandens* Lour.	1.262	1.587	1.097	3.945
17	*Dendrocnide sinuata* (Blume) Chew	1.755	1.421	0.706	3.883
18	*Cyperus compressus* L.	1.317	1.421	0.941	3.679
19	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	1.865	1.223	0.572	3.660
20	*Leea aequata* L.	1.700	1.256	0.644	3.601
21	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.317	1.355	0.898	3.569
22	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	1.481	1.256	0.739	3.477
23	*Piper chuvya* Miq.	1.481	1.256	0.739	3.477
24	*Impatiens trilobata* Colebr.	0.768	1.223	1.389	3.380
25	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.481	1.157	0.681	3.319
26	*Ageratum houstonianum* Mill.	1.262	1.190	0.822	3.274
27	*Tectaria gemmifera* (Fée) Alston	1.042	1.190	0.996	3.228
28	*Tetrastigma serrulatum* (Roxb.) Planch.	1.481	1.058	0.623	3.162
29	*Desmodium laxiflorum* DC.	1.481	1.025	0.603	3.109
30	*Homalomena rubescens* (Roxb.) Kunth	0.439	0.860	1.708	3.006
31	*Dioscorea bulbifera* L.	1.152	1.025	0.776	2.952
32	*Rungia pectinata* (L.) Nees	0.987	1.025	0.905	2.917
33	*Lygodium flexuosum* (L.) Sw.	1.317	0.926	0.613	2.855
34	*Smilax ovalifolia* Roxb. *ex* D.Don	1.317	0.893	0.591	2.800
35	*Phyllanthus urinaria* L.	0.987	0.959	0.847	2.793
36	*Elatostema rupestre* (Buch.-Ham. *ex* D.Don) Wedd.	0.933	0.959	0.896	2.788
37	*Commelina diffusa* Burm.f.	0.713	0.893	1.091	2.697

Sl. No.	SPECIES	RF	RD	RA	IVI
38	*Piper hamiltonii* C.DC.	0.878	0.893	0.887	2.657
39	*Drymaria cordata* (L.) Willd. *ex* Schult.	0.933	0.860	0.804	2.596
40	*Stellaria media* (L.) Vill.	0.878	0.860	0.854	2.591
41	*Maesa chisia* Buch.-Ham. *ex* D. Don	0.658	0.793	1.051	2.503
42	*Persicaria chinensis* (L.) H. Gross	0.933	0.793	0.742	2.468
43	*Achyranthes bidentata* Blume	1.042	0.760	0.636	2.439
44	*Amischotolype hookeri* (Hassk.) H.Hara	1.042	0.760	0.636	2.439
45	*Merremia vitifolia* (Burm. f.) Hallier f.	1.042	0.760	0.636	2.439
46	*Pouzolzia zeylanica* (L.) Benn.	0.658	0.760	1.007	2.426
47	*Clausena excavata* Burm.f.	0.987	0.760	0.671	2.419
48	*Nelsonia canescens* (Lam.) Spreng.	0.768	0.760	0.863	2.392
49	*Girardinia diversifolia* (Link) Friis	0.823	0.760	0.806	2.389
50	*Tetrastigma dubium* (Lawson) Planch.	0.823	0.727	0.771	2.321
51	*Piper mullesua* Buch.-Ham. *ex* D. Don	1.042	0.694	0.581	2.317
52	*Piper betleoides* C.DC.	0.439	0.628	1.248	2.315
53	*Pouzolzia hirta* Blume *ex* Hassk.	0.878	0.694	0.690	2.262
54	*Persicaria hydropiper* (L.) Delarbre	0.329	0.529	1.401	2.259
55	*Biophytum sensitivum* (L.) DC.	0.768	0.694	0.788	2.250
56	*Vallaris solanacea* (Roth) Kuntze	0.933	0.628	0.587	2.148
57	*Carex indica* L.	0.494	0.595	1.051	2.140
58	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	0.878	0.628	0.624	2.130
59	*Axonopus compressus* (Sw.) P.Beauv.	0.658	0.628	0.832	2.118
60	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.274	0.430	1.366	2.070
61	*Cyanthillium cinereum* (L.) H.Rob..	0.658	0.595	0.788	2.041
62	*Barleria cristata* L.	0.878	0.562	0.558	1.998
63	*Alocasia fallax* Schott	0.603	0.562	0.812	1.977
64	*Glycosmis pentaphylla* (Retz.) DC.	0.768	0.562	0.638	1.968
65	*Strobilanthes wallichii* Nees	0.658	0.562	0.744	1.965
66	*Merremia hirta* (L.) Merr.	0.713	0.562	0.687	1.962
67	*Paederia foetida* L.	0.713	0.562	0.687	1.962
68	*Lindernia ciliata* (Colsm.) Pennell	0.274	0.397	1.261	1.932
69	*Sauropus compressus* Müll.Arg.	0.768	0.529	0.600	1.897
70	*Sida acuta* Burm.f.	0.768	0.529	0.600	1.897
71	*Gloriosa superba* L.	0.329	0.430	1.138	1.897
72	*Triumfetta rhomboidea* Jacq.	0.713	0.529	0.647	1.889
73	*Oxalis corniculata* L.	0.165	0.264	1.401	1.830
74	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook.f. & Thomson	0.768	0.496	0.563	1.827
75	*Maesa indica* (Roxb.) A.DC.	0.713	0.463	0.566	1.742
76	*Premna bengalensis* C.B.Clarke	0.713	0.463	0.566	1.742
77	*Tetrastigma planicaule* (Hook.f.) Gagnep.	0.658	0.463	0.613	1.734
78	*Typhonium trilobatum* (L.) Schott	0.439	0.430	0.854	1.722
79	*Tetrastigma campylocarpum* (Kurz) Planch.	0.494	0.430	0.759	1.682
80	*Cyclea bicristata* (Griff.) Diels	0.658	0.430	0.569	1.657
81	*Jasminum dispermum* Wall.	0.658	0.430	0.569	1.657
82	*Pueraria sikkimensis* Prain	0.494	0.397	0.701	1.591
83	*Psychotria erratica* Hook.f	0.384	0.364	0.826	1.573
84	*Acmella calva* (DC.) R.K.Jansen	0.439	0.364	0.722	1.525
85	*Pericampylus glaucus* (Lam.) Merr.	0.494	0.364	0.642	1.500
86	*Pothos scandens* L.	0.494	0.364	0.642	1.500
87	*Lobelia nummularia* Lam.	0.329	0.298	0.788	1.415
88	*Curculigo orchioides* Gaertn.	0.274	0.264	0.841	1.379
89	*Urena lobata* L.	0.274	0.264	0.841	1.379
90	*Berchemia floribunda* (Wall.) Brongn.	0.439	0.298	0.591	1.327
91	*Piper peepuloides* Wall.	0.439	0.298	0.591	1.327
92	*Toona ciliata* M.Roem.	0.439	0.298	0.591	1.327

Sl. No.	SPECIES	RF	RD	RA	IVI
93	*Acacia pennata* (L.) Willd.	0.494	0.298	0.525	1.317
94	*Deeringia amaranthoides* (Lam.) Merr.	0.329	0.264	0.701	1.294
95	*Helminthostachys zeylanica* (L.) Hook.	0.329	0.264	0.701	1.294
96	*Mimosa pudica* L.	0.329	0.264	0.701	1.294
97	*Ophiopogon intermedius* D.Don.	0.110	0.132	1.051	1.293
98	*Croton caudatus* Geiseler	0.274	0.231	0.736	1.241
99	*Lasia spinosa* (L.) Thwaites	0.219	0.198	0.788	1.206
100	*Duchesnea indica* (Jacks.) Focke	0.329	0.231	0.613	1.174
101	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.329	0.231	0.613	1.174
102	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.384	0.231	0.525	1.141
103	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.384	0.231	0.525	1.141
104	*Naravelia zeylanica* (L.) DC.	0.384	0.231	0.525	1.141
105	*Shorea robusta* Gaertn.	0.384	0.231	0.525	1.141
106	*Murraya paniculata* (L.) Jack	0.274	0.198	0.631	1.103
107	*Piper sylvaticum* Roxb.	0.274	0.198	0.631	1.103
108	*Dalbergia stipulacea* Roxb.	0.329	0.198	0.525	1.053
109	*Croton persimilis* Müll.Arg.	0.165	0.132	0.701	0.997
110	*Morinda angustifolia* Roxb.	0.165	0.132	0.701	0.997
111	*Oxalis debilis* var. *corymbosa* (DC.) Lourteig	0.110	0.099	0.788	0.997
112	*Ficus pumila* L.	0.274	0.165	0.525	0.965
113	*Stereospermum tetragonum* DC.	0.274	0.165	0.525	0.965
114	*Alangium chinense* (Lour.) Harms	0.219	0.132	0.525	0.877
115	*Aristolochia tagala* Cham.	0.219	0.132	0.525	0.877
116	*Bridelia retusa* (L.) A.Juss.	0.219	0.132	0.525	0.877
117	*Sterculia villosa* Roxb.	0.219	0.132	0.525	0.877
118	*Zanthoxylum rhetsa* DC.	0.219	0.132	0.525	0.877
119	*Actinodaphne obovata* (Nees) Blume	0.165	0.099	0.525	0.789
120	*Gmelina arborea* Roxb.	0.165	0.099	0.525	0.789
121	*Litsea monopetala* (Roxb.) Pers.	0.165	0.099	0.525	0.789
122	*Syzygium cumini* (L.) Skeels	0.165	0.099	0.525	0.789
123	*Uvaria hamiltonii* Hook. f. & Thomson	0.165	0.099	0.525	0.789

Table 79. Phytosociological data of herb layer of natural vegetation in Pre-monsoon in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	4.361	6.569	1.270	12.199
2	*Clerodendrum infortunatum* L.	2.497	3.817	1.288	7.603
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	1.826	3.395	1.567	6.789
4	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	2.199	2.730	1.046	5.975
5	*Mikania micrantha* Kunth	1.789	2.574	1.213	5.576
6	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.162	2.264	0.883	5.308
7	*Diplazium esculentum* (Retz.) Sw.	1.267	2.375	1.579	5.221
8	*Pupalia lappacea* (L.) Juss.	1.752	2.286	1.100	5.137
9	*Ardisia solanacea* (Poir.) Roxb.	2.497	1.798	0.607	4.902
10	*Leea aequata* L.	2.572	1.687	0.553	4.811
11	*Spermacoce alata* Aubl.	1.528	2.086	1.151	4.765
12	*Lygodium flexuosum* (L.) Sw.	1.454	2.064	1.197	4.714
13	*Amischotolype hookeri* (Hassk.) H.Hara	1.603	1.731	0.910	4.244
14	*Cyperus compressus* L.	1.267	1.753	1.166	4.187
15	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	1.714	1.553	0.764	4.032
16	*Oplismenus burmanni* (Retz.) P.Beauv..	0.969	1.620	1.409	3.998
17	*Pteris biaurita* L.	1.826	1.420	0.655	3.902
18	*Pronephrium nudatum* (Roxb.) Holttum	1.230	1.531	1.049	3.811

Sl. No.	SPECIES	RF	RD	RA	IVI
19	*Persicaria chinensis* (L.) H. Gross	1.342	1.487	0.934	3.763
20	*Commelina diffusa* Burm.f.	1.267	1.465	0.974	3.706
21	*Chloranthus elatior* Link	1.379	1.398	0.854	3.632
22	*Tetrastigma planicaule* (Hook.f.) Gagnep.	1.789	1.176	0.554	3.519
23	*Lepidagathis incurva* Buch.-Ham. ex D. Don	1.416	1.287	0.766	3.469
24	*Boehmeria sp*	1.267	1.287	0.856	3.410
25	*Ageratum houstonianum* var. *muticescens* B.L.Rob.	1.342	1.265	0.795	3.401
26	*Gomphostemma ovatum* Wall. *ex* Benth.	1.528	1.198	0.661	3.388
27	*Impatiens trilobata* Colebr.	1.230	1.265	0.867	3.362
28	*Drymaria cordata* (L.) Willd. *ex* Schult.	0.895	1.265	1.192	3.351
29	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	0.634	1.154	1.535	3.323
30	*Achyranthes bidentata* Blume	0.969	1.198	1.042	3.210
31	*Girardinia diversifolia* (Link) Friis	1.454	1.087	0.631	3.172
32	*Elatostema rupestre* (Buch.-Ham. *ex* D.Don) Wedd.	0.634	1.087	1.446	3.168
33	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.342	1.087	0.683	3.112
34	*Synedrella nodiflora* (L.) Gaertn.	0.857	1.132	1.113	3.102
35	*Phaulopsis imbricata* (Forssk.) Sweet	0.969	1.087	0.946	3.002
36	*Dendrocnide sinuata* (Blume) Chew	1.081	1.065	0.831	2.977
37	*Tectaria gemmifera* (Fée) Alston	0.969	1.065	0.926	2.961
38	*Clausena excavata* Burm.f.	1.416	0.954	0.568	2.938
39	*Piper peepuloides* Wall.	1.379	0.932	0.570	2.881
40	*Maesa indica* (Roxb.) A. DC.	1.342	0.910	0.572	2.823
41	*Biophytum sensitivum* (L.) DC.	1.155	0.954	0.696	2.806
42	*Psychotria erratica* Hook.f.	0.634	0.932	1.240	2.806
43	*Rungia pectinata* (L.) Nees	0.186	0.466	2.108	2.760
44	*Phyllanthus niruri* L.	0.857	0.954	0.938	2.750
45	*Piper sylvaticum* Roxb.	1.006	0.866	0.725	2.597
46	*Sauropus compressus* Müll.Arg.	1.155	0.821	0.599	2.576
47	*Athyrium* sp	1.081	0.821	0.640	2.542
48	*Pilea peploides* (Gaudich.) Hook. & Arn.	0.783	0.843	0.908	2.534
49	*Dioscorea bulbifera* L.	0.857	0.843	0.829	2.530
50	*Glycosmis pentaphylla* (Retz.) DC.	1.044	0.821	0.663	2.528
51	*Casearia vareca* Roxb.	1.044	0.710	0.574	2.327
52	*Gouania leptostachya* DC.	1.044	0.710	0.574	2.327
53	*Piper chuvya* Miq.	1.044	0.688	0.556	2.287
54	*Nelsonia canescens* (Lam.) Spreng.	0.857	0.644	0.633	2.134
55	*Curculigo orchioides* Gaertn.	0.932	0.599	0.542	2.073
56	*Sida acuta* Burm.f.	0.895	0.599	0.565	2.058
57	*Globba racemosa* Sm.	0.596	0.599	0.847	2.042
58	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	0.895	0.577	0.544	2.015
59	*Pollia subumbellata* C.B.Clarke	0.559	0.577	0.870	2.006
60	*Desmodium laxiflorum* DC.	0.783	0.577	0.621	1.981
61	*Colebrookea oppositifolia* Sm.	0.671	0.577	0.725	1.973
62	*Piper betleoides* C.DC.	0.708	0.533	0.634	1.875
63	*Pericampylus glaucus* (Lam.) Merr.	0.708	0.510	0.607	1.826
64	*Helminthostachys zeylanica* (L.) Hook.	0.634	0.510	0.679	1.823
65	*Ophiopogon intermedius* D.Don	0.261	0.355	1.147	1.763
66	*Vallaris solanacea* (Roth) Kuntze	0.671	0.466	0.585	1.722
67	*Morinda angustifolia* Roxb.	0.634	0.466	0.620	1.720
68	*Triumfetta rhomboidea* Jacq.	0.447	0.422	0.795	1.664
69	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.335	0.377	0.948	1.661
70	*Acmella calva* (DC.) R.K.Jansen	0.485	0.422	0.733	1.640
71	*Pouzolzia zeylanica* (L.) Benn.	0.485	0.422	0.733	1.640
72	*Cissus repens* Lam.	0.559	0.422	0.636	1.616
73	*Solanum aculeatissimum* Jacq.	0.522	0.399	0.645	1.567

Sl. No.	SPECIES	RF	RD	RA	IVI
74	*Dicliptera bupleuroides* Nees	0.522	0.377	0.609	1.508
75	*Acacia pennata* (L.) Willd.	0.410	0.355	0.730	1.495
76	*Alysicarpus rugosus* (Willd.) DC.	0.447	0.355	0.669	1.471
77	*Crateva religiosa* G.Forst.	0.485	0.355	0.618	1.457
78	*Merremia vitifolia* (Burm. f.) Hallier f.	0.522	0.355	0.574	1.450
79	*Oxalis corniculata* L.	0.261	0.266	0.860	1.388
80	*Asystasia macrocarpa* Nees	0.410	0.311	0.639	1.359
81	*Lobelia nummularia* Lam.	0.410	0.311	0.639	1.359
82	*Mitracarpus hirtus* (L.) DC.	0.335	0.289	0.725	1.349
83	*Xanthosoma brasiliense* (Desf.) Engl.	0.335	0.289	0.725	1.349
84	*Celastrus paniculatus* Willd.	0.447	0.311	0.585	1.343
85	*Combretum decandrum* Jacq.	0.447	0.311	0.585	1.343
86	*Pueraria sikkimensis* Prain	0.410	0.289	0.593	1.292
87	*Plectranthus mollis* (Aiton) Spreng.	0.186	0.200	0.903	1.289
88	*Thunbergia fragrans* Roxb.	0.485	0.289	0.502	1.275
89	*Merremia hirta* (L.) Merr.	0.298	0.244	0.690	1.232
90	*Asparagus racemosus* Willd.	0.335	0.244	0.613	1.193
91	*Croton caudatus* Geiseler	0.335	0.244	0.613	1.193
92	*Pothos scandens* L.	0.335	0.244	0.613	1.193
93	*Smilax ovalifolia* Roxb. ex D.Don	0.335	0.244	0.613	1.193
94	*Urena lobata* L.	0.149	0.155	0.878	1.183
95	*Deeringia amaranthoides* (Lam.) Merr.	0.261	0.200	0.645	1.106
96	*Jasminum dispermum* Wall.	0.261	0.200	0.645	1.106
97	*Oxalis debilis* var. *corymbosa* DC.	0.224	0.178	0.669	1.070
98	*Caesalpinia cucullata* Roxb.	0.298	0.200	0.565	1.062
99	*Lasia spinosa* (L.) Thwaites	0.298	0.200	0.565	1.062
100	*Litsea monopetala* (Roxb.) Pers.	0.298	0.200	0.565	1.062
101	*Murraya paniculata* (L.) Jack	0.298	0.200	0.565	1.062
102	*Baliospermum solanifolium* (Burm.) Suresh	0.186	0.155	0.703	1.044
103	*Cheilocostus speciosus* (J.Koenig) C.D.Specht.	0.149	0.133	0.753	1.035
104	*Porana paniculata* Roxb.	0.224	0.155	0.585	0.964
105	*Albizia lucidior* (Steud.) I.C.Nielsen	0.186	0.133	0.602	0.922
106	*Capparis olacifolia* Hook.f. & Thomson	0.186	0.133	0.602	0.922
107	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.261	0.155	0.502	0.918
108	*Aristolochia tagala* Cham.	0.261	0.155	0.502	0.918
109	*Uvaria hamiltonii* Hook. f. & Thomson	0.149	0.111	0.627	0.887
110	*Goodyera* sp	0.112	0.089	0.669	0.870
111	*Parabaena sagittata* Miers	0.112	0.089	0.669	0.870
112	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.112	0.089	0.669	0.870
113	*Actinodaphne obovata* (Nees) Blume	0.224	0.133	0.502	0.859
114	*Chukrasia tabularis* A.Juss.	0.224	0.133	0.502	0.859
115	*Mallotus philippensis* (Lam.) Müll.Arg.	0.224	0.133	0.502	0.859
116	*Mussaenda roxburghii* Hook.f.	0.224	0.133	0.502	0.859
117	*Dregea volubilis* (L.f.) Benth. *ex* Hook.f..	0.224	0.133	0.502	0.859
118	*Dalbergia stipulacea* Roxb.	0.149	0.089	0.502	0.740
119	*Naravelia zeylanica* (L.) DC.	0.149	0.089	0.502	0.740
120	*Shorea robusta* Gaertn.	0.149	0.089	0.502	0.740
121	*Streblus asper* Lour.	0.149	0.089	0.502	0.740
122	*Dillenia indica* L.	0.112	0.067	0.502	0.680
123	*Eurya acuminata* DC.	0.112	0.067	0.502	0.680
124	*Ficus pumila* L.	0.112	0.067	0.502	0.680
125	*Miliusa roxburghiana* Hook.f. & Thomson	0.112	0.067	0.502	0.680
126	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.112	0.067	0.502	0.680
127	*Meyna spinosa* Roxb. *ex* Link	0.075	0.044	0.502	0.621
128	*Pterygota alata* (Roxb.) R.Br.	0.075	0.044	0.502	0.621

Sl. No.	SPECIES	RF	RD	RA	IVI
129	*Zanthoxylum rhetsa* DC.	0.075	0.044	0.502	0.621
130	*Balakata baccata* (Roxb.) Esser	0.037	0.022	0.502	0.561
131	*Pterospermum acerifolium* (L.) Willd.	0.037	0.022	0.502	0.561
132	*Sterculia villosa* Roxb.	0.037	0.022	0.502	0.561
133	*Syzygium cumini* (L.) Skeels	0.037	0.022	0.502	0.561
134	*Tinospora sinensis* (Lour.) Merr.	0.037	0.022	0.502	0.561

Table 80. Phytosociological data of herb layer of natural vegetation in Post-monsoon in NRVK site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	3.491	4.410	0.886	8.787
2	*Chloranthus elatior* Link	2.389	3.163	0.928	6.480
3	*Clerodendrum infortunatum* L.	2.228	2.880	0.907	6.015
4	*Setaria palmifolia* (J. Koenig) Stapf.	1.011	2.747	1.906	5.664
5	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	0.873	2.287	1.837	4.997
6	*Diplazium esculentum* (Retz.) Sw.	1.539	2.361	1.076	4.975
7	*Mikania micrantha* Kunth	1.791	2.034	0.796	4.622
8	*Tectaria gemmifera* (Fée) Alston	1.447	1.886	0.914	4.246
9	*Pteris semipinnata* L.	1.011	1.871	1.298	4.180
10	*Dryopteris sikkimensis* (Bedd.) Kuntze	1.677	1.663	0.696	4.035
11	*Pronephrium nudatum* (Roxb.) Holttum	1.631	1.604	0.690	3.924
12	*Oplismenus burmanni* (Retz.) P.Beauv.	1.194	1.693	0.994	3.881
13	*Dendrocnide sinuata* (Blume) Chew	1.332	1.663	0.875	3.870
14	*Spermacoce alata* Aubl.	0.988	1.678	1.191	3.857
15	*Dryopteris sparsa* (D. Don) Kuntze	1.286	1.604	0.874	3.764
16	*Pteris biaurita* L.	1.309	1.529	0.819	3.658
17	*Chromolaena odorata* (L.) R.M.King & H.Rob.	1.424	1.425	0.702	3.551
18	*Pollia subumbellata* C.B.Clarke	1.286	1.455	0.793	3.535
19	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	1.654	1.277	0.541	3.472
20	*Amischotolype hookeri* (Hassk.) H.Hara	1.217	1.321	0.761	3.300
21	*Impatiens trilobata* Colebr.	1.539	1.203	0.548	3.290
22	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	1.194	1.292	0.758	3.245
23	*Ageratum houstonianum* Mill.	1.171	1.247	0.747	3.165
24	*Persicaria chinensis* (L.) H. Gross	1.263	1.203	0.668	3.134
25	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.562	1.069	0.480	3.111
26	*Achyranthes bidentata* Blume	0.666	1.143	1.204	3.013
27	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	0.781	1.128	1.013	2.923
28	*Carex indica* L.	0.988	1.128	0.801	2.917
29	*Biophytum sensitivum* (L.) DC.	0.735	1.084	1.034	2.853
30	*Gomphostemma ovatum* Wall. *ex* Benth.	1.240	1.024	0.579	2.844
31	*Lygodium flexuosum* (L.) Sw.	1.240	1.024	0.579	2.844
32	*Psychotria erratica* Hook.f.	1.286	0.950	0.518	2.755
33	*Elephantopus scaber* L.	1.217	0.950	0.547	2.715
34	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.332	0.906	0.477	2.715
35	*Cyperus rotundus* L.	1.011	0.995	0.690	2.696
36	*Pouzolzia zeylanica* (L.) Benn.	0.942	0.995	0.741	2.677
37	*Tetrastigma dubium* (Lawson) Planch.	1.286	0.861	0.470	2.617
38	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	0.942	0.935	0.697	2.574
39	*Phaulopsis imbricata* (Forssk.) Sweet	0.781	0.935	0.840	2.556
40	*Dioscorea bulbifera* L.	0.965	0.906	0.658	2.529
41	*Commelina diffusa* Burm.f.	1.171	0.831	0.498	2.501
42	*Spermacoce ocymoides* Burm.f.	0.781	0.906	0.813	2.500
43	*Girardinia diversifolia* (Link) Friis	0.988	0.861	0.611	2.460
44	*Tetrastigma campylocarpum* (Kurz) Planch.	1.125	0.772	0.481	2.379
45	*Triumfetta rhomboidea* Jacq.	0.666	0.831	0.875	2.373
46	*Glycosmis pentaphylla* (Retz.) DC.	1.056	0.772	0.512	2.341
47	*Maesa indica* (Roxb.) A. DC.	1.056	0.757	0.503	2.316

Sl. No.	SPECIES	RF	RD	RA	IVI
48	*Phyllanthus urinaria* L.	0.620	0.772	0.873	2.265
49	*Piper betleoides* C.DC.	0.873	0.728	0.585	2.185
50	*Pupalia lappacea* (L.) Juss.	0.482	0.683	0.993	2.158
51	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	0.712	0.713	0.702	2.127
52	*Athyrium* sp	0.620	0.683	0.772	2.075
53	*Globba racemosa* Sm.	0.712	0.683	0.673	2.068
54	*Lobelia nummularia* Lam.	0.827	0.653	0.554	2.034
55	*Sida acuta* Burm.f.	0.827	0.638	0.541	2.007
56	*Stellaria media* (L.) Vill.	0.528	0.579	0.769	1.876
57	*Commelina suffruticosa* Blume	0.758	0.579	0.536	1.873
58	*Curculigo orchioides* Gaertn.	0.712	0.579	0.570	1.861
59	*Gouania leptostachya* DC.	0.781	0.564	0.507	1.852
60	*Sauropus compressus* Müll.Arg.	0.758	0.549	0.508	1.816
61	*Dicliptera bupleuroides* Nees	0.620	0.535	0.604	1.759
62	*Floscopa scandens* Lour.	0.712	0.505	0.497	1.714
63	*Leea guineensis* G. Don	0.643	0.490	0.534	1.667
64	*Desmodium laxiflorum* DC.	0.620	0.475	0.537	1.633
65	*Piper chuvya* Miq.	0.620	0.475	0.537	1.633
66	*Typhonium trilobatum* (L.) Schott	0.551	0.475	0.604	1.631
67	*Elatostema rupestre* (Buch.-Ham. *ex* D.Don) Wedd.	0.597	0.475	0.558	1.630
68	*Oxalis corniculata* L.	0.528	0.460	0.611	1.600
69	*Zingiber zerumbet* (L.) Roscoe ex Sm.	0.322	0.386	0.842	1.550
70	*Piper hamiltonii* C.DC.	0.505	0.431	0.598	1.533
71	*Merremia vitifolia* (Burm. f.) Hallier f.	0.597	0.431	0.506	1.533
72	*Rungia pectinata* (L.) Nees	0.299	0.356	0.837	1.492
73	*Pericampylus glaucus* (Lam.) Merr.	0.597	0.401	0.471	1.469
74	*Morinda angustifolia* Roxb.	0.574	0.401	0.490	1.465
75	*Cyanthillium cinereum* (L.) H.Rob.	0.551	0.401	0.510	1.462
76	*Acmella calva* (DC.) R.K.Jansen	0.528	0.401	0.532	1.461
77	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.436	0.386	0.620	1.443
78	*Vallaris solanacea* (Roth) Kuntze	0.551	0.386	0.491	1.428
79	*Axonopus compressus* (Sw.) P.Beauv.	0.367	0.356	0.680	1.404
80	*Lindernia ciliata* (Colsm.) Pennell	0.436	0.356	0.573	1.365
81	*Homalomena rubescens* (Roxb.) Kunth	0.367	0.341	0.652	1.361
82	*Piper mullesua* Buch.-Ham. ex D. Don	0.390	0.341	0.613	1.345
83	*Phyllanthus niruri* L.	0.413	0.341	0.579	1.334
84	*Cyclea bicristata* (Griff.) Diels	0.459	0.341	0.521	1.322
85	*Solanum aculeatissimum* Jacq.	0.253	0.282	0.783	1.318
86	*Acacia pennata* (L.) Willd.	0.390	0.327	0.587	1.304
87	*Alocasia fallax* Schott	0.390	0.327	0.587	1.304
88	*Bridelia retusa* (L.) A.Juss.	0.390	0.327	0.587	1.304
89	*Helminthostachys zeylanica* (L.) Hook.	0.390	0.327	0.587	1.304
90	*Dioscorea deltoidea* Wall. *ex* Griseb.	0.367	0.312	0.595	1.274
91	*Clausena excavata* Burm.f.	0.413	0.312	0.529	1.254
92	*Sida rhombifolia* L.	0.413	0.312	0.529	1.254
93	*Anisomeles indica* (L.) Kuntze	0.253	0.252	0.701	1.206
94	*Lasia spinosa* (L.) Thwaites	0.184	0.208	0.793	1.185
95	*Xanthosoma brasiliense* (Desf.) Engl.	0.184	0.208	0.793	1.185
96	*Smilax ovalifolia* Roxb. ex D.Don	0.390	0.282	0.507	1.179
97	*Mimosa pudica* L.	0.322	0.267	0.583	1.172
98	*Oxalis debilis* var. *corymbosa* (DC.) Lourteig	0.276	0.252	0.642	1.170
99	*Hedyotis scandens* Roxb.	0.299	0.252	0.593	1.144
100	*Urena lobata* L.	0.322	0.252	0.550	1.124
101	*Croton caudatus* Geiseler	0.345	0.252	0.514	1.111
102	*Thunbergia fragrans* Roxb.	0.367	0.252	0.482	1.102

Sl. No.	SPECIES	RF	RD	RA	IVI
103	*Colebrookea oppositifolia* Sm.	0.299	0.238	0.558	1.094
104	*Ardisia solanacea* (Poir.) Roxb.	0.322	0.238	0.518	1.077
105	*Piper peepuloides* Wall.	0.322	0.238	0.518	1.077
106	*Capparis olacifolia* Hook.f. & Thomson	0.345	0.238	0.484	1.066
107	*Parabaena sagittata* Miers	0.345	0.238	0.484	1.066
108	*Trichosanthes tricuspidata* Lour.	0.345	0.238	0.484	1.066
109	*Persicaria hydropiper* (L.) Delarbre	0.207	0.193	0.655	1.055
110	*Casearia glomerata* Roxb.	0.253	0.208	0.577	1.037
111	*Dioscorea prazeri* Prain & Burkill	0.253	0.208	0.577	1.037
112	*Nelsonia canescens* (Lam.) Spreng.	0.161	0.163	0.712	1.036
113	*Tetrastigma planicaule* (Hook. f.) Gagnep.	0.322	0.223	0.486	1.030
114	*Amorphophallus bulbifer* (Roxb.) Blume	0.276	0.208	0.529	1.012
115	*Aristolochia tagala* Cham.	0.276	0.208	0.529	1.012
116	*Shorea robusta* Gaertn.	0.276	0.208	0.529	1.012
117	*Smilax zeylanica* L.	0.276	0.208	0.529	1.012
118	*Celastrus paniculatus* Willd.	0.299	0.208	0.488	0.995
119	*Cissus repens* Lam.	0.299	0.208	0.488	0.995
120	*Jasminum scandens* (Retz.) Vahl	0.299	0.208	0.488	0.995
121	*Litsea monopetala* (Roxb.) Pers.	0.299	0.208	0.488	0.995
122	*Pothos scandens* L.	0.299	0.208	0.488	0.995
123	*Mussaenda roxburghii* Hook.f.	0.322	0.208	0.453	0.983
124	*Premna bengalensis* C.B.Clarke	0.322	0.208	0.453	0.983
125	*Caesalpinia cucullata* Roxb.	0.253	0.193	0.536	0.981
126	*Rauvolfia serpentina* (L.) Benth. ex Kurz	0.253	0.193	0.536	0.981
127	*Stephania glabra* (Roxb.) Miers	0.253	0.193	0.536	0.981
128	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	0.184	0.163	0.623	0.970
129	*Stephania japonica* (Thunb.) Miers	0.184	0.163	0.623	0.970
130	*Bauhinia purpurea* L.	0.276	0.193	0.491	0.960
131	*Deeringia amaranthoides* (Lam.) Merr.	0.230	0.178	0.544	0.952
132	*Uvaria hamiltonii* Hook. f. & Thomson	0.299	0.193	0.453	0.945
133	*Ficus pumila* L.	0.207	0.163	0.554	0.924
134	*Thunbergia grandiflora* (Roxb. ex Rottl.) Roxb.	0.276	0.178	0.453	0.907
135	*Dregea volubilis* (L.f.) Benth. *ex* Hook.f.	0.276	0.178	0.453	0.907
136	*Gmelina arborea* Roxb.	0.230	0.163	0.499	0.892
137	*Toona ciliata* M.Roem.	0.230	0.163	0.499	0.892
138	*Duchesnea indica* (Jacks.) Focke	0.161	0.134	0.583	0.877
139	*Strobilanthes wallichii* Nees	0.161	0.134	0.583	0.877
140	*Barleria cristata* L.	0.138	0.119	0.604	0.861
141	*Casearia vareca* Roxb.	0.138	0.119	0.604	0.861
142	*Dioscorea pentaphylla* L.	0.138	0.119	0.604	0.861
143	*Tetrastigma serrulatum* (Roxb.) Planch.	0.138	0.119	0.604	0.861
144	*Pueraria sikkimensis* Prain	0.207	0.148	0.504	0.859
145	*Dischidia bengalensis* Colebr.	0.115	0.104	0.635	0.853
146	*Berchemia floribunda* (Wall.) Brongn.	0.184	0.134	0.510	0.827
147	*Meyna spinosa* Roxb. *ex* Link	0.184	0.134	0.510	0.827
148	*Zanthoxylum rhetsa* DC.	0.184	0.134	0.510	0.827
149	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.207	0.134	0.453	0.794
150	*Mallotus philippensis* (Lam.) Müll.Arg.	0.207	0.134	0.453	0.794
151	*Paederia foetida* L.	0.207	0.134	0.453	0.794
152	*Actinodaphne obovata* (Nees) Blume	0.184	0.119	0.453	0.756
153	*Naravelia zeylanica* (L.) DC.	0.184	0.119	0.453	0.756
154	*Dalbergia stipulacea* Roxb.	0.161	0.104	0.453	0.718
155	*Merremia hirta* (L.) Merr.	0.161	0.104	0.453	0.718
156	*Alangium chinense* (Lour.) Harms	0.115	0.074	0.453	0.642
157	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.069	0.045	0.453	0.567

Table 81. Phytosociological data of tree layer of natural vegetation in winter in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Machilus glaucescens* (Nees) H.W. Li	4.39	8.57	3.24	16.21
2	*Bauhinia variegata* L.	6.83	6.43	1.56	14.82
3	*Stereospermum tetragonum* DC.	5.85	6.07	1.72	13.65
4	*Baccaurea ramiflora* Lour.	6.34	5.71	1.50	13.55
5	*Actinodaphne obovata* (Nees) Blume	3.90	5.36	2.28	11.54
6	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	5.37	4.64	1.44	11.45
7	*Sorindeia madagascariensis* Thouars ex DC.	5.37	3.93	1.22	10.51
8	*Shorea robusta* Gaertn.	3.90	3.93	1.67	9.50
9	*Turpinia pomifera* (Roxb.) DC.	3.90	3.93	1.67	9.50
10	*Gynocardia odorata* R.Br.	3.90	3.21	1.37	8.49
11	*Castanopsis lanceifolia* (Oerst.) Hickel & A.Camus	2.93	3.21	1.82	7.97
12	*Garuga floribunda* Decne.	2.44	3.21	2.19	7.84
13	*Castanopsis indica* (Roxb. ex Lindl.) A.DC.	2.93	2.86	1.62	7.41
14	*Albizia lucidior* (Steud.) I.C.Nielsen	0.49	1.43	4.87	6.78
15	*Holarrhena pubescens* Wall. *ex* G.Don	1.95	2.50	2.13	6.58
16	*Syzygium cumini* (L.) Skeels	2.44	2.14	1.46	6.04
17	*Elaeocarpus lanceifolius* Roxb.	1.95	2.14	1.82	5.92
18	*Litsea monopetala* (Roxb.) Pers.	1.46	1.79	2.03	5.28
19	*Syzygium formosum* (Wall.) Masam.	1.95	1.79	1.52	5.26
20	*Semecarpus anacardium* L.f.	0.49	1.07	3.65	5.21
21	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.98	1.43	2.43	4.84
22	*Sphaerosacme decandra* (Wall.) T.D.Penn.	0.98	1.43	2.43	4.84
23	*Aphanamixis polystachya* (Wall.) R.Parker	1.46	1.43	1.62	4.51
24	*Streblus asper* Lour.	1.46	1.43	1.62	4.51
25	*Artocarpus chama* Buch.-Ham.	0.98	1.07	1.82	3.87
26	*Ficus benjamina* L.	0.98	1.07	1.82	3.87
27	*Alstonia scholaris* (L.) R.Br.	1.46	1.07	1.22	3.75
28	*Premna mollissima* Roth	1.46	1.07	1.22	3.75
29	*Pterospermum acerifolium* (L.) Willd.	0.49	0.71	2.43	3.64
30	*Callicarpa arborea* Roxb.	0.98	0.71	1.22	2.91
31	*Dillenia indica* L.	0.98	0.71	1.22	2.91
32	*Magnolia cathcartii* (Hook.f. & Thomson) Noot.	0.98	0.71	1.22	2.91
33	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng	0.98	0.71	1.22	2.91
34	*Oroxylum indicum* (L.) Kurz	0.98	0.71	1.22	2.91
35	*Schima wallichii* Choisy	0.98	0.71	1.22	2.91
36	*Sterculia villosa* Roxb.	0.98	0.71	1.22	2.91
37	*Terminalia chebula* Retz.	0.98	0.71	1.22	2.91
38	*Aglaia lawii*(Wight) C.J.Saldanha	0.49	0.36	1.22	2.06
39	*Alangium chinense* (Lour.) Harms	0.49	0.36	1.22	2.06
40	*Bombax ceiba* L.	0.49	0.36	1.22	2.06
41	*Canarium sikkimense* King	0.49	0.36	1.22	2.06
42	*Casearia vareca* Roxb.	0.49	0.36	1.22	2.06
43	*Pterygota alata* (Roxb.) R.Br.	0.49	0.36	1.22	2.06
44	*Ceiba pentandra* (L.) Gaertn.	0.49	0.36	1.22	2.06
45	*Chisocheton cumingianus* (C.DC.) Harms	0.49	0.36	1.22	2.06
46	*Chisocheton cumingianus* subsp. *balansae* (C.DC.) Mabb.	0.49	0.36	1.22	2.06

Sl. No.	SPECIES	RF	RD	RA	IVI
47	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.49	0.36	1.22	2.06
48	*Crateva religiosa* G.Forst.	0.49	0.36	1.22	2.06
49	*Dillenia pentagyna* Roxb.	0.49	0.36	1.22	2.06
50	*Erythrina stricta* Roxb.	0.49	0.36	1.22	2.06
51	*Eurya acuminata* DC.	0.49	0.36	1.22	2.06
52	*Ficus hispida* L.f.	0.49	0.36	1.22	2.06
53	*Ilex godajam* Colebr. *ex* Hook.f.	0.49	0.36	1.22	2.06
54	*Lagerstroemia parviflora* Roxb.	0.49	0.36	1.22	2.06
55	*Leea guineensis* G. Don	0.49	0.36	1.22	2.06
56	*Litsea panamanja* (Buch.-Ham. *ex* Nees) Hook. f.	0.49	0.36	1.22	2.06
57	*Litsea salicifolia* (J. Roxb. ex Nees) Hook. f.	0.49	0.36	1.22	2.06
58	*Mallotus philippensis* (Lam.) Müll.Arg.	0.49	0.36	1.22	2.06
59	*Meliosma simplicifolia* (Roxb.) Walp.	0.49	0.36	1.22	2.06
60	*Rhus succedanea* L.	0.49	0.36	1.22	2.06
61	*Terminalia alata* Roth	0.49	0.36	1.22	2.06
62	*Mallotus repandus* (Willd.) Müll.Arg.	0.49	0.36	1.22	2.06
63	*Vitex peduncularis* Wall. *ex* Schauer	0.49	0.36	1.22	2.06
64	*Wrightia arborea* (Dennst.) Mabb.	0.49	0.36	1.22	2.06

Table 82. Phytosociological data of tree layer of natural vegetation in Post-monsoon in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Machilus glaucescens* (Nees) H.W. Li	4.15	8.16	3.18	15.49
2	*Bauhinia variegata* L.	6.45	6.12	1.53	14.11
3	*Stereospermum tetragonum* DC.	5.53	5.78	1.69	13.00
4	*Baccaurea ramiflora* Lour.	5.99	5.44	1.47	12.90
5	*Actinodaphne obovata* (Nees) Blume	3.69	5.10	2.23	11.02
6	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	5.07	4.42	1.41	10.90
7	*Sorindeia madagascariensis* Thouars *ex* DC.	5.07	3.74	1.19	10.00
8	*Shorea robusta* Gaertn.	4.15	4.08	1.59	9.82
9	*Turpinia pomifera* (Roxb.) DC.	3.23	3.40	1.70	8.33
10	*Gynocardia odorata* R.Br.	3.69	3.06	1.34	8.09
11	*Castanopsis lanceifolia* (Oerst.) Hickel & A.Camus	2.76	3.06	1.79	7.61
12	*Garuga floribunda* Decne.	2.30	3.06	2.15	7.51
13	*Castanopsis indica* (Roxb. ex Lindl.) A.DC.	2.76	2.72	1.59	7.08
14	Syzygium cumini (L.) Skeels	2.30	2.38	1.67	6.35
15	*Holarrhena pubescens* Wall. *ex* G.Don	1.84	2.38	2.09	6.31
16	*Elaeocarpus laurifolius* A.Gray	1.84	2.04	1.79	5.67
17	*Albizia lucidior* (Steud.) I.C.Nielsen	0.92	1.70	2.98	5.60
18	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	1.38	1.70	1.99	5.07
19	*Litsea salicifolia* (J. Roxb. *ex* Nees) Hook. f.	1.38	1.70	1.99	5.07
20	*Semecarpus anacardium* L.f	0.46	1.02	3.58	5.06
21	*Syzygium formosum* (Wall.) Masam.	1.84	1.70	1.49	5.03
22	*Sphaerosacme decandra* (Wall.) T.D.Penn.	0.92	1.36	2.38	4.67
23	*Callicarpa arborea* Roxb.	1.38	1.36	1.59	4.33
24	*Streblus asper* Lour.	1.38	1.36	1.59	4.33
25	*Aphanamixis polystachya* (Wall.) R.Parker	1.38	1.36	1.59	4.33
26	*Ficus benjamina* L.	0.92	1.02	1.79	3.73
27	*Artocarpus chama* Buch.-Ham.	0.92	1.02	1.79	3.73
28	*Sterculia villosa* Roxb.	1.38	1.02	1.19	3.59
29	*Premna mollissima* Roth	1.38	1.02	1.19	3.59

Sl. No.	SPECIES	RF	RD	RA	IVI
30	*Alstonia scholaris* (L.) R. Br.	1.38	1.02	1.19	3.59
31	*Pterospermum acerifolium* (L.) Willd.	0.46	0.68	2.38	3.52
32	*Oroxylum indicum* (L.) Kurz	0.92	0.68	1.19	2.79
33	*Magnolia cathcartii* (Hook.f. & Thomson) Noot.	0.92	0.68	1.19	2.79
34	*Bombax ceiba* L.	0.92	0.68	1.19	2.79
35	*Toona ciliata* M.Roem.	0.92	0.68	1.19	2.79
36	*Leea guineensis* G. Don	0.92	0.68	1.19	2.79
37	*Erythrina stricta* Roxb.	0.92	0.68	1.19	2.79
38	*Eurya acuminata* DC.	0.92	0.68	1.19	2.79
39	*Terminalia chebula* Retz.	0.92	0.68	1.19	2.79
40	*Rhus succedanea* L.	0.92	0.68	1.19	2.79
41	*Schima wallichii* Choisy	0.92	0.68	1.19	2.79
42	*Dillenia indica* L.	0.92	0.68	1.19	2.79
43	*Chukrasia tabularis* A.Juss.	0.46	0.34	1.19	1.99
44	*Ziziphus jujuba* Mill.	0.46	0.34	1.19	1.99
45	*Uvaria hamiltonii* Hook. f. & Thomson	0.46	0.34	1.19	1.99
46	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.46	0.34	1.19	1.99
47	*Ceiba pentandra* (L.) Gaertn.	0.46	0.34	1.19	1.99
48	*Lagerstroemia parviflora* Roxb.	0.46	0.34	1.19	1.99
49	*Terminalia alata* Roth	0.46	0.34	1.19	1.99
50	*Ficus hispida* L.f.	0.46	0.34	1.19	1.99
51	*Tectona grandis* L.f.	0.46	0.34	1.19	1.99
52	*Macaranga denticulata* (Blume) Müll.Arg.	0.46	0.34	1.19	1.99
53	*Meliosma simplicifolia* (Roxb.) Walp.	0.46	0.34	1.19	1.99
54	*Mallotus nudiflorus* (L.) Kulju & Welzen.	0.46	0.34	1.19	1.99
55	*Litsea monopetala* (Roxb.) Pers.	0.46	0.34	1.19	1.99
56	*Mallotus philippensis* (Lam.) Müll.Arg.	0.46	0.34	1.19	1.99
57	*Wrightia arborea* (Dennst.) Mabb.	0.46	0.34	1.19	1.99
58	*Ilex godajam* Colebr. *ex* Hook.f.	0.46	0.34	1.19	1.99
59	*Pterygota alata* (Roxb.) R.Br.	0.46	0.34	1.19	1.99
60	*Chisocheton cumingianus* subsp. *balansae* (C.DC.) Mabb.	0.46	0.34	1.19	1.99
61	*Canarium sikkimense* King	0.46	0.34	1.19	1.99
62	*Crateva religiosa* G.Forst.	0.46	0.34	1.19	1.99
63	*Vitex peduncularis* Wall. ex Schauer.	0.46	0.34	1.19	1.99
64	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng	0.46	0.34	1.19	1.99
65	*Aglaia lawii* (Wight) C.J.Saldanha	0.46	0.34	1.19	1.99
66	*Alangium chinense* (Lour.) Harms	0.46	0.34	1.19	1.99
67	*Casearia vareca* Roxb.	0.46	0.34	1.19	1.99

Table 83. Phytosociological data of shrub layer of natural vegetation in winter in Lataguri site

Sl.No.	SPECIES	RF	RD	RA	IVI
1	*Mikania micrantha* Kunth	5.73	13.25	2.02	20.99
2	*Justicia adhatoda* L.	2.75	4.85	1.54	9.14
3	*Clerodendrum infortunatum* L.	2.98	3.24	0.95	7.16
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.44	2.83	0.72	6.99
5	*Litsea monopetala* (Roxb.) Pers.	3.44	2.83	0.72	6.99
6	*Croton caudatus* Geiseler	2.75	3.13	0.99	6.88
7	*Sorindeia madagascariensis* Thouars *ex* DC.	3.90	2.33	0.52	6.74
8	*Coffea benghalensis* B.Heyne *ex* Schult.	1.38	3.13	1.99	6.50
9	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	2.29	2.43	0.92	5.64
10	*Lygodium flexuosum* (L.) Sw.	1.38	2.22	1.41	5.01
11	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.38	2.22	1.41	5.01
12	*Piper hamiltonii* C.DC.	0.46	1.42	2.69	4.57
13	*Baliospermum solanifolium* (Burm.) Suresh	0.92	1.72	1.63	4.27
14	*Gomphostemma ovatum* Wall. *ex* Benth.	0.46	1.21	2.31	3.98

Sl.No.	SPECIES	RF	RD	RA	IVI
15	*Ixora athroantha* Bremek.	0.46	1.21	2.31	3.98
16	*Maesa indica* (Roxb.) A.DC.	0.46	1.21	2.31	3.98
17	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.92	1.52	1.44	3.88
18	*Leea aequata* L.	1.83	1.31	0.62	3.77
19	*Dracaena angustifolia* (Medik.) Roxb.	0.46	1.11	2.12	3.69
20	*Tinospora sinensis* (Lour.) Merr.	0.23	0.71	2.69	3.63
21	*Tetrastigma serrulatum* (Roxbergh) Planch.	1.83	1.21	0.58	3.63
22	*Merremia vitifolia* (Burm. f.) Hallier f.	1.38	1.31	0.83	3.52
23	*Piper betleoides* C.DC.	1.83	1.11	0.53	3.48
24	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	1.15	1.31	1.00	3.46
25	*Dendrocnide sinuata* (Blume) Chew	0.69	1.21	1.54	3.44
26	*Smilax orthoptera* A. DC.	1.83	0.91	0.43	3.18
27	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.15	1.11	0.85	3.11
28	*Tephrosia candida* (Roxb.) DC.	1.15	1.11	0.85	3.11
29	*Pueraria sikkimensis* Prain	1.15	1.11	0.85	3.11
30	*Ardisia solanacea* (Poir.) Roxb.	1.61	0.91	0.49	3.01
31	*Casearia vareca* Roxb.	1.61	0.91	0.49	3.01
32	*Baccaurea ramiflora* Lour.	1.38	0.91	0.58	2.86
33	*Tetrastigma planicaule* (Hook.f.) Gagnep.	1.61	0.81	0.44	2.85
34	*Celastrus paniculatus* Willd.	1.15	0.91	0.69	2.75
35	*Persicaria chinensis* (L.) H. Gross	1.15	0.91	0.69	2.75
36	*Alpinia calcarata* (Haw.) Roscoe	0.92	0.91	0.87	2.69
37	*Syzygium tetragonum* (Wight) Wall. *ex* Walp.	0.92	0.91	0.87	2.69
38	*Melastoma malabathricum* L.	0.69	0.81	1.03	2.52
39	*Merremia hirta* (L.) Merr.	0.69	0.81	1.03	2.52
40	*Barleria cristata* L.	0.46	0.71	1.35	2.51
41	*Chloranthus elatior* Link	0.46	0.71	1.35	2.51
42	*Dillenia indica* L.	1.15	0.71	0.54	2.39
43	*Syzygium cumini* (L.) Skeels	1.15	0.71	0.54	2.39
44	*Casearia glomerata* Roxb.	0.92	0.71	0.67	2.30
45	*Cyclea bicristata* (Griff.) Diels	0.92	0.71	0.67	2.30
46	*Merremia hirta* (L.) Merr.	0.92	0.71	0.67	2.30
47	*Tetrastigma campylocarpum* (Kurz) Planch.	0.92	0.71	0.67	2.30
48	*Sauropus androgynus* (L.) Merr.	0.69	0.71	0.90	2.29
49	*Glycosmis pentaphylla* (Retz.) DC.	0.46	0.61	1.15	2.22
50	*Ilex godajam* Colebr. *ex* Hook.f.	0.46	0.61	1.15	2.22
51	*Solanum torvum* Sw.	0.46	0.61	1.15	2.22
52	*Capparis acutifolia* Sweet	1.15	0.61	0.46	2.21
53	*Uvaria hamiltonii* Hook. f. & Thomson	1.15	0.61	0.46	2.21
54	*Baliospermum solanifolium* (Burm.) Suresh	0.23	0.40	1.54	2.17
55	*Crateva religiosa* G.Forst.	0.23	0.40	1.54	2.17
56	*Thunbergia fragrans* Roxb.	0.92	0.61	0.58	2.10
57	*Litsea glutinosa* (Lour.) C.B.Rob.	0.69	0.61	0.77	2.06
58	*Dioscorea pentaphylla* L.	1.15	0.51	0.38	2.04
59	*Bridelia retusa* (L.) A.Juss.	0.92	0.51	0.48	1.90
60	*Combretum decandrum* Jacq.	0.69	0.51	0.64	1.83
61	*Jasminum laurifolium* Roxb. *ex* Hornem.	0.69	0.51	0.64	1.83
62	*Morinda angustifolia* Roxb.	0.69	0.51	0.64	1.83
63	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	0.69	0.51	0.64	1.83
64	*Vallaris solanacea* (Roth) Kuntze	0.23	0.30	1.15	1.69
65	*Piper chuvya* Miq.	0.23	0.30	1.15	1.69
66	*Debregeasia longifolia* (Burm.f.) Wedd.	0.23	0.30	1.15	1.69
67	*Urena lobata* L.	0.23	0.30	1.15	1.69
68	*Leea guineensis* G. Don	0.69	0.40	0.51	1.61
69	*Dalbergia stipulacea* Roxb.	0.69	0.40	0.51	1.61

Sl.No.	SPECIES	RF	RD	RA	IVI
70	*Syzygium formosum* (Wall.) Masam.	0.69	0.40	0.51	1.61
71	*Dalbergia sissoo* DC.	0.69	0.30	0.38	1.38
72	*Bauhinia purpurea* L.	0.46	0.30	0.58	1.34
73	*Cleidion spiciflorum* (Burm.f.) Merr.	0.46	0.30	0.58	1.34
74	*Clerodendrum serratum* (L.) Moon	0.46	0.30	0.58	1.34
75	*Deeringia amaranthoides* (Lam.) Merr.	0.46	0.30	0.58	1.34
76	*Pterospermum acerifolium* (L.) Willd.	0.46	0.30	0.58	1.34
77	*Litsea panamanja* (Buch.-Ham. *ex* Nees) Hook. f.	0.46	0.30	0.58	1.34
78	*Macaranga denticulata* (Blume) Müll.Arg.	0.46	0.30	0.58	1.34
79	*Meliosma simplicifolia* (Roxb.) Walp.	0.46	0.30	0.58	1.34
80	*Lannea coromandelica* (Houtt.) Merr.	0.46	0.30	0.58	1.34
81	*Wrightia arborea* (Dennst.) Mabb.	0.46	0.30	0.58	1.34
82	*Solanum khasianum* C.B. Clarke	0.23	0.20	0.77	1.20
83	*Alangium chinense* (Lour.) Harms.	0.23	0.20	0.77	1.20
84	*Semecarpus anacardium* L.f.	0.23	0.20	0.77	1.20
85	*Clerodendrum indicum* (L.) Kuntze	0.23	0.20	0.77	1.20
86	*Callicarpa arborea* Roxb.	0.23	0.20	0.77	1.20
87	*Saurauia napaulensis* DC.	0.23	0.20	0.77	1.20
88	*Lagerstroemia speciosa* (L.) Pers.	0.23	0.20	0.77	1.20
89	*Dioscorea bulbifera* L.	0.23	0.20	0.77	1.20
90	*Naravelia zeylanica* (L.) DC.	0.23	0.20	0.77	1.20
91	*Flemingia* Sp	0.23	0.20	0.77	1.20
92	*Pterygota alata* (Roxb.) R.Br.	0.23	0.20	0.77	1.20
93	*Catunaregam spinosa* (Thunb.) Tirveng.	0.23	0.20	0.77	1.20
94	*Aphanamixis polystachya* (Wall.) R.Parker	0.46	0.20	0.38	1.05
95	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.46	0.20	0.38	1.05
96	*Pandanus unguifer* Hook.f.	0.46	0.20	0.38	1.05
97	*Stereospermum tetragonum* DC.	0.46	0.20	0.38	1.05
98	*Pericampylus glaucus* (Lam.) Merr.	0.23	0.10	0.38	0.72
99	*Abrus pulchellus* Thwaites	0.23	0.10	0.38	0.72
100	*Actinodaphne obovata* (Nees) Blume	0.23	0.10	0.38	0.72
101	*Angiopteris evecta* (G. Forst.) Hoffm.	0.23	0.10	0.38	0.72
102	*Acacia pennata* (L.) Willd.	0.23	0.10	0.38	0.72
103	*Aristolochia Cathcartii* Hooker f.	0.23	0.10	0.38	0.72
104	*Aristolochia saccata* Wall.	0.23	0.10	0.38	0.72
105	*Artocarpus chama* Buch.-Ham.	0.23	0.10	0.38	0.72
106	*Calamus* Sp	0.23	0.10	0.38	0.72
107	*Bischofia javanica* Blume	0.23	0.10	0.38	0.72
108	*shorea robusta* Gaertn.	0.23	0.10	0.38	0.72
109	*Alstonia scholaris* (L.) R. Br.	0.23	0.10	0.38	0.72
110	*Chukrasia tabularis* A.Juss.	0.23	0.10	0.38	0.72
111	*Holmskioldia sanguinea* Retz.	0.23	0.10	0.38	0.72
112	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm.	0.23	0.10	0.38	0.72
113	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.23	0.10	0.38	0.72
114	*Sabia paniculata* Edgew. *ex* Hook. f. & Thomson	0.23	0.10	0.38	0.72
115	*Stephania glabra* (Roxb.) Miers	0.23	0.10	0.38	0.72
116	*Machilus glaucescens* (Nees) Wight.	0.23	0.10	0.38	0.72
117	*Senna occidentalis* (L.) Link	0.23	0.10	0.38	0.72
118	*Meyna spinosa* Roxb. *ex* Link	0.23	0.10	0.38	0.72
119	*Miliusa roxburghiana* Hook.f. & Thomson	0.23	0.10	0.38	0.72
120	*Streblus asper* Lour.	0.23	0.10	0.38	0.72
121	*Pothos scandens* L.	0.23	0.10	0.38	0.72
122	*Albizia lucidior* (Steud.) I.C.Nielsen	0.23	0.10	0.38	0.72
123	*Albizia chinensis* (Osbeck) Merr.	0.23	0.10	0.38	0.72
124	*Turpinia pomifera* (Roxb.) DC.	0.23	0.10	0.38	0.72

Sl.No.	SPECIES	RF	RD	RA	IVI
125	*Toddalia asiatica* (L.) Lam.	0.23	0.10	0.38	0.72
126	*Toona ciliata* M.Roem.	0.23	0.10	0.38	0.72
127	*Trichosanthes lepiniana* (Naudin) Cogn.	0.23	0.10	0.38	0.72

Table 84. Phytosociological data of shrub layer of natural vegetation in Pre-monsoon in Lataguri site

Sl.No	SPECIES	RF	RD	RA	IVI
1	*Mikania micrantha* Kunth	5.57	12.82	2.04	20.43
2	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.34	5.19	1.38	9.91
3	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	2.67	4.96	1.64	9.27
4	*Croton caudatus* Geiseler	2.90	4.48	1.37	8.75
5	*Clerodendrum infortunatum* L.	0.89	3.70	3.68	8.27
6	*Litsea monopetala* (Roxb.) Pers.	3.34	2.83	0.75	6.92
7	Capparis acutifolia Sweet	3.79	2.44	0.57	6.80
8	*Baliospermum solanifolium* (Burm.) Suresh	0.89	2.68	2.66	6.23
9	*Meyna spinosa* Roxb. *ex* Link	3.56	1.65	0.41	5.63
10	*Antidesma bunius* (L.) Spreng.	1.34	2.12	1.41	4.87
11	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	2.23	1.89	0.75	4.87
12	*Tetracera sarmentosa* (L.) Vahl	0.22	0.87	3.44	4.53
13	*Smilax orthoptera* A. DC.	2.00	1.73	0.76	4.50
14	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.34	1.73	1.15	4.21
15	*Tetrastigma planicaule* (Hook.f.) Gagnep.	1.56	1.65	0.94	4.15
16	*Coffea benghalensis* B.Heyne *ex* Schult.	1.34	1.65	1.10	4.08
17	*Ardisia solanacea* (Poir.) Roxb.	1.56	1.49	0.85	3.90
18	*Syzygium tetragonum* (Wight) Wall. *ex* Walp.	0.89	1.49	1.49	3.87
19	*Tetrastigma serrulatum* (Roxb.) Planch.	1.78	1.34	0.66	3.78
20	*Piper peepuloides* Roxb.	0.45	1.10	2.19	3.74
21	*Casearia vareca* Roxb.	1.56	1.34	0.76	3.66
22	*Leea aequata* L.	1.78	1.02	0.51	3.31
23	*Gomphostemma ovatum* Wall. *ex* Benth.	0.45	0.94	1.88	3.27
24	*Ixora arestantha* A.C.Sm.	0.45	0.94	1.88	3.27
25	*Maesa indica* (Roxb.) A. DC.	0.45	0.94	1.88	3.27
26	*Justicia adhatoda* L.	0.89	1.18	1.17	3.24
27	*Cyclea bicristata* (Griff.) Diels	0.89	1.10	1.10	3.09
28	*Dioscorea bulbifera* L.	1.34	1.02	0.68	3.04
29	*Barleria cristata* L.	0.45	0.87	1.72	3.03
30	*Dracaena angustifolia* (Medik.) Roxb.	0.45	0.87	1.72	3.03
31	*Tinospora sinensis* (Lour.) Merr.	0.22	0.55	2.19	2.96
32	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook.f. & Thomson	1.11	1.02	0.81	2.95
33	*Syzygium cumini* (L.) Skeels	1.11	1.02	0.81	2.95
34	*Tetrastigma campylocarpum* (Kurz) Planch.	0.89	1.02	1.02	2.93
35	*Dendrocnide sinuata* (Blume) Chew	0.67	0.94	1.25	2.86
36	*Berchemia floribunda* (Wall.) Brongn.	1.11	0.87	0.69	2.67
37	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.11	0.87	0.69	2.67
38	*Mucuna pruriens* (L.) DC.	1.11	0.87	0.69	2.67
39	*Uvaria hamiltonii* Hook. f. & Thomson	1.11	0.87	0.69	2.67
40	*Alpinia calcarata* (Haw.) Roscoe	0.89	0.87	0.86	2.62
41	*Baccaurea ramiflora* Lour.	1.34	0.71	0.47	2.51
42	*Sauropus androgynus* (L.) Merr.	0.67	0.79	1.04	2.50
43	*Celastrus paniculatus* Willd.	1.11	0.71	0.56	2.38
44	*Persicaria chinensis* (L.) H. Gross	1.11	0.71	0.56	2.38
45	*Casearia glomerata* Roxb.	0.89	0.63	0.63	2.15
46	*Melastoma malabathricum* L.	0.67	0.63	0.83	2.13
47	*Merremia hirta* (L.) Merr.	0.67	0.63	0.83	2.13
48	*Clerodendrum serratum* (L.) Moon	1.11	0.55	0.44	2.10

Sl.No	SPECIES	RF	RD	RA	IVI
49	*Dillenia indica* L.	1.11	0.55	0.44	2.10
50	*Merremia hirta* (L.) Merr.	0.89	0.55	0.55	1.99
51	*Mussaenda treutleri* Stapf	1.11	0.47	0.38	1.96
52	*Glycosmis pentaphylla* (Retz.) DC.	0.45	0.47	0.94	1.86
53	*Ilex godajam* Colebr. *ex* Hook.f.	0.45	0.47	0.94	1.86
54	*Solanum torvum* Sw.	0.45	0.47	0.94	1.86
55	*Bauhinia purpurea* L.	0.89	0.47	0.47	1.83
56	*Baliospermum solanifolium* (Burm.) Suresh	0.22	0.31	1.25	1.79
57	*Crateva religiosa* G.Forst.	0.22	0.31	1.25	1.79
58	*Litsea glutinosa* (Lour.) C.B.Rob.	0.67	0.47	0.63	1.77
59	*Girardinia diversifolia* (Link) Friis	0.89	0.39	0.39	1.68
60	*Bridelia retusa* (L.) A.Juss.	0.89	0.39	0.39	1.68
61	*Combretum decandrum* Jacq.	0.67	0.39	0.52	1.58
62	*Dalbergia stipulacea* Roxb.	0.67	0.39	0.52	1.58
63	*Jasminum laurifolium* Roxb. *ex* Hornem.	0.67	0.39	0.52	1.58
64	*Morinda angustifolia* Roxb.	0.67	0.39	0.52	1.58
65	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	0.67	0.39	0.52	1.58
66	*Vallaris solanacea* (Roth) Kuntze	0.67	0.39	0.52	1.58
67	*Miliusa roxburghiana* Hook.f. & Thomson	0.67	0.31	0.42	1.40
68	*Syzygium formosum* (Wall.) Masam.	0.67	0.31	0.42	1.40
69	*Dioscorea deltoidea* Wall. *ex* Griseb.	0.22	0.24	0.94	1.40
70	*Leea guineensis* G. Don	0.22	0.24	0.94	1.40
71	*Piper chuvya* Miq.	0.22	0.24	0.94	1.40
72	*Urena lobata* L.	0.22	0.24	0.94	1.40
73	*Bauhinia variegata* L.	0.67	0.24	0.31	1.22
74	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.45	0.24	0.47	1.15
75	*Cleidion spiciflorum* (Burm.f.) Merr.	0.45	0.24	0.47	1.15
76	*Deeringia amaranthoides* (Lam.) Merr.	0.45	0.24	0.47	1.15
77	*Litsea panamanja* (Buch.-Ham. ex Nees) Hook. f.	0.45	0.24	0.47	1.15
78	*Macaranga denticulata* (Blume) Müll.Arg.	0.45	0.24	0.47	1.15
79	*Murraya paniculata* (L.) Jack	0.45	0.24	0.47	1.15
80	*Pavetta tomentosa* Roxb. *ex* Sm.	0.45	0.24	0.47	1.15
81	*Pterospermum acerifolium* (L.) Willd.	0.45	0.24	0.47	1.15
82	*Tetrastigma dubium* (Lawson) Planch.	0.45	0.24	0.47	1.15
83	*Triumfetta rhomboidea* Jacq.	0.45	0.24	0.47	1.15
84	*Wrightia arborea* (Dennst.) Mabb.	0.45	0.24	0.47	1.15
85	*Alangium chinense* (Lour.) Harms	0.22	0.16	0.63	1.01
86	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	0.22	0.16	0.63	1.01
87	*Aristolochia saccata* Wall.	0.22	0.16	0.63	1.01
88	*Callicarpa arborea* Roxb.	0.22	0.16	0.63	1.01
89	*Catunaregam longispina* (Link) Tirveng.	0.22	0.16	0.63	1.01
90	*Clerodendrum indicum* (L.) Kuntze	0.22	0.16	0.63	1.01
91	*Crotalaria pallida* Aiton	0.22	0.16	0.63	1.01
92	*Dioscorea pentaphylla* L.	0.22	0.16	0.63	1.01
93	*Dioscorea pubera* Blume	0.22	0.16	0.63	1.01
94	*Hedyotis scandens* Roxb.	0.22	0.16	0.63	1.01
95	*Naravelia zeylanica* (L.) DC.	0.22	0.16	0.63	1.01
96	*Pterygota alata* (Roxb.) R.Br.	0.22	0.16	0.63	1.01
97	*Saurauia napaulensis* DC.	0.22	0.16	0.63	1.01
98	*Semecarpus anacardium* L.f.	0.22	0.16	0.63	1.01
99	*Aphanamixis polystachya* (Wall.) R.Parker	0.45	0.16	0.31	0.92
100	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.45	0.16	0.31	0.92
101	*Pandanus unguifer* Hook.f.	0.45	0.16	0.31	0.92
102	*Pericampylus glaucus* (Lam.) Merr.	0.45	0.16	0.31	0.92
103	*Stereospermum tetragonum* DC.	0.45	0.16	0.31	0.92

Sl.No	SPECIES	RF	RD	RA	IVI
104	*Abrus pulchellus*Thwaites	0.22	0.08	0.31	0.61
105	*Acacia pennata* (L.) Willd.	0.22	0.08	0.31	0.61
106	*Actinodaphne obovata* (Nees) Blume	0.22	0.08	0.31	0.61
107	*Albizia lucidior* (Steud.) I.C.Nielsen	0.22	0.08	0.31	0.61
108	*Alstonia scholaris* (L.) R.Br.	0.22	0.08	0.31	0.61
109	*Angiopteris evecta* (G. Forst.) Hoffm.	0.22	0.08	0.31	0.61
110	*Aristolochia saccata* Wall.	0.22	0.08	0.31	0.61
111	*Aristolochia tagala* Cham.	0.22	0.08	0.31	0.61
112	*Artocarpus chama* Buch.-Ham.	0.22	0.08	0.31	0.61
113	*Artocarpus lacucha* Buch.-Ham.	0.22	0.08	0.31	0.61
114	*Bischofia javanica* Blume	0.22	0.08	0.31	0.61
115	*Calamus guruba* Buch.-Ham. *ex* Mart.	0.22	0.08	0.31	0.61
116	*Chukrasia tabularis* A.Juss.	0.22	0.08	0.31	0.61
117	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm.	0.22	0.08	0.31	0.61
118	*Cryptolepis sinensis* (Lour.) Merr.	0.22	0.08	0.31	0.61
119	*Ficus hispida* L.f.	0.22	0.08	0.31	0.61
120	*Ficus pumila* L.	0.22	0.08	0.31	0.61
121	*Gouania leptostachya* DC.	0.22	0.08	0.31	0.61
122	*Holmskioldia sanguinea* Retz.	0.22	0.08	0.31	0.61
123	*Lasia spinosa* (L.) Thwaites	0.22	0.08	0.31	0.61
124	*Meliosma simplicifolia* (Roxb.) Walp.	0.22	0.08	0.31	0.61
125	*Momordica dioica* Roxb. *ex* Willd.	0.22	0.08	0.31	0.61
126	*Machilus glaucescens* (Nees) Wight	0.22	0.08	0.31	0.61
127	*Pothos scandens* L.	0.22	0.08	0.31	0.61
128	*Sabia paniculata* Edgew. *ex* Hook.f. & Thomson	0.22	0.08	0.31	0.61
129	*Shorea robusta* Gaertn.	0.22	0.08	0.31	0.61
130	*Smilax zeylanica* L.	0.22	0.08	0.31	0.61
131	*Stephania glabra* (Roxb.) Miers	0.22	0.08	0.31	0.61
132	*Toddalia asiatica* (L.) Lam.	0.22	0.08	0.31	0.61
133	*Toona ciliata* M.Roem.	0.22	0.08	0.31	0.61
134	*Trichosanthes lepiniana* (Naudin) Cogn.	0.22	0.08	0.31	0.61
135	*Turpinia pomifera* (Roxb.) DC.	0.22	0.08	0.31	0.61
136	*Ziziphus rugosa* Lam.	0.22	0.08	0.31	0.61

Table 85. Phytosociological data of shrub layer of natural vegetation in Post-monsoon in Lataguri site

Sl.No.	SPECIES	RF	RD	RA	IVI
1	*Mikania micrantha* Kunth	8.32	12.20	1.29	21.81
2	*Alpinia nigra* (Gaertn.) Burtt	1.07	6.06	5.01	12.14
3	*Alpinia calcarata* (Haw.) Roscoe	1.71	6.36	3.28	11.34
4	*Piper peepuloides* Wall.	3.62	5.70	1.38	10.71
5	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.62	5.33	1.30	10.25
6	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.28	4.67	3.22	9.17
7	*Baliospermum solanifolium* (Burm.) Suresh	4.05	4.09	0.89	9.03
8	*Alpinia galanga* (L.) Willd.	1.07	4.24	3.50	8.80
9	*Merremia vitifolia* (Burm. f.) Hallier f.	3.62	3.14	0.76	7.53
10	*Natsiatum herpeticum* Buch.-Ham. ex Arn.	2.77	2.63	0.84	6.24
11	*Dregea volubilis* (L.f.) Benth. *ex* Hook.f.	2.56	1.97	0.68	5.21
12	*Tetrastigma planicaule* (Hook. f.) Gagnep.	1.49	1.90	1.12	4.51
13	*Girardinia diversifolia* (Link) Friis	0.21	0.73	3.02	3.96
14	*Morinda angustifolia* Roxb.	0.64	1.31	1.81	3.77
15	*Leea aequata* L.	1.71	1.31	0.68	3.70
16	*Coffea benghalensis* B.Heyne *ex* Schult.	1.07	1.31	1.09	3.47
17	*Chisocheton cumingianus* (C.DC.) Harms	1.49	1.17	0.69	3.35
18	*Rubus* sp	0.43	0.95	1.96	3.34

Sl.No.	SPECIES	RF	RD	RA	IVI
19	*Pandanus unguifer* Hook.f.	1.07	1.24	1.03	3.33
20	*Pueraria sikkimensis* Prain	1.71	0.88	0.45	3.04
21	*Croton persimilis* Müll.Arg.	0.43	0.80	1.66	2.89
22	*Tetrastigma serrulatum* (Roxb.) Planch.	1.49	0.80	0.47	2.77
23	*Clerodendrum infortunatum* L.	1.28	0.88	0.60	2.76
24	*Dendrocnide sinuata* (Blume) Chew	0.64	0.88	1.21	2.72
25	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.85	0.80	0.83	2.49
26	*Lagerstroemia speciosa* (L.) Pers.	0.21	0.44	1.81	2.46
27	*Litsea cubeba* (Lour.) Pers.	1.28	0.66	0.45	2.39
28	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	0.64	0.73	1.01	2.38
29	*Syzygium cumini* (L.) Skeels	0.85	0.73	0.75	2.34
30	*Uncaria scandens* (Sm.) Hutch.	0.64	0.66	0.91	2.20
31	*Tetrastigma campylocarpum* (Kurz) Planch.	0.85	0.66	0.68	2.19
32	*Senna occidentalis* (L.) Link	1.07	0.58	0.48	2.13
33	*Croton caudatus* Geiseler	0.21	0.37	1.51	2.09
34	*Deeringia amaranthoides* (Lam.) Merr.	0.21	0.37	1.51	2.09
35	*Merremia hirta* (L.) Merr.	0.85	0.58	0.60	2.04
36	*Cyclea bicristata* (Griff.) Diels	1.07	0.51	0.42	2.00
37	*Mucuna pruriens* (L.) DC.	0.43	0.51	1.06	1.99
38	*Bridelia sikkimensis* Gehrm.	1.07	0.44	0.36	1.87
39	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	1.07	0.44	0.36	1.87
40	*Thunbergia fragrans* Roxb.	1.07	0.44	0.36	1.87
41	*Bauhinia variegata* L.	0.64	0.51	0.70	1.86
42	*Dracaena angustifolia* (Medik.) Roxb.	0.64	0.51	0.70	1.86
43	*Crateva religiosa* G.Forst.	0.43	0.44	0.91	1.77
44	*Melastoma malabathricum* L.	0.43	0.44	0.91	1.77
45	*Lantana camara* L.	0.43	0.44	0.91	1.77
46	*Ampelocissus sikkimensis* (M.A.Lawson) Planch.	0.43	0.44	0.91	1.77
47	*Abrus pulchellus* Thwaites	0.85	0.44	0.45	1.74
48	*Litsea monopetala* (Roxb.) Pers.	1.07	0.37	0.30	1.73
49	*Baccaurea ramiflora* Lour.	0.64	0.44	0.60	1.68
50	*Alangium alpinum* (C.B.Clarke) W.W.Sm. & Cave	0.85	0.37	0.38	1.60
51	*Syzygium tetragonum* (Wight) Wall. *ex* Walp.	0.85	0.37	0.38	1.60
52	*Barleria strigosa* Willd.	0.43	0.37	0.75	1.55
53	*Cayratia japonica* (Thunb.) Gagnep.	0.43	0.37	0.75	1.55
54	*Piper betleoides* C.DC.	0.43	0.37	0.75	1.55
55	*Antidesma bunius* (L.) Spreng.	0.43	0.37	0.75	1.55
56	*Antidesma acidum* Retz.	0.43	0.37	0.75	1.55
57	*Angiopteris evecta* (G. Forst.) Hoffm.	0.64	0.37	0.50	1.51
58	*Leea guineense* G.Don	0.64	0.37	0.50	1.51
59	*Sloanea sterculiacea* (Benth.) Rehder & E.H. Wilson	0.85	0.29	0.30	1.45
60	*Calamus* sp	0.21	0.22	0.91	1.34
61	*Pothos chinensis* (Raf.) Merr.	0.21	0.22	0.91	1.34
62	*Gouania leptostachya* DC.	0.21	0.22	0.91	1.34
63	*Uvariaha miltonii* Hook. f. & Thomson	0.21	0.22	0.91	1.34
64	*Dalbergia stipulacea* Roxb.	0.64	0.29	0.40	1.33
65	*Dioscorea pentaphylla* L.	0.64	0.29	0.40	1.33
66	*Pterygota alata* (Roxb.) R.Br.	0.64	0.29	0.40	1.33
67	*Smilax ovalifolia* Roxb. *ex* D.Don	0.64	0.29	0.40	1.33
68	*Murraya paniculata* (L.) Jack	0.64	0.29	0.40	1.33
69	*Bambusa* sp	0.43	0.29	0.60	1.32
70	*Combretum decandrum* Jacq.	0.43	0.29	0.60	1.32
71	*Ficus pumila* L.	0.43	0.29	0.60	1.32
72	*Maesa macrophylla* Wall.	0.43	0.29	0.60	1.32

Sl.No.	SPECIES	RF	RD	RA	IVI
73	*Albizia chinensis* (Osbeck) Merr.	0.64	0.22	0.30	1.16
74	*Litsea panamanja* (Buch.-Ham. *ex* Nees) Hook. f.	0.64	0.22	0.30	1.16
75	*Pericampylus glaucus* (Lam.) Merr.	0.64	0.22	0.30	1.16
76	*Schefflera pubigera* (Brongn. *ex* Planch.) Frodin.	0.43	0.22	0.45	1.10
77	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	0.43	0.22	0.45	1.10
78	*Aristolochia tagala* Cham.	0.43	0.22	0.45	1.10
79	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.43	0.22	0.45	1.10
80	*Stereospermum tetragonum* DC.	0.43	0.22	0.45	1.10
81	*Justicia adhatoda* L.	0.43	0.22	0.45	1.10
82	*Stephania glabra* (Roxb.) Miers	0.43	0.22	0.45	1.10
83	*Celastrus paniculatus* Willd.	0.43	0.22	0.45	1.10
84	*Tetrastigma dubium* (Lawson) Planch.	0.43	0.22	0.45	1.10
85	*Turpinia pomifera* (Roxb.) DC.	0.21	0.15	0.60	0.96
86	*Aristolochia saccata* Wall.	0.21	0.15	0.60	0.96
87	*Commelina suffruticosa* Blume	0.21	0.15	0.60	0.96
88	*Cryptolepis sinensis* (Lour.) Merr.	0.21	0.15	0.60	0.96
89	*Dioscorea bulbifera* L.	0.21	0.15	0.60	0.96
90	*Macaranga denticulata* (Blume) Müll.Arg.	0.21	0.15	0.60	0.96
91	*Ficus benjamina* L.	0.21	0.15	0.60	0.96
92	*Pterospermum acerifolium* (L.) Willd.	0.21	0.15	0.60	0.96
93	*Mallotus philippensis* (Lam.) Müll.Arg.	0.21	0.15	0.60	0.96
94	*Urena lobata* L.	0.21	0.15	0.60	0.96
95	*Vallaris solanacea* (Roth) Kuntze	0.21	0.15	0.60	0.96
96	*Ziziphus mauritiana* Lam.	0.43	0.15	0.30	0.87
97	*Actinodaphne obovata* (Nees) Blume	0.43	0.15	0.30	0.87
98	*Trichosanthes tricuspidata* Lour.	0.43	0.15	0.30	0.87
99	*Lannea coromandelica* (Houtt.) Merr.	0.43	0.15	0.30	0.87
100	*Merremia hirta* (L.) Merr.	0.43	0.15	0.30	0.87
101	*Bauhinia purpurea* L.	0.43	0.15	0.30	0.87
102	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC.	0.43	0.15	0.30	0.87
103	*Clerodendrum indicum* (L.) Kuntze	0.43	0.15	0.30	0.87
104	*Tetracera sarmentosa* (L.) Vahl	0.43	0.15	0.30	0.87
105	*Abroma augusta* (L.) L.f.	0.43	0.15	0.30	0.87
106	*Ichnocarpus frutescens* (L.) W.T.Aiton	0.43	0.15	0.30	0.87
107	*Pothos scandens* L.	0.43	0.15	0.30	0.87
108	*Smilax zeylanica* L.	0.43	0.15	0.30	0.87
109	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.21	0.07	0.30	0.59
110	*Acacia pennata* (L.) Willd.	0.21	0.07	0.30	0.59
111	*Tinospora sinensis* (Lour.) Merr.	0.21	0.07	0.30	0.59
112	*Alstonia scholaris* (L.) R. Br.	0.21	0.07	0.30	0.59
113	*Lygodium flexuosum* (L.) Sw.	0.21	0.07	0.30	0.59
114	*Miliusa roxburghiana* Hook.f. & Thomson	0.21	0.07	0.30	0.59
115	*Berchemia floribunda* (Wall.) Brongn.	0.21	0.07	0.30	0.59
116	*Bridelia retusa* (L.) A.Juss.	0.21	0.07	0.30	0.59
117	*Caesalpinia cucullata* Roxb.	0.21	0.07	0.30	0.59
118	*Piper Chuvya* Miq.	0.21	0.07	0.30	0.59
119	*Gynocardia odorata* R. Br.	0.21	0.07	0.30	0.59
120	*Sterculia villosa* Roxb.	0.21	0.07	0.30	0.59
121	*Dioscorea deltoidea* Wall. *ex* Griseb.	0.21	0.07	0.30	0.59
122	*Holmskioldia sanguinea* Retz.	0.21	0.07	0.30	0.59
123	*Cissampelos pareira* L.	0.21	0.07	0.30	0.59
124	*Debregeasia longifolia* (Burm.f.) Wedd.	0.21	0.07	0.30	0.59
125	*Dillenia indica* L.	0.21	0.07	0.30	0.59
126	*Aphanamixis polystachya* (Wall.) R.Parker	0.21	0.07	0.30	0.59
127	*Meyna spinosa* Roxb. *ex* Link	0.21	0.07	0.30	0.59

Sl.No.	SPECIES	RF	RD	RA	IVI
128	*Flacourtia indica* (Burm.f.) Merr.	0.21	0.07	0.30	0.59
129	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.21	0.07	0.30	0.59
130	*Glycosmis cyanocarpa* var. *cymosa* Kurz.	0.21	0.07	0.30	0.59
131	*Maesa indica* (Roxb.) A. DC.	0.21	0.07	0.30	0.59
132	*Callicarpa arborea* Roxb.	0.21	0.07	0.30	0.59
133	*Syzygium nervosum* A.Cunn. *ex* DC.	0.21	0.07	0.30	0.59
134	*Flueggea virosa* (Roxb. *ex* Willd.) Royle	0.21	0.07	0.30	0.59
135	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.21	0.07	0.30	0.59
136	*Eurya acuminata* DC.	0.21	0.07	0.30	0.59
137	*Solanum torvum* Sw.	0.21	0.07	0.30	0.59
138	*Bauhinia vahlii* Wight & Arn.	0.21	0.07	0.30	0.59
139	*Urtica dioica* L.	0.21	0.07	0.30	0.59
140	*Jasminum scandens* (Retz.) Vahl	0.21	0.07	0.30	0.59
141	*Paederia foetida* L.	0.21	0.07	0.30	0.59
142	*Porana paniculata* Roxb.	0.21	0.07	0.30	0.59
143	*Premna barbata* Wall. *ex* Schauer	0.21	0.07	0.30	0.59
144	*Triumfetta rhomboidea* Jacq.	0.21	0.07	0.30	0.59
145	*Solanum aculeatissimum* Jacq.	0.21	0.07	0.30	0.59
146	*Tephrosia candida* (Roxb.) DC.	0.21	0.07	0.30	0.59
147	*Toddalia asiatica* (L.) Lam.	0.21	0.07	0.30	0.59
148	*Balakata baccata* (Roxb.) Esser.	0.21	0.07	0.30	0.59
149	*Sauropus compressus* Müll.Arg.	0.21	0.07	0.30	0.59
150	*Wrightia arborea* (Dennst.) Mabb.	0.21	0.07	0.30	0.59

Table 86. Phytosociological data of herb layer of natural vegetation in winter in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Mikania micrantha* Kunth	10.377	10.218	0.907	21.503
2	*Oplismenus burmanni* (Retz.) P.Beauv.	5.094	6.349	1.149	12.592
3	*Ageratum houstonianum* Mill.	4.340	6.746	1.433	12.518
4	*Piper betleoides* C.DC.	6.604	4.067	0.568	11.239
5	*Dryopteris sparsa* (D. Don) Kuntze	3.962	4.861	1.131	9.954
6	*Clerodendrum infortunatum* L.	2.264	3.770	1.534	7.568
7	*Chloranthus elatior* Link	3.208	2.877	0.827	6.911
8	*Persicaria chinensis* (L.) H. Gross	3.019	2.381	0.727	6.127
9	*Thelypteris nudata* (Roxb.) C.V. Morton.	2.264	2.282	0.929	5.475
10	*Diplazium esculentum* (Retz.) Sw.	1.698	2.183	1.184	5.065
11	*Coffea benghalensis* B.Heyne *ex* Schult.	2.264	1.885	0.767	4.916
12	*Dracaena angustifolia* (Medik.) Roxb.	1.321	1.885	1.315	4.521
13	*Eragrostis amabilis* (L.) Wight & Arn.	0.943	1.786	1.744	4.474
14	*Barleria cristata* L.	2.075	1.587	0.705	4.368
15	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.453	1.389	0.522	4.364
16	*Glycosmis pentaphylla* (Retz.) DC.	0.189	0.694	3.392	4.275
17	*Pupalia lappacea* (L.) Juss.	1.132	1.687	1.373	4.192
18	*Merremia vitifolia* (Burm. f.) Hallier f.	1.509	1.587	0.969	4.066
19	*Elatostema monandrum* (Buch.-Ham. *ex* D.Don) H.Hara	0.755	1.488	1.817	4.060
20	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.509	1.488	0.909	3.906
21	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	0.943	1.488	1.454	3.885
22	*Molineria capitulata* (Lour.) Herb.	1.698	1.290	0.700	3.688
23	*Piper Chuvya* Miq.	1.698	1.290	0.700	3.688
24	*Axonopus compressus* (Sw.) P.Beauv.	1.132	1.389	1.131	3.652
25	*Alpinia calcarata* (Haw.) Roscoe	0.943	1.290	1.260	3.493
26	*Commelina diffusa* Burm.f.	0.943	1.290	1.260	3.493

Sl. No.	SPECIES	RF	RD	RA	IVI
27	*Piper hamiltonii* C. DC.	1.698	1.091	0.592	3.382
28	*Chromolaena odorata* (L.) R.M.King & H.Rob.	1.509	1.091	0.666	3.267
29	*Merremia hirta* (L.) Merr.	1.321	0.992	0.692	3.005
30	*Croton caudatus* Geiselar	0.566	0.893	1.454	2.913
31	*Acmella calva* (DC.) R.K.Jansen	0.377	0.694	1.696	2.768
32	*Ageratum conyzoides* (L.) L.	0.377	0.694	1.696	2.768
33	*Curculigo orchioides* Gaertn.	1.132	0.893	0.727	2.752
34	*Pteris biaurita* L.	1.132	0.893	0.727	2.752
35	*Tetrastigma campylocarpum* (Kurz) Planch.	1.132	0.893	0.727	2.752
36	*Gomphostemma ovatum* Wall. *ex* Benth.	0.566	0.794	1.292	2.652
37	*Tetrastigma serrulatum* (Roxb.) Planch.	1.132	0.794	0.646	2.572
38	*Crinum amoenum* Ker Gawl. *ex* Roxb	0.189	0.397	1.938	2.524
39	*Tetrastigma planicaule* (Hook. f.) Gagnep.	0.755	0.794	0.969	2.517
40	*Phrynium pubinerve* Blume	0.377	0.595	1.454	2.426
41	*Digitaria ciliaris* (Retz.) Koeler	0.566	0.694	1.131	2.391
42	*Hedychium thyrsiforme* Sm.	0.566	0.694	1.131	2.391
43	*Smilax ovalifolia* Roxb. *ex* D.Don	0.943	0.694	0.678	2.316
44	*Phaulopsis imbricata* (Forssk.) Sweet	0.566	0.595	0.969	2.130
45	*Piper peepuloides* Roxb.	0.566	0.595	0.969	2.130
46	*Persicaria strigosa* (R.Br.) Nakai	0.943	0.595	0.581	2.120
47	*Pennisetum glaucum* (L.) R.Br.	0.377	0.496	1.211	2.085
48	*Pouzolzia hirta* (Blume) *ex* Hassk.	0.377	0.496	1.211	2.085
49	*Pteris semipinnata* L.	0.377	0.496	1.211	2.085
50	*Shorea robusta* Gaertn.	0.377	0.496	1.211	2.085
51	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.755	0.595	0.727	2.077
52	*Asplenium* sp	0.189	0.298	1.454	1.940
53	*Callicarpa arborea* Roxb.	0.189	0.298	1.454	1.940
54	*Impatiens trilobata* Colebr.	0.189	0.298	1.454	1.940
55	*Lasia spinosa* (L.) Thwaites	0.189	0.298	1.454	1.940
56	*Persicaria barbata* (L.) H.Hara	0.189	0.298	1.454	1.940
57	*Phaius tankervilleae* (Banks) Blume	0.189	0.298	1.454	1.940
58	*Lepidagathis incurva* Buch-Ham *ex* D. Don	0.566	0.496	0.808	1.870
59	*Bauhinia purpurea* L.	0.755	0.496	0.606	1.856
60	*Commelina suffruticosa* Blume	0.755	0.496	0.606	1.856
61	*Athyrium* sp	0.377	0.397	0.969	1.743
62	*Litsea glutinosa* (Lour.) C.B.Rob.	0.377	0.397	0.969	1.743
63	*Piper mullesua* Buch.-Ham. *ex* D. Don	0.377	0.397	0.969	1.743
64	*Setaria pumila* (Poir.) Roem. & Schult.	0.377	0.397	0.969	1.743
65	*Tectaria gemmifera* (Fée) Alston	0.377	0.397	0.969	1.743
66	*Dicliptera bupleuroides* Nees	0.566	0.397	0.646	1.609
67	*Pothos scandens* L.	0.566	0.397	0.646	1.609
68	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	0.377	0.298	0.727	1.402
69	*Setaria palmifolia* (J. Koenig) Stapf	0.377	0.298	0.727	1.402
70	*Solanum aculeatissimum* Jacq.	0.377	0.298	0.727	1.402
71	*Blumea lacera* (Burm.f.) DC.	0.189	0.198	0.969	1.356
72	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	0.189	0.198	0.969	1.356
73	*Gouania leptostachya* DC.	0.189	0.198	0.969	1.356
74	*Ixora athroantha* Bremek.	0.189	0.198	0.969	1.356
75	*Jasminum dispermum* Wall.	0.189	0.198	0.969	1.356
76	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	0.189	0.198	0.969	1.356
77	*Smilax zeylanica* L.	0.189	0.198	0.969	1.356
78	*Cyanthillium cinereum* (L.) H.Rob.	0.189	0.198	0.969	1.356
79	*Deeringia amaranthoides* (Lam.) Merr.	0.566	0.298	0.485	1.348
80	*Ardisia solanacea* (Poir.) Roxb.	0.377	0.198	0.485	1.060

Sl. No.	SPECIES	RF	RD	RA	IVI
81	*Cyclea bicristata* (Griff.) Diels	0.377	0.198	0.485	1.060
82	*Pericampylus glaucus* (Lam.) Merr.	0.377	0.198	0.485	1.060
83	*Sida acuta* Burm.f.	0.377	0.198	0.485	1.060
84	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.377	0.198	0.485	1.060
85	*Tetrastigma dubium* (Lawson) Planch.	0.377	0.198	0.485	1.060
86	*Toona ciliata* M.Roem.	0.377	0.198	0.485	1.060
87	*Achyranthes bidentata* Blume	0.189	0.099	0.485	0.772
88	*Actinodaphne obovata* (Nees) Blume	0.189	0.099	0.485	0.772
89	*Alocasia fallax* Schott	0.189	0.099	0.485	0.772
90	*Ampelocissus barbata* (Wall.) Planch.	0.189	0.099	0.485	0.772
91	*Aristolochia saccata* Wall.	0.189	0.099	0.485	0.772
92	*Asystasia macrocarpa* Nees	0.189	0.099	0.485	0.772
93	*Baccaurea ramiflora* Lour.	0.189	0.099	0.485	0.772
94	*Bauhinia vahlii* Wight & Arn.	0.189	0.099	0.485	0.772
95	*Cyperus cyperoides* (L.) Kuntze	0.189	0.099	0.485	0.772
96	*Desmodium laxiflorum* DC.	0.189	0.099	0.485	0.772
97	*Crotalaria pallida* Aiton	0.189	0.099	0.485	0.772
98	*Dillenia indica* L.	0.189	0.099	0.485	0.772
99	*Floscopa scandens* Lour.	0.189	0.099	0.485	0.772
100	*Goodyera* sp	0.189	0.099	0.485	0.772
101	*Leea guineensis* G. Don	0.189	0.099	0.485	0.772
102	*Macaranga denticulata* (Blume) Müll.Arg.	0.189	0.099	0.485	0.772
103	*Mallotus philippensis* (Lam.) Müll.Arg.	0.189	0.099	0.485	0.772
104	*Morus macroura* Miq.	0.189	0.099	0.485	0.772
105	*Pandanus unguifer* Hook.f.	0.189	0.099	0.485	0.772
106	*Curcuma zedoaria* (Christm.) Roscoe	0.189	0.099	0.485	0.772
107	*Rungia pectinata* (L.) Nees	0.189	0.099	0.485	0.772
108	*Solanum torvum* Sw.	0.189	0.099	0.485	0.772
109	*Stephania glabra* (Roxb.) Miers	0.189	0.099	0.485	0.772
110	*Synedrella nodiflora* (L.) Gaertn.	0.189	0.099	0.485	0.772
111	*Syzygium formosum* (Wall.) Masam.	0.189	0.099	0.485	0.772
112	*Triumfetta rhomboidea* Jacq.	0.189	0.099	0.485	0.772

Table 87. Phytosociological data of herb layer of natural vegetation in Pre-monsoon in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Oplismenus compositus* (L.) P. Beauv.	4.95	9.08	1.65	15.68
2	*Phyllanthus urinaria* L.	7.31	6.83	0.84	14.98
3	*Phrynium pubinerve* Blume	3.01	5.20	1.55	9.77
4	*Mikania micrantha* Kunth	4.73	3.96	0.75	9.44
5	*Spermacoce alata* Aubl.	1.72	4.81	2.52	9.05
6	*Dryopteris sikkimensis* (Bedd.) Kuntze	3.01	4.27	1.28	8.56
7	*Alpinia galanga* (L.) Willd.	0.65	3.18	4.44	8.27
8	*Impatiens trilobata* Colebr.	2.37	3.80	1.45	7.62
9	*Pupalia lappacea* (L.) Juss.	7.10	0.31	0.04	7.45
10	*Ageratum conyzoides* (L.) L.	1.94	3.26	1.52	6.71
11	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	1.08	2.95	2.47	6.49
12	*Oplismenus burmanni* (Retz.) P.Beauv.	2.58	2.87	1.00	6.45
13	*Eranthemum pulchellum* Andrews	0.22	1.09	4.55	5.85
14	*Piper betleoides* C.DC.	1.72	2.17	1.14	5.03
15	*Lindernia ciliata* (Colsm.) Pennell	0.86	1.94	2.03	4.83
16	*Bauhinia purpurea* L.	2.37	1.71	0.65	4.72
17	*Chromolaena odorata* (L.) R.M.King & H.Rob.	2.37	1.63	0.62	4.62
18	*Ageratum houstonianum* Mill.	0.43	1.32	2.76	4.51
19	*Floscopa scandens* Lour.	1.51	1.79	1.07	4.36
20	*Coffea benghalensis* B.Heyne *ex* Schult.	2.15	1.48	0.62	4.24

Sl. No.	SPECIES	RF	RD	RA	IVI
21	*Commelina diffusa* Burm.f.	0.22	0.78	3.25	4.24
22	*Drimycarpus racemosus* (Roxb.) Hook.f. *ex* Marchand.	1.51	1.63	0.97	4.11
23	*Gloriosa superba* L.	0.43	1.16	2.44	4.03
24	*Thelypteris nudata* (Roxb.) C.V. Morton.	1.94	1.32	0.61	3.87
25	*Digitaria ciliaris* (Retz.) Koeler	0.22	0.70	2.92	3.84
26	*Axonopus compressus* (Sw.) P.Beauv.	0.43	1.01	2.11	3.55
27	*Dioscorea pentaphylla* L.	1.72	1.16	0.61	3.49
28	*Chloranthus elatior* Link	1.51	1.24	0.74	3.49
29	*Cyperus pangorei* Rottb.	0.86	1.16	1.22	3.24
30	*Tetrastigma serrulatum* (Roxb.) Planch.	1.51	1.01	0.60	3.12
31	*Elatostema monandrum* (Buch.-Ham. *ex* D.Don) H.Hara	0.86	1.01	1.06	2.92
32	*Tetrastigma campylocarpum* (Kurz) Planch.	1.29	0.93	0.65	2.87
33	*Blumea lacera* (Burm.f.) DC.	0.43	0.78	1.62	2.83
34	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.29	0.85	0.60	2.74
35	*Persicaria chinensis* (L.) H. Gross	0.65	0.85	1.19	2.69
36	*Commelina suffruticosa* Blume	1.08	0.85	0.71	2.64
37	*Pteris biaurita* L.	1.51	0.70	0.42	2.62
38	*Piper peepuloides* Roxb.	0.86	0.85	0.89	2.61
39	*Synedrella nodiflora* (L.) Gaertn.	0.86	0.85	0.89	2.61
40	*Molineria capitulata* (Lour.) Herb.	1.08	0.78	0.65	2.50
41	*Floscopa scandens* Lour.	0.65	0.70	0.97	2.32
42	*Globba andersonii* C.B.Clarke *ex* Baker	0.86	0.70	0.73	2.29
43	*Dracaena angustifolia* (Medik.) Roxb.	1.08	0.62	0.52	2.22
44	*Merremia vitifolia* (Burm. f.) Hallier f.	0.86	0.62	0.65	2.13
45	*Angiopteris evecta* (G. Forst.) Hoffm.	0.65	0.54	0.76	1.95
46	*Lobelia nummularia* Lam.	0.65	0.54	0.76	1.95
47	*Tetrastigma planicaule* (Hook.f.) Gagnep.	0.65	0.54	0.76	1.95
48	*Barleria cristata* L.	0.65	0.47	0.65	1.76
49	*Senna tora* (L.) Roxb.	0.43	0.39	0.81	1.63
50	*Dicliptera bupleuroides* Nees	0.43	0.39	0.81	1.63
51	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.43	0.39	0.81	1.63
52	*Lasia spinosa* (L.) Thwaites	0.65	0.39	0.54	1.57
53	*Achyranthes bidentata* Blume	0.22	0.23	0.97	1.42
54	*Deeringia amaranthoides* (Lam.) Merr.	0.22	0.23	0.97	1.42
55	*Ipomoea alba* L.	0.22	0.23	0.97	1.42
56	*Rungia pectinata* (L.) Nees	0.22	0.23	0.97	1.42
57	*Sida rhombifolia* L.	0.22	0.23	0.97	1.42
58	*Helminthostachys zeylanica* (L.) Hook.	0.22	0.23	0.97	1.42
59	*Triumfetta rhomboidea* Jacq.	0.22	0.23	0.97	1.42
60	*Begonia ovatifolia* A.DC.	0.43	0.31	0.65	1.39
61	*Desmodium oblongum* Benth.	0.43	0.31	0.65	1.39
62	*Gouania leptostachya* DC.	0.43	0.31	0.65	1.39
63	*Pueraria phaseoloides* (Roxb.) Benth.	0.43	0.31	0.65	1.39
64	*Phaius tankervilleae* (Banks) Blume	0.65	0.31	0.43	1.39
65	*Smilax zeylanica* L.	0.65	0.31	0.43	1.39
66	*Pandanus unguifer* Hook.f.	0.65	0.23	0.32	1.20
67	*Clerodendrum infortunatum* L.	0.43	0.23	0.49	1.15
68	*Chlorophytum arundinaceum* Baker	0.43	0.23	0.49	1.15
69	*Merremia hirta* (L.) Merr.	0.43	0.23	0.49	1.15
70	*Phlogacanthus thyrsiflorus* Nees	0.43	0.23	0.49	1.15
71	*Sauropus compressus* Müll.Arg.	0.43	0.23	0.49	1.15
72	*Alpinia calcarata* (Haw.) Roscoe	0.22	0.16	0.65	1.02
73	*Cissampelos pareira* L.	0.22	0.16	0.65	1.02
74	*Rotheca serrata* (L.) Steane & Mabb.	0.22	0.16	0.65	1.02
75	*Croton caudatus* Geiseler	0.22	0.16	0.65	1.02
76	*Cryptolepis sinensis* (Lour.) Merr.	0.22	0.16	0.65	1.02

Sl. No.	SPECIES	RF	RD	RA	IVI
77	*Urena lobata* L.	0.22	0.16	0.65	1.02
78	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	0.22	0.16	0.65	1.02
79	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	0.22	0.16	0.65	1.02
80	*Mallotus philippensis* (Lam.) Müll.Arg.	0.22	0.16	0.65	1.02
81	*Syzygium formosum* (Wall.) Masam.	0.22	0.16	0.65	1.02
82	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.22	0.16	0.65	1.02
83	*Typhonium trilobatum* (L.) Schott	0.22	0.16	0.65	1.02
84	*Ampelocissus barbata* (Wall.) Planch.	0.22	0.16	0.65	1.02
85	*Combretum album* Pers.	0.43	0.16	0.32	0.91
86	*Dalbergia stipulacea* Roxb.	0.43	0.16	0.32	0.91
87	*Ichnocarpus frutescens* (L.) W.T.Aiton	0.43	0.16	0.32	0.91
88	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.43	0.16	0.32	0.91
89	*Leea guineensis* G. Don	0.43	0.16	0.32	0.91
90	*Melastoma malabathricum* L.	0.43	0.16	0.32	0.91
91	*Acacia pennata* (L.) Willd.	0.22	0.08	0.32	0.62
92	*Amaranthus iridis* L.	0.22	0.08	0.32	0.62
93	*Acmella uliginosa* (Sw.) Cass.	0.22	0.08	0.32	0.62
94	*Vallaris solanacea* (Roth) Kuntze	0.22	0.08	0.32	0.62
95	*Ardisia solanacea* (Poir.) Roxb.	0.22	0.08	0.32	0.62
96	*Eurya acuminata* DC.	0.22	0.08	0.32	0.62
97	*Bridelia glauca* Blume	0.22	0.08	0.32	0.62
98	*Caesalpinia cucullata* Roxb.	0.22	0.08	0.32	0.62
99	*Sorindeia madagascariensis*Thouars *ex* DC.	0.22	0.08	0.32	0.62
100	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	0.22	0.08	0.32	0.62
101	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	0.22	0.08	0.32	0.62
102	*Curculigo orchioides* Gaertn.	0.22	0.08	0.32	0.62
103	*Dillenia indica* L.	0.22	0.08	0.32	0.62
104	*Dioscorea belophylla* (Prain) Voigt *ex* Haines	0.22	0.08	0.32	0.62
105	*Aeschynanthus acuminatus* Wall. *ex* A.DC.	0.22	0.08	0.32	0.62
106	*Flemingia* sp	0.22	0.08	0.32	0.62
107	*Glycosmis cyanocarpa* var. *cymosa* Kurz	0.22	0.08	0.32	0.62
108	*Jasminum laurifolium* Roxb. *ex* Hornem.	0.22	0.08	0.32	0.62
109	*Jasminum arborescens* Roxb.	0.22	0.08	0.32	0.62
110	*Colebrookea oppositifolia* Sm.	0.22	0.08	0.32	0.62
111	Polyalthia simiarum (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook.f. & Thomson	0.22	0.08	0.32	0.62
112	*Sabia paniculata* Edgew. *ex* Hook. f. & Thomson	0.22	0.08	0.32	0.62
113	*Litsea glutinosa* (Lour.) C.B.Rob.	0.22	0.08	0.32	0.62
114	*Maesa indica* (Roxb.) A. DC.	0.22	0.08	0.32	0.62
115	*Morus macroura* Miq.	0.22	0.08	0.32	0.62
116	*Solanum aculeatissimum* Jacq.	0.22	0.08	0.32	0.62
117	*Pteris semipinnata* L.	0.22	0.08	0.32	0.62
118	*Selaginella* sp	0.22	0.08	0.32	0.62
119	*Sida acuta* Burm.f.	0.22	0.08	0.32	0.62
120	*Syzygium cumini* (L.) Skeels	0.22	0.08	0.32	0.62
121	*Triumfetta tomentosa* Bojer *ex* Bouton	0.22	0.08	0.32	0.62
122	*Oxalis corniculata* L.	0.22	0.08	0.32	0.62
123	*Wrightia arborea* (Dennst.) Mabb.	0.22	0.08	0.32	0.62

Table 88. Phytosociological data of herb layer of natural vegetation in Post-monsoon in Lataguri site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Piper chuvya* Miq.	7.12	8.57	1.03	16.72
2	*Oplismenus burmanni* (Retz.) P.Beauv.	6.35	7.33	0.99	14.66
3	*Eragrostis amabilis* (L.) Wight & Arn.	1.70	6.41	3.23	11.34
4	*Mikania micrantha* Kunth	3.87	4.38	0.97	9.22

Sl. No.	SPECIES	RF	RD	RA	IVI
5	*Dryopteris sikkimensis* (Bedd.) Kuntze	4.02	4.19	0.89	9.10
6	*Chloranthus elatior* Link	3.10	3.34	0.92	7.36
7	*Ageratum conyzoides* (L.) L.	1.39	3.66	2.26	7.31
8	*Ageratum houstonianum* Mill.	1.39	3.20	1.97	6.57
9	*Pupalia lappacea* (L.) Juss.	2.79	2.68	0.83	6.29
10	*Diplazium esculentum* (Retz.) Sw.	2.94	2.55	0.74	6.24
11	*Elatostema monandrum* (Buch.-Ham. *ex* D.Don) H.Hara	1.39	2.68	1.65	5.73
12	*Phrynium pubinerve* Blume	1.86	2.35	1.09	5.30
13	*Thelypteris nudata* (Roxb.) C.V. Morton.	2.01	1.83	0.78	4.62
14	*Cyperus compressus* L.	1.24	1.90	1.31	4.45
15	*Tetrastigma dubium* (Lawson) Planch.	2.48	1.44	0.50	4.41
16	*Chromolaena odorata* (L.) R.M.King & H.Rob.	1.86	1.70	0.79	4.34
17	*Commelina suffruticosa* Blume	1.39	1.50	0.93	3.82
18	*Oplismenus compositus* (L.) P.Beauv.	1.24	1.50	1.04	3.79
19	*Persicaria chinensis* (L.) H. Gross	1.39	1.37	0.85	3.61
20	*Dracaena angustifolia* (Medik.) Roxb.	1.70	1.18	0.59	3.47
21	*Floscopa scandens* Lour.	1.24	1.18	0.82	3.23
22	*Combretum decandrum* Jacq.	1.39	1.11	0.68	3.19
23	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.39	1.11	0.68	3.19
24	*Merremia hirta* (L.) Merr.	1.55	1.05	0.58	3.17
25	*Lasia spinosa* (L.) Thwaites	1.39	1.05	0.64	3.08
26	*Dicliptera bupleuroides* Nees	0.62	0.98	1.36	2.96
27	*Coffea benghalensis* B.Heyne *ex* Schult.	1.08	1.05	0.83	2.96
28	*Carex indica* L.	0.15	0.39	2.18	2.72
29	*Ludwigia perennis* L.	0.46	0.78	1.45	2.70
30	*Croton caudatus* Geiseler	0.93	0.92	0.85	2.69
31	*Eleusine indica* (L.) Gaertn.	0.93	0.85	0.79	2.56
32	*Pouzolzia hirta* Blume ex Hassk.	0.31	0.59	1.63	2.53
33	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.93	0.78	0.73	2.44
34	*Eurya acuminata* DC.	0.62	0.72	1.00	2.34
35	*Alpinia calcarata* (Haw.) Roscoe	0.46	0.65	1.21	2.33
36	*Barleria strigosa* Willd.	0.46	0.65	1.21	2.33
37	*Pouzolzia zeylanica* (L.) Benn.	0.46	0.65	1.21	2.33
38	*Deeringia amaranthoides* (Lam.) Merr.	0.31	0.52	1.45	2.28
39	*Thelypteris nudata* (Roxb.) C.V. Morton.	1.08	0.59	0.47	2.14
40	*Pothos scandens* L.	1.08	0.59	0.47	2.14
41	*Centella asiatica* (L.) Urb.	0.31	0.46	1.27	2.04
42	*Piper betleoides* C.DC.	0.31	0.46	1.27	2.04
43	*Drymaria cordata* (L.) Willd. *ex* Schult.	0.62	0.59	0.82	2.02
44	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.62	0.59	0.82	2.02
45	*Setaria plicata* (Lam.) T.Cooke	0.62	0.59	0.82	2.02
46	*Molineria capitulata* (Lour.) Herb.	0.62	0.52	0.73	1.87
47	*Bauhinia variegata* L.	0.15	0.26	1.45	1.87
48	*Acmella uliginosa* (Sw.) Cass.	0.31	0.39	1.09	1.79
49	*Polygonum hidropiper* Neck.	0.46	0.46	0.85	1.77
50	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.77	0.46	0.51	1.74
51	*Leea aequata* L.	0.77	0.46	0.51	1.74
52	*Ardisia solanacea* (Poir.) Roxb.	0.62	0.46	0.63	1.71
53	*Barleria cristata* L.	0.62	0.46	0.63	1.71
54	*Phlogacanthus thyrsiflorus* Nees	0.46	0.39	0.73	1.58
55	*Synedrella nodiflora* (L.) Gaertn.	0.46	0.39	0.73	1.58
56	*Syzygium tetragonum* (Wight) Wall. *ex* Walp.	0.46	0.39	0.73	1.58
57	*Spermacoce alata* Aubl.	0.62	0.39	0.54	1.56
58	*Pandanus unguifer* Hook.f.	0.62	0.39	0.54	1.56
59	*Achyranthes bidentata* Blume	0.31	0.33	0.91	1.54
60	*Holmskioldia sanguinea* Retz.	0.31	0.33	0.91	1.54

Sl. No.	SPECIES	RF	RD	RA	IVI
61	*Hygrophila auriculata* (Schumach.) Heine	0.31	0.33	0.91	1.54
62	*Bauhinia purpurea* L.	0.77	0.33	0.36	1.46
63	*Amischotolype hookeri* (Hassk.) H.Hara	0.15	0.20	1.09	1.44
64	*Impatiens trilobata* Colebr.	0.15	0.20	1.09	1.44
65	*Bambusa* sp	0.15	0.20	1.09	1.44
66	*Bridelia glauca* Blume	0.62	0.33	0.45	1.40
67	*Cyclea bicristata* (Griff.) Diels	0.62	0.33	0.45	1.40
68	*Begonia ovatifolia* A.DC.	0.31	0.26	0.73	1.30
69	*Urena lobata* L.	0.31	0.26	0.73	1.30
70	*Bauhinia vahlii* Wight & Arn.	0.62	0.26	0.36	1.24
71	*Litsea panamanja* (Buch.-Ham. *ex* Nees) Hook. f.	0.62	0.26	0.36	1.24
72	*Sauropus compressus* Müll.Arg.	0.62	0.26	0.36	1.24
73	*Clerodendrum infortunatum* L.	0.46	0.26	0.48	1.21
74	*Tetrastigma campylocarpum* (Kurz) Planch.	0.46	0.26	0.48	1.21
75	*Sabia paniculata* Edgew. *ex* Hook. f. & Thomson	0.31	0.20	0.54	1.05
76	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	0.31	0.20	0.54	1.05
77	*Merremia hirta* (L.) Merr.	0.31	0.20	0.54	1.05
78	*Colebrookea oppositifolia* Sm.	0.31	0.20	0.54	1.05
79	*Persicaria capitata* (Buch.-Ham. *ex* D.Don) H.Gross	0.31	0.20	0.54	1.05
80	*Tetrastigma planicaule* (Hook. f.) Gagnep.	0.31	0.20	0.54	1.05
81	*Turpinia pomifera* (Roxb.) DC.	0.31	0.20	0.54	1.05
82	*Cayratia japonica* (Thunb.) Gagnep.	0.46	0.20	0.36	1.02
83	*Dioscorea prazeri* Prain & Burkill	0.46	0.20	0.36	1.02
84	*Axonopus compressus* (Sw.) P.Beauv.	0.15	0.13	0.73	1.01
85	*Cryptolepis sinensis* (Lour.) Merr.	0.15	0.13	0.73	1.01
86	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	0.15	0.13	0.73	1.01
87	*Floscopa scandens* Lour.	0.15	0.13	0.73	1.01
88	*Pteris biaurita* L.	0.15	0.13	0.73	1.01
89	*Pterospermum acerifolium* (L.) Willd.	0.15	0.13	0.73	1.01
90	*Selaginella* sp	0.15	0.13	0.73	1.01
91	*Abrus pulchellus* Thwaites	0.31	0.13	0.36	0.80
92	*Actinodaphne obovata* (Nees) Blume	0.31	0.13	0.36	0.80
93	*Alangium alpinum* (C.B.Clarke) W.W.Sm. & Cave	0.31	0.13	0.36	0.80
94	*Callicarpa arborea* Roxb.	0.31	0.13	0.36	0.80
95	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.31	0.13	0.36	0.80
96	*Litsea cubeba* (Lour.) Pers.	0.31	0.13	0.36	0.80
97	*Melastomama labathricum* L.	0.31	0.13	0.36	0.80
98	*Morinda angustifolia* Roxb.	0.31	0.13	0.36	0.80
99	*Stereospermum tetragonum* DC.	0.31	0.13	0.36	0.80
100	*Merremia vitifolia* (Burm. f.) Hallier f.	0.31	0.13	0.36	0.80
101	*Sida acuta* Burm.f.	0.31	0.13	0.36	0.80
102	*Sloanea sterculiacea* (Benth.) Rehder & E.H. Wilson	0.31	0.13	0.36	0.80
103	*Smilax zeylanica* L.	0.31	0.13	0.36	0.80
104	*Sauropus androgynus* (L.) Merr.	0.31	0.13	0.36	0.80
105	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.31	0.13	0.36	0.80
106	*Acacia pennata* (L.) Willd.	0.15	0.07	0.36	0.58
107	*Pueraria phaseoloides* (Roxb.) Benth.	0.15	0.07	0.36	0.58
108	*Angiopteris evecta* (G. Forst.) Hoffm.	0.15	0.07	0.36	0.58
109	*Vallaris solanacea* (Roth) Kuntze	0.15	0.07	0.36	0.58
110	*Typhonium trilobatum* (L.) Schott	0.15	0.07	0.36	0.58
111	*Aristolochia saccata* Wall.	0.15	0.07	0.36	0.58
112	*Castanopsis indica* (Roxb. ex Lindl.) A.DC.	0.15	0.07	0.36	0.58
113	*Syzygium cumini* (L.) Skeels	0.15	0.07	0.36	0.58
114	*Curculigo orchioides* Gaertn.	0.15	0.07	0.36	0.58
115	*Dalbergia stipulacea* Roxb.	0.15	0.07	0.36	0.58

Sl. No.	SPECIES	RF	RD	RA	IVI
116	*Debregeasia longifolia* (Burm.f.) Wedd.	0.15	0.07	0.36	0.58
117	*Hylodesmum laxum* (DC.) H.Ohashi & R.R.Mill.	0.15	0.07	0.36	0.58
118	*Digitaria ciliaris* (Retz.) Koeler	0.15	0.07	0.36	0.58
119	*Ficus benjamina* L.	0.15	0.07	0.36	0.58
120	*Flemingia* sp	0.15	0.07	0.36	0.58
121	*Syzygium kurzii* (Duthie) N.P.Balakr.	0.15	0.07	0.36	0.58
122	*Globba sp*	0.15	0.07	0.36	0.58
123	*Glycosmis cyanocarpa* var. *cymosa* Kurz.	0.15	0.07	0.36	0.58
124	*Gouani a leptostachya* DC.	0.15	0.07	0.36	0.58
125	*Hoyaparasitica* Wall. *ex* Traill	0.15	0.07	0.36	0.58
126	Ichnocarpus frutescens (L.) W.T.Aiton	0.15	0.07	0.36	0.58
127	*Jasminum dispermum* Wall.	0.15	0.07	0.36	0.58
128	*Leucas grandis* Vatke	0.15	0.07	0.36	0.58
129	*Maesa indica* (Roxb.) A. DC.	0.15	0.07	0.36	0.58
130	*Maesa macrophylla* C.B.Clarke	0.15	0.07	0.36	0.58
131	*Solanum aculeatissimum* Jacq.	0.15	0.07	0.36	0.58
132	*Pericampylus glaucus* (Lam.) Merr.	0.15	0.07	0.36	0.58
133	*Persicaria hydropiper* (L.) Delarbre	0.15	0.07	0.36	0.58
134	*Piper peepuloides* Roxb.	0.15	0.07	0.36	0.58
135	*Porana paniculata* Roxb.	0.15	0.07	0.36	0.58
136	*Pteris semipinnata* L.	0.15	0.07	0.36	0.58
137	*Pueraria sikkimensis* Prain	0.15	0.07	0.36	0.58
138	*Hyptis suaveolens* (L.) Poit.	0.15	0.07	0.36	0.58
139	*Berchemia floribunda* (Wall.) Brongn.	0.15	0.07	0.36	0.58
140	*Rubus sp*	0.15	0.07	0.36	0.58
141	*Aristolochia tagala* Cham.	0.15	0.07	0.36	0.58
142	*Rungia pectinata* (L.) Nees	0.15	0.07	0.36	0.58
143	*Shorea robusta* Gaertn.	0.15	0.07	0.36	0.58
144	*Balakata bacca ta* (Roxb.) Esser.	0.15	0.07	0.36	0.58
145	*Dryopteris sparsa* (D. Don) Kuntze	0.15	0.07	0.36	0.58
146	*Triumfetta rhomboidea* Jacq.	0.15	0.07	0.36	0.58
147	*Wrightia arborea* (Dennst.) Mabb.	0.15	0.07	0.36	0.58
148	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.15	0.07	0.36	0.58
149	*Ziziphus rugosa* Lam.	0.15	0.07	0.36	0.58

Table 89. Phytosociological data of tree layer of natural vegetation in winter in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia speciosa* (L.) Pers.	5.78	10.58	3.03	19.40
2	*Shorea robusta* Gaertn.	5.20	6.57	2.09	13.86
3	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC.	2.89	5.11	2.93	10.93
4	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet.	4.05	4.38	1.79	10.22
5	*Aphanamixis polystachya* (Wall.) R.Parker	4.62	4.01	1.44	10.08
6	*Stereospermum tetragonum* DC.	4.05	3.28	1.35	8.68
7	*Terminalia myriocarpa* Van Heurck & Müll. Arg.	2.89	3.65	2.09	8.63
8	*Firmiana colorata* (Roxb.) R.Br.	2.89	3.65	2.09	8.63
9	*Syzygium cumini* (L.) Skeels	2.31	3.28	2.35	7.95
10	*Mallotus nudiflorus* (L.) Kulju & Welzen.	2.89	2.92	1.67	7.48
11	*Careya arborea* Roxb.	1.73	2.55	2.44	6.73
12	*Tectona grandis* L.f.	1.73	2.55	2.44	6.73
13	*Machilus glaucescens* (Nees) Wight	2.31	2.19	1.57	6.07
14	*Lagerstroemia parviflora* Roxb.	2.31	2.19	1.57	6.07
15	*Streblus asper* Lour.	1.73	2.19	2.09	6.02
16	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng	1.73	1.82	1.74	5.30
17	*Schima wallichii* Choisy	1.73	1.82	1.74	5.30
18	*Pueraria sikkimensis* Prain	1.73	1.82	1.74	5.30

Sl. No.	SPECIES	RF	RD	RA	IVI
19	*Toona ciliata* M.Roem.	1.73	1.82	1.74	5.30
20	*Tetrameles nudiflora* R.Br.	2.31	1.46	1.05	4.82
21	*Terminalia alata* Wall.	0.58	1.09	3.14	4.81
22	*Casearia vareca* Roxb.	1.16	1.46	2.09	4.71
23	*Holarrhena pubescens* Wall. *ex* G.Don	1.73	1.46	1.39	4.59
24	*Premna barbata* Wall. *ex* Schauer	1.73	1.09	1.05	3.88
25	*Dysoxylum excelsum* Blume	1.73	1.09	1.05	3.88
26	*Lannea coromandelica* (Houtt.) Merr.	1.73	1.09	1.05	3.88
27	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	1.73	1.09	1.05	3.88
28	*Sterculia villosa* Roxb.	1.73	1.09	1.05	3.88
29	*Chisocheton cumingianus* (C.DC.) Harms	1.16	1.09	1.57	3.82
30	*Capparis acutifolia* Sweet	1.16	1.09	1.57	3.82
31	*Wrightia arborea* (Dennst.) Mabb.	1.16	1.09	1.57	3.82
32	*Turpinia pomifera* (Roxb.) DC.	1.16	1.09	1.57	3.82
33	*Crateva religiosa* G.Forst.	0.58	0.73	2.09	3.40
34	*Saurauia roxburghii* Wall.	0.58	0.73	2.09	3.40
35	*Bridelia retusa* (L.) A.Juss.	0.58	0.73	2.09	3.40
36	*Flacourtia jangomas* (Lour.) Raeusch.	0.58	0.73	2.09	3.40
37	*Alangium chinense* (Lour.) Harms	1.16	0.73	1.05	2.93
38	*Phyllanthus emblica* L.	1.16	0.73	1.05	2.93
39	*Terminalia bellirica* (Gaertn.) Roxb.	1.16	0.73	1.05	2.93
40	*Chukrasia tabularis* A.Juss.	1.16	0.73	1.05	2.93
41	*Pterospermum acerifolium* (L.) Willd.	1.16	0.73	1.05	2.93
42	*Cephalanthus tetrandra* (Roxb.) Ridsdale & Bakh.f.	1.16	0.73	1.05	2.93
43	*Bauhinia vahlii* Wight & Arn.	1.16	0.73	1.05	2.93
44	*Baccaurea ramiflora* Lour.	1.16	0.73	1.05	2.93
45	*Pterygota alata* (Roxb.) R.Br.	1.16	0.73	1.05	2.93
46	*Mangifera indica* L.	0.58	0.36	1.05	1.99
47	*Antidesma bunius* (L.) Spreng.	0.58	0.36	1.05	1.99
48	*Bauhinia variegata* L.	0.58	0.36	1.05	1.99
49	*Sorindeia madagascariensis* Thouars *ex* DC.	0.58	0.36	1.05	1.99
50	*Acacia pennata* (L.) Willd.	0.58	0.36	1.05	1.99
51	*Dillenia indica* L.	0.58	0.36	1.05	1.99
52	*Alstonia scholaris* (L.) R. Br.	0.58	0.36	1.05	1.99
53	*Premna bengalensis* C.B.Clarke	0.58	0.36	1.05	1.99
54	*Sphaerosacme decandra* (Wall.) T.D.Penn.	0.58	0.36	1.05	1.99
55	*Dipterocarpus turbinatus* C.F.Gaertn.	0.58	0.36	1.05	1.99
56	*Morinda angustifolia* Roxb.	0.58	0.36	1.05	1.99
57	*Terminalia chebula* Retz.	0.58	0.36	1.05	1.99
58	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.58	0.36	1.05	1.99
59	*Sloanea sterculiacea* (Benth.) Rehder & E.H. Wilson	0.58	0.36	1.05	1.99
60	*Bischofia javanica* Blume	0.58	0.36	1.05	1.99
61	*Murraya paniculata* (L.) Jack	0.58	0.36	1.05	1.99
62	*Meliosma simplicifolia* (Roxb.) Walp.	0.58	0.36	1.05	1.99
63	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.58	0.36	1.05	1.99
64	*Litsea monopetala* (Roxb.) Pers.	0.58	0.36	1.05	1.99
65	*Bombax ceiba* L.	0.58	0.36	1.05	1.99
66	*Mallotus philippensis* (Lam.) Müll.Arg.	0.58	0.36	1.05	1.99
67	*Dalbergia stipulacea* Roxb.	0.58	0.36	1.05	1.99
68	*Erythrina stricta* Roxb.	0.58	0.36	1.05	1.99
69	*Butea monosperma* (Lam.) Taub.	0.58	0.36	1.05	1.99

Table 90. Phytosociological data of tree layer of natural vegetation in Post-monsoon in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Lagerstroemia speciosa* (L.) Pers.	5.49	10.00	2.89	18.38
2	*Shorea robusta* Gaertn.	4.95	6.21	1.99	13.14
3	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	3.85	5.86	2.42	12.12
4	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC.	2.75	4.83	2.79	10.36
5	*Aphanamixis polystachya* (Wall.) R.Parker	4.40	3.79	1.37	9.56
6	*Stereospermum tetragonum* DC.	3.85	3.10	1.28	8.23
7	*Firmiana colorata* (Roxb.) R.Br.	2.75	3.45	1.99	8.19
8	*Callicarpa arborea* Roxb.	2.20	3.10	2.24	7.54
9	*Syzygium cumini* (L.) Skeels	2.20	3.10	2.24	7.54
10	*Mallotus repandus* (Willd.) Müll.Arg.	2.75	2.76	1.59	7.10
11	*Streblus asper* Lour.	2.75	2.76	1.59	7.10
12	*Careya arborea* Roxb	1.65	2.41	2.32	6.38
13	*Tectona grandis* L.f.	1.65	2.41	2.32	6.38
14	*Machilus glaucescens* (Nees) Wight	2.20	2.07	1.49	5.76
15	*Lagerstroemia parviflora* Roxb.	2.20	2.07	1.49	5.76
16	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng	1.65	1.72	1.66	5.03
17	*Schima wallichii* Choisy	1.65	1.72	1.66	5.03
18	*Pueraria sikkimensis* Prain	1.65	1.72	1.66	5.03
19	*Toona ciliata* M.Roem.	1.65	1.72	1.66	5.03
20	*Tetrameles nudiflora* R.Br.	2.20	1.38	1.00	4.57
21	*Terminalia alata* Wall.	0.55	1.03	2.99	4.57
22	*Casearia vareca* Roxb.	1.10	1.38	1.99	4.47
23	*Bridelia retusa* (L.) A.Juss.	1.10	1.38	1.99	4.47
24	*Lannea coromandelica* (Houtt.) Merr.	1.65	1.38	1.33	4.35
25	*Holarrhena pubescens* Wall. *ex* G.Don	1.65	1.38	1.33	4.35
26	*Premna barbata* Wall. ex Schauer.	1.65	1.03	1.00	3.68
27	*Dysoxylum excelsum* Blume	1.65	1.03	1.00	3.68
28	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook.f. & Thomson	1.65	1.03	1.00	3.68
29	*Sterculia villosa* Roxb.	1.65	1.03	1.00	3.68
30	*Chisocheton cumingianus* (C.DC.) Harms	1.10	1.03	1.49	3.63
31	*Capparis acutifolia* Sweet	1.10	1.03	1.49	3.63
32	*Wrightia arborea* (Dennst.) Mabb.	1.10	1.03	1.49	3.63
33	*Turpinia pomifera* (Roxb.) DC.	1.10	1.03	1.49	3.63
34	*Crateva religiosa* G.Forst.	0.55	0.69	1.99	3.23
35	*Ailanthus integrifolia* Lam.	0.55	0.69	1.99	3.23
36	*Flacourtia jangomas* (Lour.) Raeusch.	0.55	0.69	1.99	3.23
37	*Alangium chinense* (Lour.) Harms	1.10	0.69	1.00	2.78
38	*Phyllanthus emblica* L.	1.10	0.69	1.00	2.78
39	*Antidesma bunius* (L.) Spreng.	1.10	0.69	1.00	2.78
40	*Terminalia bellirica* (Gaertn.) Roxb.	1.10	0.69	1.00	2.78
41	*Terminalia myriocarpa* Van Heurck & Müll. Arg.	1.10	0.69	1.00	2.78
42	*Chukrasia tabularis* A.Juss.	1.10	0.69	1.00	2.78
43	*Pterospermum acerifolium* (L.) Willd.	1.10	0.69	1.00	2.78
44	*Cephalanthus tetrandra* (Roxb.) Ridsdale & Bakh.f.	1.10	0.69	1.00	2.78
45	*Bauhinia vahlii* Wight & Arn.	1.10	0.69	1.00	2.78
46	*Baccaurea ramiflora* Lour.	1.10	0.69	1.00	2.78
47	*Pterygota alata* (Roxb.) R.Br.	1.10	0.69	1.00	2.78
48	*Bombax ceiba* L.	1.10	0.69	1.00	2.78
49	*Mangifera indica* L.	0.55	0.34	1.00	1.89
50	*Bauhinia variegata* L.	0.55	0.34	1.00	1.89
51	*Sorindeia madagascariensis* Thouars *ex* DC.	0.55	0.34	1.00	1.89
52	*Acacia pennata* (L.) Willd.	0.55	0.34	1.00	1.89
53	*Dillenia indica* L.	0.55	0.34	1.00	1.89
54	*Alstonia scholaris* (L.) R.Br.	0.55	0.34	1.00	1.89

Sl. No.	SPECIES	RF	RD	RA	IVI
55	*Premna bengalensis* C. B.Clarke	0.55	0.34	1.00	1.89
56	*Sphaerosacme decandra* (Wall.) T.D. Penn.	0.55	0.34	1.00	1.89
57	*Trevesia palmata* (Roxb. *ex* Lindl.) Vis.	0.55	0.34	1.00	1.89
58	*Erythrina stricta* Roxb.	0.55	0.34	1.00	1.89
59	*Eurya acuminate* DC.	0.55	0.34	1.00	1.89
60	*Dipterocarpus turbinatus* C.F. Gaertn	0.55	0.34	1.00	1.89
61	*Saurauia roxburghii* Wall.	0.55	0.34	1.00	1.89
62	*Morinda angustifolia* Roxb.	0.55	0.34	1.00	1.89
63	*Terminalia chebula* Retz.	0.55	0.34	1.00	1.89
64	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem.	0.55	0.34	1.00	1.89
65	*Sloanea sterculiacea* (Benth.) Rehder & E.H. Wilson	0.55	0.34	1.00	1.89
66	*Bischofia javanica* Blume	0.55	0.34	1.00	1.89
67	*Murraya paniculata* (L.) Jack	0.55	0.34	1.00	1.89
68	*Meliosma simplicifolia* (Roxb.) Walp.	0.55	0.34	1.00	1.89
69	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	0.55	0.34	1.00	1.89
70	*Mallotus philippensis* (Lam.) Müll.Arg.	0.55	0.34	1.00	1.89
71	*Dalbergia stipulacea* Roxb.	0.55	0.34	1.00	1.89
72	*Sterculia lanceifolia* Roxb.	0.55	0.34	1.00	1.89
73	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	0.55	0.34	1.00	1.89

Table 91. Phytosociological data of shrub layer of natural vegetation in winter in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	4.98	14.27	5.56	24.80
2	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.55	9.04	4.93	17.53
3	*Mikania micrantha* Kunth	4.50	8.61	3.70	16.81
4	*Lantana camara* L.	1.66	4.14	4.84	10.63
5	*Croton caudatus* Geiselar	2.61	4.25	3.16	10.01
6	*Ardisia solanacea* (Poir.) Roxb.	3.32	3.49	2.04	8.84
7	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	1.90	3.38	3.45	8.72
8	*Ichnocarpus frutescens* (L.) W.T.Aiton	3.08	3.38	2.12	8.58
9	*Lygodium flexuosum* (L.) Sw.	3.79	2.94	1.50	8.24
10	*Gouania leptostachya* DC.	4.03	2.29	1.10	7.42
11	*Morinda angustifolia* Roxb.	1.90	2.61	2.67	7.18
12	*Justicia adhatoda* L.	1.90	2.51	2.56	6.96
13	*Merremia vitifolia* (Burm. f.) Hallier f.	3.79	2.07	1.06	6.92
14	*Ixora athroantha* Bremek.	2.13	2.40	2.18	6.71
15	*Casearia vareca* Roxb.	2.84	2.29	1.56	6.69
16	*Mimosa himalayana* Gamble	1.42	2.07	2.82	6.31
17	*Dioscorea bulbifera* L.	3.32	1.85	1.08	6.25
18	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	3.32	1.85	1.08	6.25
19	*Cryptolepis dubia* (Burm.f.) M.R.Almeida	3.32	1.74	1.02	6.08
20	*Paederia foetida* L.	2.61	1.53	1.13	5.27
21	*Dioscorea pentaphylla* L.	2.13	1.53	1.39	5.04
22	*Melastoma malabathricum* L.	2.13	1.42	1.29	4.84
23	*Litsea glutinosa* (Lour.) C.B.Rob.	2.13	1.20	1.09	4.42
24	*Sida acuta* Burm.f.	0.71	0.98	2.67	4.36
25	*Caesalpinia cucullata* Roxb.	1.66	0.98	1.15	3.78
26	*Maesa indica* (Roxb.) A. DC	1.18	0.87	1.43	3.48
27	*Murraya paniculata* (L.) Jack.	1.18	0.87	1.43	3.48
28	*Jasminum dispermum* Wall.	1.42	0.87	1.19	3.48
29	*Piper betleoides* C. DC.	1.42	0.87	1.19	3.48
30	*Desmodium laxiflorum* DC.	1.42	0.76	1.04	3.22
31	*Smilax ovalifolia* Roxb. *ex* D.Don	1.42	0.76	1.04	3.22

Sl. No.	SPECIES	RF	RD	RA	IVI
32	*Momordica dioica* Roxb. *ex* Willd.	0.71	0.65	1.78	3.15
33	*Crotalaria alata* D. Don	0.95	0.65	1.34	2.94
34	*Dioscorea prazeri* Prain & Burkill	0.95	0.65	1.34	2.94
35	*Sauropus compressus* Mull.Arg.	0.95	0.65	1.34	2.94
36	*Acacia pennata* (L.) Willd.	1.18	0.65	1.07	2.91
37	*Crateva religiosa* G.Forst.	1.18	0.65	1.07	2.91
38	*Bridelia sikkimensis* Gehrm.	1.18	0.54	0.89	2.62
39	*Capparis acutifolia* Sweet	0.71	0.44	1.19	2.33
40	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	0.71	0.44	1.19	2.33
41	*Tetrastigma dubium* (Lawson) Planch.	0.71	0.44	1.19	2.33
42	*Dalbergia stipulacea* Roxb.	0.95	0.44	0.89	2.27
43	*Flacourtia indica* (Burm.f.) Merr.	0.95	0.44	0.89	2.27
44	*Albizia lucidior* (Steud.) I.C.Nielsen	0.71	0.33	0.89	1.93
45	*Callicarpa arborea* Roxb.	0.71	0.33	0.89	1.93
46	*Combretum decandrum* Jacq.	0.71	0.33	0.89	1.93
47	*Desmos dumosus* (Roxb.) Saff.	0.71	0.33	0.89	1.93
48	*Jasminum scandens* (Retz.) Vahl	0.71	0.33	0.89	1.93
49	*Mallotus philippensis* (Lam.) Müll.Arg.	0.71	0.33	0.89	1.93
50	*Sterculia villosa* Roxb.	0.71	0.33	0.89	1.93
51	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.47	0.22	0.89	1.58
52	*Actinodaphne obovata* (Nees) Blume	0.47	0.22	0.89	1.58
53	*Cissus repens* Lam.	0.47	0.22	0.89	1.58
54	*Dillenia indica* L.	0.47	0.22	0.89	1.58
55	*Lagerstroemia parviflora* Roxb.	0.47	0.22	0.89	1.58
56	*Leea aequata* L.	0.47	0.22	0.89	1.58
57	*Pterygota alata* (Roxb.) R.Br.	0.47	0.22	0.89	1.58
58	*Sterculia lanceifolia* Roxb.	0.47	0.22	0.89	1.58
59	*Tetrastigma planicaule* (Hook. f.) Gagnep.	0.47	0.22	0.89	1.58
60	*Toona ciliata* M.Roem.	0.47	0.22	0.89	1.58
61	*Uvaria hamiltonii* Hook.f. & Thomson	0.47	0.22	0.89	1.58
62	*Wrightia arborea* (Dennst.) Mabb.	0.24	0.11	0.89	1.24
63	*Premna barbata* Wall. *ex* Schauer.	0.24	0.11	0.89	1.24
64	*Sorindeia madagascariensis* Thouars *ex* DC.	0.24	0.11	0.89	1.24
65	*Syzygium cumini* (L.) Skeels	0.24	0.11	0.89	1.24
66	*Tectona grandis* L.f.	0.24	0.11	0.89	1.24

Table 92. Phytosociological data of shrub layer of natural vegetation in Pre-monsoon in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L.	3.09	16.27	10.21	29.57
2	*Coffea benghalensis* B.Heyne *ex* Schult.	3.97	13.53	6.60	24.10
3	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.75	7.38	3.81	14.95
4	*Triumfetta rhomboidea* Jacq.	2.87	7.00	4.73	14.60
5	*Urena lobata* L.	1.99	5.68	5.54	13.20
6	*Mikania micrantha* Kunth	3.53	4.07	2.23	9.83
7	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb.	2.87	2.55	1.73	7.15
8	*Piper chuvya* Miq.	3.53	2.18	1.19	6.90
9	*Dendrocnide sinuata* (Blume) Chew.	2.43	2.18	1.74	6.34
10	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	3.09	1.99	1.25	6.32
11	*Casearia glomerata* Roxb.	3.31	1.61	0.94	5.86
12	*Baliospermum solanifolium* (Burm.) Suresh	2.87	1.61	1.09	5.56
13	*Vallaris solanacea* (Roth) Kuntze	3.09	1.51	0.95	5.55
14	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	1.77	1.61	1.77	5.14
15	*Morinda angustifolia* Roxb.	1.32	1.51	2.22	5.05

Sl. No.	SPECIES	RF	RD	RA	IVI
16	*Piper mullesua* Buch.-Ham. *ex* D. Don	1.99	1.51	1.48	4.98
17	*Girardinia diversifolia* (Link) Friis	2.65	1.32	0.97	4.94
18	*Bridelia glauca* Blume	2.43	1.32	1.06	4.81
19	*Barleria cristata* L.	1.99	1.23	1.20	4.42
20	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.99	1.23	1.20	4.42
21	*Murraya paniculata* (L.) Jack	1.55	1.23	1.54	4.32
22	*Celastrus paniculatus* Willd.	1.99	1.14	1.11	4.23
23	*Ardisia solanacea* (Poir.) Roxb.	1.55	1.14	1.42	4.11
24	*Bauhinia purpurea* L.	1.77	1.04	1.14	3.95
25	*Dioscorea bulbifera* L.	1.77	1.04	1.14	3.95
26	Clausena excavata Burm. f.	1.99	0.95	0.92	3.86
27	*Dioscorea pentaphylla* L.	1.55	0.76	0.95	3.25
28	*Litsea monopetala* (Roxb.) Pers.	1.32	0.66	0.97	2.96
29	*Macaranga denticulata* (Blume) Müll.Arg.	1.32	0.66	0.97	2.96
30	Pterigota alata (Roxb.) R. Br.	1.32	0.66	0.97	2.96
31	*Crotalaria alata* D.Don	1.10	0.66	1.16	2.93
32	*Pueraria sikkimensis* Prain	1.10	0.66	1.16	2.93
33	*Lagerstroemia speciosa* (L.) Pers.	1.32	0.57	0.83	2.72
34	*Thunbergia fragrans* Roxb.	1.32	0.57	0.83	2.72
35	*Maesa indica* (Roxb.) A. DC.	0.88	0.57	1.25	2.70
36	*Actinodaphne obovata* (Nees) Blume	1.10	0.47	0.83	2.41
37	*Albizia lucidior* (Steud.) I.C. Nielsen *ex* H. Hara	1.10	0.47	0.83	2.41
38	*Machilus glaucescens* (Nees) Wight	1.10	0.47	0.83	2.41
39	*Uvaria hamiltonii* Hook. f. & Thomson	1.10	0.47	0.83	2.41
40	*Wrightia arborea* (Dennst.) Mabb.	1.10	0.47	0.83	2.41
41	*Desmodium oblongum* Benth.	0.66	0.38	1.11	2.15
42	*Mallotus philippensis* (Lam.) Müll.Arg.	0.66	0.38	1.11	2.15
43	*Acacia pennata* (L.) Willd.	0.88	0.38	0.83	2.09
44	*Crateva religiosa* G.Forst.	0.88	0.38	0.83	2.09
45	*Litsea glutinosa* (Lour.) C.B.Rob.	0.88	0.38	0.83	2.09
46	*Sabia lanceolata* Colebr.	0.88	0.38	0.83	2.09
47	*Stephania japonica* (Thunb.) Miers	0.88	0.38	0.83	2.09
48	*Tetrastigma planicaule* (Hook.f.) Gagnep.	0.88	0.38	0.83	2.09
49	*Streblus asper* Lour.	0.44	0.28	1.25	1.97
50	*Bauhinia vahlii* Wight & Arn.	0.66	0.28	0.83	1.78
51	*Firmiana colorata* (Roxb.) R.Br.	0.66	0.28	0.83	1.78
52	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook.f. & Thomson	0.66	0.28	0.83	1.78
53	*Pterospermum acerifolium* (L.) Willd.	0.66	0.28	0.83	1.78
54	*Sauropus compressus* Müll.Arg.	0.66	0.28	0.83	1.78
55	*Smilax orthoptera* A.DC.	0.66	0.28	0.83	1.78
56	*Sterculia villosa* Roxb.	0.66	0.28	0.83	1.78
57	*Antidesma bunius* (L.) Spreng.	0.44	0.19	0.83	1.46
58	*Baliospermum solanifolium* (Burm.) Suresh	0.44	0.19	0.83	1.46
59	*Callicarpa arborea* Roxb.	0.44	0.19	0.83	1.46
60	*Dalbergia stipulacea* Roxb.	0.44	0.19	0.83	1.46
61	*Dillenia pentagyna* Roxb.	0.44	0.19	0.83	1.46
62	*Grewia asiatica* L.	0.44	0.19	0.83	1.46
63	*Holmskioldia sanguinea* Retz.	0.44	0.19	0.83	1.46
64	*Jasminum dispermum* Wall.	0.44	0.19	0.83	1.46
65	*Leea aequata* L.	0.44	0.19	0.83	1.46
66	*Meliosma simplicifolia* (Roxb.) Walp.	0.44	0.19	0.83	1.46
67	*Meyna spinosa* Roxb. *ex* Link	0.44	0.19	0.83	1.46

Sl. No.	SPECIES	RF	RD	RA	IVI
68	*Tectona grandis* L.f.	0.44	0.19	0.83	1.46
69	*Toona ciliata* M.Roem.	0.44	0.19	0.83	1.46
70	*Careya arborea* Roxb.	0.22	0.09	0.83	1.15
71	*Shorea robusta* Gaertn.	0.22	0.09	0.83	1.15
72	*Sloanea sterculiacea* (Benth.) Rehder & E.H. Wilson	0.22	0.09	0.83	1.15

Table 93. Phytosociological data of shrub layer of natural vegetation in Post-monsoon in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	8.25	17.56	4.20	30.00
2	*Urena lobata* L.	3.59	14.78	8.11	26.49
3	*Clerodendrum infortunatum* L.	5.50	10.52	3.78	19.79
4	*Triumfetta rhomboidea* Jacq.	2.96	6.97	4.64	14.57
5	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.59	5.97	3.28	12.84
6	*Sorindeia madagascariensis* Thouars *ex* DC.	4.86	3.62	1.47	9.96
7	*Lygodium flexuosum* (L.) Sw.	0.42	1.63	7.63	9.68
8	*Phlogacanthus thyrsiflorus* Nees	3.59	3.55	1.95	9.10
9	*Capparis olacifolia* Hook.f. & Thomson	3.38	2.49	1.45	7.32
10	*Pueraria sikkimensis* Prain	3.59	2.35	1.29	7.23
11	*Morinda angustifolia* Roxb.	2.75	2.42	1.73	6.90
12	*Sida acuta* Burm.f.	3.38	1.85	1.08	6.31
13	*Mikania micrantha* Kunth	2.96	1.85	1.23	6.04
14	*Clausena excavata* Burm.f.	2.75	1.63	1.17	5.56
15	*Litsea glutinosa* (Lour.) C.B.Rob.	2.75	1.00	0.71	4.46
16	*Vallaris solanacea* (Roth) Kuntze	2.33	1.00	0.84	4.16
17	*Barleria cristata* L.	1.06	1.00	1.86	3.91
18	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	2.11	0.92	0.86	3.90
19	*Litsea monopetala* (Roxb.) Pers.	2.11	0.85	0.80	3.76
20	*Dioscorea bulbifera* L.	1.69	0.92	1.08	3.69
21	*Sabia lanceolata* Colebr.	1.90	0.85	0.88	3.64
22	*Murraya paniculata* (L.) Jack	1.48	0.92	1.23	3.64
23	*Ardisia solanacea* (Poir.) Roxb.	1.27	0.92	1.44	3.63
24	*Sauropus compressus* Müll.Arg.	1.69	0.85	0.99	3.54
25	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.69	0.78	0.91	3.39
26	*Persea glaucescens* (Nees) D.G. Long	1.27	0.71	1.11	3.08
27	*Bauhinia vahlii* Wight & Arn.	1.27	0.64	0.99	2.90
28	*Merremia vitifolia* (Burm. f.) Hallier f.	1.27	0.50	0.77	2.54
29	*Casearia vareca* Roxb.	0.85	0.50	1.16	2.50
30	*Justicia adhatoda* L.	0.85	0.50	1.16	2.50
31	*Dioscorea pentaphylla* L.	1.06	0.50	0.93	2.48
32	*Miliusa roxburghiana* Hook.f. & Thomson	1.06	0.50	0.93	2.48
33	*Lantana camara* L.	0.21	0.21	1.99	2.41
34	*Stephania japonica* (Thunb.) Miers	0.21	0.21	1.99	2.41
35	*Piper betleoides* C.DC.	0.63	0.43	1.33	2.39
36	*Lagerstroemia speciosa* (L.) Pers.	1.27	0.43	0.66	2.36
37	*Acacia pennata* (L.) Willd.	1.06	0.43	0.80	2.28
38	*Desmodium laxiflorum* DC.	0.85	0.43	0.99	2.27
39	*Piper mullesua* Buch.-Ham. *ex* D. Don	0.85	0.43	0.99	2.27
40	*Girardinia diversifolia* (Link) Friis	0.63	0.36	1.11	2.09
41	*Stereospermum tetragonum* DC.	0.63	0.36	1.11	2.09
42	*Maesa indica* (Roxb.) A. DC.	0.42	0.28	1.33	2.03
43	*Shorea robusta* Gaertn.	0.85	0.36	0.83	2.03
44	*Ilex godajam* Colebr. *ex* Hook.f.	0.63	0.28	0.88	1.80
45	*Jasminum scandens* (Retz.) Vahl	0.63	0.28	0.88	1.80
46	*Macaranga denticulata* (Blume) Müll.Arg.	0.63	0.28	0.88	1.80

Sl. No.	SPECIES	RF	RD	RA	IVI
47	*Ocotea lancifolia* (Schott) Mez	0.21	0.14	1.33	1.68
48	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	0.21	0.14	1.33	1.68
49	*Crateva religiosa* G.Forst.	0.42	0.21	0.99	1.63
50	*Cryptolepis dubia* (Burm.f.) M.R.Almeida	0.42	0.21	0.99	1.63
51	*Melastoma malabathricum* L.	0.42	0.21	0.99	1.63
52	*Uvaria hamiltonii* Hook.f. & Thomson	0.42	0.21	0.99	1.63
53	*Actinodaphne obovata* (Nees) Blume	0.63	0.21	0.66	1.51
54	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	0.63	0.21	0.66	1.51
55	*Careya arborea* Roxb.	0.63	0.21	0.66	1.51
56	*Firmiana colorata* (Roxb.) R.Br.	0.63	0.21	0.66	1.51
57	*Ixora athroantha* Bremek.	0.63	0.21	0.66	1.51
58	*Piper chuvya* Miq.	0.63	0.21	0.66	1.51
59	*Smilax ovalifolia* Roxb. *ex* D.Don	0.63	0.21	0.66	1.51
60	*Styrax serrulatus* Roxb.	0.63	0.21	0.66	1.51
61	*Albizia lucidior* (Steud.) I.C.Nielsen	0.42	0.14	0.66	1.23
62	*Bauhinia purpurea* L.	0.42	0.14	0.66	1.23
63	*Meliosma pinnata* (Roxb.) Maxim.	0.42	0.14	0.66	1.23
64	*Caesalpinia cucullata* Roxb.	0.21	0.07	0.66	0.95
65	*Dalbergia stipulacea* Roxb.	0.21	0.07	0.66	0.95
66	*Dillenia indica* L.	0.21	0.07	0.66	0.95
67	*Flacourtia indica* (Burm.f.) Merr.	0.21	0.07	0.66	0.95
68	*Goniothalamus sesquipedalis* (Wall.) Hook.f. & Thomson	0.21	0.07	0.66	0.95
69	*Grewia asiatica* L.	0.21	0.07	0.66	0.95
70	*Leea aequata* L.	0.21	0.07	0.66	0.95
71	*Ostodes paniculata* Blume	0.21	0.07	0.66	0.95
72	*Phyllanthus emblica* L.	0.21	0.07	0.66	0.95
73	*Sterculia villosa* Roxb.	0.21	0.07	0.66	0.95
74	*Syzygium cumini* (L.) Skeels	0.21	0.07	0.66	0.95
75	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	0.21	0.07	0.66	0.95
76	*Toona ciliata* M.Roem.	0.21	0.07	0.66	0.95

Table 94. Phytosociological data of herb layer of natural vegetation in winter in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	7.79	5.33	0.94	14.06
2	*Mikania micrantha* Kunth	0.61	3.75	8.36	12.73
3	*Oplismenus burmanni* (Retz.) P.Beauv.	4.71	5.82	1.69	12.23
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	4.71	4.64	1.35	10.70
5	*Pupalia lappacea* (L.) Juss.	2.66	4.54	2.34	9.54
6	*Diplazium esculentum* (Retz.) Sw.	4.30	3.85	1.23	9.38
7	*Synedrella nodiflora* (L.) Gaertn.	3.07	4.05	1.80	8.93
8	*Clerodendrum infortunatum* L.	2.66	3.85	1.98	8.49
9	*Barleria cristata* L.	2.87	3.46	1.65	7.97
10	*Commelina diffusa* Burm.f.	2.87	3.06	1.46	7.39
11	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	1.84	3.16	2.35	7.35
12	*Dendrocnide sinuata* (Blume) Chew	3.48	2.76	1.09	7.34
13	*Dryopteris sikkimensis* (Bedd.) Kuntze	3.07	2.67	1.19	6.93
14	*Urena lobata* L.	2.05	2.76	1.85	6.66
15	*Lygodium flexuosum* (L.) Sw.	3.28	2.27	0.95	6.50
16	*Ageratum conyzoides* (L.) L.	2.25	2.37	1.44	6.06
17	*Cyperus compressus* L.	2.25	2.37	1.44	6.06
18	*Piper peepuloides* Roxb.	2.25	2.27	1.38	5.91
19	*Digitaria ciliaris* (Retz.) Koeler	1.84	2.27	1.69	5.80
20	*Justicia adhatoda* L.	2.87	1.97	0.94	5.79
21	*Phaulopsis imbricata* (Forssk.) Sweet	1.84	2.07	1.54	5.46
22	*Setaria palmifolia* (J. Koenig) Stapf	1.84	2.07	1.54	5.46

Sl. No.	SPECIES	RF	RD	RA	IVI
23	*Thelypteris nudata* (Roxb.) C.V. Morton.	1.43	1.78	1.70	4.91
24	*Triumfetta rhomboidea* Jacq.	0.20	0.59	3.96	4.76
25	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.84	1.48	1.10	4.43
26	*Eleusine indica* (L.) Gaertn.	0.82	1.28	2.15	4.25
27	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.64	1.38	1.16	4.18
28	*Sida acuta* Burm.f.	1.64	1.28	1.07	4.00
29	*Maesa indica* (Roxb.) A.DC.	1.64	1.18	0.99	3.81
30	*Phlogacanthus thyrsiflorus* Nees	1.43	1.18	1.13	3.75
31	*Ophiopogon intermedius* D.Don	0.82	1.09	1.82	3.72
32	*Dioscorea belophylla* (Prain) Voigt *ex* Haines	1.43	1.09	1.04	3.56
33	*Piper betleoides* C.DC.	1.64	0.99	0.83	3.45
34	*Desmodium oblongum* Benth.	1.23	0.89	0.99	3.11
35	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.23	0.79	0.88	2.90
36	*Vallaris solanacea* (Roth) Kuntze	1.02	0.79	1.06	2.87
37	*Boehmeria* sp	0.61	0.69	1.54	2.85
38	*Elephantopus scaber* L.	0.61	0.69	1.54	2.85
39	*Piper Chuvya* Miq.	0.61	0.69	1.54	2.85
40	*Tetrastigma serrulatum* (Roxb.) Planch.	1.23	0.69	0.77	2.69
41	*Biophytum reinwardtii* (Zucc.) Klotzsch	0.41	0.49	1.65	2.55
42	*Chlorophytum arundinaceum* Baker	0.41	0.49	1.65	2.55
43	*Spermacoce alata* Aubl.	0.61	0.59	1.32	2.53
44	*Floscopa scandens* Lour.	0.61	0.59	1.32	2.53
45	*Cheilocostus speciosus* (J.Koenig) C.D.Specht.	0.20	0.30	1.98	2.48
46	*Pollia subumbellata* C.B. Clarke	0.20	0.30	1.98	2.48
47	*Jasminum dispermum* Wall.	0.82	0.59	0.99	2.40
48	*Deeringia amaranthoides* (Lam.) Merr.	0.61	0.49	1.10	2.21
49	*Psychotria erratica* Hook.f.	0.61	0.49	1.10	2.21
50	*Rungia himalayensis* C.B.Clarke	0.61	0.49	1.10	2.21
51	*Eclipta prostrata* (L.) L.	0.41	0.39	1.32	2.13
52	*Girardinia diversifolia* (Link) Friis	0.61	0.39	0.88	1.89
53	*Alocasia fallax* Schott	0.20	0.20	1.32	1.72
54	*Crotalaria alata* D.Don	0.20	0.20	1.32	1.72
55	*Lasia spinosa* (L.) Thwaites	0.20	0.20	1.32	1.72
56	*Adenostemma lavenia* (L.) Kuntze	0.41	0.30	0.99	1.70
57	*Crinum amoenum* Ker Gawl. *ex* Roxb.	0.41	0.30	0.99	1.70
58	*Pterygota alata* (Roxb.) R.Br.	0.41	0.30	0.99	1.70
59	*Smilax orthoptera* A.DC.	0.41	0.30	0.99	1.70
60	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	0.41	0.30	0.99	1.70
61	*Pueraria sikkimensis* Prain	0.61	0.30	0.66	1.57
62	*Sauropus compressus* Müll.Arg.	0.61	0.30	0.66	1.57
63	*Ficus hispida* L.f.	0.41	0.20	0.66	1.27
64	*Nelsonia canescens* (Lam.) Spreng.	0.41	0.20	0.66	1.27
65	*Paederia foetida* L.	0.41	0.20	0.66	1.27
66	*Thunbergia fragrans* Roxb.	0.41	0.20	0.66	1.27
67	*Toona ciliata* M.Roem.	0.41	0.20	0.66	1.27
68	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.41	0.20	0.66	1.27
69	*Capparis acutifolia* Sweet	0.20	0.10	0.66	0.96
70	*Erythrina stricta* Roxb.	0.20	0.10	0.66	0.96
71	*Pericampylus glaucus* (Lam.) Merr.	0.20	0.10	0.66	0.96
72	*Piper hamiltonii* C.DC.	0.20	0.10	0.66	0.96
73	*Pothos scandens* L.	0.20	0.10	0.66	0.96
74	*Zanthoxylum nitidum* (Roxb.) DC.	0.20	0.10	0.66	0.96

Table 95. Phytosociological data of herb layer of natural vegetation in Pre-monsoon in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	5.50	5.10	1.17	11.77
2	*Oplismenus burmanni* (Retz.) P.Beauv.	3.11	4.12	1.67	8.90
3	*Dryopteris sikkimensis* (Bedd.) Kuntze	3.94	3.66	1.17	8.78
4	*Chromolaena odorata* (L.) R.M.King & H.Rob.	2.63	4.12	1.98	8.73
5	*Pupalia lappacea* (L.) Juss.	3.70	3.73	1.27	8.70
6	*Mikania micrantha* Kunth	3.94	3.07	0.98	8.00
7	*Synedrella nodiflora* (L.) Gaertn.	2.15	3.53	2.07	7.75
8	*Axonopus compressus* (Sw.) P.Beauv.	2.51	3.47	1.74	7.72
9	*Clerodendrum infortunatum* L.	2.75	3.07	1.41	7.23
10	*Commelina diffusa* Burm.f.	3.23	2.81	1.10	7.14
11	*Diplazium esculentum* (Retz.) Sw.	3.11	2.81	1.14	7.06
12	*Urena lobata* L.	2.75	2.68	1.23	6.66
13	*Cyperus compressus* L.	1.91	2.81	1.86	6.58
14	*Achyrospermum wallichianum* (Benth.) Benth. ex Hook.f.	1.31	2.68	2.58	6.57
15	*Setaria palmifolia* (J.Koenig) Stapf	2.63	2.22	1.07	5.92
16	*Dendrocnide sinuata* (Blume) Chew	1.55	2.22	1.81	5.58
17	*Lygodium flexuosum* (L.) Sw.	2.03	2.09	1.30	5.42
18	*Barleria cristata* L.	1.91	1.96	1.30	5.17
19	*Digitaria ciliaris* (Retz.) Koeler	1.55	1.90	1.54	4.99
20	*Justicia adhatoda* L.	1.91	1.77	1.17	4.84
21	*Sida acuta* Burm.f.	1.91	1.77	1.17	4.84
22	*Ageratum conyzoides* (L.) L.	1.67	1.77	1.33	4.77
23	*Phaulopsis imbricata* (Forssk.) Sweet	1.43	1.70	1.50	4.63
24	*Pronephrium nudatum* (Roxb.) Holttum	1.91	1.50	0.99	4.41
25	*Triumfetta rhomboidea* Jacq.	2.03	1.44	0.89	4.36
26	*Girardinia diversifolia* (Link) Friis	1.91	1.37	0.91	4.19
27	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.43	1.44	1.27	4.14
28	*Ophiopogon intermedius* D.Don	0.60	1.11	2.35	4.06
29	*Phlogacanthus thyrsiflorus* Nees	1.31	1.24	1.19	3.75
30	*Piper peepuloides* Wall.	0.96	1.18	1.55	3.69
31	*Ichnocarpus frutescens* (L.) W.T.Aiton	1.55	1.18	0.96	3.69
32	*Vallaris solanacea* (Roth) Kuntze	1.79	1.11	0.78	3.69
33	*Biophytum reinwardtii* (Zucc.) Klotzsch	0.48	0.85	2.25	3.57
34	*Pollia subumbellata* C.B.Clarke	0.48	0.85	2.25	3.57
35	*Piper betleoides* C.DC.	1.08	1.05	1.23	3.35
36	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.43	0.92	0.81	3.16
37	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	1.31	0.92	0.88	3.11
38	*Rungia himalayensis* C.B.Clarke	0.48	0.72	1.90	3.10
39	*Eclipta prostrata* (L.) L.	0.96	0.92	1.21	3.08
40	*Maesa indica* (Roxb.) A. DC.	1.08	0.92	1.07	3.07
41	*Spermacoce alata* Aubl.	0.36	0.59	2.07	3.02
42	*Piper chuvya* Miq.	0.96	0.85	1.12	2.93
43	*Boehmeria sp*	0.60	0.72	1.52	2.84
44	*Desmodium oblongum* Benth.	1.08	0.78	0.92	2.78
45	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	0.96	0.78	1.04	2.78
46	*Elephantopus scaber* L.	0.96	0.72	0.95	2.63
47	*Tetrastigma serrulatum* (Roxb.) Planch.	0.96	0.72	0.95	2.63
48	*Strobilanthes sp*	0.72	0.65	1.15	2.52
49	*Deeringia amaranthoides* (Lam.) Merr.	0.60	0.59	1.24	2.43
50	*Chlorophytum arundinaceum* Baker	0.48	0.52	1.38	2.38
51	*Dioscorea belophylla* (Prain) Voigt *ex* Haines	0.72	0.59	1.04	2.34
52	*Floscopa scandens* Lour.	0.24	0.33	1.73	2.29
53	*Nelsonia canescens* (Lam.) Spreng.	0.60	0.52	1.11	2.23
54	*Eleusine indica* (L.) Gaertn.	0.48	0.46	1.21	2.14
55	*Curculigo orchioides* Gaertn.	0.36	0.39	1.38	2.13

Sl. No.	SPECIES	RF	RD	RA	IVI
56	*Impatiens trilobata* Colebr.	0.36	0.39	1.38	2.13
57	*Psychotria erratica* Hook.f.	0.60	0.46	0.97	2.02
58	*Smilax orthoptera* A.DC.	0.72	0.46	0.81	1.98
59	*Crinum amoenum* Ker Gawl. *ex* Roxb.	0.48	0.39	1.04	1.91
60	*Piper hamiltonii* C.DC.	0.48	0.39	1.04	1.91
61	*Sauropus compressus* Müll.Arg.	0.48	0.39	1.04	1.91
62	*Paederia foetida* L.	0.36	0.33	1.15	1.84
63	*Pueraria sikkimensis* Prain	0.72	0.39	0.69	1.80
64	*Erythrina stricta* Roxb.	0.12	0.13	1.38	1.63
65	*Cyanthillium cinereum* (L.) H.Rob.	0.12	0.13	1.38	1.63
66	*Alocasia fallax* Schott	0.36	0.26	0.92	1.54
67	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	0.36	0.26	0.92	1.54
68	*Lasia spinosa* (L.) Thwaites	0.36	0.26	0.92	1.54
69	*Pothos scandens* L.	0.36	0.26	0.92	1.54
70	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.36	0.26	0.92	1.54
71	*Crotalaria alata* D.Don	0.24	0.20	1.04	1.47
72	*Ficus hispida* L.f.	0.24	0.20	1.04	1.47
73	*Jasminum dispermum* Wall.	0.48	0.26	0.69	1.43
74	*Pericampylus glaucus* (Lam.) Merr.	0.36	0.20	0.69	1.25
75	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn.	0.36	0.20	0.69	1.25
76	*Thunbergia fragrans* Roxb.	0.36	0.20	0.69	1.25
77	*Toona ciliate* M.Roem.	0.36	0.20	0.69	1.25
78	*Adenostemma lavenia* (L.) Kuntze	0.24	0.13	0.69	1.06
79	*Capparis acutifolia* Sweet	0.24	0.13	0.69	1.06
80	*Flemingia* sp	0.24	0.13	0.69	1.06
81	*Pterygota alata* (Roxb.) R.Br.	0.24	0.13	0.69	1.06
82	*Trichosanthes tricuspidata* Lour.	0.24	0.13	0.69	1.06
83	*Zanthoxylum nitidum* (Roxb.) DC.	0.24	0.13	0.69	1.06

Table 96. Phytosociological data of herb layer of natural vegetation in Post-monsoon in Sevoke site

Sl. No.	SPECIES	RF	RD	RA	IVI
1	*Coffea benghalensis* B.Heyne *ex* Schult.	3.21	5.09	1.85	10.15
2	*Chromolaena odorata* (L.) R.M.King & H.Rob.	3.88	4.52	1.36	9.75
3	*Clerodendrum infortunatum* L.	2.27	3.95	2.03	8.25
4	*Diplazium esculentum* (Retz.) Sw.	3.50	3.32	1.11	7.93
5	*Mikania micrantha* Kunth	3.02	3.48	1.34	7.85
6	*Synedrella nodiflora* (L.) Gaertn.	2.27	3.48	1.79	7.54
7	*Dryopteris sikkimensis* (Bedd.) Kuntze	2.08	2.75	1.55	6.38
8	*Morinda angustifolia* Roxb.	3.12	2.13	0.80	6.05
9	*Ageratum conyzoides* (L.) L.	2.08	2.49	1.40	5.97
10	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	1.51	2.44	1.89	5.84
11	*Pupalia lappacea* (L.) Juss.	2.27	2.23	1.15	5.65
12	*Axonopus compressus* (Sw.) P.Beauv.	2.17	2.23	1.20	5.61
13	*Commelina diffusa* Burm.f.	2.08	2.23	1.25	5.57
14	*Ichnocarpus frutescens* (L.) W.T.Aiton	2.74	1.97	0.84	5.56
15	*Eragrostis amabilis* (L.) Wight & Arn.	1.98	2.18	1.28	5.45
16	*Digitaria ciliaris* (Retz.) Koeler	0.85	1.92	2.64	5.41
17	*Lygodium flexuosum* (L.) Sw.	2.55	1.87	0.86	5.28
18	*Cyperus compressus* L.	1.42	1.92	1.58	4.92
19	*Urena lobata* L.	1.51	1.87	1.44	4.83
20	*Setaria palmifolia* (J.Koenig) Stapf	1.51	1.77	1.36	4.64
21	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	1.80	1.71	1.12	4.62
22	*Merremia vitifolia* (Burm. f.) Hallier f.	2.36	1.51	0.74	4.61
23	*Kyllinga nemoralis* (J.R.Forst. & G.Forst.) Dandy *ex* Hutch. & Dalziel	1.32	1.71	1.51	4.55

Sl. No.	SPECIES	RF	RD	RA	IVI
24	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1.04	1.61	1.81	4.46
25	*Sida acuta* Burm.f.	1.32	1.66	1.47	4.45
26	*Phaulopsis imbricata* (Forssk.) Sweet	1.32	1.61	1.42	4.35
27	*Piper betleoides* C.DC.	1.98	1.40	0.83	4.21
28	*Strobilanthes sp*	1.51	1.51	1.16	4.18
29	*Phlogacanthus thyrsiflorus* Nees	1.04	1.45	1.63	4.13
30	*Persicaria chinensis* (L.) H. Gross	1.23	1.40	1.33	3.96
31	*Rungia himalayensis* C.B.Clarke	1.13	1.35	1.39	3.88
32	*Ophiopogon intermedius* D.Don	1.70	1.19	0.82	3.72
33	*Peristrophe bicalyculata* (Retz.) Nees	1.61	1.14	0.83	3.58
34	*Barleriastrig osa* Willd.	1.23	1.19	1.14	3.56
35	*Pteris biaurita* L.	1.70	1.09	0.75	3.54
36	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy	1.51	1.14	0.88	3.54
37	*Thelypteris nudata* (Roxb.) C.V. Morton.	1.51	1.14	0.88	3.54
38	*Vallaris solanacea* (Roth) Kuntze	0.85	1.09	1.50	3.44
39	*Pteris semipinnata* L.	1.42	0.88	0.73	3.03
40	*Tectaria gemmifera* (Fée) Alston	1.23	0.88	0.84	2.95
41	*Aerva sanguinolenta* (L.) Blume	0.85	0.88	1.21	2.95
42	*Carex indica* L.	0.38	0.62	1.93	2.93
43	*Chlorophytum arundinaceum* Baker	0.85	0.83	1.14	2.82
44	*Gouania leptostachya* DC	0.47	0.67	1.67	2.82
45	*Tetrastigma campylocarpum* (Kurz) Planch.	1.04	0.83	0.93	2.80
46	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult.	0.57	0.73	1.50	2.79
47	*Biophytum reinwardtii* (Zucc.) Klotzsch	0.57	0.67	1.39	2.63
48	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1.04	0.73	0.82	2.58
49	*Deeringia amaranthoides* (Lam.) Merr.	1.04	0.67	0.76	2.47
50	*Smilax orthoptera* A.DC.	1.04	0.67	0.76	2.47
51	*Achyranthes bidentata* Blume	0.85	0.67	0.93	2.45
52	*Maesa indica* (Roxb.) A.DC.	0.66	0.62	1.10	2.39
53	*Piper chuvya* Miq.	0.76	0.62	0.96	2.34
54	*Desmodium oblongum* Benth.	0.95	0.62	0.77	2.34
55	*Floscopa scandens* Lour.	0.85	0.62	0.86	2.33
56	*Dioscorea belophylla* (Prain) Voigt *ex* Haines	0.85	0.57	0.78	2.21
57	*Merremia hirta* (L.) Merr.	0.85	0.57	0.78	2.21
58	*Paederia foetida* L.	0.66	0.47	0.83	1.95
59	*Cyanthillium cinereum* (L.) H.Rob.	0.28	0.31	1.28	1.88
60	*Pseuderanthemum latifolium* B. Hansen	0.38	0.36	1.12	1.87
61	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.	0.38	0.36	1.12	1.87
62	*Barleria cristata* L.	0.47	0.36	0.90	1.73
63	*Pericampylus glaucus* (Lam.) Merr.	0.47	0.36	0.90	1.73
64	*Leucas aspera* (Willd.) Link.	0.19	0.21	1.28	1.68
65	*Pothos scandens* L.	0.57	0.36	0.75	1.68
66	*Pueraria sikkimensis* Prain	0.57	0.36	0.75	1.68
67	*Curculigo orchioides* Gaertn.	0.38	0.31	0.96	1.65
68	*Gomphostemma ovatum* Wall. *ex* Benth.	0.28	0.26	1.07	1.61
69	*Tetrastigma dubium* (Lawson) Planch.	0.28	0.26	1.07	1.61
70	*Tetrastigma leucostaphylum* (Dennst.) Alston	0.09	0.10	1.28	1.48
71	*Jasminum dispermum* Wall.	0.38	0.26	0.80	1.44
72	*Toona ciliata* M.Roem.	0.47	0.26	0.64	1.37
73	*Phrynium pubinerve* Blume	0.19	0.16	0.96	1.31
74	*Thunbergia fragrans* Roxb.	0.19	0.16	0.96	1.31
75	*Litsea glutinosa* (Lour.) C.B.Rob.	0.38	0.21	0.64	1.23
76	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn.	0.38	0.21	0.64	1.23
77	*Trichosanthes tricuspidata* Lour.	0.38	0.21	0.64	1.23
78	*Actinodaphne obovata* (Nees) Blume	0.28	0.16	0.64	1.08

Sl. No.	SPECIES	RF	RD	RA	IVI
79	*Bauhinia purpurea* L.	0.28	0.16	0.64	1.08
80	*Capparis acutifolia* Sweet	0.28	0.16	0.64	1.08
81	*Ficus pumila* L.	0.28	0.16	0.64	1.08
82	*Miliusa roxburghiana* Hook.f. & Thomson	0.28	0.16	0.64	1.08
83	*Ostodes paniculata* Blume	0.28	0.16	0.64	1.08
84	*Phyllanthus emblica* L.	0.28	0.16	0.64	1.08
85	*Shorea robusta* Gaertn.	0.28	0.16	0.64	1.08
86	*Callicarpa arborea* Roxb.	0.19	0.10	0.64	0.93
87	*Crateva religiosa* G.Forst.	0.19	0.10	0.64	0.93
88	*Flemingia* sp	0.19	0.10	0.64	0.93
89	*Pterygota alata* (Roxb.) R.Br.	0.19	0.10	0.64	0.93
90	*Pueraria phaseoloides* (Roxb.) Benth.	0.19	0.10	0.64	0.93
91	*Sauropus compressus* Müll.Arg.	0.19	0.10	0.64	0.93
92	*Stephania glabra* (Roxb.) Miers	0.19	0.10	0.64	0.93
93	*Sterculia villosa* Roxb.	0.19	0.10	0.64	0.93
94	*Stereospermum tetragonum* DC.	0.19	0.10	0.64	0.93
95	*Uvariaha miltonii* Hook. f. & Thomson	0.19	0.10	0.64	0.93

ANNEXURE – IIA
[Tables of Phytosociological data of Aggressive Weeds]

Table 1. Phytosociological data of shrub layer in non-invaded areas [TNI = Total number of individuals, F = Frequency, D = Density, A = Abundance, RF = Relative Frequency, RD = Relative Density, RA = Relative Abundance, IVI = Importance Value Index]

Sl. No	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
1	*Clerodendrum infortunatum* L. [Lamiaceae]	137	0.68	5.48	8.06	5.25	16.85	7.59	29.69
2	*Coffea benghalensis* B. Heyne *ex* Schult. [Rubiaceae]	109	0.52	4.36	8.38	4.01	13.41	7.9	25.32
3	*Triumfetta rhomboidea* Jacq. [Malvaceae]	83	0.56	3.32	5.93	4.32	10.21	5.59	20.12
4	*Urena lobata* L. [Malvaceae]	73	0.56	2.92	5.21	4.32	8.98	4.91	18.21
5	*Mikania micrantha* Kunth [Compositae]	63	0.76	2.52	3.32	5.86	7.75	3.12	16.74
6	*Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [Apocynaceae]	27	0.48	1.08	2.25	3.7	3.32	2.12	9.14
7	*Murraya paniculata* (L.) Jack [Rutaceae]	21	0.36	0.84	2.33	2.78	2.58	2.2	7.56
8	*Dendrocnide sinuata* (Blume) Chew. [Urtiaceae]	19	0.44	0.76	1.73	3.4	2.34	1.63	7.36
9	*Euphorbia pulcherrima* Willd. *ex* Klotzsch. [Euphorbiaceae]	16	0.28	0.64	2.29	2.16	1.97	2.15	6.28
10	*Morinda angustifolia* Roxb. [Rubiaceae]	14	0.24	0.56	2.33	1.85	1.72	2.2	5.77
11	*Phlogacanthus thyrsiformis* (Roxb. & Hardw.) Mabb. [Acanthaceae]	13	0.36	0.52	1.44	2.78	1.6	1.36	5.74
12	*Clausena excavata* Burm.f. [Rutaceae]	13	0.32	0.52	1.63	2.47	1.6	1.53	5.6
13	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy [Convolvulaceae]	12	0.36	0.48	1.33	2.78	1.48	1.26	5.51
14	*Croton roxburghii* Wall. [Euphorbiaceae]	11	0.4	0.44	1.1	3.09	1.35	1.04	5.48
15	*Albizia lucidior* (Steud.) I.C.Nielsen [Leguminosae]	11	0.36	0.44	1.22	2.78	1.35	1.15	5.28
16	*Mallotus philippensis* (Lam.) Mull.-Arg. [Euphorbiaceae]	9	0.32	0.36	1.13	2.47	1.11	1.06	4.64
17	*Barleria cristata* L. [Acanthaceae]	8	0.24	0.32	1.33	1.85	0.98	1.26	4.09
18	*Streblus asper* Lour. [Moraceae]	8	0.24	0.32	1.33	1.85	0.98	1.26	4.09
19	*Leea aequata* L. [Vitaceae]	7	0.28	0.28	1	2.16	0.86	0.94	3.96
20	*Sauropus compressus* Mull.-Arg. [Phyllanthaceae]	7	0.24	0.28	1.17	1.85	0.86	1.1	3.81
21	*Crotalaria alata* D.Don [Leguminosae]	7	0.16	0.28	1.75	1.23	0.86	1.65	3.74
22	*Wrightia arborea* (Dennst.) Mabb. [Apocynaceae]	7	0.2	0.28	1.4	1.54	0.86	1.32	3.72
23	*Callicarpa arborea* Roxb. [Lamiaceae]	6	0.24	0.24	1	1.85	0.74	0.94	3.53
24	*Tectona grandis* L. f. [Lamiaceae]	6	0.24	0.24	1	1.85	0.74	0.94	3.53
25	*Butea monosperma* (Lam.) Taub. [Leguminosae]	6	0.2	0.24	1.2	1.54	0.74	1.13	3.41
26	*Dalbergia sissoo* DC. [Leguminosae]	6	0.2	0.24	1.2	1.54	0.74	1.13	3.41
27	*Solanum torvum* Sw. [Solanaceae]	6	0.16	0.24	1.5	1.23	0.74	1.41	3.39
28	*Desmodium oblongum* Benth. [Leguminosae]	5	0.12	0.2	1.67	0.93	0.62	1.57	3.11
29	*Grewia asiatica* L. [Malvaceae]	5	0.12	0.2	1.67	0.93	0.62	1.57	3.11
30	*Bauhinia purpurea* L. [Leguminosae]	5	0.16	0.2	1.25	1.23	0.62	1.18	3.03
31	*Lagerstroemia speciosa* (L.) Pers. [Lythraceae]	5	0.16	0.2	1.25	1.23	0.62	1.18	3.03
32	*Maesa indica* (Roxb.) A.DC. [Primulaceae]	5	0.16	0.2	1.25	1.23	0.62	1.18	3.03

Sl No	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
33	*Holmskioldia sanguinea* Retz. [Lamiaceae]	4	0.08	0.16	2	0.62	0.49	1.88	2.99
34	*Careya arborea* Roxb. [Lecythidaceae]	4	0.16	0.16	1	1.23	0.49	0.94	2.67
35	*Erythrina stricta* Roxb. [Leguminosae]	4	0.16	0.16	1	1.23	0.49	0.94	2.67
36	*Meyna spinosa* Roxb. *ex* Link [Rubiaceae]	4	0.12	0.16	1.33	0.93	0.49	1.26	2.67
37	*Shorea robusta* Gaertn. [Dipterocarpaceae]	4	0.12	0.16	1.33	0.93	0.49	1.26	2.67
38	*Sterculia villosa* Roxb. [Malvaceae]	4	0.16	0.16	1	1.23	0.49	0.94	2.67
39	*Thunbergia fragrans* Roxb. [Acanthaceae]	4	0.12	0.16	1.33	0.93	0.49	1.26	2.67
40	*Artemisia indica* Willd. [Compositae]	3	0.08	0.12	1.5	0.62	0.37	1.41	2.4
41	*Casearia glomerata* Roxb. [Salicaceae]	3	0.08	0.12	1.5	0.62	0.37	1.41	2.4
42	*Jasminum dispermum* Wall. [Oleaceae]	3	0.08	0.12	1.5	0.62	0.37	1.41	2.4
43	*Smilax orthoptera* A.DC. [Smilacaceae]	3	0.08	0.12	1.5	0.62	0.37	1.41	2.4
44	*Stephania glabra* (Roxb.) Miers [Menispermaceae]	3	0.08	0.12	1.5	0.62	0.37	1.41	2.4
45	*Tephrosia candida* (Roxb.) DC. [Leguminosae: Papilionoideae]	3	0.08	0.12	1.5	0.62	0.37	1.41	2.4
46	*Tetrastigma serrulatum* (Roxb.) Planch. [Vitaceae]	3	0.08	0.12	1.5	0.62	0.37	1.41	2.4
47	*Abroma augusta* (L.) L.f. [Malvaceae]	3	0.12	0.12	1	0.93	0.37	0.94	2.24
48	*Antidesma bunius* (L.) Spreng. [Phyllanthaceae]	3	0.12	0.12	1	0.93	0.37	0.94	2.24
49	*Bridelia glauca* Blume [Phyllanthaceae]	3	0.12	0.12	1	0.93	0.37	0.94	2.24
50	*Celastrus paniculatus* Willd. [Celastraceae]	3	0.12	0.12	1	0.93	0.37	0.94	2.24
51	*Litsea monopetala* (Roxb.) Pers. [Lauraceae]	3	0.12	0.12	1	0.93	0.37	0.94	2.24
52	*Macaranga denticulata* (Blume) Müll.-Arg. [Euphorbiaceae]	3	0.12	0.12	1	0.93	0.37	0.94	2.24
53	*Alstonia scholaris* (L.) R.Br. [Apocynaceae]	2	0.08	0.08	1	0.62	0.25	0.94	1.81
54	*Bombax ceiba* L. [Malvaceae]	2	0.08	0.08	1	0.62	0.25	0.94	1.81
55	*Buddleja asiatica* Lour. [Buddlejaceae]	2	0.08	0.08	1	0.62	0.25	0.94	1.81
56	*Dillenia pentagyna* L. [Dilleniaceae]	2	0.08	0.08	1	0.62	0.25	0.94	1.81
57	*Terminalia bellirica* (Gaertn.) Roxb. [Combretaceae]	2	0.08	0.08	1	0.62	0.25	0.94	1.81
58	*Vitex negundo* L. [Lamiaceae]	2	0.08	0.08	1	0.62	0.25	0.94	1.81
59	*Actinodaphne obovata* (Nees) Blume [Lauraceae]	1	0.04	0.04	1	0.31	0.12	0.94	1.37
60	*Maesa macrophylla* (Wall.) A. DC. [Primulaceae]	1	0.04	0.04	1	0.31	0.12	0.94	1.37
61	*Premna mollissima* Roth [Lamiaceae]	1	0.04	0.04	1	0.31	0.12	0.94	1.37
62	*Pterospermum acerifolium* (L.) Willd. [Malvaceae]	1	0.04	0.04	1	0.31	0.12	0.94	1.37

Table 2. Phytosociological data of shrub layer in invaded area

Sl No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
1	*Mimosa invisa* Colla [Leguminosae: Mimosoideae]	327	0.84	13.08	15.57	8.714	35.74	16.97	61.43
2	*Lantana camara* L. [Lamiaceae]	123	0.56	4.92	8.786	5.809	13.44	9.577	28.83
3	*Mikania micrantha* Kunth [Compositae]	97	0.84	3.88	4.619	8.714	10.6	5.035	24.35

Sl No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
4	*Clerodendrum infortunatum* L. [Lamiaceae]	58	0.44	2.32	5.273	4.564	6.339	5.748	16.65
5	*Chromolaena odorata* (L.) R.M. King & H. Rob. [Compositae]	44	0.48	1.76	3.667	4.979	4.809	3.997	13.78
6	*Tithonia diversifolia* (Hemsl.) A. Gray [Compositae]	43	0.44	1.72	3.909	4.564	4.699	4.261	13.52
7	*Coffea benghalensis* B. Heyne *ex* Schult. [Rubiaceae]	41	0.56	1.64	2.929	5.809	4.481	3.192	13.48
8	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy [Convolvulaceae]	26	0.52	1.04	2	5.394	2.842	2.18	10.42
9	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult. [Apocynaceae]	17	0.48	0.68	1.417	4.979	1.858	1.544	8.381
10	*Triumfetta rhomboidea* Jacq. [Malvaceae]	12	0.24	0.48	2	2.49	1.311	2.18	5.981
11	*Morinda angustifolia* Roxb. [Rubiaceae]	8	0.2	0.32	1.6	2.075	0.874	1.744	4.693
12	*Streblus asper* Lour. [Moraceae]	7	0.24	0.28	1.167	2.49	0.765	1.272	4.526
13	*Tectona grandis* L.f. [Lamiaceae]	7	0.24	0.28	1.167	2.49	0.765	1.272	4.526
14	*Desmodium oblongum* Benth. [Leguminosae: Papilionoideae]	7	0.2	0.28	1.4	2.075	0.765	1.526	4.366
15	*Urena lobata* L. [Malvaceae]	7	0.2	0.28	1.4	2.075	0.765	1.526	4.366
16	*Barleria cristata* L. [Acanthaceae]	5	0.12	0.2	1.667	1.245	0.546	1.817	3.608
17	*Callicarpa arborea* Roxb. [Lamiaceae]	5	0.16	0.2	1.25	1.66	0.546	1.363	3.569
18	*Dalbergia sissoo* DC. [Leguminosae: Papilionoideae]	5	0.16	0.2	1.25	1.66	0.546	1.363	3.569
19	*Erythrina stricta* Roxb. [Leguminosae: Papilionoideae]	5	0.16	0.2	1.25	1.66	0.546	1.363	3.569
20	*Macaranga denticulata* (Blume) Mull.-Arg. [Euphorbiaceae]	5	0.16	0.2	1.25	1.66	0.546	1.363	3.569
21	*Bridelia glauca* Blume [Phyllanthaceae]	4	0.12	0.16	1.333	1.245	0.437	1.453	3.135
22	*Litsea monopetala* (Roxb.) Pers. [Lauraceae]	4	0.12	0.16	1.333	1.245	0.437	1.453	3.135
23	*Luffa cylindrica* (L.) M. Roem. [Cucurbitaceae]	4	0.12	0.16	1.333	1.245	0.437	1.453	3.135
24	*Wrightia arborea* (Dennsdt.) Mabb. [Apocynaceae]	4	0.12	0.16	1.333	1.245	0.437	1.453	3.135
25	*Ziziphus mauritiana* Lam. [Rhamnaceae]	4	0.12	0.16	1.333	1.245	0.437	1.453	3.135
26	*Croton roxburghii* Wall. [Euphorbiaceae]	3	0.08	0.12	1.5	0.83	0.328	1.635	2.793
27	*Butea monosperma* (Lam.) Taub. [Leguminosae: Papilionoideae]	3	0.12	0.12	1	1.245	0.328	1.09	2.663
28	*Lagerstroemia speciosa* (L.) Pers. [Lythraceae]	3	0.12	0.12	1	1.245	0.328	1.09	2.663
29	*Phlogacanthus thyrsiformis* (Roxb. & Hardw.) Mabb. [Acanthaceae]	3	0.12	0.12	1	1.245	0.328	1.09	2.663
30	*Sauropus compressus* Mull.-Arg. [Phyllanthaceae]	3	0.12	0.12	1	1.245	0.328	1.09	2.663
31	*Shorea robusta* Gaertn. f. [Dipterocarpaceae]	3	0.12	0.12	1	1.245	0.328	1.09	2.663
32	*Sterculia villosa* Roxb. [Malvaceae]	3	0.12	0.12	1	1.245	0.328	1.09	2.663
33	*Albizia lucidior* (Steud.) I. C. Nielsen [Leguminosae: Mimosoideae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
34	*Antidesma bunius* (L.) Spreng. [Phyllanthaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139

Sl No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
35	*Bauhinia purpurea* L. [Leguminosae: Caesalpinioideae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
36	*Holmskioldia sanguinea* Retz. [Lamiaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
37	*Lannea coromandelica* (Houtt.) Merr. [Anacardiaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
38	*Maesa indica* (Roxb.) A. DC. [Primulaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
39	*Solanum torvum* Sw. [Solanaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
40	*Stephania glabra* (Roxb.) Miers [Menispermaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
41	*Tephrosia candida* (Roxb.) DC. [Leguminosae: Papilionoideae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
42	*Trichosanthes tricuspidata* Lour. [Cucurbitaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
43	*Vitex negundo* L. [Lamiaceae]	2	0.08	0.08	1	0.83	0.219	1.09	2.139
44	*Careya arborea* Roxb. [Lecythidaceae]	1	0.04	0.04	1	0.415	0.109	1.09	1.614
45	*Crotalaria alata* D. Don [Leguminosae: Papilionoideae]	1	0.04	0.04	1	0.415	0.109	1.09	1.614
46	*Thunbergia fragrans* Roxb. [Acanthaceae]	1	0.04	0.04	1	0.415	0.109	1.09	1.614

Table 3. Phytosociological data of herb layer in non-invaded area

Sl No	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
1	*Ageratum conyzoides* (L.) L. [Compositae]	97	0.08	1.94	24.25	1.03	6.21	5.97	13.21
2	*Chromolaena odorata* (L.) R.M. King & H. Rob. [Compositae]	78	0.1	1.56	15.6	1.29	5	3.84	10.12
3	*Diplazium esculentum* (Retz.) Sw. [Athyriaceae]	64	0.14	1.28	9.14	1.8	4.1	2.25	8.15
4	*Mimosa pudica* L. [Leguminosae: Mimosoideae]	37	0.04	0.74	18.5	0.51	2.37	4.55	7.44
5	*Lantana camara* L. [Lamiaceae]	23	0.02	0.46	23	0.26	1.47	5.66	7.39
6	*Triumfetta rhomboidea* Jacq. [Malvaceae]	31	0.38	0.62	1.63	4.88	1.99	0.4	7.27
7	*Spermacoce alata* Aubl. [Rubiaceae]	43	0.18	0.86	4.78	2.31	2.75	1.18	6.24
8	*Dryopteris sikkimensis* (Bedd.) Kuntze [Dryopteridaceae]	38	0.1	0.76	7.6	1.29	2.43	1.87	5.59
9	*Lygodium flexuosum* (L.) Sw. [Lygodiaceae]	33	0.06	0.66	11	0.77	2.11	2.71	5.59
10	*Oplismenus burmanni* (Retz.) P. Beauv. [Poaceae]	33	0.06	0.66	11	0.77	2.11	2.71	5.59
11	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don [Acanthaceae]	26	0.04	0.52	13	0.51	1.67	3.2	5.38
12	*Globba racemosa* Sm. [Zingiberaceae]	8	0.36	0.16	0.44	4.63	0.51	0.11	5.25
13	*Cyanotis vaga* (Lour.) Schult. & Schult. f. [Commelinaceae]	29	0.12	0.58	4.83	1.54	1.86	1.19	4.59
14	*Ichnocarpus frutescens* (L.) W.T. Aiton [Apocynaceae]	21	0.04	0.42	10.5	0.51	1.35	2.58	4.44
15	*Amaranthus viridis* L. [Amaranthaceae]	24	0.16	0.48	3	2.06	1.54	0.74	4.33
16	*Floscopa scandens* Lour. [Commelinaceae]	9	0.28	0.18	0.64	3.6	0.58	0.16	4.33
17	*Urena lobata* L. [Malvaceae]	23	0.16	0.46	2.88	2.06	1.47	0.71	4.24
18	*Cyperus rotundus* L. [Cyperaceae]	26	0.1	0.52	5.2	1.29	1.67	1.28	4.23
19	*Senna tora* (L.) Roxb. [Leguminosae: Caesalpinioideae]	23	0.14	0.46	3.29	1.8	1.47	0.81	4.08

Sl No	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
20	*Commelina diffusa* Burm.f. [Commelinaceae]	23	0.14	0.46	3.29	1.8	1.47	0.81	4.08
21	*Cyperus compressus* L. [Cyperaceae]	17	0.22	0.34	1.55	2.83	1.09	0.38	4.3
22	*Oxalis corniculata* L. [Oxalidaceae]	18	0.14	0.36	2.57	1.8	1.15	0.63	3.59
23	*Tithonia diversifolia* (Hemsl.) A. Gray [Compositae]	14	0.18	0.28	1.56	2.31	0.9	0.38	3.59
24	*Setaria palmifolia* (J. Konig) Stapf. [Poaceae]	19	0.06	0.38	6.33	0.77	1.22	1.56	3.55
25	*Amaranthus spinosus* L. [Amaranthaceae]	17	0.12	0.34	2.83	1.54	1.09	0.7	3.33
26	*Cuscuta reflexa* Roxb. [Convolvulaceae]	17	0.12	0.34	2.83	1.54	1.09	0.7	3.33
27	*Alternanthera sessilis* (L.) R.Br. *ex* DC. [Amaranthaceae]	16	0.08	0.32	4	1.03	1.02	0.98	3.04
28	*Phyllanthus urinaria* L. [Phyllanthaceae]	11	0.08	0.22	2.75	1.03	0.7	0.68	2.41
29	*Cheilocostus speciosus* (J. Koenig) C.D. Specht. [Costaceae]	9	0.06	0.18	3	0.77	0.58	0.74	2.09
30	*Euphorbia hirta* L. [Euphorbiaceae]	7	0.1	0.14	1.4	1.29	0.45	0.34	2.08
31	*Physalis minima* L. [Solanaceae]	7	0.1	0.14	1.4	1.29	0.45	0.34	2.08
32	*Merremia vitifolia* (Burm. f.) Hallier f. [Convolvulaceae]	9	0.1	0.18	1.8	1.29	0.58	0.44	2.3
33	*Solanum americanum* Mill. [Solanaceae]	9	0.1	0.18	1.8	1.29	0.58	0.44	2.3
34	*Dioscorea pentaphylla* L. [Dioscoreaceae]	8	0.04	0.16	4	0.51	0.51	0.98	2.01
35	*Hyptis suaveolens* (L.) Poit. [Lamiaceae]	4	0.06	0.08	1.33	0.77	0.26	0.33	1.36
36	*Ocimum tenuiflorum* L. [Lamiaceae]	4	0.06	0.08	1.33	0.77	0.26	0.33	1.36
37	*Mallotus philippensis* (Lam.) Mull. Arg. [Euphorbiaceae]	4	0.04	0.08	2	0.51	0.26	0.49	1.26
38	*Paederia foetida* L. [Rubiaceae]	4	0.04	0.08	2	0.51	0.26	0.49	1.26
39	*Phaulopsis imbricata* (Forssk.) Sweet [Acanthaceae]	4	0.04	0.08	2	0.51	0.26	0.49	1.26
40	*Piper betleoides* C. DC. [Piperaceae]	4	0.04	0.08	2	0.51	0.26	0.49	1.26
41	*Tetrastigma dubium* (Lawson) Planch. [Vitaceae]	4	0.04	0.08	2	0.51	0.26	0.49	1.26
42	*Naravelia zeylanica* (L.) DC. [Ranunculaceae]	3	0.06	0.06	1	0.77	0.19	0.25	1.21
43	*Morinda angustifolia* Roxb. [Rubiaceae]	3	0.02	0.06	3	0.26	0.19	0.74	1.19
44	*Curculigo orchioides* Gaertn. [Hypoxidaceae]	3	0.04	0.06	1.5	0.51	0.19	0.37	1.08
45	*Sauropus compressus* Mull.-Arg. [Phyllanthaceae]	3	0.04	0.06	1.5	0.51	0.19	0.37	1.08
46	*Thunbergia fragrans* Roxb. [Acanthaceae]	3	0.04	0.06	1.5	0.51	0.19	0.37	1.08
47	*Drymaria cordata* subsp. *diandra* (Blume) J.A.Duke [Caryophyllaceae]	5	0.06	0.1	1.67	0.77	0.32	0.41	1.5
48	*Stephania glabra* (Roxb.) Miers [Menispermaceae]	5	0.06	0.1	1.67	0.77	0.32	0.41	1.5
49	*Leea aequata* L. [Vitaceae]	1	0.02	0.02	1	0.26	0.06	0.25	0.57
50	*Pterygota alata* (Roxb.) R.Br. [Malvaceae]	1	0.02	0.02	1	0.26	0.06	0.25	0.57
51	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn. [Icacinaceae]	12	0.02	0.24	12	0.26	0.77	2.95	3.98
52	*Dioscorea belophylla* Voigt *ex* Haines [Dioscoreaceae]	13	0.04	0.26	6.5	0.51	0.83	1.6	2.95
53	*Pouzolzia zeylanica* (L.) Benn. [Urticaceae]	29	0.04	0.58	14.5	0.51	1.86	3.57	5.94
54	*Anisomeles indica* (L.) Kuntze [Lamiaceae]	8	0.06	0.16	2.67	0.77	0.51	0.66	1.94
55	*Eleusine indica* (L.) Gaertn. [Poaceae]	8	0.06	0.16	2.67	0.77	0.51	0.66	1.94

Sl No	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
56	*Sida rhombifolia* L. [Malvaceae]	8	0.06	0.16	2.67	0.77	0.51	0.66	1.94
57	*Cyanthillium cinereum* (L.) H. Rob. [Compositae]	8	0.06	0.16	2.67	0.77	0.51	0.66	1.94
58	*Dicliptera bupleuroides* Nees [Acanthaceae]	7	0.08	0.14	1.75	1.03	0.45	0.43	1.91
59	*Elephantopus scaber* L. [Compositae]	7	0.08	0.14	1.75	1.03	0.45	0.43	1.91
60	*Hypericum japonicum* Thunb. [Hypericaceae]	7	0.08	0.14	1.75	1.03	0.45	0.43	1.91
61	*Leucas zeylanica* (L.) W.T. Aiton. [Lamiaceae]	7	0.08	0.14	1.75	1.03	0.45	0.43	1.91
62	*Cynodon dactylon* (L.) Pers. [Poaceae]	31	0.14	0.62	4.43	1.8	1.99	1.09	4.88
63	*Hydrocotyle sibthorpioides* Lam. [Apiaceae]	19	0.16	0.38	2.38	2.06	1.22	0.58	3.86
64	*Clerodendrum infortunatum* L. [Lamiaceae]	61	0.14	1.22	8.71	1.8	3.91	2.14	7.85
65	*Kyllinga nemoralis* (Forst & Forst) Dandy *ex* Hutch. & Dalziel [Cyperaceae]	41	0.12	0.82	6.83	1.54	2.63	1.68	5.85
66	*Phyllanthus emblica* L. [Phyllanthaceae]	3	0.2	0.06	0.3	2.57	0.19	0.07	2.84
67	*Alocasia fallax* Schott [Araceae]	7	0.06	0.14	2.33	0.77	0.45	0.57	1.79
68	*Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schultes [Apocynaceae]	7	0.06	0.14	2.33	0.77	0.45	0.57	1.79
69	*Oldenlandia diffusa* (Willd.) Roxb. [Rubiaceae]	6	0.08	0.12	1.5	1.03	0.38	0.37	1.78
70	*Tinospora sinensis* (Lour.) Merr. [Menispermaceae]	6	0.08	0.12	1.5	1.03	0.38	0.37	1.78
71	*Elatostema monandrum* (Buch.-Ham. *ex* D. Don) H. Hara [Urticaceae]	8	0.02	0.16	8	0.26	0.51	1.97	2.74
72	*Persicaria chinensis* (L.) H. Gross [Polygonaceae]	8	0.02	0.16	8	0.26	0.51	1.97	2.74
73	*Synedrella nodiflora* (L.) Gaertn. [Compositae]	43	0.24	0.86	3.58	3.08	2.75	0.88	6.72
74	*Imperata cylindrica* (L.) Raeusch. [Poaceae]	28	0.16	0.56	3.5	2.06	1.79	0.86	4.71
75	*Typhonium trilobatum* (L.) Schott [Araceae]	13	0.06	0.26	4.33	0.77	0.83	1.07	2.67
76	*Centella asiatica* (L.) Urb. [Apiaceae]	13	0.08	0.26	3.25	1.03	0.83	0.8	2.66
77	*Biophytum sensitivum* (L.) DC. [Oxalidaceae]	6	0.04	0.12	3	0.51	0.38	0.74	1.64
78	*Desmodium oblongum* Benth. [Leguminosae: Papilionoideae]	6	0.04	0.12	3	0.51	0.38	0.74	1.64
79	*Erigeron canadensis* L. [Compositae]	6	0.04	0.12	3	0.51	0.38	0.74	1.64
80	*Ophioglossum reticulatum* L. [Ophioglossaceae]	6	0.04	0.12	3	0.51	0.38	0.74	1.64
81	*Sida acuta* Burm. f. [Malvaceae]	27	0.02	0.54	27	0.26	1.73	6.64	8.63
82	*Albizia lucidior* (Steud.) I.C. Nielsen [Leguminosae: Mimosoideae]	2	0.02	0.04	2	0.26	0.13	0.49	0.88
83	*Senna occidentalis* (L.) Link [Leguminosae: Caesalpinioideae]	2	0.04	0.04	1	0.51	0.13	0.25	0.89
84	*Jasminum dispermum* Wall. [Oleaceae]	2	0.04	0.04	1	0.51	0.13	0.25	0.89
85	*Litsea glutinosa* (Lour.) C.B. Rob. [Lauraceae]	2	0.02	0.04	2	0.26	0.13	0.49	0.88
86	*Momordica dioica* Roxb. *ex* Willd. [Cucurbitaceae]	2	0.02	0.04	2	0.26	0.13	0.49	0.88
87	*Smilax orthoptera* A.DC. [Smilacaceae]	2	0.02	0.04	2	0.26	0.13	0.49	0.88

Table 4. Phytosociological data of herb layer in weed-invaded area

Sl No	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
1	*Mimosa invisa* Colla [Leguminosae: Mimosoideae]	213	0.78	4.26	5.46	6.6	14.34	3.65	24.6
2	*Ageratum conyzoides* (L.) L. [Compositae]	134	0.46	2.68	5.83	3.89	9.02	3.9	16.81
3	*Chromolaena odorata* (L.) R.M. King & H. Rob. [Compositae]	117	0.68	2.34	3.44	5.75	7.88	2.3	15.93
5	*Clerodendrum infortunatum* L. [Lamiaceae]	119	0.34	2.38	7	2.88	8.01	4.68	15.57
5	*Parthenium hysterophorus* L. [Compositae]	67	0.46	1.34	2.91	3.89	4.51	1.95	10.35
6	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn. [Icacinaceae]	13	0.02	0.26	13	0.17	0.88	8.7	9.74
7	*Lantana camara* L. [Lamiaceae]	47	0.34	0.94	2.76	2.88	3.16	1.85	7.89
8	*Mimosa pudica* L. [Leguminosae: Mimosoideae]	41	0.32	0.82	2.56	2.71	2.76	1.71	7.18
9	*Sida acuta* Burm.f. [Malvaceae]	34	0.44	0.68	1.55	3.72	2.29	1.03	7.05
10	*Senna tora* (L.) Roxb. [Leguminosae: Caesalpinioideae]	31	0.44	0.62	1.41	3.72	2.09	0.94	6.75
11	*Oplismenus burmanni* (Retz.) P. Beauv. [Poaceae]	33	0.38	0.66	1.74	3.21	2.22	1.16	6.6
12	*Triumfetta rhomboidea* Jacq. [Malvaceae]	29	0.36	0.58	1.61	3.05	1.95	1.08	6.08
13	*Cyperus compressus* L. [Cyperaceae]	29	0.28	0.58	2.07	2.37	1.95	1.39	5.71
14	*Dryopteris sikkimensis* (Bedd.) Kuntze [Dryopteridaceae]	29	0.24	0.58	2.42	2.03	1.95	1.62	5.6
15	*Diplazium esculentum* (Retz.) Sw. [Athyriaceae]	27	0.2	0.54	2.7	1.69	1.82	1.81	5.32
16	*Spermacoce alata* Aubl. [Rubiaceae]	24	0.26	0.48	1.85	2.2	1.62	1.24	5.05
17	*Urena lobata* L. [Malvaceae]	22	0.28	0.44	1.57	2.37	1.48	1.05	4.9
18	*Synedrella nodiflora* (L.) Gaertn. [Compositae]	23	0.16	0.46	2.88	1.35	1.55	1.92	4.83
19	*Imperata cylindrica* (L.) Raeusch. [Poaceae]	23	0.18	0.46	2.56	1.52	1.55	1.71	4.78
20	*Hydrocotyle sibthorpioides* Lam. [Apiaceae]	21	0.12	0.42	3.5	1.02	1.41	2.34	4.77
21	*Kyllinga nemoralis* (J.R. Forst. & G. Forst.) Dandy *ex* Hutch. & Dalziel [Cyperaceae]	21	0.16	0.42	2.63	1.35	1.41	1.76	4.52
22	*Lygodium flexuosum* (L.) Sw. [Lygodiaceae]	21	0.18	0.42	2.33	1.52	1.41	1.56	4.5
23	*Ichnocarpus frutescens* (L.) W.T. Aiton [Apocynaceae]	16	0.26	0.32	1.23	2.2	1.08	0.82	4.1
24	*Cyanotis vaga* (Lour.) Schult. & Schult. f. [Commelinaceae]	18	0.16	0.36	2.25	1.35	1.21	1.51	4.07
25	*Tabernaemontana divaricata* (L.) R. Br. *ex* Roem. & Schult. [Apocynaceae]	16	0.24	0.32	1.33	2.03	1.08	0.89	4
26	*Commelina diffusa* Burm. f. [Commelinaceae]	17	0.18	0.34	1.89	1.52	1.14	1.26	3.93
27	*Leucas zeylanica* (L.) W. T. Aiton. [Lamiaceae]	14	0.2	0.28	1.4	1.69	0.94	0.94	3.57
28	*Pouzolzia zeylanica* (L.) Benn. [Urticaceae]	14	0.12	0.28	2.33	1.02	0.94	1.56	3.52
29	*Phaulopsis imbricata* (Forssk.) Sweet [Acanthaceae]	13	0.1	0.26	2.6	0.85	0.88	1.74	3.46
30	*Centella asiatica* (L.) Urb. [Apiaceae]	13	0.18	0.26	1.44	1.52	0.88	0.97	3.36
31	*Anisomeles indica* (L.) Kuntze [Lamiaceae]	13	0.14	0.26	1.86	1.18	0.88	1.24	3.3
32	*Dioscorea pentaphylla* L. [Dioscoreaceae]	13	0.14	0.26	1.86	1.18	0.88	1.24	3.3
33	*Tithonia diversifolia* (Hemsl.) A. Gray [Compositae]	12	0.18	0.24	1.33	1.52	0.81	0.89	3.22
34	*Cyperus rotundus* L. [Cyperaceae]	12	0.16	0.24	1.5	1.35	0.81	1	3.17
35	*Drymaria cordata* subsp. *diandra* (Blume) J.A.Duke [Caryophyllaceae]	12	0.16	0.24	1.5	1.35	0.81	1	3.17
36	*Amaranthus spinosus* L. [Amaranthaceae]	11	0.16	0.22	1.38	1.35	0.74	0.92	3.01

Sl No	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
37	*Dioscorea belophylla* Voigt *ex* Haines [Dioscoreaceae]	11	0.16	0.22	1.38	1.35	0.74	0.92	3.01
38	*Hyptis suaveolens* (L.) Poit. [Lamiaceae]	9	0.08	0.18	2.25	0.68	0.61	1.51	2.79
39	*Sida rhombifolia* L. [Malvaceae]	9	0.08	0.18	2.25	0.68	0.61	1.51	2.79
40	*Phyllanthus urinaria* L. [Phyllanthaceae]	9	0.1	0.18	1.8	0.85	0.61	1.2	2.66
41	*Hypericum japonicum* Thunb. [Hypericaceae]	8	0.1	0.16	1.6	0.85	0.54	1.07	2.46
42	*Alternanthera sessilis* (L.) R. Br. *ex* DC. [Amaranthaceae]	8	0.12	0.16	1.33	1.02	0.54	0.89	2.45
43	*Cheilocostus speciosus* (J. Koenig) C. D. Specht [Costaceae]	7	0.12	0.14	1.17	1.02	0.47	0.78	2.27
44	*Elephantopus scaber* L. [Compositae]	6	0.06	0.12	2	0.51	0.4	1.34	2.25
45	*Morinda angustifolia* Roxb. [Rubiaceae]	7	0.1	0.14	1.4	0.85	0.47	0.94	2.25
46	*Setaria palmifolia* (J. Koenig) Stapf [Poaceae]	6	0.06	0.12	2	0.51	0.4	1.34	2.25
47	*Solanum americanum* Mill. [Solanaceae]	7	0.1	0.14	1.4	0.85	0.47	0.94	2.25
48	*Senna occidentalis* (L.) Link [Leguminosae: Caesalpinioideae]	6	0.08	0.12	1.5	0.68	0.4	1	2.08
49	*Piper betleoides* C. DC. [Piperaceae]	6	0.08	0.12	1.5	0.68	0.4	1	2.08
50	*Cyanthillium cinereum* (L.) H.Rob. [Compositae]	6	0.08	0.12	1.5	0.68	0.4	1	2.08
51	*Merremia vitifolia* (Burm.f.) Hallier f [Convolvulaceae]	6	0.1	0.12	1.2	0.85	0.4	0.8	2.05
52	*Eleusine indica* (L.) Gaertn. [Poaceae]	4	0.04	0.08	2	0.34	0.27	1.34	1.95
53	*Jasminum dispermum* Wall. [Oleaceae]	4	0.04	0.08	2	0.34	0.27	1.34	1.95
54	*Ophioglossum reticulatum* L. [Ophioglossaceae]	4	0.04	0.08	2	0.34	0.27	1.34	1.95
55	*Globba racemosa* Sm. [Zingiberaceae]	4	0.06	0.08	1.33	0.51	0.27	0.89	1.67
56	*Momordica dioica* Roxb. *ex* Willd. [Cucurbitaceae]	4	0.06	0.08	1.33	0.51	0.27	0.89	1.67
57	*Paederia foetida* L. [Rubiaceae]	4	0.06	0.08	1.33	0.51	0.27	0.89	1.67
58	*Stephania glabra* (Roxb.) Miers [Menispermaceae]	4	0.06	0.08	1.33	0.51	0.27	0.89	1.67
59	*Tetrastigma dubium* (Lawson) Planch. [Vitaceae]	4	0.06	0.08	1.33	0.51	0.27	0.89	1.67
60	*Typhonium trilobatum* (L.) Schott [Araceae]	4	0.06	0.08	1.33	0.51	0.27	0.89	1.67
61	*Curculigo orchioides* Gaertn. [Hypoxidaceae]	2	0.02	0.04	2	0.17	0.13	1.34	1.64
62	*Leea aequata* L. [Vitaceae]	2	0.02	0.04	2	0.17	0.13	1.34	1.64
63	*Dicliptera bupleuroides* Nees [Acanthaceae]	4	0.08	0.08	1	0.68	0.27	0.67	1.62
64	*Naravelia zeylanica* (L.) DC. [Ranunculaceae]	4	0.08	0.08	1	0.68	0.27	0.67	1.62
65	*Sauropus compressus* Mull.-Arg. [Phyllanthaceae]	3	0.04	0.06	1.5	0.34	0.2	1	1.54
66	*Alocasia fallax* Schott [Araceae]	3	0.06	0.06	1	0.51	0.2	0.67	1.38
67	*Smilax orthoptera* A.DC. [Smilacaceae]	2	0.04	0.04	1	0.34	0.13	0.67	1.14
68	*Thunbergia fragrans* Roxb. [Acanthaceae]	2	0.04	0.04	1	0.34	0.13	0.67	1.14
69	*Tinospora sinensis* (Lour.) Merr. [Menispermaceae]	2	0.04	0.04	1	0.34	0.13	0.67	1.14
70	*Desmodium oblongum* Benth. [Leguminosae: Papilionoideae e]	1	0.02	0.02	1	0.17	0.07	0.67	0.91
71	*Litsea glutinosa* (Lour.) C.B.Rob. [Lauraceae]	1	0.02	0.02	1	0.17	0.07	0.67	0.91

Table 5. Phytosociological data of the vegetation non-invaded by *Parthenium*

Sl.No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
1	*Axonopus compressus* (Sw.) P. Beauv. [Poaceae]	89	0.5	1.8	3.4	3.65	5.86	2.15	11.66
2	*Senna tora* (L.) Roxb. [Leguminosae: Caesalpinioideae]	73	0.6	1.5	2.6	3.93	4.81	1.64	10.37
3	*Amaranthus viridis* L. [Amaranthaceae]	62	0.5	1.2	2.3	3.79	4.08	1.45	9.31
4	*Ageratum houstonianum* Mill. [Compositae]	57	0.4	1.1	3	2.66	3.75	1.89	8.31
5	*Chromolaena odorata* (L.) R.M. King & H. Rob. [Compositae]	47	0.4	0.9	2.5	2.66	3.09	1.56	7.32
6	*Chrysopogon aciculatus* (Retz.) Trin. [Poaceae]	46	0.2	0.9	4.2	1.54	3.03	2.63	7.2
7	*Amaranthus spinosus* L. [Amaranthaceae]	43	0.4	0.9	2	2.95	2.83	1.29	7.07
8	*Leucas zeylanica* (L.) W.T. Aiton. [Lamiaceae]	43	0.3	0.9	2.9	2.1	2.83	1.8	6.74
9	*Cleome rutidosperma* DC. [Cleomaceae]	37	0.4	0.7	1.9	2.66	2.44	1.23	6.33
10	*Mimosa pudica* L. [Leguminosae: Mimosoideae]	37	0.3	0.7	2.2	2.38	2.44	1.37	6.19
11	*Mikania micrantha* Kunth [Compositae]	37	0.3	0.7	2.8	1.82	2.44	1.79	6.05
12	*Cynodon dactylon* (L.) Pers. [Poaceae]	32	0.2	0.6	4	1.12	2.11	2.52	5.75
13	*Oplismenus burmanni* (Retz.) P.Beauv. [Poaceae]	31	0.2	0.6	3.9	1.12	2.04	2.44	5.6
14	*Synedrella nodiflora* (L.) Gaertn. [Compositae]	33	0.2	0.7	2.8	1.68	2.17	1.73	5.59
15	*Pupalia lappacea* (L.) Juss. [Amaranthaceae]	32	0.2	0.6	2.7	1.68	2.11	1.68	5.47
16	*Spermacoce alata* Aubl. [Rubiaceae]	31	0.3	0.6	2.2	1.96	2.04	1.39	5.4
17	*Bidens pilosa* L. [Compositae]	28	0.3	0.6	1.6	2.38	1.84	1.04	5.26
18	*Rumex dentatus* L. [Polygonaceae]	26	0.3	0.5	1.5	2.38	1.71	0.96	5.06
19	*Cyanthillium cinereum* (L.) H. Rob. [Compositae]	24	0.4	0.5	1.3	2.52	1.58	0.84	4.94
20	*Centella asiatica* (L.) Urb. [Apiaceae]	27	0.2	0.5	2.3	1.68	1.78	1.42	4.88
21	*Alternanthera sessilis* (L.) R.Br. *ex* DC. [Amaranthaceae]	24	0.3	0.5	1.8	1.82	1.58	1.16	4.57
22	*Phaulopsis imbricate* (Forssk.) Sweet [Acanthaceae]	23	0.3	0.5	1.6	1.96	1.51	1.03	4.51
23	*Rungia pectinata* (L.) Nees [Acanthaceae]	23	0.2	0.5	1.9	1.68	1.51	1.21	4.4
24	*Laphangium affine* (D.Don) Tzvelev. [Compositae]	23	0.2	0.5	2.6	1.26	1.51	1.61	4.39
25	*Kyllinga nemoralis* (J. R. Forst. & G. Forst.) Dandy *ex* Hutch. & Dalziel [Cyperaceae]	22	0.2	0.4	2.8	1.12	1.45	1.73	4.3
26	*Boerhavia diffusa* L. [Nyctaginaceae]	22	0.2	0.4	2.2	1.4	1.45	1.38	4.24
27	*Ageratum conyzoides* (L.) L. [Compositae]	21	0.2	0.4	1.9	1.54	1.38	1.2	4.13
28	*Cynoglossum lanceolatum* Forssk. [Boraginaceae]	19	0.3	0.4	1.5	1.82	1.25	0.92	3.99
29	*Sida acuta* Burm. f. [Malvaceae]	18	0.3	0.4	1.4	1.82	1.18	0.87	3.88
30	*Cyperus rotundus* L. [Cyperaceae]	16	0.1	0.3	3.2	0.7	1.05	2.01	3.77
31	*Richardia scabra* L. [Rubiaceae]	17	0.1	0.3	2.8	0.84	1.12	1.78	3.74
32	*Elephantopus scaber* L. [Compositae]	12	0.1	0.2	4	0.42	0.79	2.52	3.73

Sl.No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
33	*Emilia sonchifolia* (L.) DC. *ex* DC. [Compositae]	18	0.2	0.4	1.8	1.4	1.18	1.13	3.72
34	*Hyptis suaveolens* (L.) Poit. [Lamiaceae]	16	0.3	0.3	1.2	1.82	1.05	0.77	3.65
35	*Euphorbia hirta* L. [Euphorbiaceae]	17	0.2	0.3	1.5	1.54	1.12	0.97	3.63
36	*Oxalis corniculata* L. [Oxalidaceae]	17	0.2	0.3	1.5	1.54	1.12	0.97	3.63
37	*Dentella repens* (L.) J.R. Forst. & G. Forst. [Rubiaceae]	17	0.2	0.3	2.1	1.12	1.12	1.34	3.58
38	*Persicaria hydropiper* (L.) Delarbre. [Polygonaceae]	16	0.1	0.3	2.3	0.98	1.05	1.44	3.47
39	*Eragrostis amabilis* (L.) Wight & Arn. [Poaceae]	13	0.1	0.3	3.3	0.56	0.86	2.05	3.46
40	*Digitaria ciliaris* (Retz.) Koeler [Poaceae]	11	0.1	0.2	3.7	0.42	0.72	2.31	3.45
41	*Oldenlandia corymbosa* L. [Rubiaceae]	11	0.1	0.2	3.7	0.42	0.72	2.31	3.45
42	*Achyranthes aspera* L. [Amaranthaceae]	16	0.2	0.3	2	1.12	1.05	1.26	3.43
43	*Cyperus compressus* L. [Cyperaceae]	12	0.1	0.2	3	0.56	0.79	1.89	3.24
44	*Spermacoce ocymoides* Burm. f. [Rubiaceae]	14	0.2	0.3	1.8	1.12	0.92	1.1	3.15
45	*Youngia japonica* (L.) DC. [Compositae]	13	0.2	0.3	1.4	1.26	0.86	0.91	3.03
46	*Blumea lacera* (Burm.f.) DC. [Compositae]	13	0.2	0.3	1.6	1.12	0.86	1.02	3
47	*Commelina diffusa* Burm. f. [Commelinaceae]	13	0.2	0.3	1.6	1.12	0.86	1.02	3
48	*Portulaca oleracea* L. [Portulacaceae]	12	0.2	0.2	1.3	1.26	0.79	0.84	2.89
49	*Parthenium hysterophorusv* L. [Compositae]	12	0.1	0.2	1.7	0.98	0.79	1.08	2.85
50	*Cardamine hirsuta* L. [Brassicaceae]	11	0.2	0.2	1.2	1.26	0.72	0.77	2.76
51	*Anisomeles indica* (L.) Kuntze [Lamiaceae]	11	0.2	0.2	1.4	1.12	0.72	0.87	2.71
52	*Lindernia ciliata* (Colsm.) Pennell [Linderniaceae]	11	0.2	0.2	1.4	1.12	0.72	0.87	2.71
53	*Xanthium strumarium* L. [Compositae]	11	0.2	0.2	1.4	1.12	0.72	0.87	2.71
54	*Mitracarpus hirtus* (L.) DC. [Rubiaceae]	8	0.1	0.2	2.7	0.42	0.53	1.68	2.63
55	*Pouzolzia zeylanica* (L.) Benn. [Urticaceae]	9	0.1	0.2	2.3	0.56	0.59	1.42	2.57
56	*Euphorbia heyneana* Spreng. [Euphorbiaceae]	9	0.1	0.2	1.8	0.7	0.59	1.13	2.43
57	*Hypericum japonicumThunb.* [Hypericaceae]	9	0.1	0.2	1.8	0.7	0.59	1.13	2.43
58	*Senna occidentalis* (L.) Link. [Leguminosae: Caesalpinioideae]	9	0.1	0.2	1.3	0.98	0.59	0.81	2.38
59	*Scoparia dulcis* L. [Plantaginaceae]	9	0.1	0.2	1.5	0.84	0.59	0.94	2.38
60	*Acalypha indica* L. [Euphorbiaceae]	8	0.1	0.2	1.6	0.7	0.53	1.01	2.24
61	*Desmodium triflorum* (L.) DC. [Leguminosae: Papilionoideae]	8	0.1	0.2	1.6	0.7	0.53	1.01	2.24
62	*Physalis minima* L. [Solanaceae]	8	0.1	0.2	1.6	0.7	0.53	1.01	2.24
63	*Heliotropium indicum* L. [Boraginaceae]	8	0.1	0.2	1.3	0.84	0.53	0.84	2.21
64	*Croton bonplandianus* Baill. [Euphorbiaceae]	7	0.1	0.1	1.8	0.56	0.46	1.1	2.12
65	*Drymaria cordata* subsp. *diandra* (Blume) J.A.Duke [Caryophyllaceae]	7	0.1	0.1	1.8	0.56	0.46	1.1	2.12

Sl.No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
66	*Evolvulus nummularius* (L.) L. [Convolvulaceae]	6	0.1	0.1	2	0.42	0.39	1.26	2.07
67	*Phyla nodiflora* (L.) Greene [Lamiaceae]	6	0.1	0.1	2	0.42	0.39	1.26	2.07
68	*Colocasia affinis* Schott [Araceae]	7	0.1	0.1	1.4	0.7	0.46	0.88	2.04
69	*Solanum americanum* Mill. [Solanaceae]	7	0.1	0.1	1.4	0.7	0.46	0.88	2.04
70	*Eclipta prostrata* (L.) L. [Compositae]	6	0.1	0.1	1.5	0.56	0.39	0.94	1.9
71	*Sida rhombifolia* L. [Malvaceae]	6	0.1	0.1	1.5	0.56	0.39	0.94	1.9
72	*Coccinia grandis* (L.) Voigt [Cucurbitaceae]	4	0	0.1	2	0.28	0.26	1.26	1.8
73	*Commelina benghalensis* L. [Commelinaceae]	5	0.1	0.1	1.7	0.42	0.33	1.05	1.8
74	*Trema orientalis* (L.) Blume [Cannabaceae]	5	0.1	0.1	1	0.7	0.33	0.63	1.66
75	*Chenopodium album* L. [Amaranthaceae]	4	0.1	0.1	1.3	0.42	0.26	0.84	1.52
76	*Solanum myriacanthum* Dunal [Solanaceae]	4	0.1	0.1	1.3	0.42	0.26	0.84	1.52

Table 6. Phytosociological data of *Parthenium* invaded area

Sl.No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
1	*Parthenium hysterophorus* L. [Compositae]	397	0.82	7.94	9.68	7.12	28.2	7.95	43.26
2	*Axonopus compressus* (Sw.) P.Beauv. [Poaceae]	67	0.54	1.34	2.48	4.69	4.76	2.04	11.48
3	*Senna tora* (L.) Roxb. [Leguminosae: Caesalpinioideae]	63	0.46	1.26	2.74	3.99	4.47	2.25	10.72
4	*Ageratum houstonianum* Mill. [Compositae]	36	0.32	0.72	2.25	2.78	2.56	1.85	7.18
5	*Chromolaena odorata* (L.) R.M. King & H. Rob. [Compositae]	34	0.3	0.68	2.27	2.6	2.41	1.86	6.88
6	*Kyllinga nemoralis* (J. R. Forst. & G. Forst.) Dandy *ex* Hutch. & Dalziel [Cyperaceae]	34	0.24	0.68	2.83	2.08	2.41	2.33	6.82
7	*Rumex dentatus* L. [Polygonaceae]	32	0.34	0.64	1.88	2.95	2.27	1.54	6.77
8	*Leucas zeylanica* (L.) W. T. Aiton. [Lamiaceae]	32	0.2	0.64	3.2	1.74	2.27	2.63	6.64
9	*Amaranthus spinosus* L. [Amaranthaceae]	31	0.18	0.62	3.44	1.56	2.2	2.83	6.59
10	*Pouzolzia zeylanica* (L.) Benn. [Urticaceae]	31	0.28	0.62	2.21	2.43	2.2	1.82	6.45
11	*Cleome rutidosperma* DC. [Cleomaceae]	28	0.32	0.56	1.75	2.78	1.99	1.44	6.2
12	*Amaranthus viridis* L. [Amaranthaceae]	27	0.26	0.54	2.08	2.26	1.92	1.7	5.88
13	*Mikania micrantha* Kunth [Compositae]	26	0.22	0.52	2.36	1.91	1.85	1.94	5.7
14	*Cynoglossum lanceolatum* Forssk. [Boraginaceae]	23	0.32	0.46	1.44	2.78	1.63	1.18	5.59
15	*Hyptis suaveolens* (L.) Poit. [Lamiaceae]	22	0.32	0.44	1.38	2.78	1.56	1.13	5.47
16	*Synedrella nodiflora* (L.) Gaertn. [Compositae]	24	0.18	0.48	2.67	1.56	1.7	2.19	5.46
17	*Ageratum conyzoides* (L.) L. [Compositae]	23	0.24	0.46	1.92	2.08	1.63	1.57	5.29
18	*Pupalia lappacea* (L.) Juss. [Amaranthaceae]	22	0.24	0.44	1.83	2.08	1.56	1.5	5.15
19	*Senna occidentalis* (L.) Link. [Leguminosae: Caesalpinioideae]	19	0.28	0.38	1.36	2.43	1.35	1.11	4.89
20	*Euphorbia heyneana* Spreng. [Euphorbiaceae]	19	0.26	0.38	1.46	2.26	1.35	1.2	4.81

Sl.No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
21	*Bidens pilosa* L. [Compositae]	17	0.26	0.34	1.31	2.26	1.21	1.07	4.54
22	*Youngia japonica* (L.) DC. [Compositae]	17	0.24	0.34	1.42	2.08	1.21	1.16	4.45
23	*Cyperus rotundus* L. [Cyperaceae]	17	0.14	0.34	2.43	1.22	1.21	1.99	4.42
24	*Colocasia affinis* Schott [Araceae]	16	0.18	0.32	1.78	1.56	1.14	1.46	4.16
25	*Cynodon dactylon* (L.) Pers. [Poaceae]	14	0.1	0.28	2.8	0.87	0.99	2.3	4.16
26	*Achyranthes aspera* L. [Amaranthaceae]	14	0.18	0.28	1.56	1.56	0.99	1.28	3.83
27	*Elephantopus scaber* L. [Compositae]	14	0.16	0.28	1.75	1.39	0.99	1.44	3.82
28	*Oxalis corniculata* L. [Oxalidaceae]	12	0.1	0.24	2.4	0.87	0.85	1.97	3.69
29	*Dentella repens* (L.) J.R. Forst. & G. Forst. [Rubiaceae]	13	0.18	0.26	1.44	1.56	0.92	1.19	3.67
30	*Alternanthera sessilis* (L.) R.Br. *ex* DC. [Amaranthaceae]	13	0.14	0.26	1.86	1.22	0.92	1.52	3.66
31	*Boerhavia diffusa* L. [Nyctaginaceae]	13	0.16	0.26	1.63	1.39	0.92	1.33	3.65
32	*Centella asiatica* (L.) Urb. [Apiaceae]	12	0.12	0.24	2	1.04	0.85	1.64	3.54
33	*Emilia sonchifolia* (L.) DC. *ex* DC. [Compositae]	12	0.18	0.24	1.33	1.56	0.85	1.09	3.51
34	*Cardamine hirsuta* L. [Brassicaceae]	11	0.1	0.22	2.2	0.87	0.78	1.81	3.45
35	*Croton bonplandianus* Baill. [Euphorbiaceae]	11	0.1	0.22	2.2	0.87	0.78	1.81	3.45
36	*Persicaria hydropiper* (L.) Delarbre. [Polygonaceae]	11	0.12	0.22	1.83	1.04	0.78	1.5	3.33
37	*Acalypha indica* L. [Euphorbiaceae]	11	0.16	0.22	1.38	1.39	0.78	1.13	3.3
38	*Laphangium affine* (D.Don) Tzvelev. [Compositae]	11	0.16	0.22	1.38	1.39	0.78	1.13	3.3
39	*Solanum americanum* Mill. [Solanaceae]	10	0.12	0.2	1.67	1.04	0.71	1.37	3.12
40	*Portulaca caoleracea* L. [Portulacaceae]	10	0.14	0.2	1.43	1.22	0.71	1.17	3.1
41	*Cyanthillium cinereum* (L.) H. Rob. [Compositae]	9	0.1	0.18	1.8	0.87	0.64	1.48	2.98
42	*Spermacoce alata* Aubl. [Rubiaceae]	9	0.12	0.18	1.5	1.04	0.64	1.23	2.91
43	*Commelina diffusa* Burm. f. [Commelinaceae]	9	0.12	0.18	1.5	1.04	0.64	1.23	2.91
44	*Eragrostis amabilis* (L.) Wight & Arn. [Poaceae]	9	0.12	0.18	1.5	1.04	0.64	1.23	2.91
45	*Euphorbia hirta* L. [Euphorbiaceae]	9	0.12	0.18	1.5	1.04	0.64	1.23	2.91
46	*Digitaria ciliaris* (Retz.) Koeler [Poaceae]	8	0.08	0.16	2	0.69	0.57	1.64	2.9
47	*Oldenlandia corymbosa* L. [Rubiaceae]	8	0.08	0.16	2	0.69	0.57	1.64	2.9
48	*Heliotropium indicum* L. [Boraginaceae]	8	0.16	0.16	1	1.39	0.57	0.82	2.78
49	*Physalis minima* L. [Solanaceae]	8	0.1	0.16	1.6	0.87	0.57	1.31	2.75
50	*Richardia scabra* L. [Rubiaceae]	5	0.04	0.1	2.5	0.35	0.36	2.05	2.75
51	*Sida acuta* Burm. f. [Malvaceae]	8	0.1	0.16	1.6	0.87	0.57	1.31	2.75
52	*Xanthium strumarium* L. [Compositae]	8	0.14	0.16	1.14	1.22	0.57	0.94	2.72
53	*Blumea lacera* (Burm.f.) DC. [Compositae]	8	0.12	0.16	1.33	1.04	0.57	1.09	2.7
54	*Scoparia dulcis* L. [Plantaginaceae]	8	0.12	0.16	1.33	1.04	0.57	1.09	2.7
55	*Commelina benghalensis* L. [Commelinaceae]	7	0.08	0.14	1.75	0.69	0.5	1.44	2.63
56	*Phyla nodiflora* (L.) Greene [Verbenaceae]	7	0.08	0.14	1.75	0.69	0.5	1.44	2.63
57	*Eclipta prostrata* (L.) L. [Compositae]	6	0.08	0.12	1.5	0.69	0.43	1.23	2.35

Sl.No.	SPECIES	TNI	F	D	A	RF	RD	RA	IVI
58	*Anisomeles indica* (L.) Kuntze [Lamiaceae]	6	0.1	0.12	1.2	0.87	0.43	0.98	2.28
59	*Mitracarpus verticillatus* (Schumach. & Thonn.) Vatke [Rubiaceae]	5	0.06	0.1	1.67	0.52	0.36	1.37	2.24
60	*Desmodium triflorum* (L.) DC. [Leguminosae: Papilionoideae]	4	0.06	0.08	1.33	0.52	0.28	1.09	1.9
61	*Sida rhombifolia* L. [Malvaceae]	4	0.06	0.08	1.33	0.52	0.28	1.09	1.9
62	*Drymaria cordata* subsp. *diandra* (Blume) J.A.Duke [Caryophyllaceae]	3	0.06	0.06	1	0.52	0.21	0.82	1.55
63	*Trema orientalis* (L.) Blume [Cannabaceae]	3	0.06	0.06	1	0.52	0.21	0.82	1.55

Annexure – IIB

[RET elements, NTFPs, Traditional Knowledge & Allelopathy]

Table 1. Rare, Endemic and Threatened Elements recorded from Terai-Duars region of West Bengal [CR = Critically Endangered, EN = Endangered, NT = Near to Threatened, VU = Vulnerable]

SL.NO.	SPECIES [FAMILY]	HABIT	STATUS
1	*Abelmoschus moschatus* Medik. [Malvaceae]	Shrub	Near to Threatened
2	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet [Malvaceae]	Tree	Endemic
3	*Ailanthus integrifolia* Lam.. [Simaroubaceae]	Tree	Endemic
4	*Alpinia calcarata* (Haw.) Roscoe [Zingiberaceae]	Herb	Endangered
5	*Ampelocissus barbata* (Wall.) Planch. [Vitaceae]	Climber	Endangered
6	*Ampelocissus sikkimensis* (M.A.Lawson) Planch. [Vitaceae]	Climber	Endemic
7	*Argyreia roxburghii* (Wall.) Arn. ex Choisy [Convolvulaceae]	Climber	Endemic
8	*Aristolochia indica* L. [Aristolochiaceae]	Climber	Vulnerable
9	*Asparagus racemosus* Willd. [Asparagaceae]	Climber	Endangered
10	*Baccaurea ramiflora* Lour. [Euphorbiaceae]	Tree	Endemic
11	*Capparis olacifolia* Hook.f. & Thomson [Capparaceae]	Shrub	Endemic
12	*Casearia vareca* Roxb. [Salicaceae]	Tree	Endemic
13	*Castanopsis lanceifolia* (Roxb.) Hickel & A.Campus [Fagaceae]	Tree	Endemic
14	*Cayratia japonica* (Thunb.) Gagnep. [Vitaceae]	Climber	Endemic
15	*Celastrus paniculatus* Willd. [Celastraceae]	Climber	Endangered
16	*Desmodium motorium* (Houtt.) Merr. [Leguminosae]	Herb	Vulnerable
17	*Dioscorea prazeri* Prain & Burkill [Dioscoreaceae]	Climber	Endangered
18	*Garuga floribunda* Decne. [Burseraceae]	Tree	Endemic
19	*Gloriosa superba* L. [Colchicaceae]	Climber	Vulnerable
20	*Gynocardia odorata* R.Br. [Achariaceae]	Tree	Endemic, Endangered
21	*Helminthostachys zeylanica* (L.) Desv. [Ophioglossaceae]	Herb	Endangered
22	*Leea aequata* L. [Vitaceae]	Shrub	Endemic
23	*Leea indica* (Burm.f.) Merr. [Vitaceae]	Shrub	Endemic
24	*Litsea panamanja* (Buch.-Ham. ex Nees) Hook. f. [Lauraceae]	Tree	Endemic
25	*Litsea salicifolia* (J. Roxb. ex Nees) Hook. f. [Lauraceae]	Tree	Endemic
26	*Mucuna pruriens* (L.) DC. [Leguminosae]	Tree	Endangered
27	*Ophioglossum reticulatum* L. [Ophioglossaceae]	Herb	Endangered
28	*Pericampylus glaucus* (Lam.) Merr. [Menispermaceae]	Climber	Vulnerable
29	*Persea glaucescens* (Ness) D.G.Long [Lauraceae]	Tree	Critically Endangered
30	*Piper chuvya* Miq. [Piperaceae]	Herb	Endemic
31	*Piper sylvaticum* Roxb. [Piperaceae]	Herb	Endemic
32	*Polyalthia simiarum* (Buch.-Ham. ex Hook.f. & Thomson) Benth. ex Hook.f. & Thomson [Annonaceae]	Tree	Endemic
33	*Psychotria erratica* Hook.f. [Rubiaceae]	Herb	Endemic
34	*Pueraria sikkimensis* Prain [Leguminosae]	Climber	Endemic

SL.NO.	SPECIES [FAMILY]	HABIT	STATUS
35	*Rauvolfia serpentina* (L.) Benth. ex Kurz [Apocynaceae]	Herb	Endangered
36	*Sauropus quadrangularis* (Willd.) Müll.Arg. [Phyllanthaceae]	Shrub	Endemic
37	*Stereospermum tetragonum* DC. [Bignoniaceae]	Tree	Vulnerable
38	*Syzygium kurzii* (Duthie) N.P.Balakr. [Myrtaceae]	Tree	Endemic
39	*Tetrastigma campylocarpum* (Kurz) Planch. [Vitaceae]	Shrub	Endemic
40	*Toona ciliata* M.Roem. [Meliaceae]	Tree	Vulnerable
41	*Tylophora indica* (Burm.f.) Merr. [Menispermaceae]	Climber	Near to Threatened

Table 2. List of NTFPs recorded from the study area [CL=Climber, H=Herb, S=Shrub, T=Tree, B=Both Plantation & Natural Forest, FA= Fringe Area, NF= Natural Forest, P= Plantation]

Sl No	Species [Family]	Local Name	Occurrence	Habit	Uses
1	*Acacia catechu* (L.f.) Willd. [Leguminosae: Mimosoideae]	*Khair*	NF	T	Gum care, medicinal
2	*Acacia pennata* (L.) Willd. [Leguminosae: Mimosoideae]	*Arare kanra*	NF	CL	Oral care, gum care
3	*Achyranthes aspera* L. [Amaranthaceae]	*Apang*	NF	H	Medicinal, religious
4	*Acorus calamus* L. [Acoraceae]	*Boch*	NF	H	Medicinal, edible
5	*Adiantum lunulatum* Burm. f. [Pteridaceae]	*Bon dhekia*	B	H	Ornamental
6	*Aegle marmelos* (L.) Correa [Rutaceae]	*Bel*	NF	T	Food, medicine, religious
7	*Aesculus assamica* Griff. [Sapindaceae]	*Satpati, Eksira*	NF	T	Medicinal, ornamental
8	*Aglaia spectabilis* (Miq.) S.S. Jain & S. Bennet [Meliaceae]	*Lali*	NF	T	Decorative
9	*Ailanthus integrifolia* Lam. [Simaroubaceae]	*Gokul*	NF	T	Dhup, ornamental
10	*Alangium chinense* (Lour.) Harms[Cornaceae]	*Akhane*	B	T	Fodder, medicinal
11	*Albizia chinensis* (Osbeck) Merr. [Leguminosae: Mimosoideae]	*Kala siris*	NF	T	Fodder
12	*Albizia lucidior* (Steud.) I.C.Nielsen [Leguminosae: Mimosoideae]	*Siris*	NF	T	Fodder
13	*Alocasia macrorrhizos* (L.) G.Don [Araceae]	*Kochu*	FA	H	Edible
14	*Alpinia nigra* (Gaertn.) Burtt [Zingiberaceae]	*Purundi*	NF	H	Decorative, edible, fodder
15	*Alstonia scholaris* (L.) R. Br. [Apocynaceae0	*Chatian*	B	T	Medicinal, decotative
16	*Amorphophallus bulbifer* (Roxb.) Blume [Araceae]	*Gurbe*	B	H	Vegetable
17	*Angiopteris evecta* (G. Forst.) Hoffm. [Marattiaceae]	*Gaikhoret*	NF	S	Cattle care
18	*Annona reticulata* L. [Annonaceae]	*Aata*	FA	T	Edible
19	*Antidesma acidum* Retz. [Phyllanthaceae]	*Bhotey Archal*	B	T	Edible
20	*Antidesma bunius* (L.) Spreng. [Phyllanthaceae]	*Archal*	B	T	Edible, fodder and medicinal

Sl No	Species [Family]	Local Name	Occurrence	Habit	Uses
21	*Aphanamixis polystachya* (Wall.) R.Parker	*Lasuni*	NF	T	Medicine, fuel
22	*Areca catechu* L. [Araceae]	*Supari*	P	T	Chewing
23	*Artocarpus chama* Buch.-Ham. [Moraceae]	*Lator*	NF	T	Edible
24	*Artocarpus heterophyllus* Lam. [Moraceae]	*Kathal*	NF	T	Edible, fodder
25	*Artocarpus lacucha* Buch.-Ham. [Moraceae]	*Barhar*	B	T	Edible, fodder, fuel
26	*Asparagus racemosus* Willd. [Asparagaceae]	*Satamuli*	NF	CL	Edible, medicinal
27	*Baccaurea ramiflora* Lour. [Phyllanthaceae]	*Kusum*	NF	T	Edible, medicinal
28	*Bambusa polymorpha* Munro [Poaceae]	*Jantha Baans*	NF	S	House building
29	*Bambusa tulda* Roxb. [Poaceae]	*Filling Baans*	FA	S	Fencing, busket
30	*Bauhinia acuminata* L. [Leguminosae: Ceasalpinoideae]	*Amla tanki*	FA	T	Edible
31	*Bauhinia purpurea* L. [Leguminosae: Ceasalpinoideae]	*Tanki*	B	T	Ornamental, edible, fodder
32	*Bauhinia vahlii* Wight & Arn. [Leguminosae: Ceasalpinoideae]	*Nagphani*	NF	CL	Religious, medicinal
33	*Bauhinia variegata* L. [Leguminosae: Ceasalpinoideae]	*Koirale*	NF	T	Fodder, religious
34	*Blumea lacera* (Burm.f.) DC. [Compositae]	-	FA	H	Aromatic
35	*Boerhavia diffusa* L. [Nyctaginaceae]	*Lore saag*	FA	H	Medicinal, edible
36	*Bombax ceiba* L. [Malvaceae]	*Simul*	B	T	Medicinal, fibre
37	*Bombax ceiba* L. [Malvaceae]	*Simul*	NF	T	Fibre and fodder
38	*Brassica rapa* L. [Brassicaceae]	-	FA	H	Edible
39	*Bridelia retusa* (L.) A.Juss. [Phyllanthaceae]	*Gayo*	NF	T	Medicinal, fodder
40	*Bridelia stipularis* (L.) Blume [Phyllanthaceae]	*Gayo lahara*	NF	CL	Medicinal, fodder
41	*Butea monosperma* (Lam.) Taub. [Leguminosae]	*Palas*	NF	T	Fodder, ornamental, medicinal
42	*Cajanus cajan* (L.) Millsp. [Leguminosae]	*Arhar*	FA	S	Edible
43	*Calamus erectus* Roxb. [Arecaceae]	*Gouribet*	NF	S	Cordage, rope
44	*Calamus viminalis* Willd. [Arecaceae]	*Betgera*	NF, FA	H	Edible, rope
45	*Callicarpa arborea* Roxb. [Lamiaceae]	*Guenlo*	B	T	Fodder, medicine
46	*Canarium sikkimense* King [Burseraceae]	*Gokul dhup*	NF	T	Medicinal, dhuna
47	*Cannabis sativa* L. [Cannabaceae]	*Bhang*	FA	H	Narcotic
48	*Careya arborea* Roxb. [Lecythidaceae]	*Kumbhi*	NF	T	Medicinal, fish poison
49	*Caryota urens* L. [Arecaceae]	*Kharate jharo*	FA	T	Fish poison
50	*Cassia fistula* L. [Leguminosae: Ceasalpinoideae]	*Sonalu*	B	T	Medicinal, fodder
51	*Castanopsis indica* (Roxb. *ex* Lindl.) A. DC. [Fagaceae]	*Katus*	NF	T	Edible, fodder, bidi making

Sl No	Species [Family]	Local Name	Occurrence	Habit	Uses
52	*Celastrus paniculatus* Willd. [Celastraceae]	*Kusur*	B	S	Medicine, cordage
53	*Centella asiatica* (L.) Urb. [Apiaceae]	*Manimuni*	FA	H	Vegetable, medicinal
54	*Cheilocostus speciosus* (J.Koenig) C. D. Specht [Costaceae]	*Bet larang*	B	CL	Cordage, rope
55	*Chenopodium album* L. [Amaranthaceae]	*Bathu*	FA	H	Edible
56	*Chloranthus elatior* Link. [Chloranthaceae]	*Junka dabai*	B	H	Leech bite sore
57	*Chromolaena odorata* (L.) R. M. King & H. Rob. [Asteraceae]	*Assam lata*	B	S	Medicinal, fuel
58	*Chukrasia tabularis* A. Juss. [Meliaceae]	*Chikrasi*	NF	H	Ornamental
59	*Cinnamomum glaucescens* (Nees) Hand.-Mazz. [Lauraceae]	*Kawlo*	B	T	Medicinal, aromatic
60	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm. [Lauraceae]	*Tejpat*	NF	T	Spice, medicinal
61	*Cissampelos pareira* L. [Vitaceae]	*Batul pati*	B	CL	Medicinal, cordage
62	*Citrus limon* (L.) Osbeck [Rutaceae]	*Jungle lebu*	NF	S	Prepare juice
63	*Citrus medica* L. [Rutaceae]	*Jungle limbu*	NF	S	Edible, medicinal
64	*Clausena excavata* Burm.f. [Rutaceae]	*Curry pata*	B	S	Spice, medicine
65	*Cleidion javanicum* Blume [Euphorbiaceae]	*Bepari*	NF	S	Food plate, fodder
66	*Clerodendrum infortunatum* L. [Lamiaceae]	*Gato*	B	S	Medicinal, fuel
67	*Coffea benghalensis* B.Heyne ex Schult. [Rubiaceae]	*Jati*	B	S	Medicinal, religious
68	*Colocasia esculenta* (L.) Schott [Araceae]	*Kachu*	NF, FA	H	Edible
69	*Crateva religiosa* G.Forst. [Capparaceae]	*Chipley*	NF	T	Fodder, medicinal
70	*Curculigo orchioides* Gaertn. [Zingiberaceae]	*Dhotisara*	B, FA	H	Packaging butter, religious
71	*Curcuma aromatica* Salisb. [Zingiberaceae]	*Kala halud*	B	H	Medicinal, aromatic
72	*Curcuma zedoaria* (Christm.) Roscoe. [Zingiberaceae]	*Soti*	B	H	Food, medicine
73	*Cymbopogon flexuosus* (Nees ex Steud.) W.Watson. [Poaceae]	*Lebu ghass*	NF	H	Mosquto repellent
74	*Dalbergia sissoo* DC.[Leguminoase]	*Sisoo*	NF	T	Fodder, medicine, fuel
75	*Deeringia amaranthoides* (Lam.) Merr. [Amaranthaceae]	*Chhorach huri*	NF	CL	Edible, Medicinal
76	*Dillenia indica* L. [Dilleniaceae]	*Chalta*	B	T	Edible, Fodder
77	*Dillenia pentagyna* Roxb. [Dilleniaceae]	*Tantari*	B	T	Fodder, medicinal
78	*Dioscorea bulbifera* L. [Dioscoreaceae]	*Githa*	B	CL	Edible
79	*Dioscorea deltoidea* Wall. *ex* Griseb. [Dioscoreaceae]	*Bon-aloo*	NF	CL	Edible, medicinal
80	*Dioscorea prazeri* Prain & Burkill [Dioscoreaceae]	*Bon-aloo*	B	CL	Edible
81	*Diplazium esculentum* (Retz.) Sw. [Athyriaceae]	*Dheki*	B	H	Edible, medicinal

Sl No	Species [Family]	Local Name	Occurrence	Habit	Uses
82	*Diplocyclos palmatus* (L.) C.Jeffrey [Cucurbitaceae]	*Hati karela*	B	CL	Vegetable
83	*Dipterocarpus retusus* Blume. [Dipterocarpaceae]	*Hollong*	NF	T	Ornamental, medicinal
84	*Dracaena angustifolia* (Medik.) Roxb. [Asparagaceae]	*Tar-chakar*	NF	S	Fodder, medicinal
85	*Drynaria quercifolia* (L.) J. Sm. [Polypodiaceae]	*Dinkia bonda*	B	H	Ornamental
86	*Dryopteris sikkimensis* (Bedd.) Kuntze [Dryopteridaceae]	*Dhekia*	B	H	Edible
87	*Duabanga grandiflora* (DC.) Walp. [Lythraceae]	*Lampati*	B	T	Ornamental
88	*Dysoxylum excelsum* Blume [Meliaceae]	*Lali*	B	T	Ornamental
89	*Entada phaseoloides* (L.) Merr. [Leguminoase]	*Gila*	NF	CL	Medicinal, decorative, religious
90	*Erythrina stricta* Roxb. [Leguminosae]	*Faladu*	B	T	Fodder, religious
91	*Ficus elastica* Roxb. *ex* Hornem. [Moraceae]	*Lator*	NF	T	Fodder
92	*Ficus hispida* L.f. [Moraceae]	*Khoksa*	NF	T	Food, fodder, religious
93	*Ficus neriifolia* Sm. [Moraceae]	*Kusum*	B	T	Edible
94	*Ficus religiosa* L. [Moraceae]	*Pipal*	NF	T	fodder, medicinal, religious
95	*Firmiana colorata* (Roxb.) R.Br. [Malvaceae]	*Firfire*	B	T	Ornamental
96	*Garuga pinnata* Roxb. [Burseraceae]	*Dabdabe*	NF	T	Fodder
97	*Glinus oppositifolius* (L.) Aug.DC. [Molluginaceae]	*Gema*	FA	H	Edible
98	*Globba racemosa* var. *hookeri* (C.B.Clarke *ex* Baker) S.Kumar. [Zingiberaceae]	*Globba*	NF	H	Fodder
99	*Glycosmis pentaphylla* (Retz.) DC. [Rutaceae]	*Dandisko*	B, FA	S	Medicinal, gumstick
100	*Gmelina arborea* Roxb. [Lamiaceae]	*Gamar*	B	T	Medicinal, fodder, fuel
101	*Grewia asiatica* L. [Malvaceae]	*Phalsa*	NF	S	Edible, fibre
102	*Haldina cordifolia* (Roxb.) Ridsdale. [Rubiaceae]	*Karam*	NF	T	Religious, medicinal
103	*Hedyotis scandens* Roxb. [Rubiaceae]	*Baina*	NF	CL	Medicinal, dye
104	*Helminthostachys zeylanica* (L.) Hook. [Ophioglossaceae]	*Mayur thang*	NF	H	Edible
105	*Holarrhena pubescens* Wall. *ex* G.Don [Apocynaceae]	*Choto khirra*	B	T	Medicinal, religious
106	*Homalomena rubescens* (Roxb.) Kunth [Araceae]	*Kokorlong*	B	H	Medicinal, fodder
107	*Ichnocarpus frutescens* (L.) W.T.Aiton [Apocynaceae]	*Dudhelahara*	B	CL	Medicinal, religious
108	*Ipomoea batatas* (L.) Lam. [Convolvulaceae]	*Mithalu*	FA	CL	Edible
109	*Justicia adhatoda* L. [Acanthaceae]	*Basak*	NF	S	Medicinal, fencing
110	*Lagerstroemia parviflora* Roxb. [Lythraceae]	*Sidha*	P	T	Fodder, ornamental
111	*Lagerstroemia speciosa* (L.) Pers. [Lythraceae]	*Jarul*	B	T	Fodder, ornamenta

Sl No	Species [Family]	Local Name	Occurrence	Habit	Uses
112	*Lannea coromandelica* (Houtt.) Merr. [Anacardiaceae]	*Jeol*	NF	T	Fodder, fuel, gum
113	*Lantana camara* L. [Verbenaceae]	*Lantana*	B	S	Medicinal, fuel
114	*Litsea monopetala* (Roxb.) Pers. [Lauraceae]	*Kutmero*	NF	T	Medicinal, fodder, fuel
115	*Luffa cylindrica* (L.) M.Roem. [Cucurbitaceae]	*Dhundul*	NF	CL	Edible, decorative
116	*Macaranga denticulata* (Blume) Mull.Arg. [Euphorbiaceae]	*Malata*	NF	T	Medicinal, dye
117	*Machilus glaucescens* (Nees) Wight. [Lauraceae]	*Kawla*	NF	T	Medicinal, edible
118	*Maesa chisia* Buch.-Ham. *ex* D. Don [Primulaceae]	*Dudh seola*	B, FA	S	Delay fermentation
119	*Magnolia champaca* (L.) Baill. *ex* Pierre. [Magnoliaceae]	*Chanp*	B	T	Ornamental
120	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng. [Magnoliaceae]	*Bhalukath*	NF	T	Ornamental
121	*Manihot esculenta* Crantz [Euphorbiaceae]	*Simultarul*	FA	T	Edible
122	*Mallotus repandus* (Willd.) Mull.Arg. [Euphorbiaceae]	-	B	T	Fodder
123	*Mangifera indica* L. [Anacardiaceae]	*Aam*	NF, FA	T	Edible, fodder
124	*Melastoma malabathricum* L. [Melastomaceae]	*Datrangi*	P	S	Fuel, dye, medicine
125	*Meliosma simplicifolia* (Roxb.) Walp. [Sabiaceae]	*Chiuri*	B	T	Fuel, food
126	*Mesua ferrea* L.[Clussiaceae]	*Nageswar*	NF	T	Fodder, medicinal
127	*Mucuna pruriens var. hirsuta* (Wight & Arn.) Wilmot-Dear [Leguminoase]	*Mukuna*	NF	CL	Medicinal, edible
128	*Mukia maderaspatana* (L.) M.Roem. [Cucurbitaceae]	*Kundri*	NF	CL	Medicinal, edible
129	*Murraya koenigii* (L.) Spreng. [Rutaceae]	*Kari patta*	B, FA	S	Aromatic, spice
130	*Murraya paniculata* (L.) Jack [Rutaceae]	*Kamini*	FA	S	Ornamental
131	*Musa paradisiaca* L.[Musaceae]	*Kala*	FA	H	Food, fooder, medicine
132	*Musa balbisiana* Colla [Musaceae]	*Kala*	FA	H	Edible
133	*Neolamarckia cadamba* (Roxb.) Bosser [Rubiaceae]	*Kadam*	NF	T	Fodder, ornamental
134	*Nyctanthes arbor-tristis* L.[Oleaceae]	*Siphali*	FA	H	Ornamental, medicinal
135	*Oroxylum indicum* (L.) Kurz [Bignoniaceae]	*Totala*	B	T	Edible, fodder
136	*Paederia foetida* L. [Rubiaceae]	*Gandhe larang*	FA	CL	Medicinal, vegetables
137	*Pandanus unguifer* Hook.f. [Pandanaceae]	-	B	T	Ornamental
138	*Phyllanthus emblica* L. [Phyllanthaceae]	*Aamla*	B	T	Edible, medicinal
139	*Phyllanthus emblica* L. [Phyllanthaceae]	*Aamla*	B	T	Edible
140	*Physalis divaricata* D. Don [Solanaceae]	*Tepari*	FA	H	Edible
141	*Piper betle* L. [Piperaceae]	*Paan*	FA	CL	Edible
142	*Piper betleoides* C.DC. [Piperaceae]	*Pipla*	NF	CL	Edible, medicinal
143	*Piper longum* L. [Piperaceae]	*Pipla*	B	CL	Edible

Sl No	Species [Family]	Local Name	Occurrence	Habit	Uses
144	*Piper nigrum* L. [Piperaceae]	*Pipla*	B	CL	Spice
145	*Polyalthia simiarum* (Buch.-Ham. ex Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson [Annonaceae]	*Khutikath*	NF	T	Fodder, local brew
146	*Premna bengalensis* C.B.Clarke [Lamiaceae]	*Gineri*	NF	T	Edible, medicinal
147	*Premna mollissima* Roth. [Lamiaceae]	*Gineri*	NF	T	Edible, fodder
148	*Psidium guajava* L. [Myrtaceae]	*Piyara, aamrut*	FA	T	Edible
149	*Pterospermum acerifolium* (L.) Willd. [Malvaceae]	*Hatipaile*	B	T	Ornamental
150	*Pterygota alata* (Roxb.) R.Br. [Malvaceae]	*Labsi*	NF	T	Ornamental
151	*Ricinus communis* L. [Euphorbiaceae]	*Reri*	FA	S	Oil, edible
152	*Rubia manjith* Roxb. *ex* Fleming [Rubiaceae]	*Manjistha*	NF	H	Dye
153	*Sapindus rarak* DC. [Sapindaceae]	*Ritha*	NF	T	Detergent
154	*Saraca asoca* (Roxb.) Willd. [Leguminosae]	*Ashok*	FA	T	Medicina, ornamental
155	*Schima wallichii* Choisy [Theaceae]	*Chilauni*	B	T	Ornamental
156	*Senna siamea* (Lam.) H.S.Irwin & Barneb [Leguminoase]	*Minjeri*	NF	T	Fodder, medicine
157	*Shorea robusta* Gaertn. [Dipterocarpaceae]	*Seora*	NF	T	Dhuna, decorative
158	*Sida acuta* Burm.f. [Malvaceae]	*Ballu jhar*	FA, B	S	Broom, medicinal
159	*Sida rhombifolia* L. [Malvaceae]	*Berala*	B	H	Medicinal, broom
160	*Smilax ovalifolia* Roxb. *ex* D.Don [Smilacacae]	*Kukurdyne*	B	CL	Vegetable
161	*Smilax zeylanica* L. [Smilacacae]	*Kukurdain i*	NF	CL	Medicinal, ornamental
162	*Solanum aculeatissimum* Jacq. [Solanaceae]	*Junglee Begun*	B, FA	S	Vegetable
163	*Stephania japonica* (Thunb.) Miers [Menispermaceae]	*Dherphue larang*	B	CL	Local brew
164	*Sterculia foetida* L. [Malvaceae]	*Narkeli*	B	T	Decorative
165	*Sterculia villosa* Roxb. [Malvaceae]	*Odal*	B	T	Making hat, fibre
166	*Syzygium cumini* (L.) Skeels [Myrtaceae]	*Jam*	NF	T	Edible
167	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult. [Apocynaceae]	*Tagar*	B	S	Ornamental, religious
168	*Tamarindus indica* L. [Leguminosae]	*Tetul*	NF	T	Edible
169	*Tephrosia candida* (Roxb.) DC. [Leguminosae]	*Paniel*	NF, FA	S	Edible
170	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn. [Combretaceae]	*Arjun*	B	T	Medicinal, ornamental
171	*Terminalia bellirica* (Gaertn.) Roxb. [Combretaceae]	*Bagera*	B	T	Edible, medicinal
172	*Terminalia chebula* Retz. [Combretaceae]	*Harra*	B	T	Edible, medicinal
173	*Tetrameles nudiflora* R. Br. [Tetramelaceae]	*Moyna*	B	T	Fuel, medicine
174	*Thysanolaena latifolia* (Roxb. *ex* Hornem.) Honda [Poaceae]	*Jharu*	B	H	Broom
175	*Tinospora crispa* (L.) Hook. f. & Thomson [Menispermaceae]	*Gurjo*	NF	CL	Medicinal, fodder

Sl No	Species [Family]	Local Name	Occurrence	Habit	Uses
176	*Tinospora sinensis* (Lour.) Merr. [Menispermaceae]	*Gurus*	NF	CL	Medicinal, fodder
177	*Toona ciliata* M.Roem.[Meliaceae]	*Toon*	B	T	Fodder, medicinal
178	*Trema orientalis* (L.) Blume [Cannabaceae]	*Kauli*	B	T	Fodder
179	*Turpinia pomifera* (Roxb.) DC. [Burseraceae]	*Thali*	B	T	Fodder
180	*Typhonium trilobatum* (L.) Schott [Araceae]	*Karengi saag*	B	H	Vegetable
181	*Vallaris solanacea* (Roth) Kuntze [Apocynaceae]	*Dudhelahara*	B	CL	Ornamental
182	*Wrightia arborea* (Dennst.) Mabb. [Apocynaceae]	*Khirra*	B	T	Medicinal, fodder
183	*Zanthoxylum budrunga* DC. [Rutaceae]	*Timbur*	NF	T	Edible
184	*Zingiber zerumbet* (L.) Roscoe *ex* Sm.[Zingiberaceae]	*Jungli aadrak*	B, FA	H	Spice
185	*Ziziphus jujuba* Mill. [Rhamnaceae]	*Boer*	NF	T	Edible, fodder, medicinal
186	*Ziziphus oenopolia* (L.) Mill. [Rhamnaceae]	*Choti boer*	B, FA	S	Edible

Table 3. List of Medicinal plants (Under NTFPs) **[CL=Climber, H=Herb, S=Shrub, T=Tree]**

Sl No.	Species [Family]	Useful parts	Habit
1	*Abelmoschus moschatus* Medik. [Malvaceae]	*Latakasturi*	S
2	*Abrus precatorius* L. [Leguminosae: Papilionoideae]	*Sada Kunch*	CL
3	*Abrus pulchellus* Thwaites [Leguminosae: Papilionoideae]	*Sada Kunch*	CL
4	*Abutilon indicum* (L.) Sweet [Malvaceae]	*Petari*	S
5	*Acacia catechu* (L.f.) Willd. [Leguminosae: Mimosoideae]	*Khayer*	T
6	*Acacia pennata* (L.) Willd [Leguminosae: Mimosoideae]	*Aarare kanta*	CL
7	*Acalypha indica* L. [Euphorbiaceae]	*Muktajhuri*	H
8	*Achyranthes aspera* L. [Amaranthaceae]	*Apang*	H
9	*Achyranthes bidentata* Blume [Amaranthaceae]	*Apang, Ankhlay jhar*	H
10	*Acmella uliginosa* (Sw.) Cass. [Compositae]	Pirazh	H
11	*Acmella calva* (DC.) R.K.Jansen [Compositae]	Kalijhar	H
12	*Acorus calamus* L.[Acoraceae]	Boch	H
13	*Actinodaphne obovata* (Nees) Blume [Lauraceae]	Bijolgota	T
14	*Aegle marmelos* (L.) Correa [Rutaceae]	Bel	T
15	*Aerva sanguinolenta* (L.) Blume [Amaranthaceae]	Lopang	H
16	*Aesculus assamica* Griff. [Sapindaceae]	Satpate, eksira	T
17	*Ageratum conyzoides* (L.) L. [Compositae]	Elame jhar	H
18	*Albizia chinensis* (Osbeck) Merr. [Leguminosae]	Kalo Siris	T
19	*Albizia lebbeck* (L.) Benth. [Leguminosae]	Siris	T
20	*Albizia procera* (Roxb.) Benth. [Leguminosae]	---	T
21	*Alocasia fallax* Schott [Araceae]	Kala kochu, kalkochu	H

Sl No.	Species [Family]	Useful parts	Habit
22	*Alpinia galanga* (L.) Willd. [Zingiberaceae]	Kulanjan	H
23	*Alstonia scholaris* (L.) R. Br. [Apocynaceae]	Chhatim, chatiyan	T
24	*Alternanthera paronychioides* A.St.-Hil. [Amaranthaceae]	---	H
25	*Alternanthera sessilis* (L.) R.Br. *ex* DC. [Amaranthaceae]	Nunia Saag	H
26	*Amaranthus blitum* L. [Amaranthaceae]	---	H
27	*Amaranthus spinosus* L. [Amaranthaceae]	Kanta notey	H
28	*Amaranthus viridis* L. [Amaranthaceae]	Bon notey	H
29	*Ambroma augusta* L.f. [Malvaceae]	Ulat kambal	S
30	*Amischotolype hookeri* (Hassk.) H.Hara [Commelinaceae]	---	H
31	*Amomum nigrum* (Gaertn.) Brutt. [Zingiberaceae]	Purundi	H
32	*Amorphophallus napalensis* (Wall.) Bogner & Mayo [Araceae]	Bon Ol, Jungli ol	H
33	*Ampelocissus barbata* (Wall.) Planch [Vitaceae]	Jangli angur	CL
34	*Andrographis paniculata* (Burm.f.) Nees [Acanthaceae]	Kalomegh	H
35	*Angiopteris erecta* Desv. [Marattiaceae]	---	H
36	*Anisomeles indica* (L.) Kuntze [Lamiaceae]	Kukursunga, gopali	H
37	*Annona reticulata* L. [Annonaceae]	Nona	T
38	*Antidesma montanum* Blume [Phyllanthaceae]	Archal	T
39	*Antidesma bunius* (L.) Spreng. [Phyllanthaceae]	Archal	T
40	*Aphanamixis Polystachya* (Wall.) R. Parker [Meliaceae]	Rasune lali	T
41	*Ardisia solanacea* (Poir.) Roxb. [Primulaceae]	Marlberry	S
42	*Areca catechu* L. [Arecaceae]	Supari	T
43	*Argemone mexicana* L. [Papaveraceae]	Siyalkanta	H
44	*Argyreia roxburghii* (Wall.) Arn. *ex* Choisy [Convolvulaceae]	---	CL
45	*Aristolochia indica* L. [Aristolochiaceae]	Ishermul	CL
46	*Aristolochia saccata* Wall. [Aristolochiaceae]	---	CL
47	*Aristolochia tagala* Cham. [Aristolochiaceae]	Kiramar	CL
48	*Artocarpus chama* Buch.-Ham. [Moraceae]	Lator, Chaplash	T
49	*Asparagus racemosus* Willd. [Asparagaceae]	Satamuli	H
50	*Ayapana triplinervis* (Vahl) R.M.King & H.Rob. [Compositae]	Ayapaan	H
51	*Azadirachta indica* A.Juss. [Meliaceae]	Neem	T
52	*Baccaurea ramiflora* Lour. [Euphorbiaceae]	Latka, kusum	T
53	*Bacopa monnieri* (L.) Wettst. [Scrophulariaceae]	Bramhi	H
54	*Barleria lupulina* Lindl. [Acanthaceae]	Kanta Bisalyakarani	S
55	*Barleria cristata* L. [Acanthaceae]	Sada Jati	S
56	*Bauhinia purpurea* L. [Leguminosae]	Rakta kanchan	T
57	*Bauhinia vahlii* Wight & Arn. [Leguminosae]	Valla	CL
58	*Bauhinia variegata* L. [Leguminosae]	Swet kanchan	T
59	*Bidens pilosa* L. [Compositae]	Kuro	H
60	*Biophytum reinwardtii* (Zucc.) Klotzsch [Oxalidaceae]	Rani lajjabati	H
61	*Bischofia javanica* Blume [Phyllanthaceae]	Kainjal	T
62	*Boerhavia diffusa* L. [Nyctaginaceae]	Punarnava	H

Sl No.	Species [Family]	Useful parts	Habit
63	*Bombax ceiba* L. [Malvaceae]	Simul	T
64	*Bridelia retusa* (L.) A.Juss. [Phyllanthaceae]	Datun	T
65	*Bridelia sikkimensis* Gehrm. [Phyllanthaceae]	Kasai datun	CL
66	*Bridelia tomentosa* Blume [Phyllanthaceae]	Kasai datun	CL
67	*Bryophyllum pinnatum* (Lam.) Oken [Crassulaceae]	Patharkuchi	H
68	*Buddleja asiatica* Lour. [Scrophulariaceae]	Bhimsen pati	S
69	*Bulbophyllum careyanum* (Hook.) Spreng. [Orchidaceae]	---	H
70	*Butea monosperma* (Lam.) Taub. [Leguminosae]	Palas	T
71	*Caesalpinia bonduc* (L.) Roxb. [Leguminosae]	Nata	S
72	*Caesalpinia pulcherrima* (L.) Sw. [Leguminosae]	Krishnachurha	S
73	*Cajanus cajan* (L.) Millsp. [Leguminosae]	Arhar	S
74	*Calotropis gigantea* (L.) Dryand. [Asclepiadaceae]	Akanda	S
75	*Canna indica* L. [Cannaceae]	Sarba jaya	H
76	*Cannabis sativa* L. [Cannabaceae]	Vang	S
77	*Careya arborea* Roxb. [Lecythidaceae]	Kumbi	T
78	*Carica papaya* L. [Caricaceae]	Pepe	T
79	*Caryota urens* L. [Arecaceae]	Rambhang	T
80	*Cascabela thevetia* (L.) Lippold [Apocynaceae]	Kolke phul	T
81	*Cassia fistula* L. [Leguminosae]	Bandarlathhi	T
82	*Cassia sophera* L. [Leguminosae]	Kalkasunda	S
83	*Catharanthus roseus* (L.) G.Don [Apocynaceae]	Nayantara	S
84	*Ceiba pentandra* (L.) Gaertn. [Malvaceae]	Sewt Simul	T
85	*Celastrus paniculatus* Willd. [Celastraceae]	Malkaguni	CL
86	*Centella asiatica* (L.) Urb. [Apiaceae]	Thankuni, manimuni	H
87	*Cheilocostus speciosus* (J.Koenig) C.D.Specht [Costaceae]	Kemuk, betlahara	H
88	*Chenopodium album* L. [Amaranthaceae]	Bhetua	H
89	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet [Lauraceae]	Sin Kaule	T
90	*Cinnamomum glaucescens* (Nees) Hand.-Mazz. [Lauraceae]	Malagiri	T
91	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm. [Lauraceae]	Tezpata	T
92	*Cissus adnata* Roxb. [Vitaceae]	---	CL
93	*Cissus quadrangularis* L. [Vitaceae]	Harhjorha	CL
94	*Citrus medica* L. [Rutaceae]	Nebu, lebu	S
95	*Cleome rutidosperma* DC. [Cleomaceae]	Torel	H
96	*Cleome viscosa* L. [Cleomaceae]	Hurhure	H
97	*Clerodendrum indicum* (L.) Kuntze [Lamiaceae]	Bamunhati	S
98	*Clerodendrum infortunatum* L. [Lamiaceae]	Vant, ghentu	S
99	*Clitoria ternatea* L. [Leguminosae]	Aparajita	CL
100	*Coccinia grandis* (L.) Voigt [Cucurbitaceae]	Talakucha	CL
101	*Cocculus laurifolius* DC. [Menispermaceae]	Daigachh	CL
102	*Codariocalyx motorius* (Houtt.) H.Ohashi [Leguminosae]	Ban Chandal	S
103	*Coelogyne fuscescens* Lindl. [Orchidaceae]	Sunakhari	H
104	*Coffea benghalensis* B.Heyne ex Schult. [Rubiaceae]	Chaitiful	S

Sl No.	Species [Family]	Useful parts	Habit
105	*Colocasia affinis* Schott [Araceae]	---	H
106	*Colocasia esculenta* (L.) Schott [Araceae]	Maankachu	H
107	*Combretum decandrum* Jacq. [Combretaceae]	Kali lahara	CL
108	*Commelina suffruticosa* Blume [Commelinaceae]	Kane jhar	H
109	*Commelina benghalensis* L. [Commelinaceae]	Kane jhar	H
110	*Crateva religiosa* G.Forst. [Capparaceae]	Barun	T
111	*Crinum amoenum* Ker Gawl. *ex* Roxb. [Amaryllidaceae]	Nagdan	H
112	*Crotalaria alata* D.Don [Leguminosae]	Atasi	S
113	*Crotalaria retusa* L. [Leguminosae]	Atasi	S
114	*Croton bonplandianus* Baill. [Euphorbiaceae]	Chur-churi	H
115	*Cryptolepis dubia* (Burm.f.) M.R.Almeida [Apocynaceae]	Kangrashringi	CL
116	*Curculigo annamitica* Gagnep. [Hypoxidaceae]	Talmuli	H
117	*Curcuma amada* Roxb. [Zingiberaceae]	Amm aada	H
118	*Curcuma caesia* Roxb. [Zingiberaceae]	Kalahaldi	H
119	*Curcuma longa* L. [Zingiberaceae]	Haldi	H
120	*Cuscuta reflexa* Roxb. [Cuscutaceae]	Swarnalata	H
121	*Cyanotis axillaris* (L.) D. Don *ex* Sweet [Commelinaceae]	---	H
122	*Cyanthillium cinereum* (L.) H.Rob. [Compositae]	Sahadebi	H
123	*Cymbidium aloifolium* (L.) Sw. [Orchidaceae]	Pargacha	H
124	*Cymbopogon jwarancusa* (Jones) Schult. [Poaceae]	Nebughas	H
125	*Cynodon dactylon* (L.) Pers. [Poaceae]	Durba	H
126	*Cyperus rotundus* L. [Cyperaceae]	Mutha ghas	H
127	*Dalbergia pinnata* (Lour.) Prain [Leguminosae]	Sisoo	CL
128	*Dalbergia stipulacea* Roxb. [Leguminosae]	Latasiris, sirislahara	CL
129	*Datura metel* L. [Solanaceae]	Dhatura	S
130	*Datura stramonium* L. [Solanaceae]	Sada-dhutra	S
131	*Deeringia amaranthoides* (Lam.) Merr [Amaranthaceae]	Chhorachhuri Saag	H
132	*Dendrobium anceps* Sw. [Orchidaceae]	Pargacha	H
133	*Dendrobium sulcatum* Lindl. [Orchidaceae]	Pargacha	H
134	*Dendrobium densiflorum* Lindl. [Orchidaceae]	Pargacha	H
135	*Dendrobium nobile* Lindl. [Orchidaceae]	Pargacha	H
136	*Desmodium gangeticum* (L.) DC. [Leguminosae]	Salparni	H
137	*Dillenia pentagyna* Roxb. [Dilleniaceae]	Tartari	T
138	*Dillenia indica* L. [Dilleniaceae]	Chalta, panchphal	T
139	*Dioscorea alata* L. [Dioscoreaceae]	Kham alu	CL
140	*Dioscorea bulbifera* L. [Dioscoreaceae]	Gittha Tarul	CL
141	*Dioscorea deltoidea* Wall. *ex* Griseb. [Dioscoreaceae]	Bhyakur	CL
142	*Dioscorea hispida* Dennst. [Dioscoreaceae]	Punglung	CL
143	*Dioscorea pentaphylla* L. [Dioscoreaceae]	Kanta alu	CL
144	*Diplocyclos palmatus* (L.) C.Jeffrey [Cucurbitaceae]	Bon Kakra	CL
145	*Dipterocarpus turbinatus* C.F.Gaertn [Dipterocarpaceae]	Garjan	T
146	*Dischidia bengalensis* Colebr. [Apocynaceae]	---	CL

Sl No.	Species [Family]	Useful parts	Habit
147	*Dregea volubilis* (L.f.) Benth. *ex* Hook.f. [Apocynaceae]	Chhint	CL
148	*Drymaria cordata* (L.) Willd. *ex* Schult. [Caryophyllaceae]	Avijal	H
149	*Drymaria cordata* subsp. *diandra* (Blume) J.A.Duke [Caryophyllaceae]	Avijal	H
150	*Duabanga grandiflora* (DC.) Walp. [Lythraceae]	Lampate	T
151	*Dysoxylum excelsum* Blume [Meliaceae]	Gandha Lahasune	T
152	*Eclipta prostrata* (L.) L. [Compositae]	Keshut	H
153	*Elaeocarpus floribundus* Blume [Elaeocarpaceae]	Jalpai	T
154	*Elephantopus scaber* L. [Compositae]	Deshigajban	H
155	*Emilia sonchifolia* (L.) DC. *ex* DC. [Compositae]	---	H
156	*Entada rheedii* Spreng. [Leguminosae]	Gila	CL
157	*Enydra fluctuans* DC. [Compositae]	Helencha	H
158	*Erythrina stricta* Roxb. [Leguminosae]	Madar	T
159	*Eupatorium adenophorum* Hort.Berol. *ex* Kunth [Compositae]	Kalo banmara	S
160	*Euphorbia hirta* L. [Euphorbiaceae]	Pusidudh	H
161	*Ficus benghalensis* L. [Moraceae]	Bot	T
162	*Ficus hispida* L.f. [Moraceae]	Khoska	T
163	*Ficus religiosa* L. [Moraceae]	Asathwa	T
164	*Firmiana colorata* (Roxb.) R.Br. [Malvaceae]	Seto odal	T
165	*Flacourtia jangomas* (Lour.) Raeusch. [Salicaceae]	Panial	T
166	*Flueggea virosa* (Roxb. *ex* Willd.) Royle [Phyllanthaceae]	Darim pate	T
167	*Garuga floribunda* Decne. [Burseraceae]	Dobdobe	T
168	*Girardinia diversifolia* (Link) Friis [Urticaceae]	Bhangrey sinsnu	S
169	*Glinus oppositifolius* (L.) Aug.DC. [Molluginaceae]	Gima	H
170	*Gloriosa superba* L. [Colchicaceae]	Ulatchandal	H
171	*Glycosmis pentaphylla* (Retz.) DC. [Rutaceae]	Ban jamir	S
172	*Grewia asiatica* L. [Malvaceae]	Falsa	T
173	*Gynocardia odorata* R. Br. [Achariaceae]	Chalmogra, ramphali	T
174	*Hedychium coccineum* Buch.-Ham. *ex* Sm. [Zingiberaceae]	---	H
175	*Hedyotis scandens* Roxb. [Rubiaceae]	Kanchiru	H
176	*Heliotropium indicum* L. [Boraginaceae]	Hatisunrh	H
177	*Helminthostachys zeylanica* (L.) Hook. [Ophioglossaceae]	Charaigarua	H
178	*Hemidesmus indicus* (L.) R. Br. *ex* Schult. [Apocynaceae]	Anantamul	CL
179	*Hibiscus rosa-sinensis* L. [Malvaceae]	Jaba	S
180	*Holarrhena pubescens* Wall. *ex* G.Don [Apocynaceae]	Kurchi	T
181	*Homalomena rubescens* (Roxb.) Kunth [Araceae]	---	H
182	*Hoya parasitica* (Roxb.) Wight [Aclepiadaceae]	Dudhe lahara	H
183	*Hydrocotyle sibthorpioides* Lam. [Araliaceae]	Gande jhar	H
184	*Hygrophila auriculata* (Schumacher) Heine [Acanthaceae]	Kulekhara	H
185	*Hypericum japonicum* Thunb. [Hypericaceae]	---	H
186	*Hyptis suaveolens* (L.) Poiteau [Lamiaceae]	Ban Tulsi	S
187	*Ichnocarpus frutescens* (L.) W.T.Aiton [Apocynaceae]	Dudhe lahara	CL

Sl No.	Species [Family]	Useful parts	Habit
188	*Imperata cylindrica* (L.) Raeusch. [Poaceae]	Kush, siru	H
189	*Jasminum scandens* (Retz.) Vahl [Oleaceae]	Hara lahara	CL
190	*Jatropha curcas* L. [Euphorbiaceae]	Sada varenda	S
191	*Justicia adhatoda* L. [Acanthaceae]	Basak	S
192	*Knema erratica* (Hook f. & Thomson) J. Sinclair [Myristicaceae]	Ramguwa	T
193	*Lagerstroemia parviflora* Roxb. [Lythraceae]	Jarul	T
194	*Lantana camara* L. [Verbenaceae]	Saibani lata	S
195	*Lasia spinosa* (L.) Thwaites [Araceae]	Kanta kochu	H
196	*Leea asiatica* (L.) Ridsdale [Vitaceae]	Kakjangha	S
197	*Leea indica* (Burm.f.) Merr. [Vitaceae]	Kakjangha	S
198	*Leucas zeylanica* (L.) W.T.Aiton [Lamiaceae]	Dandakalas	H
199	*Lippia alba* (Mill.) N.E.Br. *ex* Britton & P.Wilson [Verbenaceae]	Ban Nebu	S
200	*Litsea monopetala* (Roxb.) Pers. [Lauraceae]	Bonsum	T
201	*Litsea glutinosa* (Lour.) C.B.Rob. [Lauraceae]	Kukurchita	T
202	*Ludwigia octovalvis* (Jacq.) P.H.Raven [Onagraceae]	Ban Lavanga	H
203	*Ludwigia perennis* L. [Onagraceae]	Ban Lavanga	H
204	*Luffa acutangula* (L.) Roxb. [Cucurbitaceae]	Dhundul	CL
205	*Lycopodiella cernua* (L.) Pic. Serm. [Lycopodiaceae]	Nagbeli	H
206	*Lygodium flexuosum* (L.) Swartz [Lygodiaceae]	Bhutraj	CL
207	*Macaranga denticulata* (Blume) Mull.Arg. [Euphorbiaceae]	Malata	T
208	*Madhuca longifolia* (J.Koenig *ex* L.) J.F.Macbr. [Sapotaceae]	Mahua	T
209	*Maesa indica* (Roxb.) A. DC. [Primulaceae]	Bilauney	S
210	*Magnolia champaca* (L.) Baill. *ex* Pierre [Magnoliaceae]	Champ	T
211	*Mallotus philippensis* (Lam.) Mull.Arg. [Euphorbiaceae]	Sindure	T
212	*Mangifera indica* L. [Anacardiaceae]	Aam	T
213	*Maranta arundinacea* L. [Marantaceae]	Arrowroot	H
214	*Marsilea minuta* L. [Marsileaceae]	Sushni	H
215	*Melastoma malabathricum* L. [Melastomataceae]	Datrangi	S
216	*Mentha longifolia* (L.) L. [Lamiaceae]	Jangli Pudina	H
217	*Mentha piperita* L. [Lamiaceae]	Pudina	H
218	*Merremia hirta* (L.) Merrill [Convolvulaceae]	---	CL
219	*Merremia vitifolia* (Burman f.) Hallier f. [Convolvulaceae]	---	CL
220	*Mesua ferrea* L. [Calophyllaceae]	Nagkesar	T
221	*Meyna spinosa* Roxb. *ex* Link [Rubiaceae]	Moyna kanta	T
222	*Mikania micrantha* Kunth [Compositae]	Assami lata	CL
223	*Mimosa himalayana* Gamble [Leguminosae]	Arare	S
224	*Mimosa pudica* L. [Leguminosae]	Lajjabati	H
225	*Momordica cochinchinensis* (Lour.) Spreng. [Cucurbitaceae]	Kakrol	Cl
226	*Momordica dioica* Roxb. *ex* Willd. [Cucurbitaceae]	Bankarela	CL
227	*Momordica charantia* L. [Cucurbitaceae]	Karela	CL
228	*Morinda angustifolia* Roxb. [Rubiaceae]	Haldikath	S

Sl No.	Species [Family]	Useful parts	Habit
229	*Mucuna pruriens* (L.) DC. [Leguminosae]	Alkushi	CL
230	*Murraya koenigii* (L.) Sprengel [Rutaceae]	Karipata	S
231	*Murraya paniculata* (L.) Jack [Rutaceae]	Kamini	S
232	*Musa paradisiaca* L. [Musaceae]	Kala	H
233	*Mussaenda roxburghii* Hook.f. [Rubiaceae]	Katmatia saak	S
234	*Naravelia zeylanica* (L.) DC. [Ranunculaceae]	Chhagalboti	CL
235	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn. [Icacinaceae]	---	CL
236	*Neolamarckia cadamba* (Roxb.) Bosser [Rubiaceae]	Kadam	T
237	*Nyctanthes arbor-tristi* L. [Oleaceae]	Seuli	T
238	*Ocimum tenuiflorum* L. [Lamiaceae]	Tulsi	S
239	*Oldenlandia corymbosa* L. [Rubiaceae]	---	H
240	*Ophioglossum reticulatum* L. [Ophioglossaceae]	Gibre	H
241	*Oroxylum indicum* (L.) Kurz [Bignoniaceae]	Totala	T
242	*Oxalis corniculata* L. [Oxalidaceae]	Amruli	H
243	*Paederia foetida* L. [Rubiaceae]	Gandalpata	CL
244	*Pandanus tectorius* Parkinson *ex* Du Roi [Pandanaceae]	Keya	S
245	*Pericampylus glaucus* (Lamk.) Merrill [Menispermaceae]	Pipalpati	CL
246	*Persea glaucescens* (Nees) D.G. Long [Lauraceae]	Kawla	T
247	*Persicaria barbata* (L.) H.Hara [Polygonaceae]	Biskathali	H
248	*Persicaria chinensis* (L.) H. Gross [Polygonaceae]	---	H
249	*Persicaria hydropiper* (L.) Delarbre [Polygonaceae]	Biskathali	H
250	*Phlogacanthus thyrsiformis* (Hardwicke) Mabberley [Acanthaceae]	Ram Basak	S
251	*Phyllanthus reticulatus* Poir. [Phyllanthaceae]	Bhui aamla	H
252	*Phyllanthus emblica* L. [Phyllanthaceae]	Amlaki	T
253	*Phyllanthus urinaria* L. [Phyllanthaceae]	Bhui aamla	H
254	*Physalis divaricata* D. Don [Solanaceae]	Ban tepari	H
255	*Physalis peruviana* L. [Solanaceae]	Ban tepari	H
256	*Piper chuvya* (Miquel) C.DC. [Piperaceae]	Chabo	CL
257	*Piper longum* L. [Piperaceae]	Pipal, Pipla	CL
258	*Piper mullesua* Buchanon-Hamilton *ex* D. Don [Piperaceae]	Pipla	CL
259	*Piper retrofractum* Vahl. [Piperaceae]	Choi	CL
260	*Piper betle* L. [Piperaceae]	Paan	CL
261	*Plumbago zeylanica* L. [Plumbaginaceae]	Chita	H
262	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson [Annonaceae]	Lapche kath	T
263	*Polygonum plebeium* R.Br. [Polygonaceae]	Nunia Saag	H
264	*Portulaca oleracea* L. [Portulacaceae]	Botolsaag	H
265	*Pouzolzia hirta* Blume *ex* Hassk. [Urticaceae]	---	H
266	*Premna bengalensis* C.B Clarke [Lamiaceae]	Gineri	T
267	*Premna barbata* Wall. *ex* Schauer [Lamiaceae]	Gineri	T
268	*Pseudognaphalium affine* (D.Don) Anderb. [Compositae]	---	H

Sl No.	Species [Family]	Useful parts	Habit
269	*Pterospermum acerifolium* (L.) Willdenow [Malvaceae]	Hantipiley	T
270	*Pterygota alata* (Roxb.) R. Brown [Malvaceae]	Narkeli	T
271	*Randia sikkimensis* Hook f. [Rubiaceae]	---	T
272	*Rauvolfia serpentine* (L.) Benth. *ex* Kurz [Apocynaceae]	Sarpagandha	S
273	*Ricinus communis* L. [Euphorbiaceae]	Rerhi	S
274	*Rotheca serrata* (L.) Steane & Mabb. [Lamiaceae]	Bharangi	H
275	*Rumex napalensis* Spreng. [Polygonaceae]	Kukurjiv	H
276	*Sapindus rarak* DC. [Sapindaceae]	Ritha	T
277	*Saraca asoca* (Roxb.) Willd. [Leguminosae]	Asok	T
278	*Sauraya roxburghii* Wallich [Actinidaceae]	Gogun	T
279	*Sauropus androgynus* (L.) Merrill [Phyllanthaceae]	Multivitamine	S
280	*Sauropus compressus* Mull.Arg. [Phyllanthaceae]	---	S
281	*Schima wallichii* Choisy [Theaceae]	Chilauney	T
282	*Senna alata* (L.) Roxb. [Leguminosae]	Dadmari	S
283	*Senna tora* (L.) Roxb. [Leguminosae]	Chakmake, Tapre	H
284	*Shorea robusta* Gaertn. [Dipterocarpaceae]	Saal	T
285	*Sida acuta* Burm.f. [Malvaceae]	Berela	S
286	*Sida cordifolia* L. [Malvaceae]	Swet Berela	H
287	*Sida rhombifolia* L. [Malvaceae]	Peet berela	H
288	*Smilax lanceifolia* Roxb. [Smilacaceae]	Kukurdainey	CL
289	*Smilax ovalifolia* Roxb. *ex* D.Don [Smilacaceae]	Kukurdainey	CL
290	*Solanum sisymbriifolium* Lam. [Solanaceae]	Sada kantikari	S
291	*Solanum americanum* Mill. [Solanaceae]	Kakmachi	H
292	*Solanum torvum* Sw. [Solanaceae]	Gothbegun	S
293	*Sphagneticola calendulacea* (L.) Pruski [Compositae]	Bhringaraj	H
294	*Stephania elegans* Hook.f. & Thomson [Menispermaceae]	Tamarke Lahara	CL
295	*Stephania glabra* (Roxb.) Miers [Menispermaceae]	Tamarke Lahara	CL
296	*Stephania japonica* (Thunb.) Miers [Menispermaceae]	Tamarke Lahara	CL
297	*Sterculia villosa* Roxb. [Malvaceae]	Odal	T
298	*Streblus asper* Loureiro [Moraceae]	Seora	T
299	*Syzygium cumini* (L.) Skeels [Myrtaceae]	Jaam	T
300	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult. [Apocynaceae]	Tagar	S
301	*Terminalia arjuna* (Roxb.*ex* DC.) Wight & Arn. [Combretaceae]	Arjun	T
302	*Terminalia myriocarpa* Van Heurck & Müll. Arg. [Combretaceae]	Panisaj	T
303	*Terminalia bellirica* (Gaertn.) Roxb. [Combretaceae]	Bahera	T
304	*Terminalia chebula* Retz. [Combretaceae]	Haritaki, Harra	T
305	*Tetrastigma bracteolatum* (Wall.) Planch. [Vitaceae]	---	CL
306	*Tetrastigma campylocarpum* (Kurz.) Planch. [Vitaceae]	---	CL
307	*Tetrastigma serrulatum* (Roxb.) Planch. [Vitaceae]	---	CL
308	*Tinospora sinensis* (Loureiro) Merrill [Menispermaceae]	Padmagulancha	CL

Sl No.	Species [Family]	Useful parts	Habit
309	*Toona ciliata* M.Roem. [Meliaceae]	Toon	T
310	*Triumfetta rhomboidea* Jacquin [Malvaceae]	Ban okra	S
311	*Tylophora indica* (Burm. f.) Merr. [Apocynaceae]	Antamul	S
312	*Vallaris solanacea* (Roth.) Kuntze [Apocynaceae]	Haparmali	S
313	*Vitex negundo* L. [Lamiaceae]	Nisinda	S
314	*Vitex peduncularis* Wall. *ex* Schauer [Lamiaceae]	Charaigarua	T
315	*Xanthium strumarium* L. [Compositae]	Onkrha	H
316	*Zanthoxylum armatum* DC. [Rutaceae]	Timbur	T
317	*Zanthoxylum nitidum* (Roxb.) DC. [Rutaceae]	Timbur	T
318	*Zingiber zerumbet* (L.) Roscoe *ex* Sm. [Zingiberaceae]	Mahabaribach	H
319	*Ziziphus jujuba* Mill. [Rhamnaceae]	Kul, Boer	T

Table 4. Edible plants [CL=Climber, H=Herb, S=Shrub, T=Tree]

Sl No.	Species [Family]	Habit	Parts used
1	*Acorus calamus* L.[Acoraceae]	H	Tender leaf
2	*Aegle marmelos* (L.) Correa [Rutaceae]	T	Fruits
3	*Alocasia macrorrhizos* (L.) G. Don [Araceae]	H	Rhizome
4	*Amorphophallus bulbifer* (Roxb.) Blume [Araceae]	H	Whole plant
5	*Annona reticulata* L. [Annonaceae]	T	Fruits
6	*Antidesma acidum* Retz. [Phyllanthaceae]	T	Fruits
7	*Antidesma bunius* (L.) Spreng. [Phyllanthaceae]	T	Fruits
8	*Artocarpus chama* Buch.-Ham. [Moraceae]	T	Fruits
9	*Artocarpus heterophyllus* Lam. [Moraceae]	T	Fruits
10	*Artocarpus lacucha* Buch.-Ham. [Moraceae]	T	Fruits
11	*Asparagus racemosus*Willd. [Asparagaceae]	CL	Rhizome
12	*Baccaurea ramiflora* Lour. [Euphorbiaceae]	T	Fruits
13	*Bauhinia acuminata* L. [Leguminosae]	T	Flower, Fruits
14	*Bauhinia purpurea* L. [Leguminosae]	T	Flower, Fruits
15	*Boerhavia diffusa* L. [Nyctaginaceae]	H	Shoot
16	*Brassica rapa* L. [Brassicaceae]	H	Leaf
17	*Cajanus cajan* (L.) Millsp. [Leguminosae]	S	Seeds
18	*Calamus viminalis* Willd. [Poaceae]	H	Fruits
19	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC. [Fagaceae]	T	Fruits
20	*Centella asiatica* (L.) Urb. [Apiaceae]	H	Whole plant
21	*Chenopodium album* L. [Amaranthaceae]	H	Shoot
22	*Citrus medica* L. [Rutaceae]	S	Fruits
23	*Cleidion javanicum* Blume [Euphorbiaceae]	S	Fruits
24	*Colocasia esculenta* (L.) Schott [Araceae]	H	Whole plant
25	*Curcuma zedoaria* (Christm.) Roscoe. [Zingiberaceae]	H	Rhizome
26	*Deeringia amaranthoides* (Lam.) Merr. [Amaranthaceae]	CL	Shoot
27	*Dillenia indica* L. [Dilleniaceae]	T	Fruits

Sl No.	Species [Family]	Habit	Parts used
28	*Dioscorea bulbifera* L. [Dioscoreaceae]	CL	Tuber
29	*Dioscorea deltoidea* Wall. *ex* Griseb. [Dioscoreaceae]	CL	Tuber
30	*Dioscorea prazeri* Prain & Burkill [Dioscoreaceae]	CL	Tuber
31	*Diplazium esculentum* (Retz.) Sw. [Athyriaceae]	H	Frond
32	*Diplocyclos palmatusn* (L.) C.Jeffrey [Cucurbitaceae]	CL	Fruits
33	*Dryopteris sikkimensis* (Bedd.) Kuntze [Dryopteridaceae]	H	Frond
34	*Ficus hispida* L.f. [Moraceae]	T	Fruits
35	*Ficus neriifolia* Sm. [Moraceae]	T	Fruits
36	*Glinus oppositifolius* (L.) Aug.DC. [Molluginaceae]	H	Shoot
37	*Grewia asiatica* L. [Malvaceae]	S	Fruits
38	*Helminthostachys zeylanica* (L.) Hook. [Ophioglossaceae]	H	Frond
39	*Ipomoea batatas* (L.) Lam. [Convolvulaceae]	CL	Shoot, tuber
40	*Luffa cylindrica* (L.) M.Roem. [Cucurbitaceae]	CL	Fruits, Shoot
41	*Machilus glaucescens* (Nees) Wight. [Lauraceae]	T	Fruits
42	*Mahonia napaulensis* DC. [Euphorbiaceae]	T	Roots
43	*Mangifera indica* L. [Anacardiaceae]	T	Fruits
44	*Meliosma simplicifolia* (Roxb.) Walp. [Sabiaceae]	T	Fruits
45	*Mucuna pruriens* (L.) DC. [Leguminosae]	CL	Fruits
46	*Mukia maderaspatana* (L.) M.Roem. [Cucurbitaceae]	CL	Shoot, fruits
47	*Musa paradisiaca* L. [Musaceae]	H	Fruits, Inflorescence
48	*Musa balbisiana* Colla [Musaceae]	H	Fruits
49	*Neolamarckia cadamba* (Roxb.) Bosser [Rubiaceae]	T	Thalamus
50	*Oroxylum indicum* (L.) Kurz [Bignoniaceae]	T	Flower
51	*Paederia foetida* L. [Rubiaceae]	CL	Leaf
52	*Phyllanthus emblica* L. [Phyllanthaceae]	T	Fruits
53	*Phyllanthus emblica* L. [Phyllanthaceae]	T	Fruits
54	*Physalis divaricata* D. Don [Solanaceae]	H	Fruits
55	*Piper betle* L. [Piperaceae]	CL	Leaf
56	*Piper betleoides* C.DC. [Piperaceae]	CL	Shoot
57	*Piper longum* L. [Piperaceae]	CL	Stem
58	*Premna bengalensis* C.B.Clarke [Lamiaceae]	T	Leaf
59	*Premna mollissima* Roth. [Lamiaceae]	T	Leaf
60	*Psidium guajava* L. [Myrtaceae]	T	Fruits
61	*Ricinus communis* L. [Euphorbiaceae]	S	Fruits
62	*Smilax ovalifolia* Roxb. *ex* D.Don [Smilacaceae]	CL	Shoot
63	*Solanum aculeatissimum* Jacq. [Solanaceae]	S	Fruits
64	*Syzygium cumini* (L.) Skeels [Myrtaceae]	T	Fruits
65	*Tamarindus indica* L. [Leguminosae]	T	Fruits, Leaf
66	*Tephrosia candida* (Roxb.) DC. [Leguminosae]	S	Pod, Leaf
67	*Terminalia bellirica* (Gaertn.) Roxb. [Combretaceae]	T	Fruits
68	*Terminalia chebula* Retz. [Combretaceae]	T	Fruits

Sl No.	Species [Family]	Habit	Parts used
69	*Typhonium trilobatum* (L.) Schott [Araceae]	H	Leaf
70	*Zanthoxylum budrunga* DC. [Rutaceae]	T	Fruits
71	*Ziziphus jujuba* Mill. [Rhamnaceae]	T	Fruits
72	*Ziziphus oenopolia* (L.) Mill. [Rhamnaceae]	S	Fruits

Table 5. Fodder plants [CL=Climber, H=Herb, S=Shrub, T=Tree]

Sl No.	Species [Family]	Habit	Parts used
1	*Alangium chinense* (Lour.) Harms [Cornaceae]	T	Twigs
2	*Albizia chinensis* (Osbeck.) Merr. [Leguminosae]	T	Leaves
3	*Albizia lucidior* (Steud.) I.C.Nielsen [Leguminosae]	T	Leaves
4	*Antidesma bunius* (L.) Spreng. [Phyllanthaceae]	T	Twigs
5	*Artocarpus heterophyllus* Lam. [Moraceae]	T	Leaves, fruits
6	*Artocarpus lacucha* Buch.-Ham. [Moraceae]	T	Leaves, fruits
7	*Bauhinia variegata* L. [Leguminosae]	T	Shoot
8	*Bauhinia purpurea* L. [Leguminosae]	T	Twigs
9	*Bombax ceiba* L. [Malvaceae]	T	Leaves, flowers
10	*Bridelia retusa* (L.) A.Juss. [Phyllanthaceae]	T	Twigs
11	*Bridelia stipularis* (L.) Blume. [Phyllanthaceae]	CL	Twigs
12	*Butea monosperma* (Lam.) Taub. [Leguminosae]	T	Twigs
13	*Callicarpa arborea* Roxb. [Lamiaceae]	T	Leaves
14	*Cassia fistula* L. [Leguminosae]	T	Twigs
15	*Castanopsis indica* (Roxb. *ex* Lindl.) A.DC. [Fagaceae]	T	Twigs
16	*Cleidion javanicum* Blume. [Euphorbiaceae]	S	Twigs
17	*Crateva religiosa* G.Forst. [Capparaceae]	T	Twigs
18	*Dalbergia sissoo* DC. [Leguminosae]	T	Twigs
19	*Dillenia indica* L. [Dilleniaceae]	T	Leaves, fruits
20	*Dillenia pentagyna* Roxb. [Dilleniaceae]	T	Leaves, fruits
21	*Dracaena angustifolia* (Medik.) Roxb. [Asparagaceae]	S	Twigs
22	*Erythrina stricta* Roxb. [Leguminosae]	T	Twigs
23	*Ficus elastica* Roxb. *ex* Hornem. [Moraceae]	T	Leaves
24	*Ficus hispida* L.f. [Moraceae]	T	Twigs, fruits
25	*Ficus religiosa* L. [Moraceae]	T	Twigs
26	*Garuga pinnata* Roxb. [Burseraceae]	T	Leaves
27	*Globba racemosa* var. *hookeri* (C.B.Clarke *ex* Baker) S.Kumar [Zingiberaceae]	H	Shoot
28	*Gmelina arborea* Roxb. [Lumiaceae]	T	Leaves
29	*Homalomena rubescens* (Roxb.) Kunth [Araceae]	H	Whole plant

Sl No.	Species [Family]	Habit	Parts used
30	*Lagerstroemia parviflora* Roxb. [Lytharaceae]	T	Twigs
31	*Lagerstroemia speciosa* (L.) Pers. [Lytharaceae]	T	Leaves
32	*Lannea coromandelica* (Houtt.) Merr. [Anacardiaceae]	T	Leave
33	*Litsea monopetala* (Roxb.) Pers. [Lauraceae]	T	Twigs
34	*Mallotus repandus* (Willd.) Mull.Arg. [Euphorbiaceae]	T	Twigs
35	*Mangifera indica* L. [Anacardiaceae]	T	Leaves, fruits
36	*Mesua ferrea* L.[Calophyllaceae]	T	Leaves
37	*Musa paradisiaca* L. [Musaceae]	H	Leaves
38	*Neolamarckia cadamba* (Roxb.) Bosser [Rubiaceae]	T	Twigs
39	*Oroxylum indicum* (L.) Kurz [Bignoniaceae]	T	Leaves
40	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson [Annonaceae]	T	Leaves
41	*Premna mollissima* Roth. [Lamiaceae]	T	Leaves
42	*Senna siamea* (Lam.) H.S.Irwin & Barneby [Leguminosae]	T	Twigs
43	*Tinospora cordifolia* (Willd.) Miers. [Menispermaceae]	CL	Stem
44	*Toona ciliata* M.Roem. [Meliaceae]	T	Leaves
45	*Trema orientalis* (L.) Blume [Cannabaceae]	T	Twigs
46	*Turpinia pomifera* (Roxb.) DC. [Staphyleaceae]	T	Twigs
47	*Wrightia arborea* (Dennst.) Mabb. [Apocymaceae]	T	Leaves
48	*Ziziphus jujuba* Mill. [Rhamnaceae]	T	Twigs

Table 6.- Ethno-veterinary plants [CL=Climber, H=Herb, S=Shrub, T=Tree]

Sl No.	Species [Family]	Habit	Parts used
1	*Abrus precatorius* L. [Leguminosae]	CL	Leaves and roots
2	*Acacia arabica* Willd. [Leguminosae]	T	Root
3	*Acacia catechu* (L.f.) Wild. [Leguminosae]	T	Root
4	*Acalypha indica* L. [Euphorbiaceae]	H	Leaves and roots
5	*Achyranthes aspera* L. [Amaranthaceae]	H	Root
6	*Acorus calamus* L. [Araceae]	H	Rhizome
7	*Aegle marmelos* (L.) Correa [Rutaceae]	T	Fruit pulp
8	*Allium cepa* L. [Liliaceae]	H	Bulb
9	*Allium sativum* L. [Liliaceae]	H	Bulb
10	*Alocasia macrorrhiza* (L.) G. Don [Araceae]	H	Petiole
11	*Aloe vera* (L.) Burm. f. [Xanthorrhoeaceae]	H	Leaf juice
12	*Alstonia scholaris* (L.) R.Br. [Apocynaceae]	T	Latex & stem bark
13	*Alternanthera sessilis* (L.) R.Br. *ex* DC. [Amaranthaceae]	H	Whole plant
14	*Amaranthus spinosus* L. [Amaranthaceae]	H	Whole plant
15	*Amorphophallus bulbifer* (Roxb.) Blume [Araceae]	H	Fresh corm
16	*Andrographis paniculata* (Burm.f.) Wall. *ex* Nees [Acanthaceae]	H	Whole plant
17	*Anisomeles indica* (L.) O. Kuntze [Lamiaceae]	S	Fresh root

Sl No.	Species [Family]	Habit	Parts used
18	*Annona reticulata* L. [Annonaceae]	T	Fresh leaves
19	*Annona squamosa* L. [Annonaceae]	T	Leaves
20	*Argemone mexicana* L. [Papavaraceae]	H	Leaves
21	*Aristolochia indica* L. [Aristolochiaceae]	CL	Twig
22	*Asparagus racemosus* Willdenow [Asparagaceae]	H	Root
23	*Azadirachta indica* A. Juss. [Meliaceae]	T	Leaves and seed oil
24	*Bambusa vulgaris* Schrader [Poaceae]	S	Tender shoots
25	*Boerhavia diffusa* L. [Nyctaginaceae]	H	Leaf decogtion
26	*Bombax ceiba* L. [Bombacaceae]	T	Leaves
27	*Butea monosperma* Kuntze [Leguminosae]	T	Stem bark
28	*Caesalpinia bonduc* (L.) Roxb. [Leguminosae]	S	Roots
29	*Calotropis gigantia* (L.) R. Br. *ex* Ait. [Asclepiadaceae]	S	Leaves
30	*Cannabis sativa* L. [Cannabinaceae]	S	Leaves
31	*Cassia fistula* L. [Leguminosae]	T	Fruits
32	*Cayratia trifolia* (L.) Domin. [Vitaceae]	CL	Leaves
33	*Centella asiatica* (L.) Urban [Apiaceae]	H	Leaves
34	*Cissus quadrangularis* L. [Vitaceae]	CL	Stem
35	*Clerodendrum infortunatum* L. [Lamiaceae]	S	Tender shoots
36	*Cocculus hirsutus* (L.) Diels [Menispermaceae]	CL	Leaves
37	*Coriandrum sativum* L. [Apiaceae]	H	Seeds
38	*Costus speciosus* (Koenig *ex* Retz.) Sm. [Costaceae]	H	Roots
39	*Curcuma longa* L. [Zingiberaceae]	H	Rhizome
40	*Cuscuta reflexa* Roxb. [Cuscutaceae]	CL	Whole plant
41	*Cynodon dactylon* (L.) Pers. [Poaceae]	H	Whole plant
42	*Cyperus rotundus* L. [Cyperaceae]	H	Roots
43	*Datura metel* L. [Solanaceae]	H	Leaves
44	*Dillenia indica* L. [Dilleniaceae]	T	Bark and fruits
45	*Eclipta alba* (L.) Hassk. [Compositae]	H	Leaves
46	*Erythrina indica* Lam. [Leguminosae]	T	Stem bark
47	*Evolvulus alsinoides* (L.) L. [Convolvulaceae]	H	Root
48	*Ficus bengalensis* L. [Moraceae]	T	Stem bark
49	*Ficus hispida* L. f. [Moraceae]	T	Fruits
50	*Gloriosa superba* L. [Colchicaceae]	H	Roots
51	*Hibiscus rosa-sinensis* L. [Malvaceae]	S	Flower
52	*Holarrhena pubescens* (Buch.-Ham.) D. Don [Apocynaceae]	T	Stem bark
53	*Justicia adhatoda* L. [Acanthaceae]	S	Leaves
54	*Lagenaria siceraria* (Molina) Standl. [Cucurbitaceae]	CL	Fruits
55	*Lantana camara* L. [Verbenaceae]	S	Leaves
56	*Leucas aspera* (Willd.) Link [Lamiaceae]	H	Whole plant
57	*Mangifera indica* L. [Anacardiaceae]	T	Cotyledons
58	*Mimosa pudica* L. [Leguminosae]	H	Roots
59	*Mimusops elengi* L. [Sapotaceae]	T	Bark
60	*Mirabilis jalapa* L. [Nyctaginaceae]	H	Roots

Sl No.	Species [Family]	Habit	Parts used
61	*Moringa oleifera* Lam. [Moringaceae]	T	Stem bark
62	*Musa paradisiaca* L. [Musaceae]	S	Fruits
63	*Neolamarkia cadamba* (Roxb.) Bosser [Rubiaceae]	T	Leaves
64	*Nicotiana tabacum* L. [Slanaceaeo]	H	Leaves
65	*Nymphaea nouchali* Burm. f. [Nymphaeaceae]	H	Rhizome
66	*Persicaria chinensis* (L.) H. Gross. [Polygonaceae]	H	Twigs
67	*Physalis minima* L. [Solanaceae]	H	Twigs
68	*Piper betel* L. [Piperaceae]	CL	Leaf
69	*Piper nigrum* L. [Piperaceae]	CL	Seeds
70	*Psidium guajava* L. [Myrtaceae]	T	Leaves
71	*Punica granatum* L. [Punicaceae]	S	Roots
72	*Ricinus communis* L. [Euphorbiaceae]	S	Seed oil and roots
73	*Saraca asoca* (Roxb.) Willd. [Leguminosae]	T	Bark
74	*Scoparia dulcis* L. [Scrophulariaceae]	H	Whole plant
75	*Sesamum indicum* L. [Pedaliaceae]	H	Seeds
76	*Solanum nigrum* L. [Solanaceae]	H	Ripen fruits
77	*Stephania glabra* (Roxb.) Miers. [Menispermaceae]	CL	Tubers
78	*Stephania japonica* (Thunberg) Miers [Menispermaceae]	CL	Leaves
79	*Tamarindus indica* L. [Leguminosae]	T	Fruits
80	*Terminalia arjuna* Wight & Arn. [Combretaceae]	T	Stem bark
81	*Tinospora cordifolia* (Willd.) Miers [Menispermaceae]	CL	Whole plant
82	*Trachyspermum ammi* (L.) Sprague [Apiaceae]	H	Seed
83	*Vigna mungo* (L.) Hepper [Leguminosae]	H	Seed
84	*Vitex negundo* L. [Verbenaceae]	T	Leaves
85	*Zingiber officinale* Roxb. [Zingiberaceae]	H	Rhizome

Table 7. Ethnomedicinal plants [CL=Climber, H=Herb, S=Shrub, T=Tree]

Sl No.	Species [Family]	Habit	Parts used
1	*Acacia catechu* (L.f.) Willd. [Leguminosae]	T	Bark, gum
2	*Achyranthes aspera* L. [Amaranthaceae]	H	Root, stem
3	*Acorus calamus* L. [Acoraceae]	H	Rhizome
4	*Aegle marmelos* (L.) Correa [Rutaceae]	T	Fruits, leaves and roots
5	*Aesculus assamica* Griff. [Sapindaceae]	T	Bark
6	*Alangium chinense* (Lour.) Harms [Cornaceae]	T	Fodder, Medicinal
7	*Alstonia scholaris* (L.) R.Br. [Apocynaceae]	T	Stem bark
8	*Antidesma bunius* (L.) Spreng. [Phyllanthaceae]	T	Fruits
9	*Aphanamixis polystachya* (Wall.).Parker [Meliaceae]	T	Bark
10	*Asparagus racemosus* Willd. [Asparagaceae]	CL	Root tuber
11	*Baccaurea ramiflora* Lour. [Euphorbiaceae]	T	Fruits
12	*Bauhinia vahlii* Wight & Arn. [Leguminosae]	CL	Flowers, Bark, Roots

Sl No.	Species [Family]	Habit	Parts used
13	*Boerhavia diffusa* L. [Nyctaginaceae]	H	Roots, twig
14	*Bombax ceiba* L. [Malvaceae]	T	Root bark, flowers
15	*Bridelia stipularis* (L.) Blume [Phyllanthaceae]	CL	Bark
16	*Bridelia retusa* (L.) Juss. [Phyllanthaceae]	T	Bark
17	*Butea monosperma* (Lam.) Taub. [Leguminosae]	T	Bark
18	*Callicarpa arborea* Roxb. [Lamiaceae]	T	Roots bark
19	*Canarium sikkimense* King [Burseraceae]	T	Bark
20	*Careya arborea* Roxb. [Lecythidaceae]	T	Bark
21	*Cassia fistula* L. [Leguminosae]	T	Bark, fruits, leaves
22	*Celastrus paniculatus* Willd. [Celastraceae]	S	Twig
23	*Centella asiatica* (L.) Urb. [Apiaceae]	H	Leaves
24	*Chromolaena odorata* (L.) R.M.King & H.Rob. [Compositae]	S	Leaves
25	*Cinnamomum cecidodaphne* Meisn. [Lauraceae]	T	Bark
26	*Cinnamomum glaucescens* (Nees) Hand.- Mazz [Lauraceae]	T	Leaves, Bark
27	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm. [Lauraceae]	T	Fruits
28	*Cissampelos pareira* L. [Menispermaceae]	S	Root tubers
29	*Citrus medica* L. [Rutaceae]	S	Fruit
30	*Clausena excavata* Burma. f. [Rutaceae]	S	Leaves
31	*Clerodendrum infortunatum* L. [Lamiaceae]	S	Roots, twig
32	*Coccinia cordifolia* (L.) Cogn. [Cucurbitaceae]	CL	Leaves, fruits
33	*Coffea benghalensis* B.Heyne *ex* Schult. [Rubiaceae]	S	Roots
34	*Crateva religiosa* G.Forst. [Capparaceae]	T	Bark, fruits, leaves
35	*Crinum amoenum* Ker Gawl. *ex* Roxb. [Amaryllidaceae]	H	Tuber
36	*Curcuma aromatica* Salisb. [Zingiberaceae]	H	Rhizome
37	*Curcuma zedoaria* (Christm.) Roscoe [Zingiberaceae]	H	Rhizome
38	*Dalbergia sissoo* DC. [Leguminosae]	T	Leaves
39	*Deeringia amaranthoides* (Lam.) Merr. [Amaranthaceae]	CL	Twig
40	*Desmodium triflorum* (L.) DC. [Leguminosae]	H	Whole plant
41	*Dillenia pentagyna* L. [Dilleniaceae]	T	Fruits, Bark
42	*Dioscorea deltoidea* Wall. *ex* Griseb. [Dioscoreaceae]	CL	Tuber
43	*Diplazium esculentum* (Retz.) Sw. [Athyriaceae]	H	Fronds
44	*Dipterocarpus macrocarpus* Vesque [Dipterocarpaceae]	T	Resin, Bark
45	*Dracaena angustifolia* (Medik.) Roxb. [Agavaceae]	S	Root, stem
46	*Drymaria cordata* subsp. *diandra* (Blume) J.A.Duke [Caryophyllaceae]	H	Leafy twig
47	*Emblica officinalis* Gaerth. [Phyllanthaceae]	T	Fruits, Bark
48	*Entada Phaseoloides* (L.) Merr [Leguminosae]	CL	Seeds
49	*Ficus religiosa* L. [Moraceae]	T	Fruits, leaves and roots
50	*Glycosmis pentaphylla* (Retz.) DC. [Rutaceae]	S	Roots, twig
51	*Gmelina arborea* Roxb. [Lamiaceae]	T	Root, Leaves, Bark, flowers
52	*Haldina cordifolia* (Roxb.) Ridsdale [Rubiaceae]	T	Leaf and shoot

Sl No.	Species [Family]	Habit	Parts used
53	*Hedyotis scandens* Roxb. [Rubiaceae]	CL	Twig
54	*Holarrhena pubescens* Wall. *ex* G.Don [Apocynaceae]	T	Stem bark
55	*Homalomena rubescens* (Roxb.) Kunth [Araceae]	H	Rhizome
56	*Hydrocotyle sibthorpioides* Lam. [Apiaceae]	H	Leafy twig
57	*Hypericum japonicum* Thunb. [Hypericaceae]	H	Leafy twig
58	*Ichnocarpus frutescens* (L.) W.T.Aiton [Apocynaceae]	CL	Twig
59	*Justicia adhatoda* L. [Acanthaceae]	S	Leaves, flowers
60	*Lantana camara* L. [Lamiaceae]	S	Roots
61	*Lasia spinosa* (L.) Thwaites [Araceae]	H	Rhizome
62	*Leucas abyssinica* (Benth.) Briq. [Lamiaceae]	H	Leaf
63	*Lippia javanica* (Burm.f.) Spreng. [Verbenaceae]	S	leaves
64	*Litsea monopetala* (Roxb.) Pers. [Lauraceae]	T	Bark, Leaves, fruits
65	*Macaranga denticulata* (Blume) Mull.Arg. [Euphorbiaceae]	T	Twig
66	*Machilus villosa* (Roxb.) Hook.f. [Lauraceae]	T	Fruits, Bark
67	*Melastoma malabathricum* L. [Melastonaceae]	S	Fruits
68	*Mesua ferrea* L. [Calophyllaceae]	T	Bark, Leaves, fruits
69	*Mimosa pudica* L. [Leguminosae]	H	root
70	*Mucuna pruriens* (L.) DC. [Leguminosae]	CL	Fruits
71	*Murdannia nudiflora* (L.) Brenan [Commelinaceae]	H	Twig
72	*Musa paradisiaca* L. [Musaceae]	H	Rhizome, root, inflorescence, Fruits
73	*Musa balbisiana* Colla [Musaceae]	H	Inflorescence
74	*Nyctanthes arbortristis* L. [Nyctaginaceae]	H	Leaves, roots, bark
75	*Oxalis corniculata* L. [Oxalidaceae]	H	leaves
76	*Paederia foetida* L. [Rubiaceae]	CL	Leaves
77	*Phlogacanthus thyrsiformis* (Roxb. *ex* Hardw.) Mabb. [Acanthaceae]	S	Leaves
78	*Phyllanthus amarus* Schumach. & Thonn. [Phyllanthaceae]	H	Whole plant
79	*Piper betleoides* C. DC. [Piperaceae]	CL	Twigs
80	*Piper attenuatum* Buch.-Ham. *ex* Miq. [Piperaceae]	CL	Leaves
81	*Piper longum* L. [Piperaceae]	CL	Fruits
82	*Piper sylvaticum* Roxb. [Piperaceae]	CL	Leaves
83	*Premna bengalensis* C.B.Clarke [Lamiaceae]	T	Leaves,
84	*Pupalia lappacea* (L.) Juss. [Amaranthaceae]	H	Whole plant
85	*Rotala rotundifolia* (Buch.-Ham. *ex* Roxb.) Koehne [Lythraceae]	H	Twig
86	*Rotheca serrata* (L.) Steane & Mabb. [Lamiaceae]	H	Bark
87	*Saraca asoca* (Roxb.) Willd. [Leguminosae]	T	Bark, frlowers
88	*Scoparia dulcis* L. [Scrophulariaceae]	H	Leaves
89	*Senna siamea* (Lam.) H.S.Irwin & Barneby [Leguminosae]	T	Bark
90	*Senna tora* (L.) Roxb. [Leguminosae]	H	Root
91	*Sida rhombifolia* L. [Malvaceae]	H	Roots, twig
92	*Smilax ovalifolia* Roxb. *ex* D.Don [Smilaceaeae]	CL	Leaves

Sl No.	Species [Family]	Habit	Parts used
93	*Smilax zeylanica* L. [Smilaceaeae]	CL	Leaves
94	*Solanum torvum* Sw. [Solanaceae]	S	Root
95	*Terminalia chebula* Retzius [Combretaceae]	T	Fruits
96	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn. [Combretaceae]	T	Bark, l, fruitseaves, fruits
97	*Terminalia bellirica* (Gaertn.) Roxb. [Combretaceae]	T	Fruits
98	*Tetrameles nudiflora* R. Br. [Tetramelaceae]	T	Roots, bark
99	*Tinospora sinensis* (Lour.) Merr. [Menispermaceae]	CL	Stem
100	*Toona ciliata* Roemer [Meliaceae]	T	Leaves, roots, bark
101	*Wrightia arborea* (Dennst.) Mabb. [Apocynaceae]	T	Medicinal, Fodder
102	*Zanthoxylum rhetsa* DC. [Rutaceae]	T	bark
103	*Zingiber officinale* Roscoe. [Zingiberaceae]	H	Rhizome
104	*Ziziphus jujuba* Mill. [Rhamnaceae]	T	Leaves

Table 8. Aromatic plants and Spices [CL=Climber, H=Herb, S=Shrub, T=Tree]

Sl No.	Species [Family]	Habit	Parts used
1	*Blumea lacera* (Burm.f.) DC. [Compositae]	H	Twig
2	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm. [Lauraceae]	T	Leaf
3	*Clausena excavata* Burm.f. [Rutaceae]	S	Leaf
4	*Curcuma aromatica* Salisb. [Zingiberaceae]	H	Rhizome
5	*Murraya koenigii* (L.) Spreng. [Rutaceae]	S	Leaf
6	*Piper nigrum* L. [Piperaceae]	CL	Fruits and seeds
7	*Zingiber zerumbet* (L.) Roscoe *ex* Sm. [Zingiberaceae]	H	Rhizome

Table 9. Rope and Cordage [CL=Climber, H=Herb, S=Shrub, T=Tree]

Sl No.	Species [Family]	Habit	Parts used
1	*Bombax ceiba* L. [Malvaceae]	T	Vegetable fibre surrounding seeds
2	*Calamus erectus* Roxb. [Arecaceae]	S	Culm
3	*Calamus viminalis* Willd. [Arecaceae]	S	Culm
4	*Ceiba pentandra* (L.) Gaertn. [Malvaceae]	T	Vegetable fibre surrounding seeds
5	*Celastrus paniculatus* Willd. [Celastraceae]	S	Climbing stem
6	*Cheilocostus speciosus* (J.Koenig) C.D.Specht [Costaceae]	CL	Climbing stem
7	*Grewia asiatica* L. [Malvaceae]	S	Stem bark
8	*Sterculia villosa* Roxb. [Malvaceae]	T	Stem bark

Table 10. Decorative and Ornamental plants [CL=Climber, H=Herb, S=Shrub, T=Tree]

Sl No.	Species [Family]	Habit	Parts used
1	*Adiantum lunulatum* Burm. f. [Adiantaceae]	H	Fronds
2	*Aesculus assamica* Griff. [Sapindaceae]	T	Fruits, leaves, inflorescence
3	*Alstonia scholaris* (L.) R. Br. [Apocynaceae]	T	Leaves
4	*Bauhinia purpurea* L. [Leguminosae]	T	Flowers, pods
5	*Butea monosperma* (Lam.) Taub. [Leguminosae]	T	Flowers, pods

Sl No.	Species [Family]	Habit	Parts used
6	*Chukrasia tabularis* A.Juss. [Meliaceae]	H	Fruits
7	*Dipterocarpus retusus* Blume [Dipterocarpaceae]	T	Fruits
8	*Drynaria quercifolia* (L.) J. Sm. [Polypodiaceae]	H	Fronds
9	*Duabanga grandiflora* (DC.) Walp. [Lythraceae]	T	Fruits
10	*Dysoxylum excelsum* Blume [Meliaceae]	T	Fruits
11	*Entada phaseoloides* (L.) Merr. [Leguminosae]	CL	Fruits, seeds
12	*Firmiana colorata* (Roxb.) R.Br. [Malvaceae]	T	Leaves, fruits
13	*Lagerstroemia parviflora* Roxb. [Lythraceae]	T	Fruits
14	*Lagerstroemia speciosa* (L.) Pers. [Lythraceae]	T	Fruits, inflorescence
15	*Luffa cutangula* (L.) Roxb. [Cucurbitaceae]	CL	Fibrous mesocarp and endocarp of fruits
16	*Magnolia champaca* (L.) Baill. *ex* Pierre [Magnoliaceae]	T	Fruits, flowers
17	*Magnolia hodgsonii* (Hook.f. & Thomson) H.Keng [Magnoliaceae]	T	Flowers
18	*Murraya paniculata* (L.) Jack [Rutaceae]	S	Flowers
19	*Neolamarckia cadamba* (Roxb.) Bosser [Rubiaceae]	T	Inflorescence
20	*Nyctanthes arbor-tristis* L. [Oleaceae]	H	Flowers
21	*Pandanus unguifer* Hook.f. [Pandanaceae]	T	Fruits
22	*Pterospermum acerifolium* (L.) Willd. [Malvaceae]	T	Fruits
23	*Pterygota alata* (Roxb.) R.Br. [Malvaceae]	T	Fruits
24	*Saraca asoca* (Roxb.) Willd. [Leguminosae]	T	Flowers
25	*Schima wallichii* Choisy [Theaceae]	T	Fruits
26	*Smilax zeylanica* L. [Smilacaceae]	CL	Leaves
27	*Tabernaemontana abbreviata* (J.F.Morales) A.O.Simoes & M.E.Endress [Apocynaceae]	S	Flowers
28	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn. [Combretaceae]	T	Fruits
29	*Vallaris solanacea* (Roth) Kuntze [Apocynaceae]	CL	Flowers

Table 11. Allelopathic effect of Teak [*Tectona grandis* L. f.] on selected herbaceous species

HERBS	Concentrations	Germination (%)	% of Inhibition or stimulation					Vigour Index			Shoot: Root	Inhibition or stimulation of Biomass (%)
			Germination	Viability	Shoot length	Root length	Seedling Length	Shoot	Root	Seedling		
S. occidentalis	CON	96.67	0.01	100.00	0.00	-0.18	0.00	582.63	221.54	804.17	2.63	0.00
	25%	86.67	-10.34	89.66	-2.06	5.19	-0.06	508.99	209.77	718.76	2.47	-12.71
	50%	83.33	-13.79	86.21	-5.85	9.56	-1.60	473.33	208.10	681.44	2.31	-20.98
	75%	80.00	-17.24	82.76	-12.49	7.78	-6.90	417.33	200.18	617.52	2.19	-25.92
	100%	63.33	-34.48	65.52	-23.02	-4.36	-17.87	293.33	139.43	432.77	2.10	-29.69
O. gratissimum	CON	71.67	0.00	100.00	0.00	0.00	0.00	114.27	575.27	689.53	0.20	0.00
	25%	53.33	-25.58	74.42	-9.46	-14.17	-13.39	76.68	365.42	442.10	0.21	-8.50
	50%	51.67	-27.91	72.09	-16.01	-16.35	-16.29	69.18	346.78	415.96	0.20	-21.46
	75%	36.67	-48.84	51.16	-20.61	-18.89	-19.18	46.07	236.82	282.88	0.19	-34.82
	100%	40.00	-44.19	55.81	-22.06	-23.20	-23.01	49.38	246.85	296.23	0.20	-40.89
A. paniculata	CON	93.33	0.00	100.00	-1.79	0.00	-1.09	347.40	225.86	573.26	1.54	0.00
	25%	81.67	-12.50	87.50	-2.64	-6.02	-3.95	303.08	186.48	489.57	1.64	-8.30
	50%	80.00	-14.28	85.71	-5.61	-11.74	-7.99	288.53	170.93	459.47	1.69	-10.84
	75%	68.33	-26.78	73.21	-8.05	-16.56	-11.35	237.98	138.12	376.10	1.74	-17.65
	100%	70.00	-25.00	75.00	-12.85	-17.11	-14.50	232.77	139.93	372.70	1.67	-29.07
P. zeylanica	CON	96.67	0.00	100.00	0.00	0.00	0.00	338.85	210.13	548.98	1.62	0.66
	25%	95.00	-1.72	98.28	-0.67	-5.85	-2.65	330.95	194.23	525.18	1.70	-14.00
	50%	91.67	-5.17	94.83	-17.38	-13.29	-15.82	265.32	172.23	437.55	1.54	-19.02
	75%	85.00	-12.07	87.93	-25.36	-21.54	-23.90	221.60	144.38	365.98	1.55	-29.04
	100%	71.67	-25.86	74.14	-27.65	-25.23	-26.72	181.45	115.43	296.88	1.62	-31.83
O. corniculata	CON	93.33	0.00	100.00	0.00	0.00	0.00	363.17	222.17	585.33	1.67	-0.12
	25%	91.67	-1.78	98.21	-2.56	-8.45	-4.79	348.00	198.33	546.33	1.76	-8.74
	50%	85.00	-8.93	91.07	-7.69	-16.90	-11.17	306.00	167.33	473.33	1.86	-18.94
	75%	80.00	-14.28	85.71	-19.66	-22.11	-20.59	250.17	147.82	397.98	1.71	-23.95
	100%	73.33	-21.43	78.57	-29.91	-26.06	-28.46	200.67	128.77	329.43	1.56	-25.71

Table 12. Allelopathic effect of Sal [*Shorea robusta* Gaertn.] on selected herbaceous species

HERBS	Concentrations	Germination (%)	% of Inhibition or stimulation					Vigour Index			Shoot: Root	Inhibition or stimulation of Biomass (%)
			Germination	Viability	Shoot length	Root length	Seedling Length	Shoot	Root	Seedling		
S. occidentalis	CON	80.00	0.00	100.00	-0.01	0.00	0.00	557.28	190.28	747.56	2.95	0.00
	25%	76.67	-17.86	95.83	-2.60	-0.78	-2.14	522.10	181.68	703.78	2.91	-4.54
	50%	73.33	-21.43	91.67	-12.47	-6.12	-10.87	448.60	163.67	612.27	2.89	-13.88
	75%	70.00	-25.00	87.50	-27.18	-8.09	-22.35	356.04	152.37	508.41	2.51	-27.81
	100%	83.33	-10.71	104.17	-13.00	-11.89	-12.72	506.23	168.80	675.03	3.33	-29.08
O. gratissimum	CON	71.67	0.00	100.00	0.00	0.00	0.00	114.27	582.67	696.93	0.20	0.00
	25%	63.33	-11.63	88.37	-16.12	-11.83	-12.53	84.15	450.19	534.34	0.19	-22.58
	50%	50.00	-30.23	69.77	-25.93	-26.16	-26.12	58.74	295.50	354.24	0.20	-31.45
	75%	43.33	-39.53	60.47	-32.48	-42.41	-40.78	46.49	200.13	246.63	0.23	-46.77
	100%	41.67	-41.86	58.14	-19.54	-11.84	-13.10	53.35	296.85	350.20	0.18	-60.08
A. paniculata	CON	93.33	0.00	100.00	0.00	0.00	0.00	356.70	225.86	582.56	1.58	0.00
	25%	81.67	-12.50	87.50	-6.31	-6.24	-6.28	290.58	187.97	478.55	1.65	-6.93
	50%	71.67	-23.21	76.79	-11.78	-19.62	-14.82	241.38	139.78	381.16	1.73	-27.03
	75%	55.00	-41.07	58.93	-15.55	-61.59	-33.41	176.27	51.37	227.63	3.58	-43.83
	100%	51.67	-44.64	55.36	-16.78	-62.96	-34.69	167.17	47.95	215.12	3.74	-46.77
P. zeylanica	CON	93.33	3.58	100	0.00	0.00	0.00	326.88	208.57	555.32	1.57	0.00
	25%	83.33	-10.71	89.286	-23.34	-22.31	-22.94	222.19	145.43	367.61	1.55	-31.64
	50%	86.67	-7.14	92.857	-15.63	-19.70	-17.22	254.8	154.83	409.63	1.65	-19.68
	75%	88.33	-5.35	94.643	-13.82	-16.04	-14.69	265.23	163.13	428.36	1.64	-9.05
	100%	91.667	-1.78	98.214	-7.91	-10.15	-8.78	294.3	183.5	487.17	1.60	-7.93
O. corniculata	CON	93.33	-1.78	100.00	0.00	0.00	-3.19	299.00	210.63	509.63	1.48	0.00
	25%	91.67	-1.78	98.21	-8.20	-4.78	-11.46	269.47	194.80	464.27	1.40	-18.92
	50%	85.00	-8.93	91.07	-11.84	-15.88	-17.82	239.87	159.65	399.51	1.51	-21.15
	75%	80.00	-14.28	85.71	-17.76	-19.70	-22.63	209.92	142.82	352.73	1.46	-30.70
	100%	73.33	-21.43	78.57	-20.04	-22.69	-25.07	186.37	127.57	313.93	1.56	-26.85

Table 13. Allelopathic effect of Jarul [*Lagerstroemia speciosa* (L.) Pers.] on selected herbaceous species

HERBS	Concentrations	Germination (%)	% of Inhibition or stimulation					Vigour Index			Shoot: Root	Inhibition or stimulation of Biomass (%)
			Germination	Viability	Shoot length	Root length	Seedling Length	Shoot	Root	Seedling		
S. occidentalis	CON	86.67	0.00	100.00	0.00	0.00	0.17	528.30	198.63	721.46	2.64	0.00
	25%	80.00	-7.69	92.31	-5.84	-2.18	-4.58	456.64	178.03	634.68	2.55	-4.38
	50%	76.67	-11.54	88.46	-7.90	-5.02	-6.86	427.96	166.07	594.03	2.58	-27.39
	75%	70.00	-19.23	80.77	-8.53	-5.89	-7.56	390.52	150.23	540.75	2.60	-7.55
	100%	63.33	-26.92	73.08	-8.70	-8.80	-8.48	347.64	131.83	479.47	2.64	-2.90
O. gratissimum	CON	86.67	0.00	100.00	0.23	0.00	-48.41	138.35	74.03	212.38	1.90	13.57
	25%	85.00	-1.92	98.08	-14.77	-1.48	-77.31	115.27	71.49	186.75	1.61	-66.53
	50%	58.33	-25.00	67.31	-16.60	-23.05	-79.52	77.15	37.97	115.12	2.03	-51.84
	75%	48.33	-36.54	55.77	-29.20	-29.30	-82.14	54.35	29.15	83.50	1.86	-66.94
	100%	41.67	-48.08	48.08	-33.62	-36.33	-83.48	43.88	22.62	66.50	1.94	-59.59
A. paniculata	CON	93.33	0.00	100.00	0.00	0.00	-0.12	356.70	224.82	581.51	1.59	1.46
	25%	76.67	-17.86	82.14	2.07	-7.05	-1.63	299.58	171.95	471.53	1.75	-12.81
	50%	71.67	-23.21	76.79	6.25	-12.72	-1.26	291.55	150.20	441.75	1.99	-19.04
	75%	70.00	-25.00	75.00	7.74	-17.15	-2.06	288.88	138.53	427.42	2.16	-25.26
	100%	66.67	-28.57	71.43	7.13	-19.36	-3.29	273.30	130.70	404.00	2.12	-29.02
P. zeylanica	CON	96.67	0.00	100.00	0.00	0.97	0.38	338.85	219.63	558.48	1.54	0.71
	25%	93.33	-3.45	96.55	-9.44	-10.60	-9.89	297.23	188.67	485.90	1.68	-12.44
	50%	93.33	-5.17	94.83	-14.39	-12.69	-13.73	274.45	178.88	453.33	1.56	-19.82
	75%	83.33	-13.79	86.21	-18.02	-28.66	-22.16	238.07	132.03	370.10	1.81	-24.87
	100%	81.67	-15.52	84.48	-23.07	-8.06	-17.22	218.45	167.22	385.67	1.37	-25.60
O. corniculata	CON	93.33	0.00	100.00	0.00	0.00	0.00	268.17	210.63	478.80	1.33	0.71
	25%	91.67	-1.79	98.21	-1.27	-4.78	-2.80	259.70	194.80	454.50	1.35	-14.17
	50%	85.00	-8.93	91.07	-1.62	-15.88	-7.85	239.87	159.65	399.51	1.51	-20.55
	75%	80.00	-14.29	85.71	-8.23	-19.70	-13.24	209.92	142.82	352.73	1.46	-24.67
	100%	73.33	-21.43	78.57	-10.78	-22.69	-15.98	186.37	127.57	313.93	1.56	-26.12

ANNEXURE – III

[Herbarium specimens for submission]

Sl. No.	Name of Plants	Field No.	Date
1	*Achyrospermum wallichianum* (Benth.) Benth. *ex* Hook.f.	1185	02-08-2010
2	*Acmella uliginosa* (Sw.) Cass	1645	03-05-2012
3	*Actinodaphne obovata* (Nees) Blume	1575	03-03-2012
4	*Aeschynanthus gracilis*	1750	25/12/2012
5	*Aesculus assamica* Griff.	1254	06-03-2010
6	*Ageratum conyzoides* (L.) L.	905	09-12-2008
7	*Ageratum conyzoides* (L.) L.	1901	07-03-2013
8	*Ageratum houstonianum* Mill.	990	11-03-2009
9	*Ageratum houstonianum* Mill.	1504	30/12/2011
10	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet	1899	07-03-2013
11	*Alangium chinense* (Lour.) Harms	1197	02-08-2010
12	*Alangium chinense* (Lour.) Harms	1287	06-04-2010
13	*Alpinia calcarata* (Haw.) Roscoe	899	09-12-2008
14	*Alpinia nigra* (Gaertn.) Burtt	1693	03-05-2012
15	*Alternanthera sessilis* (L.) R.Br. *ex* DC.	1397	06-05-2010
16	*Amaranthus spinosus* L.	1850	26/12/2012
17	*Annona reticulata* L.	1276	06-03-2010
18	*Antidesma acidum* Retz.	1916	03-08-2013
19	*Argyreia roxburghii* Choisy	1756	25/12/2012
20	*Aristolochia saccata* Wall.	1580	03-03-2012
21	*Aristolochia tagala* Cham.	605	28/5/2008
22	*Aristolochia tagala* Cham.	889	09-11-2008
23	*Artemisia indica* Willd.	1648	03-05-2012
24	*Artocarpus Sp*	947	09-12-2008
25	*Artocarpus lacucha* Buch.-Ham.	1898	07-03-2013
26	*Athyrium* sp	1298	06-04-2010
27	*Axonopus compressus* (Sw.) P. Beauv.	580	27/5/2008
28	*Azadirachta indica* A. Juss.	1028	11-04-2009
29	*Balakata baccata* (Roxb.) Esser.	1792	25/12/2012
30	*Bambusa* sp	1563	03-03-2012
31	*Bauhinia purpurea* L.	1445	29/12/2011
32	*Bischofia javanica* Blume	721	29/5/2008
33	*Bridelia glauca* Blume	1975	03-08-2013
34	*Buddleja asiatica* Lour.	1267	06-03-2010

Sl. No.	Name of Plants	Field No.	Date
35	*Butea monosperma* (Lam.) Taub	1854	26/12/2012
36	*Callicarpa arborea* Roxb.	1607	03-04-2012
37	*Callicarpa Sp*	683	29/5/2008
38	*Callicarpa Sp*	1111	11-07-2009
39	*Casearia glomerata* Roxb.	1299	06-04-2010
40	*Casearia vareca* Roxb.	1741	25/12/2012
41	*Cassia fistula* L.	1452	29/12/2011
42	*Catunaregam longispina* (Link) Tirveng.	980	09-12-2008
43	*Celastrus paniculatus* Wild.	1921	03-08-2013
44	*Chloranthus elatior* Link.	1697	03-05-2012
45	*Chromolaena odorata* (L.) R.M.King & H.Rob.	1300	06-04-2010
46	*Chrysopogon aciculatus* (Retz.) Trin.	675	29/5/2008
47	*Chrysopogon aciculatus* (Retz.) Trin.	809	30/5/2008
48	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	1011	11-04-2009
49	*Cinnamomum glaucescens* (Nees) Hand.- Mazz	1798	26/12/2012
50	*Cleome rutidosperma* DC.	1256	06-03-2010
51	*Cleome rutidosperma* DC.	1982	03-08-2013
52	*Clerodendrum infortunatum* L.	1862	26/12/2012
53	*Coffea benghalensis* B.Heyne *ex* Schult.	977	09-12-2008
54	*Colebrookea oppositifolia* Sm.	1652	03-05-2012
55	*Commelina suffruticosa* Blume	1556	03-03-2012
57	*Cordia oblique*	1734	25/12/2012
58	*Crotalaria Sp*	1456	29/12/2011
59	*Crotalaria pallida* Aiton.	1023	11-04-2009
60	*Croton caudatus* Gieselar	1244	06-03-2010
61	*Croton caudatus* Gieselar	1927	03-08-2013
62	*Curculigo recurvata* W.T.Aiton	672	29/5/2008
63	*Cyanotis vaga* (Lour.) Schult. & Schult.f.	1590	03-03-2012
64	*Cymbopogon jwarancusa* (Jones) Schult.	754	30/5/2008
65	*Cymbopogon jwarancusa* (Jones) Schult.	1867	26/12/2012
66	*Dalbergia sissoo* DC.	1305	06-04-2010
67	*Dicliptera bupleuroides* Nees	1725	25/12/2012
68	*Dioscorea bulbifera* L.	1034	11-04-2009
69	*Dioscorea belophylla* (Prain) Voigt *ex* Haines	1610	03-05-2012
70	*Diplazium esculentum* (Retz.) Sw.	732	29/5/2008
71	*Dryopteris sparsa* (D. Don) Kuntze	1432	29/12/2011
72	*Dryopteris sikkimensis* (Bedd.) Kuntze	1355	06-04-2010
73	*Dryopteris Sp*	1800	26/12/2012
74	*Duchesnea indica* (Jacks.) Focke	1045	11-05-2009
75	*Elaeocarpus floribundus* Blume	1578	03-03-2012

Sl. No.	Name of Plants	Field No.	Date
76	*Elephantopus scaber* L.	1932	03-08-2013
77	*Enydra fluctuans* DC.	869	09-11-2008
78	*Eranthemum pulchellum* Andrews	1873	26/12/2012
79	*Erigeron canadensis* L.	1663	03-05-2012
80	*Eupatorium adenophorum* Hort.Berol. *ex* Kunth	1367	06-04-2010
81	*Eurya acuminata* DC.	666	29/5/2008
82	*Evolvulus alsinoides* (L.) L.	1896	07-03-2013
83	*Ficus benjamina* L.	756	30/5/2008
84	*Ficus hispida* L.f.	1423	29/12/2011
85	*Flemingia* sp	1543	30/12/2011
86	*Globba* sp	575	27/5/2008
87	*Gmelina arborea* Roxb.	1311	06-04-2010
88	*Gomphostemma ovatum* Wall *ex* Benth.	1941	03-08-2013
89	*Gouania leptostachya* DC.	1565	03-03-2012
90	*Grewia eriocarpa* Juss.	953	09-12-2008
91	*Grewia eriocarpa* Juss.	1462	29/12/2011
148	*Grewia sp*	1701	03-05-2012
92	*Hedyotis scandens* Roxb.	1882	26/12/2012
93	*Heliotropium indicum* L.	1223	06-03-2010
94	*Holarrhena pubescens* Wall. *ex* G.Don	1616	03-05-2012
95	*Holmskioldia sanguinea* Retz.	691	29/5/2008
96	*Homalomena rubescens* (Roxb.) Kunth	825	30/5/2008
97	*Hyptis suaveolens* (L.) Poit.	1473	29/12/2011
98	*Ichnocarpus frutescens* (L.) W.T.Aiton	1441	29/12/2011
99	*Ichnocarpus frutescens* (L.) W.T.Aiton	1885	26/12/2012
100	*Ichnocarpus volubilis*	1534	30/12/2011
101	*Imperata cylindrica* (L.) Raeusch.	1987	03-08-2013
102	*Jasminum dispermum* Wall.	1056	11-05-2009
103	*Lannea coromandelica* (Houtt.) Merr.	533	27/5/2008
104	*Lantana camara* L.	1211	06-03-2010
105	*Leea guineensis* G. Don	1411	29/12/2011
106	*Leea aequata* L.	1593	03-04-2012
107	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	834	30/5/2008
108	*Lepidagathis incurva* Buch.-Ham. *ex* D. Don	1945	03-08-2013
109	*Leucas indica* (L.) Sm.	698	29/5/2008
110	*Leucas indica* (L.) Sm.	1321	06-04-2010
111	*Litsea panamaja* (Nees) Hook.f.	1674	03-05-2012
56	*Litsea salicifolia*	1069	11-05-2009
112	*Litsea glutinosa* (Lour.) C.B.Rob.	1500	30/12/2011

Sl. No.	Name of Plants	Field No.	Date
113	*Litsea glutinosa* (Lour.) C.B.Rob.	1809	26/12/2012
114	*Ludwigia perennis* L.	1482	29/12/2011
115	*Macaranga denticulata* (Blume) Müll.Arg.	838	09-11-2008
116	*Machilus glaucescens* (Nees) Wight.	1889	07-03-2013
117	*Maesa chisia* Buch.-Ham. *ex* D. Don	1343	06-04-2010
118	*Mallotus philippensis* (Lam.) Müll.Arg.	1625	03-05-2012
119	*Mangifera indica* L.	1071	11-05-2009
120	*Maranta arundinacea* L.	1766	25/12/2012
121	*Marsilea minuta* L.	765	30/5/2008
122	*Melastoma malabathricum* L.	1521	30/12/2011
123	*Melastoma malabathricum* L.	1988	03-08-2013
124	*Melochia corchorifolia*	1102	11-06-2009
125	*Melochia corchorifolia* L.	1587	03-03-2012
126	*Merremia hirta* (L.) Merr.	615	28/5/2008
127	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem	875	09-11-2008
128	*Micromelum integerrimum* (Buch.-Ham. *ex* DC.) Wight & Arn. *ex* M. Roem	1893	07-03-2013
129	*Mitracarpus hirtus* (L.) DC.	1378	06-04-2010
130	*Morinda angustifolia* Roxb.	1682	03-05-2012
131	*Morus alba* Miq.	1172	02-08-2010
132	*Morus australis* Poir.	504	27/5/2008
133	*Murraya koenigii* (L.) Spreng.	867	09-11-2008
134	*Naravelia zeylanica* (L.) DC.	1490	30/12/2011
135	*Natsiatum herpeticum* Buch.-Ham. *ex* Arn.	1525	30/12/2011
136	*Nelsonia canescens* (Lam.) Spreng.	1097	11-06-2009
137	*Oldenlandia corymbosa* L.	1775	25/12/2012
138	*Paederia foetida* L.	627	28/5/2008
139	*Paederia foetida* L.	896	09-12-2008
140	*Parthenium hysterophorus* L.	1948	03-08-2013
141	*Persicaria chinensis* (L.) H. Gross	1403	29/12/2011
142	*Persicaria hydropiper* (L.) Delarbre	1137	02-07-2010
143	*Phaulopsis imbricata* (Forssk.) Sweet	1817	26/12/2012
144	*Phlogacanthus thyrsiformis* (Hardwicke) Mabberley	1560	03-03-2012
145	*Phyllanthus emblica* L.	921	09-12-2008
146	*Pilea sp*	1705	03-05-2012
147	*Piper boehmarifolia*	1994	03-08-2013
149	*Pothos scandens* L.	943	09-12-2008
150	*Pouzolzia zeylanica* (L.) Benn.	1492	30/12/2011
151	*Premna bengalensis* C.B Clarke	1150	02-07-2010
152	*Premna mollissima* Roth	1630	03-05-2012

Sl. No.	Name of Plants	Field No.	Date
153	*Pronephrium Sp*	565	27/5/2008
154	*Pteris semipinnata* L.	1380	06-04-2010
155	*Pterospermum acerifolium* (L.) Willd.	1952	03-08-2013
156	*Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne	929	09-12-2008
157	*Rotheca serrata* (L.) Steane & Mabb.	1823	26/12/2012
158	*Saurauia roxburghii* Wall.	1638	03-05-2012
159	*Schima wallichii* Choisy	1094	11-06-2009
160	*Scoparia dulcis* L.	632	28/5/2008
161	*Selaginella sp*	933	09-12-2008
162	*Senna occidentalis* (L.) Link.	592	28/5/2008
163	*Senna siamea* (Lam.) H.S.Irwin & Barneby	1782	25/12/2012
164	*Senna tora* (L.) Roxb.	945	09-12-2008
165	*Senna tora* (L.) Roxb.	1375	06-04-2010
166	*Sida acuta* Burm.f.	1573	03-03-2012
167	*Sloanea sterculiacea* (Benth) Rehder & E.H. Wilson	1178	02-08-2010
168	*Sloanea sterculiacea* (Benth) Rehder & E.H. Wilson	1996	03-08-2013
169	*Smilax ovalifolia* Roxb. *ex* D.Don	1495	30/12/2011
170	*Smilax zeylanica* L.	791	30/5/2008
171	*Smilax zeylanica* L.	1835	26/12/2012
172	*Sorindeia madagascariensis* Thouars *ex* DC.	520	27/5/2008
173	*Spermacoce ocymoides* Burm.f.	1687	03-05-2012
174	*Spermacoce ocymoides* Burm.f.	1962	03-08-2013
175	*Stellaria media* (L.) Vill.	1063	11-05-2009
176	*Stephania japonica* (Thunb.) Miers	645	29/5/2008
177	*Streblus asper* Lour	1711	25/12/2012
178	*Syzygium cumini* (L.) Skeels	878	09-11-2008
179	*Syzygium cumini* (L.) Skeels	1408	29/12/2011
180	*Syzygium cumini* (L.) Skeels	1698	03-05-2012
181	*Syzygium kurzii* (Duthie) N.P.Balakr.	552	27/5/2008
182	*Syzygium kurzii* (Duthie) N.P.Balakr.	1382	06-04-2010
183	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult	1842	26/12/2012
184	*Tectona grandis* L.f.	1998	03-08-2013
185	*Tectona grandis*L.f.	1200	06-03-2010
186	*Terminalia arjuna* (Roxb. *ex* DC.) Wight & Arn.	1512	30/12/2011
187	*Tetracera sarmentosa* (L.) Vahl	572	27/5/2008
188	*Tetrastigma planicaule* (Hook. f.) Gagnep	798	30/5/2008
189	*Thelypteris nudata* (Roxb.) C.V. Morton.	1699	03-05-2012
190	*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda	1895	07-03-2013
191	*Toona ciliata* M.Roem.	1394	06-05-2010
192	*Toona ciliata* M.Roem.	1973	03-08-2013

Sl. No.	Name of Plants	Field No.	Date
193	*Uncaria macrophylla* Wall.	654	29/5/2008
194	*Uncaria macrophylla* Wall.	919	09-12-2008
195	*Urena lobata* L.	1640	03-05-2012
196	*Vitex negundo* L.	1199	02-08-2010
197	*Xanthium strumarium* L.	1785	25/12/2012
198	*Youngia japonica* (L.) DC.	770	30/5/2008
199	*Youngia japonica* (L.) DC.	1601	03-04-2012
200	*Ziziphus jujuba* Mill.	977	09-12-2008
201	*Ziziphus oenopolia* (L.) Mill.	1209	06-03-2010

SL NO	SPECIES	FIELD NO	DATE
1	*Abelmoschus moschatus* Medik	540	27/05/08
2	*Abroma augusta* (L.) L.f.	1251	06-03-2010
3	*Abrus precatorius* L.	1216	06-03-2010
4	*Acacia catechu* (L.f.) Wild.	1329	06-04-2010
5	*Achyranthes aspera* L.	610	28/05/08
6	*Adiantum lunulatum* Burm. f.	774	30/05/08
7	*Albizia lebbeck* (L.) Benth.	1264	06-03-2010
8	*Albizia procera* (Roxb.) Benth.	1875	02-08-2010
9	*Alstonia scholaris (L.) R. Br.*	1130	02-07-2010
10	*Alternanthera sessilis* (L.) R.Br. ex DC.	1466	29/12/11
11	*Amorphophallus bulbifer* (Roxb.) Blume	545	27/05/08
12	*Ampelocissus sikkimensis* (Lawson) Planchon	1831	26/12/12
13	*Andrographis paniculata* (Burm.f.) Wall. Ex Nees	1760	25/12/12
14	*Angiopteris evecta* (G. Forst.) Hoffm.	1896	26/12/12
15	*Annona reticulata* L.	1153	02-07-2010
16	*Ardisia solanacea* (Poir.) Roxb.	1336	06-04-2010
17	*Aristolochia indica* L.	1716	25/12/12
18	*Aristolochia tagala* Cham.	909	09-12-2008
19	*Artemisia dubia* L.*ex* B.D.Jacks	649	28/05/08
20	*Artocarpus chama Buch.*-Ham.	1188	02-08-2010
21	*Artocarpus heterophyllus* Lam.	1073	11-05-2009
22	*Asparagus racemosus* Wild	803	30/5/08
23	*Ayapana triplinervis* (Vahl) R.M.King & H.Rob.	1140	02-07-2010
24	*Bacopa monnieri* (L.) Wettst.	507	27/05/08
25	*Barleria strigosa* Willd.	998	11-03-2009
26	*Bauhinia purpurea* L.	1159	02-07-2010
27	*Bauhinia variegata* L.	1419	29/12/11
28	*Biophytum sensitivum* (L.) DC.	1657	03-05-2012
29	*Bischofia javanica* Blume	1133	02-07-2010
30	*Bryophyllum pinnatum* (Lam.) Oken	1089	11-06-2009
31	*Cannabis sativa* L.	602	28/05/08
32	*Centella asiatica* (L.) Urb.	959	09-12-2008
33	*Cheilocostus speciosus* (J.Koenig) C. D. Specht	1663	03-05-2012
34	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm.	1122	11-07-2009

SL NO	SPECIES	FIELD NO	DATE
35	*Cissus quadrangularis* L.	1061	11-05-2009
36	*Citrus medica* L.	1006	11-03-2009
37	*Cleome rutidosperma* DC.	1052	11-05-2009
38	*Clerodendrum indicum* (L.) Kuntze	780	30/05/08
39	*Clitoria ternatea* L.	1911	03-07-2013
40	*Codariocalyx motorius* (Houtt.) H.Ohashi	1031	11-04-2009
41	*Coffea benghalensis* B.Heyne *ex* Schult.	686	29/05/08
42	*Coffea benghalensis* B.Heyne *ex* Schult.	1971	03-03-2013
43	*Commelina suffruticosa* Blume	517	27/05/08
44	*Commelina suffruticosa* Blume	555	27/05/08
45	*Commelina benghalensis* L.	481	02-08-2010
46	*Crotalaria cytisoides DC.*	1360	04-06-2010
47	*Curculigo orchioides* Gaertn.	1192	02-08-2010
48	*Curcuma caesia* Roxb.	872	09-11-2008
49	*Curcuma zedoaria* (Christm.) Roscoe	1777	25/12/12
50	*Dalbergia latifolia* roxb.	1261	06-03-2010
51	*Dalbergia sissoo DC*	938	09-12-2008
52	*Datura metel* L.	596	28/5/08
53	*Datura stramonium* L.	587	27/05/08
54	*Deeringia amaranthoides* (Lam.) Merr	636	28/05/08
55	*Dioscorea pubera* Blume	514	27/05/08
56	*Diplazium esculentum* (Retz.) Sw.	639	28/05/08
57	*Elaeocarpus floribundus* Blume	1438	29/12/11
58	*Emilia sonchifolia* (L.) DC. ex DC.	547	27/05/08
59	*Enydra fluctuans* DC.	957	09-12-2008
60	*Euphorbia hirta* L.	969	09-12-2008
61	*Ficus hispida* L.f.	1190	02-08-2010
62	*Ficus religiosa* L.	1405	29/12/11
63	*Firmiana colorata* (Roxb.) R.Br.	1351	06-04-2010
64	*Flacourtia indica* (Burm.f.) Merr.	1977	03-08-2013
65	*Flacourtia jangomas* (Lour.) Raeusch	1980	03-08-2013
66	*Gloriosa superba* L.	1107	11-06-2009
67	*Glycosmis pentaphylla* (Retz.) DC.	662	29/05/08
68	*Grewia asiatica* L.	1219	06-03-2010
69	*Gynocardia odorata* R. Br.	1174	02-08-2010
70	*Hemidesmus indicus* (L.) R. Br. ex Schult.	1229	06-03-2010
71	*Holarrhena pubescens* Wall. ex G.Don	1105	11-06-2009
72	*Hygrophila auriculata* (Schumach.) Heine	1371	06-04-2010
73	*Jasminum sp*	738	29-05-2008
74	*Justicia adhatoda* L.	993	11-03-2009
75	*Lagerstroemia parviflora Roxb.*	1147	02-07-2010
76	*Lagerstroemia speciosa* (L.) Pers.	963	09-12-2008
77	*Lasia spinosa* (L.) Thwaites	583	27/5/08
78	*Leea asiatica* (Linnaeus) Ridsdale	1951	03-08-2013
79	*Litsea monopetala* (Roxb.) Pers.	1099	11-06-2009
80	*Ludwigia octovalvis* (Jacq.) P.H.Raven	656	29/05/08
81	*Ludwigia perennis* L.	568	27/5/08
82	*Maesa indica* (Roxb.) A. DC.	1627	03-05-2012
83	*Mallotus nudiflorus* (L.) Kulju & Welzen.	1416	29/12/11

SL NO	SPECIES	FIELD NO	DATE
84	*Maranta arundinacea* L.	528	25/05/2008
85	*Mentha piperita* L.	529	25/05/08
86	*Mesua ferrea* L	902	09-12-2008
87	*Michelia champaca* L.	1788	25/12/12
88	*Mikania micrantha* Kunth	1789	25/12/12
89	*Mimosa pudica* L.	1049	11-05-2009
90	*Mimosa himalayana* Gamble	1203	06-03-2010
91	*Mimusops elengi* L.	1248	06-03-2010
92	*Morinda angustifolia* Roxb.	1157	02-07-2010
93	*Morus macroura* Miq.	1448	29/12/11
94	*Murraya paniculata* (L.) Jack	975	09-12-2008
95	*Mussaenda roxburghii* Hook. f.	1967	03-08-2013
96	*Mussaenda sp*	561	27-05-2008
97	*Naravelia zeylanica* (L.) DC.	1207	06-03-2010
98	*Naravelia zeylanica* (L.) DC.	1227	26/12/12
99	*Natsiatum herpaticum Buch.-Ham ex Arm.*	679	29/5/08
100	*Neolamarckia cadamba* (Roxb.) Bosser	1213	06-03-2010
101	*Nyctanthes arbor-tristis* L.	1568	03-03-2012
102	Ocimum gratissimum L.	821	30/5/08
103	*Ocimum tenuiflorum* L.	786	30/5/08
104	*Oroxylum indicum* (L.) Kurz	1039	11-04-2009
105	*Pandanus unguifer* Hook.f.	1428	29/12/11
106	*Persicaria chinensis* (L.) H. Gross	621	28/05/08
107	*Phyllanthus urinaria* L.	1239	06-03-2010
108	*Physalis minima* L.	845	09-11-2008
109	*Piper betel* L.	778	30/5/08
110	*Piper betel* L.	740	29/5/08
111	*Piper betleoides C. DC.*	525	27/5/08
112	*Piper hamiltonii* C. DC.	806	30/5/08
113	*Piper longum* L.	537	27/5/08
114	*Piper nigrum* L.	583	27/5/08
115	*Piper peepuloides* Roxb.	512	27/5/08
116	*Piper attenuatum* Buch.-Ham. ex Miq.	695	29/5/08
117	*Plumbago zeylanica* L.	1635	03-05-2012
118	*Plumbago zeylanica* L.	1529	30/12/11
119	*Polyalthia simiarum* (Buch.-Ham. *ex* Hook. f. & Thomson) Benth. *ex* Hook. f. & Thomson	1164	02-07-2010
120	*Premna mollissima* Roth	1476	29/12/11
121	*Psidium guajava* L.	734	29/05/08
122	*Pteris semipinnata* L.	758	30/05/08
123	*Punica granatum* L.	749	30/5/08
124	*Rauvolfia serpentina* (L.) Benth. ex Kurz	1025	11-04-2009
125	*Ricinus communis L.*	1145	02-07-2010
126	*Saraca asoca (Roxb) Willd*	693	29/05/08
127	*Sauropus sp*	1508	30/12/11
128	*Sauropus sp*	727	29-05-2008
129	*Setaria palmifolia* (J. Koenig) Stapf.	859	09-11-2008
130	*Shorea robusta* Gaertn.	1226	06-03-2010
131	*Solanum aculeatissimum* Jacq.	578	27/5/08
132	*Streblus asper* Lour.	1323	06-04-2010

SL NO	SPECIES	FIELD NO	DATE
133	*Syzygium formosum* (Wall.) Masam.	1413	29/12/11
134	*Tabernaemontana divaricata* (L.) R.Br. *ex* Roem. & Schult	1119	11-07-2009
135	*Tephrosia candida* (Roxb.) DC.	1169	02-08-2010
136	*Terminalia bellirica* (Gaertn.) Roxb.	926	09-12-2008
137	*Terminalia bellirica* (Gaertn.) Roxb.	1002	11-03-2009
138	*Tetracera sarmentosa* (L.) Vahl	1517	30/12/11
139	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	1839	26/12/12
140	*Thunbergia grandiflora* (Roxb. *ex* Rottl.) Roxb.	659	29/5/08
141	*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda	1016	11-04-2009
142	*Tinospora sinensis* (Lour.) Merr.	1721	25/12/12
143	*Toona ciliata* M.Roem.	703	29/5/08
144	*Trema orientalis* (L.) Blume	1084	11-06-2009
145	*Triumfetta rhomboidea* Jacq.	1309	06-04-2010
146	*Typhonium trilobatum* (L.) Schott.	1769	25/12/12
147	*Vallaris solanacea* (Roth) Kuntze	1903	03-07-2013
148	*Vallaris solanacea* (Roth) Kuntze	1905	03-07-2013
149	*Vitex negundo* L.	1315	06-04-2010
150	*Wrightia arborea* (Dennst.) Mabb.	1278	06-03-2010
151	*Zingiber officinale* Roscoe	882	09-11-2008
152	*Zingiber officinale* Roscoe	1744	25/12/12
153	*Zingiber zerumbet* (L.) Roscoe ex Sm.	814	30/5/08

Annexure - IV

[List of Publication, Seminar and Workshop Participated]

I. Publication Based on thesis

Biswas, Kishor & Das, A.P. 2012. Plants used for dental and oral health care in northern part of West Bengal, India. In G.G. Maiti & S.K. Mukherjee, (eds.), International Seminar on "**Multidisciplinary Approaches in Angiospenn Systematics**". University of Kalyani, Kalyani. Pp.648 – 651.

Sarkar, Ajita; **Biswas, Kishor** & Das, A.P. 2010. Ethnobotany of *Kirat Parab* of *Magar* Community in Buxa Duar area of West Bengal, India. ***Ethnobotany*** 22: 82 – 85.

Das, A.P.; Samanta, A. K. & **Biswas, Kishor.** 2010. A census of *Piper* L. (Piperaceae) in Terai, Duars and the hills of Darjeeling and Sikkim Himalayas. ***Pleione*** 4(1): 33 – 41.

Das, A.P.; Ghosh, C.; Sarkar, A.; Biswas, R.; **Biswas, K**.; Chowdhury, D.; Lama, A.; Moktan, S. & Chowdhury, A. 2010. Preliminary report on the Medicinal Plants from three MPCAs in Terai and Duars of West Bengal, India. ***Pleione*** 4(1): 90 – 101.

Biswas, Kishor & Das, A.P. 2016. Allelopathic effects of Teak (*Tectona grandis* L.f.) on germination and seedling growth of *Plumbago zeylanica* L. ***Pleione*** 10(2): 262 – 2068.

Biswas, Kishor & Das, A.P. 2017. Impact of invasive alien weeds on phytodiversity of Terai – Duars region of West Bengal, India. ***NBU Journal of Plant Sciences***.[Communicated]

II. Publication other than thesis

Biswas, Kishor & Das, A.P. 2011. Documentation of wild leafy vegetables from the tribal dominatedparts of Malda District of West Bengal, India. In C. Ghosh & A.P. Das, ***Recent Studies in Biodiversity and Traditional Knowledge in India***. Sarat Book House, Kolkata. Pp. 301 – 306.

III. Abstract

Biswas, Rajib; **Biswas, Kishor** & Das, A.P. 2008. Aquatic Flowering Plants of Rasik Beel in Coochbehar District of West Bengal. Intrnational Seminar on "**Multidisciplinary Approaches in Angiospenn Systematics**". University of Kalyani, Kalyani.

Biswas, Rajib; Sarkar, Ajita; Ghosh, Chandra; **Biswas, Kishor** & Das, A.P. 2008. Ferns of North Bengal University Campus in Darjiling District of West Bengal. Intrnational Seminar on "**Multidisciplinary Approaches in Angiospenn Systematics**". University of Kalyani, Kalyani.

Biswas, Kishor & Das, A. P. 2011. Wild leafy vegetables from the Malda District of West Bengal, India. *Nat. Sem. Explor. Protec. Cons. Biodv. Trad. Knowl.* Gour College, Malda P- 39.

Anand Lama, **Kishore Biswas**, Rajib Biswas and A. P. Das 2011. Flora of northern bank of Mangdechhu River in Trongsa, Bhutan with notes on endemic and threatened plants. *Nat. Sem. Explor. Protec. Cons. Biodv. Trad. Knowl.* Gour College, Malda P- 50.

Chowdhury, Anurag; **Biswas, Kishor** & Das, A.P. 2011. Comparative analysis of Herbaceous plants in some natural and plantation forests of Terai and Duars in West Bengal. *Nat. Sem. Explor. Protec. Cons. Biodv. Trad. Knowl.* Gour College, Malda P- 42.

Biswas, Kishor & Das, A. P. 2011. Wild leafy vegetables from the Malda District of West Bengal, India. *Nat. Sem. Explor. Protec. Cons. Biodv. Trad. Knowl.* Gour College, Malda P- 39.

Biman Krishna Saha, **Kishor Biswas** & A. P. Das 2012. Allelopathic effects of trees used in plantation on indigenous rice varieties in Terai of West Bengal, India. Abstract in *National Conference on Recent Trends on Plant Diversity and Conservation Strategies*, Nagaland University, Lumami.

Kishor Biswas & A. P. Das 2012. Botanical identity of some plant materials sold by *Ojhas* in rural markets of North Bengal, India. Abstract in *National Conference on Recent Trends on Plant Diversity and Conservation Strategies*, Nagaland University, Lumami.

Kishor Biswas & A. P. Das 2017. Phytosociological Analysis of Teak (Tectona grandis L. f.) Plantation in Terai Region of West Bengal, India. West Bengal Regional Science congress. 2017. [Communicated]

III. Seminar and Workshop Participated

- International Seminar on "Multidisciplinary Approaches in Angiospenn Systematics”. University of Kalyani, Kalyani.
- Propagation and cultivation of Medicinal plants, NBU, West Bengal
- Biodiversity showcasing Northern West Bengal, Siliguri, West Bengal
- Sustainable utilization of Plant and Microbial Resources, NBU, West Bengal
- Access to E-resources under UGC INFONET Digital Library Consortium, NBU, West Bengal
- Microbial Wealth - Plant Health, NBU, West Bengal
- The Exploration, Protection and Conservation of Biodiversity and Traditional knowledge, Gour Mahavidyalaya, Malda, West Bengal
- User awareness programme on access to E- recources under N-LIST Programme, NBU, West Bengal
- National Seminar on Biotechnology for people: Applications and Awareness. Department of Botany, Prasannadeb Women’s college Jalpaiguri, West Bengal
- Diversity conservation and Sustainable utilization of Plant and Traditional knowledge in eastern Himalaya, Department of Botany, NBU, West Bengal
- National Symposium on Recent trends in Plants and Microbial Research. Department of Botany, NBU, West Bengal.

Pleione 4(1): 90 - 101. 2010. ISSN 0973 - 9467

Preliminary report on the Medicinal Plants from three MPCAs in Terai and Duars of West Bengal, India

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Abstract

FRLHT in collaboration with the West Bengal Forest Department and scientists from Universities, Research Institutes and other organizations in a meeting at Kolkata during December 4 – 7, 2007 selected three Medicinal Plants Coservation Areas (MPCA) in Terai and Duars region of West Bengal [1. Rajavatkhaoa PMCA, 2. Lataguri MPCA and 3. North Sevoke Forest MPCA]. Four season floristic survey in these MPCAs resulted in the record of 309 species of potential Medicinal Plants. Out of these, 25 species are representing the list of 46 threatened species prepared in the meeting referred above.

Key words: Medicinal Plants, Conservation, Terai, Duars

INTRODUCTION

The northernmost part of West Bengal touching the feet of Eastern Himalaya is generally referred as Terai and Duars (west and east of the river Tista, respectively). This forest clad region is quite rich in biodiversity and its vegetations are contiguous with the Eastern Himalaya. Also, this area is covered by the IUCN recognised Himalaya Hotspot for conservation (Conservation International 2005). Numerous rare and threatened species of plants are the inhabitants of these forests. The wide diversity in habitat structure helped numerous species of plants to settle in the area (Rai & Das 2008). The forests are mostly mixed-deciduous types and other prominent vegetations include riverine scrubs and forests, herblands, shrubby-scrubs, savannah type tall grasslands etc. In addition, wide areas in Terai and Duars are also covered with mono- or mixed-cultured plantation forests using both local and exotic species. However, with the rapid extension of civilisation, the exploitation and damage to the natural habitat by anthropogenic reasons is beyond any limit. This is certainly adversely affecting the biodiversity of this region.

The collection of wide variety of medicinal and aromatic plants from different types of vegetation of this area is in practice since long and the control over such exploitation is negligible. There are regular collectors and vendors for this trade and huge quantity of plant materials, legally or illegally, are exported to long distant markets.

The recent realisation about the need of conservation has forced the concerned agencies to take up some steps in this regard but there are numerous constrains. Whatever may be the situation, the biodiversity is being affected and the population of useful plants is now dwindling rapidly. Man is now realising the benefits of using plant-based medicines over the synthetic chemicals for the remedy of their various diseases. This has led to the unimaginable expansion of the market of medicinal plants round the world. Being a megadiversity country, India's participation in this market should bein a big way. Exploitation of naturally growing plants for this market can not help us to do so. For this we need to do following two things:

1. *In situ* and *ex situ* conservation of medicinal plants over wide areas; and
2. The cultivation of medicinal plants for marketing.

Realising the situation, different projects at the Government and NGO level are being undertaken for conservation and cultivation of medicinal plants.

Foundation for Revitalisation of Local Health Traditions (FRLHT), Bangalore is in big way coming out in such activities taking the help of different state Forest Department, Universities, NGOs and other scientists. Accordingly, a meeting was held at Kolkata during December 4 – 7, 2007 and has recognised a number of Medicinal Plants Conservation Areas (MPCA) in West Bengal. For the plains of North Bengal i.e. Duars and Terai region three such MPCAs has been recognised as follows:

1. **Rajavatkhaoa Forests** (NRVK – 8; NRVK – 9): 400 hectares
2. **Lataguri Forest** (Sursuti – 4): 100 hectares
3. **North Sevok Forest**: 100 hectares

These forests are quite rich in biodiversity (both plants and animals) with appreciably low anthropogenic activities. The selected Forest Compartments are mainly natural forests with small amount of plantations and are very well connected or contiguous with other protected areas like

(i) **Buxa Tiger Reserve** for Rajavatkhaoa MPCA

(ii) **Gorumara National Park** for Lataguri MPCA, and

(iii) **Mahananda Wildlife Sanctuary** for North Sevoke MPCA.

Present paper deals with the records of different medicinal plants growing in these 3 *in-situ* conservatories in Duars and Terai of West Bengal.

The said meeting also prepared a list of 46 species of medicinal plants those are to be treated as threatened in West Bengal.

MATERIALS AND METHODS

The methodogoly followed for the entire work is quite big, but for the present report preparation of a detailed flora for each of the three MPCAs was the basic requirement. Sampling was done through two methods, (i) random collection from all places covering all types of habitat in different seasons of the year; and (ii) collection through nested quadrates.

For quadrate sampling, each MPCA was properly demarcated. Then, a number of longitudinal and transverse grids were marked in the forest. On such grids, in one particular corner one nested quadrate was selected. This selection was completely random as no other criteria were considered for this purpose. All the quadrates were marked properly using wooden pegs and also markings on nearest trees in all the four corners of the large (20 m x 20 m) quadrate. Three sizes of quadrates were demarcated: 20m x 20m for canopy, 5m x 5m for shrub layer and 1m x 1m for the ground covering vegetation (Misra 1966; Rai 2006; Ghosh 2006). Surveys were conducted during 2008 – 2010 in four different seasons (i) Premonsoon, (ii) Post-monsoon, (iii) Winter, and (iv) Summer.

Specimens of all types of plants were collected and processed into mounted herbarium sheets following Jain & Rao (1977) and were identified in the Taxonomy and Environmental Biology Laboratory of the Department of Botany, University of North Bengal using different literature (Hooker 1872 - 1897; Prain 1903; Hara 1966, 1971, Ohashi 1975; Hara *et al* 1978, 1979, 1982; Grierson & Long 1983, 1984, 1987,1991, 1999, 1001; Noltie 1994, 2000; Pearce & Cribb 2002). Finally, the specimens were matched at CAL and NBU Herbaria.

One set of specimens has been stored at NBU-Herbarium and the remaining sets were submitted to the Forest Department for their onward transport to the FRLHT.

Medicinal and aromatic plants of the recorded flora have been recognised using a number of references including Kirtikar & Basu (1935), Biswas & Chopra (1956), Chopra *et al* (1956), Jain

(1991), Gurung (2002), Das & Mandal (2003), Khare (2004). In addition to medicinal plants used for the production of medicines commercially, ethnomedicinal plants are also recorded.

Uses of plants if any or any other observations of interest made during the fieldwork.

RESULT AND DISCUSSION

Quite a large number of plants of different major taxonomic groups including Pteridophytes and Angiosperms have been recorded from these three MPCAs (unpublished data). However, plants with known aromatic and/or medicinal values were recognized and presented in APPENDIX I.

The record of the occurrence of 309 species of medicinal plants in three MPCAs located in the Terai and Duars of West Bengal is an expression of the importance of the vegetation and flora of this region. Not only that, out of the 46 species of threatened medicinal plants recognized in December 2007 meeting 25 species has been recorded from these three MPCAs (Table 1). Names of these 25 species are *Abelmoschus moschatus, Alpinia calcarata, Ampelocissus barbata, Aphanamixis polystachya, Aristolochia indica, Asparagus racemosus, Celastrus paniculatus, Cinnamomum bejolghota, Ciannamomum cecidodaphne, Dioscorea prazeri, Drosera burmanii, Gloriosa superba, Gynocardia odorata, Helminthostachys zeylanica, Litsea glutinosa, Lycopodiella cernua, Mesua ferrea, Mucuna pruriens, Ophioglossum reticulatum, Pericampylus glaucus, Persea glaucescens, Pterocarpus marsupium, Rauvolfia serpentina, Stereospermum colais* and *Toona ciliata.*

Table 1. Numerical distribution of recorded threatened species of medicinal plants from three MPCAs under study.

Sl. No.	MPCAs	No. of listed species	Total no. of listed species recorded
1.	Rajavatkhawa MPCA	24	20
2.	Lataguri MPCA	24	
3.	North Sevoke MPCA	20	

The distribution of remaining 11 species [*Aconitum bisma, Aconitum ferox, Aconitum spicatum, Berberis aristata, Desmodium motorium, Gymnema sylvestre, Ipomoea mauritiana, Lumnitzera racemosa, Morinda citrifolia, Nypa fruticans, Olax nana, Panax pseudoginseng, Picrorhiza kurroa, Podophyllum hexandrum, Sonnertia caseolaris, Swertia chirayita, Taxus wallichiana, Thalictrum foliosum, Tylophora indica, Viscum articulatum* and *Xylocarpus granatum*], are restricted mostly to othe regions of the state. It is interesting to note that all the three MPCAs of North Bengal plains support the occurrence of a large number of (20 or more species) Medicinal Plants.

However, the occurrence of some other species like *Persea glausescens, Gloriosa superba, Drosera burmanii, Alpinia calcarata* and *Cinnamomum cecidodaphne* are also not very rare as it was discussed in December 2007 meeting. The population of all these plants is increasing and plants are with good health. The occurrence of *Pterospermum mersupium* is quite low in this region.

In spite of this, the result of the survey in three different MPCAs shows the occurrence of huge number of medicinal plant species which are only available in these three conservation plots. So, it is expected that along with the conservation of these 25 threatened Medicinal Plants, these MPCAs will also conserve all other medicinal plants now known to grow there. However, proper conservation strategies are to be framed and to be implemented in its strictest form to protect these important green wealth of the country.

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APPENDIX I

List of medicinal and aromatic plants recorded from three MPCAs in Terai and Duars of West Bengal

Name of Plants	Family	Field No.	Local Name	In MPCA	Used as
Abelmoschus moshatus Medikus	Malvaceae	3888	*Lata kasturi*	R/ L	A
Abrus pulchellus Wallich *ex* Thwaites	Papilionaceae	257	*Badami Kunch*	R/ L/ S	M
Acacia catechu (L.f.) Willdenow	Mimosaceae	3783	*Khayer*	R/ L/ S	M
Acacia pennata (Linnaeus) Willdenow	Mimosaceae	3514		R/ L/ S	M
Achyranthus bidentata Blume	Amaranthaceae	28	*Ankhlay Jhar*	R/ L/ S	M
Acmella calva (DC.) Jansen	Asteraceae	3900	*Kalijhar*	R/ L/ S	M
Acmella uliginosa (Swartz) Cassini	Asteraceae	3580	*Kalijhar*	R/ L/ S	M
Acmella uliginosa (Swartz) Cassini	Asteraceae	4098		R/ L/ S	M
Actinodaphne obovata (Nees) Blume	Lauraceae	2708		R/ L/ S	M
Aerva sanguinolenta (Linnaeus) Blume	Amaranthaceae	3673	*Lopang*	R/ L/ S	M
Aesculus assamica Griffith	Hippocastanaceae	452	*Satpate*	R/ L	M
Ageratum conyzoides Linnaeus	Asteraceae	10	*Elame jhar*	R/ L/ S	M
Alocasia fallax Schott	Araceae	44	*Kalo kachu*	R/ L/ S	
Alpinia calcarata Roscoe	Zingiberaceae	3554		L	M
Alpinia nigra (Gaertner) Burtt	Zingiberaceae	2478	*Purundi*	R/ L	M
Alstonia scholaris (Linnaeus) R. Brown	Apocynaceae	3538	*Chhatian,Chhatim*	R/ L/ S	M
Alternanthera sessilis (Linnaeus) DC.	Amaranthaceae	485	*Nunia Saag*	R/ L/ S	M
Amorphophallus napalensis (Wallich) Bogner & Mayo	Araceae	3865	*Bon Ol*	R/ L/ S	M
Ampelocissus barbata (Wallich) Planchon	Vitaceae	4099	*Jangli angur*	R/ L/ S	M
Anisomeles indica (Linnaeus) Kuntze	Lamiaceae	130	*Gopali*	R/ L/ S	A
Antidesma acidum Retzius	Euphorbiaceae	491	*Archal*	R/ L/ S	M
Antidesma acuminatum Wight	Euphorbiaceae	220	*Archal*	R/ L	M
Antidesma bunius (L.) Sprengel	Euphorbiaceae	2511	*Archal*	R/ L	M
Aphanamixis polystachya (Wallich) Parker	Meliaceae	505	*Rasune Lali*	R/ L/ S	M
Argyreia roxburghii Choisy	Convolvulaceae	3791		R/ L/ S	M
Aristolochia indica Linnaeus	Aristolochiaceae	4158	*Iswarmul*	R/ L	M
Aristolochia saccata Wallich	Aristolochiaceae	4334		R/ L/ S	M
Artemesia indica Willdenow	Asteraceae	244	*Titeypati*	S	M
Artocarpus chama Buch.-Ham.	Moraceae	4296	*Lathar, Chaplash*	R/ L/ S	M
Asparagus officinalis Linnaeus	Asparagaceae	387	*Asparagus*	R/ L/ S	M
Asparagus racemosus Willdenow	Asparagaceae	2723	*Satabari, Satamuli*	R/ L	M
Baccaurea ramiflora Loureiro	Euphorbiaceae	379	*Kusum, Latka*	R/ L/ S	M
Barleria strigosa Willdnew	Acanthaceae	3704	*Nil Jati*	R/ L/ S	M

Name of Plants	**Family**	**Field No.**	**Local Name**	**In MPCA**	**Used as**
Bauhinia malabarica Roxburgh	Caesalpinaceae	4455	*Kanchan*	R/ L	M
Bauhinia purpurea Linnaeus	Caesalpinaceae	3797	*Rakta Kanchan*	R/ L/ S	M
Bauhinia variegata Linnaeus	Caesalpinaceae	4150	*Swet Kanchan*	R/ L/ S	M
Biophytum reinwardtii (Zuccarini) Klotzsch	Oxalidaceae	3551	*Rani Lajjabati*	R/ L/ S	M
Biophytum sensitivum DC.	Oxalidaceae	151	*Rani Lajjabati*	R/ L/ S	M
Bischofia javanica Blume	Bischofiaceae	4408	*Kainjal*	R/ L/ S	M
Bombax ceiba Linnaeus	Bombacaceae	3611	*Simul*	R/ L/ S	M
Bridelia retusa (Linnaeus) Sprengel	Euphorbiaceae	3774	*Datan, Gayo*	R/ L/ S	M
Bridelia sikkimensis Gehrmann	Euphorbiaceae	2250	*Kasai Datan*	R/ L/ S	M
Bridelia tomentosa Blume	Euphorbiaceae	269	*Kasai Datan*	S	M
Buddleja asiatica Loureiro	Buddlejaceae	3757	*Bhimsen pati*	S	M
Caesalpina cucullata Roxburgh	Caesalpiniaceae	3732	*Ultey kate*	R/ L/ S	M
Callicarpa arborea Roxburgh	Verbenaceae	2178	*Gwelo*	R/ L/ S	M
Careya arborea Roxburgh	Barringtoniaceae	4195	*Kumbhi*	R/ L/ S	M
Caryota urens Linnaeus	Arecaceae	3571	*Rambhang*	R/ L/ S	M
Cassia fistula Linnaeus	Caesalpiniaceae	330	*Bandarlathi*	R/ L/ S	M
Cassia tora Linnaeus	Caesalpiniaceae	2411	*Tapre*	R/ L/ S	M
Celastrus paniculatus Willdenow	Celastraceae	3525	*Malkaguni*	R/ L/ S	M
Centella asiatica (Linnaeus) Urban	Apiaceae	4130	*Thankuni*	R/ L/ S	M
Chlorophytum arundinaceum Baker	Antheriaceae	3853	*Makai phul*	S	M
Chromolaena odoratum (Linnaeus) King & Robinson	Asteraceae	3553	*Bonmara*	R/ L/ S	M
Chukrasia tabularis A. Jussieu	Meliaceae	2074	*Chikrasi*	R/ L/ S	M
Ciannamomum cecidodaphne Meisner	Lauraceae	4433	*Malagiri*	R/ L	M
Cinnamomum bejolghota (Hamilton) Sweet	Lauraceae	373	*Janglee tejpat, Sin Kaule*	R/ L/ S	M
Cissampelos pareira Linnaeus	Menispermaceae	4213	*Batulepati*	R/ L/ S	M
Citrus medica Linnaeus	Rutaceae	3785	*Lebu*	R/ L/ S	M
Clausena excavata Burm.f.	Rutaceae	3700	*Junglee Karipata*	R/ L	A
Clerodendrum indicum (L.) Kuntze	Verbenaceae	4142	*Bamanhati*	R/ L/ S	M
Clerodendrum viscosum Ventenat	Verbenaceae	117	*Bhant, Ghentu*	R/ L/ S	M
Cocculus laurifolius DC.	Menispermaceae	4164	*Dai gachh*	R/ L/ S	
Colocasia esculenta (Linnaeus) Schott	Araceae	60	*Man kachhu*	R/ L/ S	M
Combretum decandrum Roxburgh	Combretaceae	63	*Kali Lahara*	R/ L/ S	M
Commelina suffruticosa Blume	Commelinaceae	3818	*Kane jhar*	R/ L/ S	M
Costus speciosus (Koenig *ex* Retzius) Smith	Costaceae	3629	*Betlaure*	R/ L/ S	M
Crateva religiosa Forst.f.	Capparaceae	419	*Chipley, Barun*	R/ L/ S	M
Crinum amoenum Roxburgh	Amaryllidaceae	4520	*Nagdan*	R/ L/ S	M
Crotalaria alata Buch-Ham *ex* D. Don	Fabaceae	4204		R/ L/ S	M
Cryptolepis buchanani R. Br. *ex* Roemer & Schultes	Asclepiadaceae	3579	*Kankrashringi*	R/ L/ S	M
Cryptolepis sinensis (Loureiro) Merrill	Asclepiadaceae	4278	*Kankrashringi*	R/ L/ S	M

Name of Plants	Family	Field No.	Local Name	In MPCA	Used as
Curculigo capitulata (Loureiro) O. Kuntze	Hypoxidaceae	3657	*Dhoti sara*	R/ L/ S	M
Curculigo orchioides Gaertner	Hypoxidaceae	3854	*Talmuli*	R/ L/ S	M
Curcuma aromatica Salisbury	Zingiberaceae	3856	*Jangli halud*	S	A, M
Curcuma ceaesia Roxburgh	Zingiberaceae	4117	*Kala Haldi*	R/ L/ S	M
Curcuma zedoaria (Chirstmann) Roscoe	Zingiberaceae	129	*Kala haldi*	R/ L/ S	M
Cuscuta reflexa Roxburgh	Cuscutaceae	4477	*Swarnalata*	L/ S	M
Cyanotis axillaris (Linnaeus) Sweet	Commelinaceae	4111		R/ L/ S	M
Cymbopogon jwarancusa (Jones) Schultes	Poaceae	4542		R	M
Cynodon dactylon (Linnaeus) Persoon	Poaceae	4097	*Dubo*	R/ L/ S	M
Cyperus rotundus Linnaeus	Cyperaceae	4105	*Mutha ghas*	R/ L/ S	M
Dactyloctenium aegypticum (Linnaeus) P. Beauvois	Poaceae	4545		R	M
Dalbergia pinnata (Loureiro) Prain	Fabaceae	469		R/ L/ S	M
Dalbergia stipulacea Roxburgh	Fabaceae	4331	*Lahara Sirish*	R/ L/ S	M
Daphne involucrata Wallich	Thymeleaceae	4500		R/ L	A
Deeringia amaranthoides (Lamarck) Merrill	Amaranthaceae	3782	*Chhorachhurisag*	R/ L/ S	M
Dentella repens J. & G. Forster	Rubiaceae	4177		R/ L/ S	M
Dicliptera bupleuroides Nees	Acanthaceae	3681		R/ L/ S	M
Dillenia indica Linnaeus	Dilleniaceae	2316	*Chalta, Panchphol*	R/ L/ S	M
Dillenia indica Linnaeus	Dilleniaceae	4431	*Paanch Phal*	R/ L/ S	M
Dioscorea belophylla Voigt *ex* Haines	Dioscoreaceae	272	*Ban Tarul*	R/ L/ S	M
Dioscorea bulbifera Linnaeus	Dioscoreaceae	4447	*Gittha Tarul*	R/ L/ S	M
Dioscorea hispida Dennstedt	Dioscoreaceae	4123		R/ L/ S	M
Dioscorea pentaphylla Linnaeus	Dioscoreaceae	2453	*Ban Tarul, Bhegur*	R/ L/ S	M
Dioscorea prazeri Prain & Burkill	Dioscoreaceae	3508	*Kukur tarul*	R/ L/ S	M
Diplazium esculentum (Koenig *ex* Retzius) Swartz	Athyriaceae	3563	*Dhekia saag*	R/ L/ S	M
Drosera burmanii Vahl	Droseraceae	4109		R/ L/ S	M
Drosera burmannii Vahl	Droseraceae	4575	*Surjasisir*	R	M
Drymaria diandra (Blume) Duke	Caryophyllaceae	2498	*Avijal*	S	M
Drynaria quercifolia (Linnaeus) J. Smith	Polypodiaceae	4467		R/ L/ S	M
Dysoxylum mellisimum Blume	Meliaceae	4143	*Chhalegach*	L	M
Echinochloa crussgalli (Linnaeus) P. Beauvois	Poaceae	4205	*Sama*	R/ L/ S	M
Eclipta prostrata (Linnaeus) Linnaeus	Asteraceae	4505	*Keshud*	R/ L/ S	M
Elephantopus scaber Linnaeus	Asteraceae	3686	*Gajialata*	R/ L/ S	M
Elusine indica (Linnaeus) Gaertner	Poaceae	4473	*Kodho jhar*	R/ L/ S	M
Entada rheedii Sprengel	Mimosaceae	2720	*Gila*	R/ L	M
Equisetum diffusum D. Don	Equisetaceae	3761	*Kurkure Jhar*	S	M
Erigeron canadensis (Linnaeus) Cronquist	Asteraceae	4113		R/ L/ S	M
Erythrina stricta Roxb.	Fabaceae	4462	*Madar*	R/ L/ S	M
Eupatorium adenophorum Sprengel	Asteraceae	4182	*Kalo Banmara*	S	M
Euphorbia heyneana Sprengel	Euphorbiaceae	4277		R/ L	M

Name of Plants	**Family**	**Field No.**	**Local Name**	**In MPCA**	**Used as**
Euphorbia hirta Linnaeus	Euphorbiaceae	4332		R	M
Euphorbia hypericifolia Linnaeus	Euphorbiaceae	4525		R/ L	M
Evolvulus alsinoides (Linnaeus) Linnaeus	Convolvulaceae	4336		R/ L/ S	M
Ficus benghalensis Linnaeus	Moraceae	4115	*Bot, Bor*	R/ S	M
Ficus hispida L.f.	Moraceae	3533	*Kak Dumur,Koksa*	R/ L/ S	M
Ficus racemosa Linnaeus	Moraceae	4237	*Dumri*	R	M
Ficus religiosa Linnaeus	Moraceae	4559	*Ashathwa*	R/ L/ S	M
Ficus semicordata J.E.Smith	Moraceae	4146	*Khaniun*	R/ L/ S	M
Flacourtia jangomas (Loureiro)Raeuschel	Flacourtiaceae	4347	*Panial*	R/ L/ S	M
Flemingia strobilifera (Linnaeus) Aiton	Fabaceae	4215	*Ghora chabuk*	R/ L/ S	M
Flueggea virosa (Willdenow) Voigt	Euphorbiaceae	4166	*Darim pate*	R/ L/ S	M
Garuga gamblei King *ex* Smith	Burseraceae	185	*Dobdabe*	R/ L/ S	M
Girardinia diversifolia (Link) Friis	Urticaceae	36	*Bhyangrey Shishnu*	R/ L/ S	M
Glinus oppositifolius (L.) A. DC.	Aizoaceae	4378	*Gimasaag*	R/ L/ S	M
Glinus oppositifolius (Linnaeus) A. DC.	Aizoaceae	4108	*Gima Saag*	R/ L/ S	M
Gloriosa superba Linnaeus	Liliaceae	2412	*Ulatchandal*	L/ S	M
Glycosmis cymosa (Kurz) Narayanaswami	Rutaceae	181	*Ban jamir, Ashseora*	L	M
Glycosmis pentaphylla (Retzius) DC.	Rutaceae	348	*Ban jamir, Ashseora*	R/ L/ S	M
Grangea maderaspatana (Linnaeus) Poiret	Asteraceae	4314		L/ S	M
Grewia asiatica Linnaeus	Tiliaceae	3790	*Falsa*	R/ L/ S	M
Gynocardia odorata R. Brown	Flacourtiaceae	217	*Chalmogra, Ramphal*	R/ L/ S	M
Hedyotis scandens Roxburgh	Rubiaceae	3651	*Kanchiru Lahara*	R/ L/ S	M
Helminthostachys zeylanica (Linnaeus) Hook.	Helminthost-achyaceae	3863		R/ L/ S	M
Holarrhena pubescens (Buchanon -Hamilton) G. Don	Apocynaceae	3833	*Kurchi, Khirra*	R/ L/ S	M
Homalomena rubescens (Roxburgh) Kunth	Araceae	399		L	M
Hoya parasitica (Roxburgh) Wight	Asclepiadaceae	4106		R/ L/ S	A, M
Hydrocotyle sibthorpioides Lamarck	Apiaceae	4356	*Gande jhar*	R/ L/ S	M
Hygrophila auriculata (Schumacher) Heine	Acanthaceae	4244	*Kulekhara*	R/ L/ S	M
Hypericum japonicum Murray	Hypericaceae	4533		R/ L/ S	M
Hyptis suaveolens (Linnaeus) Poiteau	Lamiaceae	4125	*Bon tulsi*	R/ L/ S	M
Ichnocarpus frutescens (Linnaeus) Aiton	Apocynaceae	3708	*Dudhe Lahara*	R/ L/ S	M
Imperata cylindrica (Linnaeus) Rauschel	Poaceae	4140	*Siru*	R/ L/ S	M
Jasminum glandiflorum Linnaeus	Oleaceae	4429		R/ L/ S	A
Jasminum multiflorum (Burm.f.) Andrews	Oleaceae	4174		R/ L/ S	A
Jasminum pubescens (Retzius) Willdenow	Oleaceae	4540		R/ L/ S	A
Jasminum scandens Vahl	Oleaceae	4224	*Hara Lahara*	R/ L/ S	A
Kaempferia rotunda Linnaeus	Zingiberaceae	3874	*Bhuichampa*	S	M

Name of Plants	Family	Field No.	Local Name	In MPCA	Used as
Kyllinga nemoralis (J.R. & G. Forster) Dandy *ex* Hutchinson & Dalziel	Cyperaceae	4569		R/ L/ S	M
Lagerstroemia hirta (Lamarck) Willdenow	Lythraceae	205	*Jarul*	R/ L/ S	M
Lagerstroemia parviflora Roxburgh	Lythraceae	263	*Sidha*	R/ L/ S	M
Lannea coromandelica (Houttuyn) Merrill	Anacardiaceae	4461	*Jiol*	R/ L/ S	M
Lantana camara Linnaeus	Verbenaceae	3778	*Saibani lata*	R/ L/ S	M
Lasia spinosa (Linnaeus) Thwaites	Araceae	4202	*Kanta kachhu*	R/ L/ S	M
Leea aequata Linnaeus	Leeaceae	4325		R/ L/ S	M
Leea asiatica (Linnaeus) Ridsdale	Leeaceae	4510		R/ L/ S	M
Leea indica (Burman) Merrill	Leeaceae	4187		R/ L/ S	M
Leucus indica (Linnaeus) R. Brown *ex* Vatke	Lamiaceae	4121	*Swetodrone*	R/ L/ S	M
Lindenbergia indica (Linnaeus) O. Kuntze	Scrophulariaceae	4579		R/ L/ S	M
Litsea cubeba (Loureiro) Persoon	Lauraceae	2509		R/ L/ S	M
Litsea glutinosa (Loureiro) Robinson	Lauraceae	99	*Kawala*	R/ L/ S	A, M
Litsea monopetala (Roxburgh) Persoon	Lauraceae	4301	*Bonsum*	R/ L/ S	M
Litsea salicifolia (Nees) Hook.f.	Lauraceae	474		R/ L/ S	A
Luffa aegyptiaca Miller	Cucurbitaceae	4246	*Dhundhul*	R/ L/ S	M
Lycopodium cernuum Linnaeus	Lycopodiaceae	2439	*Nagbeli*	L/ S	M
Lygodium flexuosum (Linnaeus) Swartz	Lygodiaceae	359	*Bhutraj*	R/ L/ S	M
Maesa indica (Roxburgh) A. DC.	Myrsinaceae	4548	*Bilauney*	R/ L/ S	M
Mallotus philippensis (Lamarck) Mueller	Euphorbiaceae	210	*Sindure*	R/ L/ S	M
Maranta arundinacea Linnaeus	Marantaceae	4156	*Ararut*	L	M
Melastoma melabathricum Linnaeus	Melastomataceae	3766	*Datrangi, Futki*	R/ L/ S	M
Melilotus indica (Linnaeus) Allioni	Fabaceae	4562		R	M
Merremia hirta (Linnaeus) Merrill	Convolvulaceae	4311		R/ L/ S	M
Merremia vitifolia (Burm.f.) Hallier f.	Convolvulaceae	4571		R/ L/ S	M
Mesua ferrea Linnaeus	Clusiaceae	4236	*Nagkesar*	R/ L/ S	M
Meyna spinosa Link	Rubiaceae	408	*Moyna kata*	R/ L/ S	M
Michelia champaca Linnaeus	Magnoliaceae	4552	*Champ*	R/ L/ S	A
Michelia velutina DC.	Magnoliaceae	426	*Champ*	R/ L	A
Micromelum integerrimum (Roxburgh) Roemer	Rutaceae	2003	*Ban-kunch*	R/ L	M
Mikania micrantha Kunth	Asteraceae	317	*Assami lata*	R/ L/ S	M
Mimosa himalayana Gamble	Mimosaceae	4419	*Arare*	R/ L/ S	M
Mimosa pudica Linnaeus	Mimosaceae	3861	*Lajjabati*	R/ L/ S	M
Momordica charantia Linnaeus	Cucurbitaceae	472	*Karela*	R/ L/ S	M
Momordica cochincninensis Sprengel	Cucurbitaceae	4152	*Kakrol*	R/ L/ S	M
Monochoria vaginalis (Burman f.) Kunth	Pontederiaceae	4235	*Piralay*	R/ L/ S	M
Morinda angustifolia Roxbergh	Rubiaceae	4572	*Haldi kath*	R/ L/ S	M
Morinda angustifolia Roxburgh	Rubiaceae	52	*Haldikath*	R/ L/ S	M
Morus laevigata Brandis	Moraceae	31	*Jangli tunt*	R/ L/ S	M
Mucuna pruriens (Linnaeus) DC.	Fabaceae	4463	*Alkushi*	R/ L/ S	M

Name of Plants	Family	Field No.	Local Name	In MPCA	Used as
Murraya koenigii (Linnaeus) Sprengel	Rutaceae	404	*Karipatta*	R/ L/ S	A
Murraya paniculata (Linnaeus) Jack	Rutaceae	422	*Kamini*	R/ L/ S	M
Mussaenda roxburghii Hook.f.	Rubiaceae	2438	*Katmatia Saag*	R/ L/ S	M
Naravelia zeylanica (Linnaeus) DC.	Ranunculaceae	3602	*Chhagalbati*	R/ L/ S	M
Natsiatum herpeticum Arnott	Icacinaceae	3747		R/ L/ S	M
Nyctanthes arbor-tristis Linnaeus	Verbenaceae	4471	*Sephali*	R/ L/ S	M
Oesbeckia nepalensis Hooker	Melastomataceae	4582		R/ L/ S	M
Oldenlandia corymbosa Linnaeus	Rubiaceae	4112	*Khetpapra*	R/ L/ S	M
Oldenlandia diffusa (Wildenow)Roxburgh	Rubiaceae	4288		R/ L/ S	M
Ophioglossum reticulatum Linnaeus	Ophioglossaceae	4459	*Gibre*	R/ L	M
Oroxylum indicum (Linnaeus) Ventenat	Bignoniaceae	2144	*Totola*	R/ L/ S	M
Oxalis corniculata Linnaeus	Oxalidaceae	4238	*Amruli Saag*	R/ L/ S	M
Paederia foetida Linnaeus	Rubiaceae	3701	*Gandhavadale*	R/ L/ S	M
Pandanus unguifer Hook.f.	Pandanaceae	4577	*Keya*	R/ L	M
Paspalum scrobiculatum Linnaeus	Poaceae	4119		R/ L/ S	M
Pavetta polyantha Bremekamp	Rubiaceae	4443	*Kanjol Phul*	R/ L/ S	M
Pericampylus glaucus (Lam.) Merrill	Menispermaceaea	3648	*Pipal-pati Lahara*	R/ L/ S	M
Persea glaucescens (Nees) Long	Lauraceae	4110	*Bhale Kawlo, Kawala*	R/ L/ S	A
Persicaria barbata (Linnaeus) Hara	Polygonaceae	4357		R/ L/ S	M
Persicaria chinensis (Linnaeus) H. Gross	Polygonaceae	143		R/ L/ S	M
Persicaria hydropiper (Linnaeus) Spach	Polygonaceae	4410	*Biskuthuli*	R/ L/ S	M
Persicaria orientalis (Linnaeus) Spach	Polygonaceae	4103		L	M
Phlogacanthus thyrsiformis (Hardwicke) Mabberley	Acanthaceae	4343	*Ram Basak, Chua*	R/ L/ S	M
Phoebe lanceolata (Nees) Nees	Lauraceae	4517	*Angare*	R/ L/ S	A
Phyllanthus emblica Linnaeus	Euphorbiaceae	281	*Amloki, Amla*	R/ L/ S	M
Phyllanthus reticulatus Poiret	Euphorbiaceae	4153	*Bhui amla*	R/ L/ S	M
Phyllanthus urinaria Linnaeus	Euphorbiaceae	2471	*Bhui amla, Hazarmani*	R/ L/ S	M
Phyllanthus virgatus Forster	Euphorbiaceae	4253		R/ L/ S	M
Physalis divaricata D. Don	Solanaceae	466	*Bon Tepari*	R/ L/ S	M
Physalis peruviana Linnaeus	Solanaceae	3879	*Bon Tepari*	R/ L/ S	M
Piper betle Linnaeus	Piperaceae	4515	*Pan*	R/ L/ S	M
Piper chuvya (Miquel) C. DC.	Piperaceae	4328	*Chaba*	R/ L/ S	M
Piper longum Linnaeus	Piperaceae	4116	*Pipal, Pipla*	R/ L/ S	M
Piper mullesua D. Don	Piperaceae	4242	*Pipla, Dala-chabo*	R/ L/ S	M
Piper peepuloides Roxburgh	Piperaceae	4491	*Ruk Pipla*	R/ L/ S	M
Piper retrofractum Vahl	Piperaceae	4159	*Choi*	R/ L/ S	M
Piper sylvaticum Roxburgh	Piperaceae	3765		R/ L/ S	M
Polyalthia simiarum (Hook.f. & Thomson) Hook. f. & Thomson	Annonaceae	4327	*Lapche Kath*	R/ L/ S	M
Polygonum hydropiper Linnaeus	Polygonaceae	4564	*Bis-kutuli*	R/ L/ S	M
Polygonum plebeium R. Brown	Polygonaceae	4104		L	M
Portulaca oleracea Linnaeus	Portulacaceae	4199		R	M

Name of Plants	Family	Field No.	Local Name	In MPCA	Used as
Pothos cathcarti Schott	Araceae	4423		R/ L/ S	M
Pothos scandens Linnaeus	Araceae	4188		R/ L/ S	M
Pothos scandens Linnaeus	Araceae	4107		R/ L/ S	M
Pouzolzia hirta (Blume) Hasskarl	Urticaceae	4469		R/ L/ S	M
Pouzolzia zeylanica (Linnaeus) Bennet & Brown	Urticaceae	4536		R/ L/ S	M
Premna barbata Wallich	Verbenaceae	2427	*Gineri*	R/ L/ S	M
Premna bengalensis C.B. Clarke	Verbenaceae	4567	*Gineri*	R/ L/ S	M
Premna mucronata Roxburgh	Verbenaceae	4192	*Gineri*	R/ L/ S	M
Premna mucronata Roxburgh	Verbenaceae	4233	*Gineri*	R/ L/ S	M
Pseudognaphalium affine (D. Don) Anderberg	Asteraceae	4101		R/ L/ S	M
Psilanthus bengalensis (Schultes) Leroy	Rubiaceae	4285	*Chaitiful*	R/ L/ S	M
Pterocarpus marsupium Roxburgh	Fabaceae	4172		R/ L	M
Pterospermum acerifolium (Linnaeus) Willdenow	Sterculiaceae	2044	*Hantipahele*	R/ L/ S	M
Pterygota alata (Roxburgh) R. Brown	Sterculiaceae	3675	*Labshi, Narkeli, Phirphire*	R/ L/ S	M
Randia sikkimensis Hook.f.	Rubiaceae	4555		R/ L/ S	M
Rauvolfia serpentina (Linnaeus) Bentham ex Kurtz	Apocynaceae	4184	*Sarpagandha*	R/ L/ S	M
Rumex trisetifer Strokes	Polygonaceae	4460		S	M
Saccharum spontanum Linnaeus	Poaceae	4114	*Kush*	R/ L/ S	M
Sapindus rarak DC.	Sapindaceae	442	*Ritha*	R/ L/ S	M
Saurauja roxburghii Wallich	Actinidiaceae	4550	*Gogun*	L	M
Sauropus androgynus (Linnaeus) Merrill	Euphorbiaceae	74	*Multivitamine*	R/ L	M
Sauropus compressus Mueller	Euphorbiaceae	3542		R/ L/ S	M
Sauropus quadrangularis (Willdenow) Mueller	Euphorbiaceae	4179		S	M
Schima wallichii (DC.) Korthals	Theaceae	2232	*Chilauney*	R/ L	M
Scindapsus officinalis (Roxburgh) Schott	Araceae	4585		R/ L/ S	M
Scoparia dulcis Linnaeus	Scrophulariaceae	4313	*Ghuma, Mithapata*	R/ L/ S	M
Shorea robusta Gaertner f.	Dipterocarpaceae	4145	*Saal*	R/ L/ S	A
Sida acuta Burm.f.	Malvaceae	3526	*Berela*	R/ L/ S	M
Sida rhombifolia Linnaeus	Malvaceae	68	*Peet Berela*	R/ L/ S	M
Smilax lanceaefolia Roxburgh	Smilacaceae	4305	*Kukurdainey*	R/ L/ S	M
Smilax ovalifolia Roxb.	Smilacaceae	433	*Kukurdainey*	R/ L/ S	M
Solanum aculeatissimum Jacquin	Solanaceae	3860	*Kalobehi*	R/ L/ S	M
Solanum nigrum Linnaeus	Solanaceae	4458	*kakmachhi*	R/ L/ S	M
Solanum torvum Swartz	Solanaceae	3750	*Gothbegun*	R/ L/ S	M
Solanum viarum Dunal	Solanaceae	69	*Boksi Kanra*	R/ L/ S	M
Sonchus oleraceus Linnaeus	Asteraceae	4372		R/ L/ S	M
Spermacoce hispida Linnaeus	Rubiaceae	4440		R	M
Stephania glabra (Roxburgh) Miers	Menispermaceae	102	*Tamarke Lahara*	R/ L/ S	M
Stephania japonica (Thunberg) Miers	Menispermaceaea	3652	*Tamarki*	R/ L/ S	M
Sterculia villosa Roxburgh	Sterculiaceae	4466	*Odal*	R/ L/ S	M

Name of Plants	**Family**	**Field No.**	**Local Name**	**In MPCA**	**Used as**
Stereospermum colais (Dillwyn) Mabberley	Bignoniaceae	3641	*Parari*	R/ L/ S	M
Streblus asper Loureiro	Moraceae	234	*Seora*	R/ L/ S	M
Synedrella nudiflora (Linnaeus) Gaertner	Asteraceae	4198		R/ L/ S	M
Syzygium cumini (Linnaeus) Skeels	Myrtaceae	364	*Jaam*	R/ L/ S	M
Tabernaemontana divaricata (Linnaeus) Roemer & Schultes	Apocynaceae	4147	*Tagar*	R/ L/ S	M
Telauma hodgsonii Hook.f. & Thomson	Magnoliaceae	3852	*Chiuri*	R/ L/ S	M
Tephrosia candida (Roxburgh) DC.	Fabaceae	3753	*Ban nim*	R/ L/ S	M
Terminalia bellirica (Gaertner) Roxburgh	Combretaceae	3789	*Bahera, Barra*	R/ L/ S	M
Terminalia chebula Retzius	Combretaceae	4511	*Haritaki, Harra*	R/ L/ S	M
Terminalia myriocarpa Heurck & Meuller	Combretaceae	4100	*Paani Saaj*	R/ L/ S	M
Tetracera sarmentosa (Linnaeus) Vahl	Dilleniaceae	3599	*Lata Chalta*	R/ L/ S	M
Thysanolaena maxima (Roxburgh) Kuntze	Poaceae	4148	*Phul jharu*	S	M
Tinospora sinensis (Loureiro) Merrill.	Menispermaceae	2477	*Padmagulancha*	R/ L/ S	M
Toddalia asiatica (Linnaeus) Lamarck	Rutaceae	3735	*Belkanta*	R/ L/ S	A
Toona ciliata Roemer	Meliaceae	145	*Toon*	R/ L/ S	M
Torenia cordata (Griffith) N.M. Datta	Scrophulariaceae	4529		R	M
Trema orientalis (Linnaeus) Blume	Ulmaceae	4161		R/ L/ S	M
Trewia nudiflora Linnaeus	Euphorbiaceae	4214	*Pithali*	R/ S	M
Trichosanthes cordata Roxburgh	Cucurbitaceae	4413		R/ L/ S	M
Trichosanthes tricuspidata Loureiro	Cucurbitaceae	3776	*Makal*	R/ L/ S	M
Triumfetta rhomboidea Jacquin	Tiliaceae	128	*Ban Okra*	R/ L/ S	M
Typhonium trilobatum (Linnaeus) Schott	Araceae	464	*Kharkon, Ghatkol*	R/ L/ S	M
Uraria picta Desv.	Fabaceae	3890	*Sankarjata*	R/ L/ S	M
Urena lobata Linnaeus	Malvaceae	3565	*Ban Okra*	R/ L/ S	M
Vallaris solanacea (Roth) O. Kuntze	Apocynaceae	19	*Haparmali*	R/ L/ S	M
Vernonia cinerea (Linnaeus) Less	Asteraceae	4127		R/ L/ S	M
Vitex negundo Linnaeus	Verbenaceae	4155	*Nisinda*	S	M
Vitex peduncularis Schauer	Verbenaceae	4359	*Charaigarua*	R/ L	M
Wattakaka volubilis (L.f.) Stapf	Asclepiadaceae	3751	*Chhint*	R/ L/ S	M
Wrightia arborea (Dennstaedt) Mabberley	Apocynaceae	3849	*Chhoto khira*	R/ L/ S	M
Xanthium strumarium Linnaeus	Asteraceae	4522	*Bon Onkra*	R/ L/ S	M
Zanonia indica Linnaeus	Cucurbitaceae	4312		R/ L/ S	M
Zanthoxylum armatum DC.	Rutaceae	4323	*Timbur*	R/ L	M
Zanthoxylum nitidum (Roxburgh) DC	Rutaceae	370	*Timbur*	R/ L/ S	A
Zanthoxylum rhetsa (Roxburgh) DC	Rutaceae	3738	*Timbur*	R/ L	M
Zingiber rubens Roxburgh	Zingiberaceae	4144		R/ L/ S	A
Zizyphus mauritiana Lamarck	Rhamnaceae	3763	*Kul, Ber*	R/ L/ S	M
Zizyphus rugosa Lamarck	Rhamnaceae	2049		R/ L/ S	M
Zornia gibbosa Spanoghe	Fabaceae	4102		R	M

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Allelopathic effects of Teak (*Tectona grandis* L.f.) on germination and seedling growth of *Plumbago zeylanica* L.

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Abstract

The present study investigated the allelopathic effects of Teak (*Tectona grandis* Linnaeus f., Verbenaceae) on the germination and seedling growth of *Plumbago zeylanica* Linnaeus (Plumbaginaceae). Surface sterilized healthy seeds were allowed to germinate in different concentration of Teak leaf extract along with a control set up. The aqueous leaf extract showed inhibitory effect on seed germination and seedling growth. Shoot vigour index, root vigour index, seedling vigour index and inhibition of biomass production under different treatment supported the allelopathic effect of teak on the receiver plant. The study suggested long term field based investigation on the allelopathic effect of teak on such valuable medicinal herbs of Sub-Himalayan belt.

Key words: Allelopathic effect, *Tectona grandis, Plumbago zeylanica*, Seed germination, Seedling growth

INTRODUCTION

Allelopathy is a natural phenomenon whereby one plant releases some biochemical substance which has inhibitory and/or stimulatory effects on some other plants (Rice 1984a; Mensah *et al*. 2015). It involves the ecological communications between species which can positively or negatively influence growth, behaviour, reproduction, and survival of associated species. In trees and forests it is an important health care issue (www.forestry.uga.edu/efr). Allelopathy acts by addition of phytotoxic substances to the environment and most of those phytotoxins inhibit germination and growth and are termed as allelochemics or allelochemicals (Whittaker & Feney 1971; Manimegalai *et al.* 2012).

A large number of higher plants as well as microorganisms have been reported to have allelopathic effects due to their capacity to produce some allelochemicals by several authors (Muller 1969; Levin 1976; Rice 1984b; Devasagayam & Ebenezar 1996; Joshi *et al*. 1992; Pande *et al*. 1996**;** Yadav *et al*. 1996).

Teak (*Tectona grandis* Linnaeus f., Verbenaceae), which is an important agroforestry tree and is largely cultivated in the tropical regions of India and other south Asian countries for its valuable and good quality timber (Leela & Arumugam 2014). The species is reported to have some allelopathic effects (Jayakumar *et at*. 1987; Macias *et al*. 2000; Sahoo *et al*. 2007; Lalmuanpuii & Sahoo 2011; Das *et al*. 2012; Manimegalai *et al.* 2012).

On the other hand, *Plumbago zeylanica* Linnaeus [Plumbaginaceae] is an important local medicinal herb and naturally grows in forests of biodiversity rich Terai-Duars belt of West Bengal. Local and the tribal people use stem, leaves, roots and root bark of this herb in different ailments – loss of appetite, gastric ulcer, diarrhoea, dysentery, fever, piles, swelling, elephantiasis, hydrocele, dyspepsia, leprosy, scabies, puerperal disease, leucoderma, rheumatism, paralysis and for abortion (Ghosh & Das 2004; Das *et al*. 2006). Local medicine men or *ojhaas*, who are involved with the practice of the traditional knowledge related to this medicinal herb, they grow it in their household gardens as they have started to realize that it is not easy to find it out just here and there as before. Differences in distributional pattern of some important medicinal herbs in plantation and natural vegetation was noted during recent survey on medicinal plants in different MPCAs, and sampling of different natural forests and plantations in Terai-Duars belt (Das *et al*. 2010). The present study aimed to investigate the allelopathic effect of Teak on the germination and seedling growth of *P. zeylanica*, which is locally known as *Chita* or *Chitu* and *Sada chita*.

MATERIALS AND METHODS

For the present study, the allelopathic effects of the leaf extract of Teak (*Tectona grandis*) on the seed germination and growth of *Plumbago zeylanic*a, all the experiments were conducted in the Taxonomy and Environmental Biology Laboratory, Department of Botany, University of North Bengal. Some plants of *P. zeylanica*, collected from Duars, were introduced into the NBU Garden of Medicinal Plants and the mature and ripen seeds were collected during January – March 2015. Seeds with uniform size, colour and weight were selected and stored in a desiccator. The mature fresh leaves of teak were collected from the plantations in Terai-Duars region of West Bengal.

Fresh and thoroughly washed 100 g leaves of teak were crushed in 250 ml of distilled water using Sandoz mixer grinder machine, filtered through muslin cloth and then Whatman No.1 filter paper and the final volume was adjusted to 1000 ml and used as mother or stock solution (100 %). Then different solution of desired concentrations 25 %, 50 %, 75 %, were prepared by proper dilution with distilled water from the stock solution (Hoque *et al*. 2003).

The methodology as suggested and used by Putnam & Duke (1978); Kadir (2001); Datta & Ghosh (1987) and Ghosh (2006) were followed for the present assay. Ten healthy seeds, which were surface sterilized in 0.1 % $HgCl_2$ solution and then washed with 1 % $AgNO_3$ solution, were placed in sterile 15 cm glass petriplates lined with single layer of Whatman filter paper moistened sufficiently by adding 15 ml of the test solution. This was set in three replicates along with a control in which the filter paper was moistened with 15 ml of distilled water. The entire set up was kept under room temperature and normal light for germination during April – May 2015 and were observed for 15 days for recording different parameters like number of seeds germinated, length of roots and shoots, seedlings etc. Germination was indicated by the emergence of radical. Different formulae which were used to calculate germination percentage, percentage of inhibition of germination, percentage of inhibition of shoot length and root length, shoot and root vigour index following Saxena *et al.* (1995), Acharyya (1998), Thind and Malik (1998), Lama (2004), Ghosh (2006) and Bajpai *et al.* (1995) and are mentioned below.

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100$$

$$\text{\% of inhibition/ stimulation} = \frac{\text{Germination \% in desired solution} - \text{Germination \% in Control solution}}{\text{Germination \% in control solution}} \times 100$$

$$\text{Inhibition or stimulation of root length (\%)} = \frac{\text{Root length in desired solution} - \text{Root Length in Control solution}}{\text{Length of root in Control solution}} \times 100$$

$$\text{Inhibition or stimulation of shoot length (\%)} = \frac{\text{Shoot length in desired solution} - \text{Shoot Length in Control solution}}{\text{Length of shoot in Control solution}} \times 100$$

$$\text{Inhibition /stimulation of seedling length (\%)} = \frac{\text{Seedling Length in desired solution} - \text{Seedling Length in Control solution}}{\text{Length of seedling in Control solution}} \times 100$$

Shoot Vigour Index = Percentage of germination × shoot length

Root Vigour Index = Percentage of germination × root length

Seedling Vigour Index = Percentage of germination × seedling length

Then the mass of data collected from the experiment were processed and analysed using MS Excel 2007. Statistical analysis was performed employing one way ANOVA test using Minitab 17 Statistical Software. Tukey Pairwise comparison was followed for separation of means at 95 % confidence.

RESULT AND DISCUSSION

The result of the present study, summarized in Figures 1 – 5 and in Table 1, indicated the effect of teak on seed germination and seedling growth of *P. zeylanica*. Figure 1 represents the germination percentage in different concentration of Teak leaf extract. While in control set 98 % seeds were germinated, it was decreased with the increase of extract concentration and the minimum of 58 % was noted with the highest concentration of teak extract (100 % or the undiluted stock solution). So, the inhibition of seed germination (Figure 2) was inversely proportional to the concentration of extract solution having recorded highest value of 40.82

Table 1. Shoot Vigour Index, Root Vigour Index and Seedling Vigour Index along with inhibition of shoot, root and seedling elongation and Biomass production in different concentration of teak leaf extracts

Extract Conc.	Germination (%)	Germination Inhibition (%)	Inhibition of root Elongation (%)	Inhibition of shoot elongation (%)	inhibition of seedling length (%)	Shoot-Vigour Index	Root-Vigour Index	Seedling-Vigour Index	Biomass Production (g)
Control	98a	00.00a	00.00a	00.00a	00.00a	3420a	2000a	5420a	0.5018a
25%	90ab	-08.16ab	-03.36a	-00.59ab	-01.61a	3113.9a (-306.52)	1787a (-212.62)	4901a (-519.14)	0.40683ab (-0.095)
50%	76bc	-22.45bc	-08.02ab	-17.28ab	-13.86a	2192b (-1228.54)	1431ab (-880.38)	3623b (-1797)	0.39333ab (-0.108)
75%	66cd	-32.65cd	-30.06b	-29.06b	-29.43b	1644b (-1776.14)	947.6b (-1052.4)	2592c (-2828.54)	0.3670b (-0.135)
100%	58d	-40.82d	-0.28ab	-14.60ab	-11.53a	1737b (-1683.52)	11034b (-896.54)	2840bc (-2580.06)	0.34770b (-0.154)

[Values in the parenthesis indicate the inhibitory effects in comparison to control. Values that do not share a letter in the same column are significantly different at P<0.05]

% and lowest 8.16 % in 100 % and 25 % concentrations, respectively and the percentage of inhibition in undiluted extract concentration only was statistically significant at P<0.05.

Both, shoot and root elongation was affected by the aqueous extracts of teak leaves (Figure 3). Degree of reduction of shoot and root length increase along with the rise of extract concentration up to 75 % at which point the highest value of inhibition were recorded (29.06 % and 30.06 % for shoot and root length respectively). Further increases in extract concentration decrease the shoot and root inhibition. As shoot and root elongation were affected and seedling is the total length of these two, similar allelopathic effect was found in case of seedling elongation also (Figure 4). Extract having concentration of 75 % was found to exert the significant degree of 29.43% inhibition of seedling length.

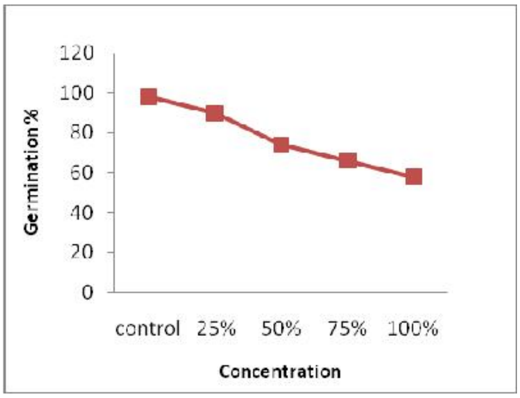

Figure 1. Percentage of seed germination in different concentration of extract

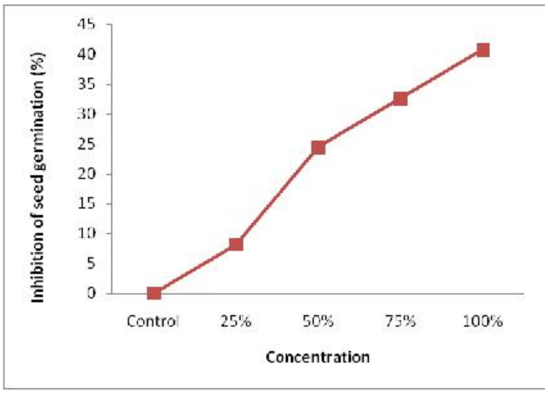

Figure 2. Percentage of inhibition of seed germination in different concentration of extract

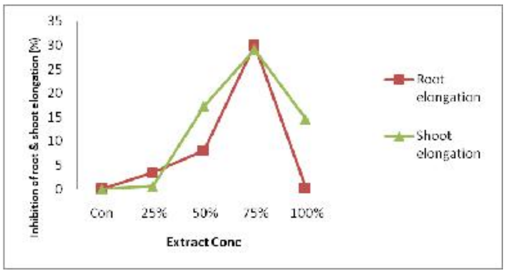

Figure 3. Inhibition of shoot and root length in different concentration of extract

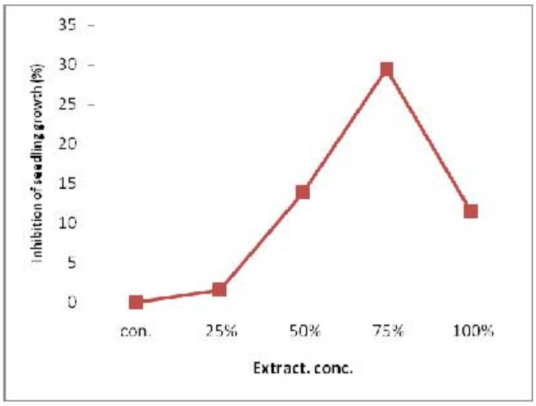

Figure 4. Inhibition of seedling elongation in different concentration of teak leafe extract

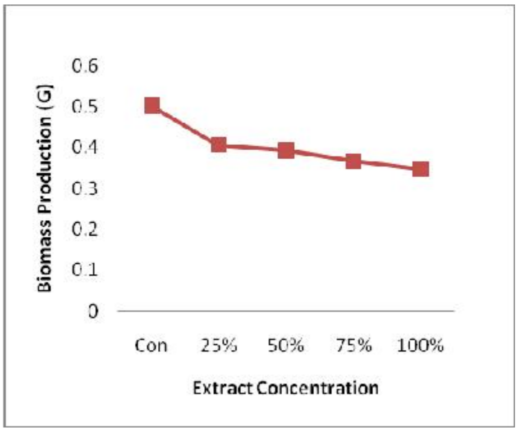

Figure 5. Biomass production in different concentration of Teak extracts

Not only the elongation of seedling but the biomass (fresh weight) production by *P. zeylanica* seedlings were also reduced by allelochemicals present in teak leaves (Figure 5). Production of biomass was hieghest in control solution and gradually decreased with the increase of extract concentration. Highest concentration of teak leaf extract reduced the biomass production to 0.3477 g only whereas in control solution it was estimated to 0.5018 g. Significant level of inhibition of biomass production was noted in 75 % and 100 % extract concentration only.

Influences on Shoot, Root and Seedling Vigour Indices are presented in Table 1. Calculated values of indices for shoot, root and seedling in control solution were 3420, 2000 and 5420 respectively. Teak leaf extract were found to have some inhibitory effect on the vigour indices and are indicated by negative (–) sign. The measures of reduction are mentioned within parenthesis. Significant and highest degree of inhibition was recorded in 75 % concentration of extract; and shoot, root and seedling vigour indices were decreased by 1776.14, 1052.4 and 2828.54 respectively.

Findings from the present investigation indicated the inhibitory effect of aqueous extracts of teak leaves on seed germination and seedling growth of *P. zeylanica* and that is corroborated by earlier reports by Jayakumar *et at*. (1987); Sahoo *et al*. (2007); Macias *et al*. (2000); Lalmuanpuii & Sahoo (2011); Das *et al*. (2012) and Manimegalai *et al.* (2012). Inhibitory effect on seed germination was directly proportional to the extract concentration, though Manimegalai *et al.* (2012) noted the stimulation of seed germination of black gram in lower concentration of teak leaf extract. On the other hand in present study teak leaf extract was found to exert inhibitory effects only.

Teak leaf extract was found to exert similar type of inhibitory effect on shoot, root and seedling elongation also. But, highest degree of inhibition was found in moderately high concentration (75 %). Suppression of seed germination, shoot, root and seedling elongation are also supported by suppression of biomass production following the same pattern. The determined Shoot Vigour Index, Root Vigour Index and Seedling Vigour Index also supported the allelopathic effects of teak extract on *P. zeylanica.*

CONCLUSION

Considering the foregoing result, it can be concluded that teak plant has some allelochemicals those inhibit seed germination and seedling growth (both length and mass) of *P. zeylanica* which is one of the important and widely used local medicinal plants growing in different forests of Terai-Duars belt. However, long term field based studies must be carried out on the allelopathic effects of teak on valuable medicinal herbs growing in this region before selecting teak for large scale plantation, especially when the area is falling within the IUCN recognised Himalaya Biodiversity Hotspot.

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Ethnobotany of *Kirat Festival of Magar* Community in Buxa Duar area of West Bengal, India

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This paper deals with *Kirat festival (Parab) of Magar* community living in Buxa Duar area of West Bengal. *Magar* tribe has a rich tradition of religion. As may as 12 plant species have been recorded which are directly or indirectly related with this festival. Significance of the rituals related to the ceremony are not only to protect the traditional knowledge but also linked to the biodiversity conservation.

Key Words : Ceremony; *Magar*; Buxa Duar; West Bengal

Introduction

The Buxa area is a mountainous tract of the district of Jalpaiguri in West Bengal, situated on Chotta Sinchula range of Eastern Himalaya. Buxa Duar is located between 27° to 26° 16′ N latitude and 89°53′ to 88°4′ Elongitude at an altitude of 795 m amsl. The area is mostly covered with densely wooded deciduous forests and grasslands. Northern boundary runs along the international border with Bhutan, Assam State in the east, Coochbehar District and Bangladesh in south and the plain region of Darjeeling district and small part of Bangladesh lies to the west. It forms the entire forested area of Buxa National Park. Numerous rivers and streams intersect this extensive tract of forests reaching up the hills. However, Buxa is famous for Buxa Duar Fort, used as a prison by the British rulers. Many freedom fighters, including Netaji Subhash Chandra Bose, were imprisoned here. After independence, it served as a refugee camp for Tibetans and Bangladeshis (Kar 2005). Temperature of the region fluctuates between 37.5° C during summer to about 6°C in winter. Rainfall occurs mainly due to south-west monsoon wind and begins from the month of May and continues till the first quarter of October. The average annual rainfall of the region is about 374 cm. There are several examples of trees being worshipped traditionally in many parts of the world under all religions and beliefs. The main objective behind plant worship has always been their conservation and utilization in the most sustainable manner.

Magars were originally living in the low altitude hills of eastern Nepal and were immigrated later to Darjeeling Hills and nearby Duars region to settle down permanently (Anonymous 2001). They used local plant resources for their sustenance from the very beginning. They were tree dwellers and also living in caves, situated in the dense forests. Their food included mainly fruits, tubers, rhizomes, honey, etc. collected from forests. From there, the *Kirat festival* (*Kirat* = son of the land) started among the *Magars*. It is celebrated on the first day of month of *Magh* (in local calendar), which generally falls in the middle of January.

On this day there is the ritual of Holy bath in the nearby river/pond in the morning before talking to anybody. Different types of tubers of *Dioscorea* species (Tarul) are collected (Plate I, Fig. A), boiled, cleaned and offered to the Sun God (Plate I, Fig. B). This is mainly confined in the morning session of the day.

Materials and Methods

During the course of the present investigation, a large of elderly people of Buxa Duar were

Table 1 : List of plants, their common and botanical names, families and parts used during *Kirat festival*

Plant name, Family and Voucher Specimen No.	Local Name	Part used
Dioscorea alata Linn. (Dioscoreaceae) [Ajita & AP Das-054]	'Bag Tarul'	Root-tuber
D. belophylla Voigt ex Haines (Dioscoreaceae) [Ajita & AP Das-074]	'Pani Tarul'	Root-tuber
D. bulbifera Linn. (Dioscoreaceae) [Ajita & AP Das-075]	'Githa'	Root-tuber
D. deltoidea Wallich ex Kunth (Dioscoreaceae) [Ajita & AP Das-087]	'Charpate Tarul'	Root-tuber
D. esculenta (Loureiro) Burkill (Dioscoreaceae)	'Ghar Tarul'	Root-tuber
D. hamiltonii Hook. f. (Dioscoreaceae) [Ajita & AP Das-046]	'Ban Tarul'	Root-tuber
D. pentaphylla Linn. (Dioscoreaceae) [Ajita & AP Das-060]	'Bhyagur'	Root-tuber
D. pubera Blume (Dioscoreaceae) [Ajita & AP Das-055]	'Panglang'	Root-tuber
Ipomoea batatas (Linn.) Lamarck (Convolvulaceae) [Ajita & AP Das-141]	'Sakar Kand'	Tuber
Manihot esculenta Crantz (Euphorbiaceae) [Ajita & AP Das-101]	'Simal Tarul'	Root-tuber
Sesamum *indicum* Linn. (Pedaliaceae) [Ajita & AP Das-145]	'Til'	Seeds
Sterculia villosa Smith (Sterculiaceae) [Ajita & AP Das-146]	'Simali'	Root
Xanthosoma brasilense (Desf.) Engler (Araceae) [Ajita & AP Das-148]	'Sikume Pindalu'	Rhizome

interviewed about *Kirat festival* using a short questionnaire. The common names of different plants were noted down and the specimens are spotted by the native people. Some local priests, commonly referred to as *'Dami'*, were also contacted and were pestered to gain knowledge about the ceremony.

Collected specimens were processed as herbarium sheets and were identified in the Taxonomy & Environmental Biology Laboratory of the Department of Botany, North Bengal University, using different floras, verified and deposited in the NBU Herbarium. Only the aerial parts of the plants were collected as voucher specimens and root-tubers were used by *Magars* as the availability of many of these plants were scarce. However, some of these plants were also introduced into the Garden of Medicinal Plants, University of North Bengal for their conservation.

Discussions

The interviews with natives provided interesting scientific and mythological information about the plants and the significance of *Kirat festival*. Among the tubers 'Ban Tarul' *(Dioscorea spp.)* has its unique importance on this occasion because in earlier times 'Ban Tarul' was their principal food. Earlier, these plants were abundant in the surrounding vegetation and native people collected tuberous root-stock regularly. On the day of festival they offer tubers of different species to God in the morning (Plate I, Fig. B). After that they put a *tika* (mark on the forehead) made of a thin slice of uncooked Ban Tarul and de-coated seeds of Til *(Sweto til)* on the forehead (Plate I, Fig F) and eat first the uncooked Ban Tarul as 'Prasad' (Plate I, Fig. E). After that they take different other varieties of boiled root-tubers including *Manihot esculenta*, species of *Dioscorea* and *Xanthosoma* and 'Set Rooti' (a kind of traditional home made bread) (Plate I, Fig. C). They boil the yams in the previous night. 'Set Roooti' is made of rice powder. The rice powder is battered in water along the milk and sugar. Other essential ingredient is mucilaginous root juice of Simali (*Sterculia villosa*), which makes the rooti soft. The prepared batter is then left for about 2-3 hours and then given the shape of small rings and fried to golden brown in boiling mustard oil for 10-12 minutes.

PLATE I: *Kirat Festival*. **A.** Collection of *Dioscorea* root-tuber; **B.** Accumulation of all desired plant materials; **C.** A plate of ceremonial food; **D.** Plant materials after collection and cleaning; **E.** All family members taking part in the festival; **F.** Kirat children with *tika* on forehead.

Based on the observations made during survey, a list of plants which are boiled to consume, have been presented in Table-I along with the local and botanical names, families and parts used.

Yams (*Dioscorea* sp.), edible aroid (*Xanthosoma* sp.), tapioca (*Manihot esculenta*) and sweet potato (*Ipomoea batatas*) provide the stable carbohydrate source for over 500 million people in the world (Coursey 1983, O'Hair 1990). Sweet potato and *Xanthosoma brasiliense* are cultivated in localities in Buxa area. Yams are wildly grown primarily in this region and some of these are also cultivated. Yams are generally propagated with their bulbils and the upper part of the root-stock. Eating of fresh yam tubers supply a good amount of antioxidant in its natural form; and it prevents the free radicals related to human diseases like cancer and cardiovascular ailments (Bhandari & Kawabata 2004). The presence of diosgenin in certain species of *Dioscorea* converting into corticosteroidal drugs and hormones is helpful in curing many diseases (Basu & Gautam 2002).

Out of the recorded plants *Ipomoea batatas, Manihot esculenta* and *Xanthosoma brasiliense* are exotics but are widely cultivated in different tropical and subtropical areas of the world including foot-hill regions of Eastern Himalaya.

Most of the religious beliefs of the ethnic culture have some significance with their bases in history of the community and its neighborhood. Due to the advent of modernization these beliefs are becoming weaker day by day and are likely to be forgotten in the near future. Recording the native culture by using modern techniques has thus become necessary.

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भारत में पश्चिम बंगाल के बक्सा-दुआर क्षेत्र में मगर समुदाय के 'कीरत उत्सव' की लोकवनस्पति

अजीता सरकार, किशोर विश्वास एवं ए.पी. दास

पादपवर्गिकी एवं पर्यावरणीय जीव विज्ञान प्रयोगशाला, वनस्पति विज्ञान विभाग, उत्तरी बंगाल विश्वविद्यालय, सिलीगुड़ी-734 013 (भारत)

इस प्रपत्र में पश्चिम बंगाल के बक्सा-दुआर क्षेत्र के मगर समुदाय के निवासियों के 'कीरत उत्सव,' (परब) के विषय में वर्णन किया गया है। मगर आदिवासी लोग धार्मिक परम्पराओं एवं रीति-रिवाजों के धनी होते हैं। लगभग ऐसी 12 पादप-प्रजातियाँ ज्ञात हैं जोकि प्रत्यक्ष एवं परोक्ष रूप से इस उत्सव से संबंधित हैं। उत्सव से संबंधित अनुष्ठान के महत्व से सिर्फ वनौषधिय ज्ञान को सुरक्षित रखना ही नहीं है बल्कि इसका संबंध जैव-विविधता के संरक्षण से भी है।