STATUS AND USE PATTERN OF JANA CHAHANA COMMUNITY FOREST AND ADJOINING NATIONAL FOREST IN RAUTAHAT DISTRICT

A THESIS

SUBMITTED FOR THE
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE MASTERS' DEGREE IN BOTANY

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DECLARATION

I, **"Santosh Kumar Gautam",** hereby declare that the work enclosed here is entirely own, except where states otherwise by reference or acknowledgement, and hasnot been published or submitted elsewhere, in whole or in part, for the requirement for any other degree or professional qualification. Any literatue, data or works done by others and cited within this thesis has been given due acknowledgement and listed in reference section.

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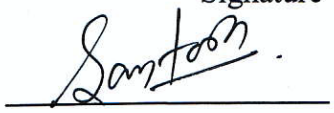

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RECOMMENDATION LETTER

This is to recommend that the Master's thesis entitled "*Status and Use Pattern of Jana Chahana Community Forest and Adjoining National Forest*" is carried out by "**Mr. Santosh Kumar Gautam"** under my supervision. This entire work is based on original scientific investigation and has not been submitted for any other degree in any institution. I therefore, recommend this thesis work for accepted for the partial fulfillment of M.Sc Degree in Botany.

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LETTER OF APPROVAL

This thesis work submitted by "Mr. Santosh Kumar Gautam" entitled "*Status and Use pattern Of Jana Chahana Community Forest and Adjoining National Forest*" submitted to Department of Botany, Amrit Campus, Tribhuvan University by "Mr. Santosh Kumar Gautam", "T.U. Registration No.: 5-2-0037-0658-2011" has been accepted for the partial fulfillment of the requirements for Masters' degree in Botany.

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ACRONYMS AND ABBREVIATIONS

C- Coverage

CF- Community Forest

CFUs- Community Forest Users

D- Density

D p H- Density per Hectare

E- East

F- Frequency

FAO- Food and Agricultural Organization

Ha- Hectare

IVI- Importance Value Index

JCCF- Jana Chahana Community Forest

K- Potassium

Kg-Kilogram

N- Nitrogen

N- North

NF- National Forest

NTFPs- Non Timber and Forest Products

P- Phosphorus

RC- Relative Coverage

RD- Relative Density

RF- Relative Frequency

T Cov- Total Coverage

US- United States

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ABSTRACT

Nepalese people in the rural area are facing poverty and their livelihood depends upon the forest resources partially or entirely. Community forest helps to restore the degraded habitat, conserve biodiversity, increase food and water supply whereas national forest provides basic requirement for livestock and human beings. National forests are declining globally, leading to climate and biological changes as its consequences. To mitigate its further worsening, community forest concept has been promoted worldwide. Present study area lies at tropical region of Rautahat District, covering national forest and its parts handed to forest users group for strong monitoring and management by local people of community forest. The two adjacent Janachahana Community forest and adjoining national forest were simultaneously studied to compare present plant diversity status and tree regeneration pattern in both the sites. Semi-structured questionnaire method was used for interviewing local respondents. Altogether 137 plant species were reported in present study, among them 113 species from JCCF, 76 species from National forest and 52 species from both sites is common. Systematic random sampling method was used to collect ecological data and calculate ecological parameters like density, frequency, coverage, IVI, diversity indices and regeneration. Plant diversity was high in community forest than national forest based on both Simpson and Shannon-Wiener diversity indices. *Shorea robusta* has good regeneration, IVI and density in both the forests type. *Shorea robusta, Dalbergia sissoo, Ficus hispida, Tectona grandis* were dominant species in Community forest whereas in National forest *Shorea robusta, Semecarpus anacardium* were dominant. Value of IVI was highest for species *Dalbergia sissoo* in JCCF and *Shorea robusta* in national forest. Regeneration status showed that species like *Mallotus philippensis, Shorea robusta, Dillenia pentagyna* in community forest and *Shorea robusta, Dillenia pentagyna* in national forest were high. Soil texture ranged from silt to sandy loam. The ethnobotanical study showed that most of the people use plant materials from the forest to cure Gastritis (*Aegle marmelos, Centella asiatica, Phyllanthus emblica, Psidium guajava, Syzygium cumuni, Terminalia bellirica, Terminalia chebula*) than the other ailments. Maximum collection of plant materials was recorded for firewoods and fodder from the JCCF throughout the year in definite time interval. Every species have their importance and their conservation should be encouraged to promote and conserve for their livelihood, income generation and also for sustainability.

Key words: Diversity, Ethnobotany, Regeneration.

1. INTRODUCTION

1.1. Background

Forests are major source for livelihood development and economic growth since ancient time. Nepal is rich in biodiversity, as a part of Himalayan hotspot (Mittermeier et al., 2004). Himalayan region contain more than 10000 species of medicinal and aromatic plants which support livelihood of 600 million people (Shengj, 2001). Majority of the plant are used for remedy of common health problems like headache, fever, dysentery, skin disease, urinary troubles, and fractures. Traditional medicinal plant has limited by overexploitation as they have deep faith of ethnomedicine. However, its conservation is still under the shade of illegal trade (Singh, 2012). Economic status and decline ecosystem are linked with the dependency of rural population in forests (Jazib, 2015). Since 1979, community forest management was established and promotion was on 1992 for establishment of non native species, which has been done after the heavy exploitation of national forest (Chand and Wilson, 1987).

FAO (1978) defined community forestry as activity of allowing local communities to manage forest for socio economic needs by maintaining ecological well beings. And, it gives more benefits to household having more land and livestock has more benefits from community forest (Adhikari, 2003). Beside these, community forest is focused on forest conservation (Thoms, 2008) by restoring degraded habit and habitats, conserving biodiversity, increasing supply of forest products, empowering of disable groups, generating income, and Human empowerments in rural area (K.C., 2012). Community forest has good history of 25 years, and is best among local people due to their participation in management and use of forest resource for its sustainability (Tylor, 1995).

Forests play a vital role in maintaining ecological balance as well as economic development in one hand and in another hand Nepalese people has set their own traditional rules, culture and strategy for conservation and utilization of those natural resources. Practice of searching important medicinal plants help in development of useful drugs (Newman and Cragg, 2007). Tamang communities are using medicinal plant in which Phytochemical and Pharmacological studies were made for primary health (Luital et al., 2014). About 70-80% people are using plants as medicine that has global interest increasing because of its low or no side effects (Jordon et al., 2010). Traditional knowledge helps in conservation and management of indigenous culture, threatened species and plant diversity (Watson and Glaspell, 2003). Traditional practice reduce socio-ecological crises like ecosystem recycle, reorganization and

renew by litter collection and making compost as major sources of soil nutrients (Colding et al., 2003).

The livelihood of forest user depends upon the forests for their socio-economic and cultural life (Shroff, 1997). The anthropogenic activities and disturbance has impact on plant species and its composition (Bhuju and Ohsawo, 2001). Due to the management practice of community forest, only the useful plants are grown that makes more homogeneity, reduce biodiversity and modify the ecological function and ecosystem services of the forests (Acharya, 2004). Control of seedling may increase the biodiversity whereas species selection and their removal decrease biodiversity (Shrestha et al, 2010). Illegal collection of medicinal plants for curative purpose includes collection of leaf which maynot cause threat however collection of entire parts leads to their extinction (Hailemaniam et al., 2009).

Rapidly increased population and poverty has decline biodiversity, natural resource and regeneration of plants. Regeneration of plants is affected by extensive looping, grazing, trampling and invasion of weeds as well as climbers. Higher regeneration value gets reduced due to soil properties, availability of nutrients and biotic disturbance (Dhaulkhandi et al., 2008). Regeneration indicates well being of forest (Murthy et al., 2002). Soil is determined on its physical properties (Soil texture, color, Grain size), Chemical (P^H, heavy metals, organic and inorganic nutrients) and Biological (micro organism, plant and animal diversity) properties (K.C. and Kalu, 2015).

In order to mitigate the consequences of haphazard use and unsustainability of eco region, most part of national forest are in continuous trend of handover to local community for conservation and eco sustainable utilization so the status of forests will be improved. Resettlement provided the opportunity for restoration of medicinal plants and increase in biodiversity in specified area (Misganaw, 2016). It also addresses some how the increasing uses of herbs for medicinal purposes are due to easy availability and high effectiveness in the treatment of ailments in comparison to other forms (Rana et al., 2010). Traditional medicinal practices are transferred to the modern medicinal system as they are easily available, cheaper and free from side effects. Community forest has increased the tree regeneration and improvement of forest by using their own rule and regulations (Adhikari et al., 2007). Soil environment also affect the growth of plant and their regeneration (K.C. et al., 2013). Status, management system and utilization system of forests must be carefully observed time to time

so that its effectiveness can be known. Community forest should be managed, utilized so that community forest can achieve its goal.

1.2 Rationale

Highly valuable plants inhabiting the national forest being major resources for livelihood, their income generation, biodiversity conservation and ecosystem maintenance; which caused more use pressure and their declination. Changing trends toward community forest, their community management system has objective for biodiversity conservation and fulfillment of livelihood need for enhancing their economic status. The present study area was a degraded national forest due to over exploitation in the past, and now has been handed to the commumity as Janachahana community forest (JCCF). Former national forest was the main sources for the livelihood of the local communities. But due to high exploitation and lack of proper forest management system, the forest was highly degraded. Consequently, this degraded part of national forest was handed over to different community groups in 2053 BS, for their conservation, management and utilization. JCCF was established in 2053 BS with the objectives to provide basic needs of the people and their participation to conserve the forest. Present investigation aims to study the over all objectives of the establishment of community forest and also suggests if it is effective to conserve the biodiversity, its natural parameters, regeneration and successful holding of the community need as well as their use pressure. This study will add another step and suggest direction for future studies to understand better approaches for biodiversity conservation and maximum mutual benefit to surrounding communities.

1.3 Research questions

Research question includes the various questions that can give answer to the practice of resource conservation and its utilization of resource.

- Is the plant diversity differing in national and community forest?
- Is the regeneration of tree species in national and community forest same?
- How do local people use forest resources?

1.4 Objectives

The objectives of study are

1.4.1 General objective

- To understand the plant diversity and use pattern of the Community forest and National forests

1.4.2 Specific objectives

- To measure plant diversity along the Community forest and National forest
- To examine regeneration pattern of trees in National and Community Forests
- To enumerate local use of forest products for livelihood

1.5 Limitations

The limitation of study is that whole area cannot be calculated and the status of every species cannot be known.

2 LITERATURE REVIEW

2.1 Biodiversity and forest management

Biodiversity refers to all the species, animals and microorganisms and their interaction among themselves and evolutionary time (Vandermeer and Perfecto, 1995). These species can use for multiple purpose such as medicine, energy and technology. Structure of forest is essential to manage the forest resource in sustainable basis and also for Biodiversity and ecosystem function (Spies, 2000). Unsustainable collection of parts of medicinal plants reduces their number and regeneration power (Singh et al., 2012).

Community forest has good documented history of 25 years, and is best practice among local people, their involvement in management of forest resource (Tylor, 1995). Asia represents most important center of knowledge with regard to the use of plant species for treatment of different diseases (Kala et al., 2004). Himalayan region contain more than 10000 species of medicinal and aromatic plants which support livelihood of 600 million people (Shengj, 2001). People are using forest products for food, fodder and other different purpose. The livelihoods of forest user are depends upon the forests for their socio economic and cultural life (Shroff, 1997). 70-80% population used plants as medicine which increases because plant has no effect (Jordon et al., 2010).

Gardner et al., (2009) worked at tropical forest their work states biodiversity depends on management of human and gives challenges. Biotic vulnerability and anthropogenic activities has affected human ecological system and modified the global environment. These activities give both challenges and opportunities for biodiversity conservation.

2.2 Forest and medicinal use

The use of medicinal plants is influence by the globalization, rapid urbanization, migration, climate change and new health care system (Quinlan and Quinlan, 2007). Traditional knowledge helps in conservation of indigenous culture, to know threatened species and also help in conservation and management of plant diversity (Watson et al., 2003). Due to climatic changes, land use pattern, socio economic and cultural changes takes place (Giday et al., 2003, Arnold and Perez, 2001, Parmesan and Yohe, 2002).

Some indigenous medicinal plants are threatened and change in species composition due to excessive use of those plants. Since 1979, community forest management was established and promotion was on 1992 by establishment of non native species which has been done after the heavy exploitation of National forest (Chand and Wilson, 1987). Practice of searching

evidence helps to know important medicinal plants which help in development of useful drugs (Newman and Cragg, 2007).

According to Morris (2010) maximum area of tropical forest destroyed by deforestation area exploitation, invasive species has change biodiversity. Anthropogenic impact affect interaction between species, ecosystem functioning. Any species loss by habitat destruction may decline on ecosystem functioning (Gonzalez et al., 2009).

According to Jazib (2015) people depends on forest directly or indirectly for products and services in rural communities and forest neighboring area, depends for survival and livelihood as food, fodder, medicine, timber and fuel wood agriculture dependent people depend upon forest for household purposes and commercial people involves logging, collection of forest manifold the pressure on stressed forests.

Colding et al., (2003) worked at multiple special management, introduction resource rotation, ecological monitoring, and succession management landscape. This practice gives priority to traditional ecological knowledge emphasis on ecological knowledge transferred, sustainability and cultural value through local people. Study gives emphasized on rule of thumb for resource management which discusses resilience and controls resource exploitation.

Ahoyo et al., (2017) worked by applying people nearby forest in warimaro forest. This study states as quantitative Ethnobotany gives knowledge about biodiversity and conservation. Their studies give knowledge about of woody species, availability of useful trees and local porosity for conservation.

Singh et al., (2012) worked on Medicinal plants data were collected by questionnaire personal interview and group discussion with pre identifier informants, identified with taxonomic expert. During study some threatened species like *Acacia catechu, Rauwolfia serpentina, and Bombax ceiba* were found and its conservation was given priority. These studies have given foresight for nature conservation.

2.3 Regeneration

Successful regeneration is indicated by sufficient population of seedling, sapling and young trees (Saxena and Singh, 1984) and the environment present is suitable (Dhaulkhandi et al., 2008). When there is maximum number of seedling than the young trees than condition is

good regeneration that depends upon average output, viability of seeds, seed dispersal, seedling growth, reproductive growth and vegetative growth (Saxena and Singh, 1984).

Natural regeneration is the ability of natural forest to reproduce and its health condition study made by Srivastava and Vasistha (2017) was focused on Assisted Natural Regeneration (ANR) method which increase regeneration by fire prevention technique and control any anthropogenic activities using barriers. It also shows clear picture of forest fire management. Protection from grazing and increasing growth of seedling, unplanned urbanization, population engaged in agriculture is creating pressure in forest, that result loss of forest and encroachment of forestland.

Sapkota et al., (2009) worked in two Community Managed forest about its diversity and regeneration by using 16 systematically laid quadrants. Density, frequency, dominance as well as IVI were calculated. Both Simpson and Shannon-wiener indices were calculated. Fragmentation of national forest into community forest also affects species richness and composition (Ewers and Didham, 2006).

2.4 Soil and diversity

Soil characteristics differ according to topography, climate, vegetation cover, microbial activities and other biotic and abiotic factor (Reddy et al., 2012, Poudel and Sah, 2003). Litter decomposition also determines the soil quality. Carbon nitrogen and other nutrients increase with humidity whereas litter composition and other biomass affect soil P^H and other component (Saeed et al., 2014). Organic matter influenced soil fertility and helps in soil conservation.

3 MATERIALS AND METHOD

3.1. Study area

The study area lies on Central Nepal in Chandrapur municipality of Rautahat district. Study was carried out on ward 4 of the municipality at $27^0 08^{'}$N and $85^0 20'$E. Study area lies on tropical region with plain land at altitude of 100-185 masl. Janachahana Community Forest (JCCF) is one of the study sites and another is adjoining national forest. JCCF was established on 2053 B.S. in order to reduce the excessive deforestation in national forest by strong monitoring and management by local peoples. It occupies the area of 211.67 hectors, surrounded by Kaptantol in south, Chadi-khola in north and east, and National forest in west (Janachahana Community forest nirdasika). As the JCCF was established after the maximum deforestation of National forest there is maximum dependency of local people in JCCF than National forest as it lies near to the people residence area. The rule is made that limited area is given to each member of forest user group for their uses in JCCF.

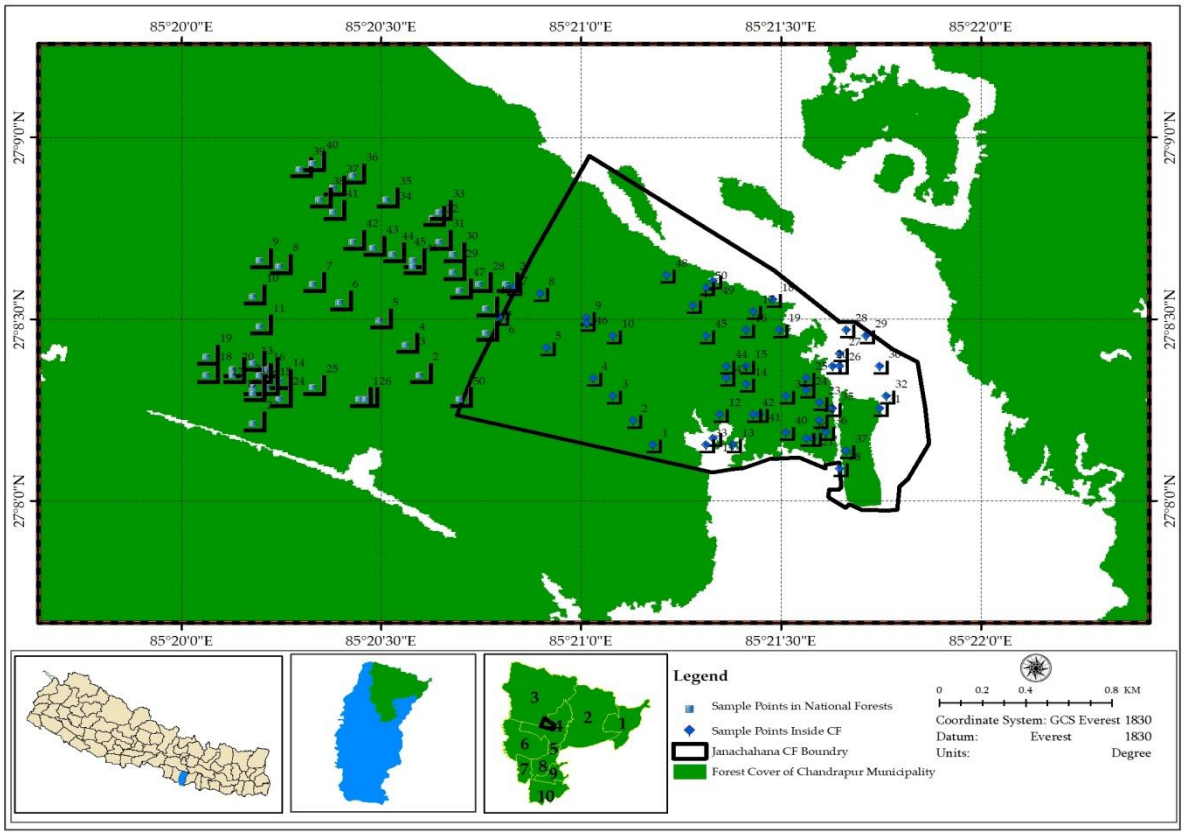

Figure 1: Map of Study Area

3.2 Vegetation

The study area lies in tropical region. The main constituent of the forest are *Shorea robusta, Dalbergia sissoo, Acacia catechu, Dalbergia latifolia* and associate species are

Dendrocalomous strictus, Terminalia bellirica, Terminalia chebula, Asparagus recemosus, Piper longum, Magnifera indica. The average canopy cover of the forest is 40%. It has the peculiar forest type i.e. riverine forest, primarily consisting of Sisoo (*Dalbergia sissoo*), and Khair (*Acacia catechu*) and plant like *Dalbergia latifolia* (JCCF nirdasika).

3.3 Climate

The climate of the study area is humid with the average rainfall of 713.8mm. The maximum temperature was 35.1°C and minimum temperature was 11.2°C (Metrological data, 2017).

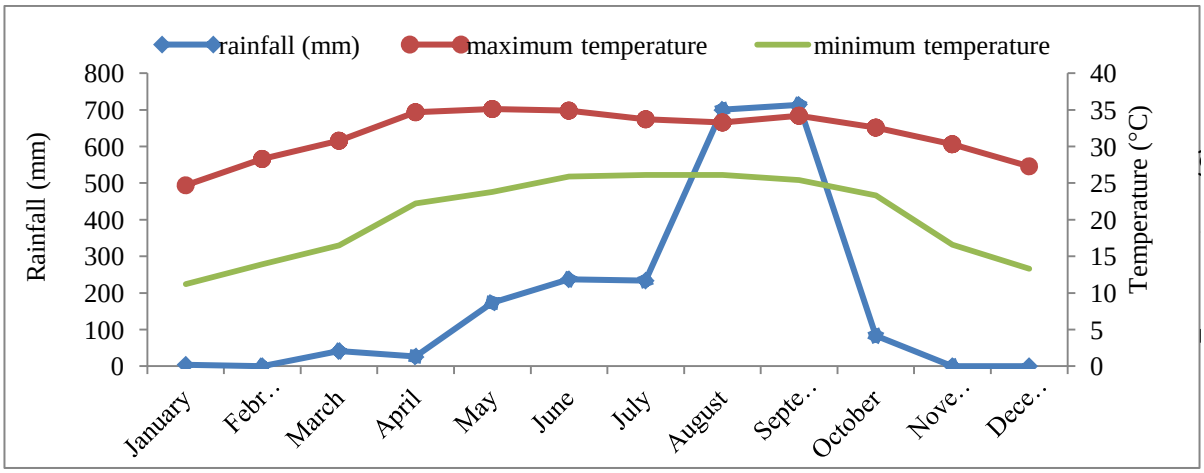

Figure 2: Temperature and rainfall in study area on 2017

3.4 Ethnicity

In my study site, major group of that area were Brahmin, Chettri, Newar, Tamang, Majhi, Gurung etc. People mainly depend on agriculture and livestock farming however, few were engaged on other services and local business. The majority of people were following Hinduism, Buddhism and few following Christianity.

3.5 Taxonomy

3.5.1 Plants collection and Herbarium preparation

Plant specimens were collected with proper photographs. The field notes of all the species were recorded in the note book. While preparing field note, date of collection, collection number, locality, vegetation, and colour of flower were noted. The plant species collected were pressed with the help of herbarium press, newspaper, card board and blotting sheets. The dried plant specimens were mounted on the herbarium sheets.

3.5.2 Identification

Identification of the plants was made using literatures (Hooker, 1872-1897; Hara et al., 1978; Hara and Williams, 1979; Hara et al., 1982; Polunin and Stainton, 1984; Stainton, 1987 and

1988; Noltie, 1994-2000; Cullen, 1996; Wu et al., 1994-2008; Harris and Harris, 2001; Pearce and Cribb, 2002). It was also identified from the literature of Chapagain et al., (2017). Some plants identification was done with the help of local forest user groups and was confirmed with experts' consultations.

3.5.3 Interview

After the collection of different plant species, an individual interview was conducted among 34 members of forest user group. Semi structured questionnaire was used for interviewing respondent (Annex 1, 2, 3). Respondent were selected based on their occupation from the area.

3.6 Ecology

3.6.1. Sampling

Random Sampling was done in different area of national and JCCF. In total 100 plots, 50 in each forest type was carried out with quadrates of size (20×20) m^2 for trees, 3 quadrates of (5×5) m^2 for shrubs and 3 quadrates of (1×1) m^2 for herbs within it. Total number of species in each plot was recorded and within the plots respective number and coverage of the plant species were recorded. For shrubs each shoots emerged from the ground were counted as individuals. And ultimately frequency, density, coverage and their relative values were calculated for IVI. Number of seedling and sapling was recorded to measure the regeneration pattern. Soil samples upto 30cm depth from the surface of 10 different quadrates were collected from both National forest and JCCF. Soil parameter like Nitrogen, Phosphorus, Potassium (NPK) and Organic content were measured in Agriculture Training Center (ATC) laboratory and calculated using following formulae.

Total Nitrogen was determined by Kjeldahl method.

Reagents:

- Digestion Mixture: 10 gm of grinded copper sulphate with 200 gm of sodium sulphate.
- Concentrated Sulphuric acid
- Sodium Hydroxide (40%)
- Mixed Indicator: 0.5 gm Bromo cresol green and 0.1 gm methyl red dissolved in 100 ml of 95% ethanol
- Boric acid (4%)
- 0.1N HCl
- Phenolphthalin Indicator

Method:

2 gm soil was taken in a 50 ml kjeldhal Digestion flask. 2 gm catalyst digestion mixture and 10 ml concentrated sulphuric acid were added. The solution was then swirled and gradually heated by increasing heat for several minutes till the sample turned turquoise. The solution was then allowed to cool for few minutes. Then distilled water was gradually added to the solution with swirling and made up to the volume. The solution was then transferred to a 100 ml volumetric flask, leaving the sand in the digestion flask and made up to the volume

20 ml aliquot with 20 ml of 40% NaOH was added to the distilling flask and distilled, collecting the liberated gas in 50 ml of 4% Boric acid solution containing few drops of mixed indicator. The final solution was then titrated with 0.01N HCl. A blank was run without soil.

Calculation:

$$\text{Soil N (\%)} = \frac{14 \times N \times S - B \times 100}{M}$$

Where,

N = Normality of HCl

S = Volume of HCl consumed with sample (ml)

B = Volume of HCl consumed with blank (ml)

M = Mass of soil taken (mg)

Available Phosphorus was determined by Olsen's Bicarbonate Method.

Reagents:

- Sodium bicarbonate ($NaHCO_3$) 0.5 M extracting solution
- Darco-G-60 or equivalent grade phosphorus free charcoal
- Ammonium molybdate solution
- Ascorbic acid solution
- Antimony potassium tartrate solution
- Sulphuric acid 2.5 M
- Using the above reagents, prepration of the Murphy-Riley color developing solution; In a 500 ml volumetric flask, 250 mL of 2.5 M H_2SO_4 is added, followed by 75 ml of ammonium molybdate solution, 50 ml of ascorbic acid

solution, and 25 ml of antimony potassium tartrate solution. Then 100 ml of distilled water is added and mixed on a magnetic stirrer.

- P- nitrophenol indicator
- Preparation of Standard stock P solution: Exactly 0.439 g A.R. grade potassium dihydrogen orthophosphate (KH_2PO_4) is dissolved in 500 mL distilled water after drying in oven at 60^0 C for 1 hour and cooling in desicator. 25 ml of 7 N H_2SO_4 is added to the solution and the volume is made 1 Litre with distilled water. This gives a 100 ppm stock solution of P (100 µg P L^{-1}) from this 5 ml solution is taken in a 100 ml volumetric flask and made up to the volume. This gives 5 ppm P solution (5 µg P L^{-1}).

Preparation of standard curve:

In order to prepare standard curve of P, 1, 2, 3, 4, and 5 ml of 5 ppm P solution were taken in 50 ml volumetric flasks. To these 5 ml of the extracting solution ($NaHCO_3$) was added. Then 10 ml of distilled water and one drop of p-nitrophenol indicator were added. Then 2.5 M H_2SO_4 was added drop wise until the solution became clear. At the point where indicator's yellow color disappeared, the correct pH (5.0) for the color development had been attained. If the end-point exceeded through addition of excessive acid, the pH could be brought back up again by adding NaOH.

To each flask 8 mL of the Murphy-Riley solution was added and the volume was made 50 mL with distilled water and mixed. Then these standards had P concentration 0.1, 0.2, 0.3, 0.4, and 0.5 µg P ml^{-1}. A blank was prepared with $NaHCO_3$ solution, distilled water and Murphy-Riley reagent. After waiting for 15 minutes, the intensity of the blue color was read on spectrophotometer at 730 nm. Absorbance values (readings) for the standards having 0, 0.1, 0.2, 0.3, 0.4 and 0.5 µg P ml^{-1} were used to construct a standard curve between absorbance values and the concentration of P in standards.

Method:

- 2.5 g sample of air dried soil (ground to less than 2 mm) was taken in a 125 ml Erlenmeyer flask.
- A little of phosphorus free Darco-G-60 or activated charcoal was added.
- To each flask 50 ml of $NaHCO_3$ solution at 25^0 C was added.
- Then shaken for 30 min on a reciprocating shaker at 120 strokes per minute.
- Similarly a blank without soil was also run.

- The extract was filtered using Whatman No. 40 filter paper. If the filtrate was cloudy, it is refiltered as necessity.
- 10 ml aliquot of the extract was taken in a 50 mL volumetric flask, and 10 ml of distilled water and one drop of p-nitrophenol indicator were added. Then content were acidified to pH by adding 2.5 M H_2SO_4 drop by drop till the color disappeared.
- 8 ml of the Murphy-Riley solution was added and made the volume up to 50 ml with distilled water. After waiting for 15 minutes, the intensity of blue color was read on spectrophotometer at 730 nm (as in case of standard).

Calculation:

$$\textbf{Available P (Kg ha}^{-1}\textbf{)} = C \times \frac{Volume\ of\ extractant}{Volume\ of\ aliquot} \times \frac{2.24}{Wt.of\ soil}$$

Where, C = μg P in the aliquot (obtained from standard curve)

Available Potassium was determined by Flame Photometer method (Gupta, 2000).

Equipments and Reagents

- Flame photometer
- Centrifuge or shaker
- Erlenmeyer flask
- Neutral normal ammonium acetate solution
- Standard KCl solution

Method

2.0 g of air dried soil was taken in a 125 ml conical flask and 20 ml of 1N ammonium acetate at pH 7 was added. The solution was shaken in a mechanical shaker for 5 minutes and then filtered through Whatman No 42 filter paper. A standard curve was drawn from the flame photometer readings of 0, 5, 10, 15, 20 and 25 ppm K standard solutions and potassium content in the soil was calculated by comparing the Flame photometer reading of soil solution with the standard curve.

Calculations

Ppm K = R × 20/2

Ppm K_2O = R × 20/2 × 1.2 = R × 12

K2O (kg/ha) = R × 12 × 2.24 = R × 26.88

Where,

R = Potassium of soil extract in ppm from the standard curve.

20 = Volume of extraction solution taken.

2 = Wt. of soil taken.

1.2 = ppm K to K2O

2.24 = kg/ha

3.6.2. Diversity indices

For the diversity calculation, Simpson and Shannon-Wiener index were calculated. Among them first represents about dominancy and later represents diversity having more species and evenness in distribution (Yadav et al., 1987).

Simpson index was first given by Simpson in 1949 with following formula

Simpson index (D) = $\Sigma\ N\ (N-1)/n_i\ (n_i-1)$

Where, N = total sample size and n_i = no. of individual species of '$_i$'

Simpson diversity index = 1-D

Similarly, Shannon-Wiener index was calculated by using following formula,

Shannon-Wiener Index (H) = $-\Sigma\ P_i \log P_i$

Where P_i = proportion of total sample represented by species (Shannon (1948)).

And Sorenson's coefficient of similarity (Ss) = 2a / b+c where a = common species, b = unique species of b and c = unique species of c which is given by Sorenson (1948).

3.6.3. Ecological parameters

Density

Density is the total number of the individuals of particular species counted in all the plots of specified size. It is usually expressed in number of individuals per hectare (for larger species) or number of individual per square meter (for smaller species). It was calculated by using following equations (Yadav et al., 1987);

$$\text{Density} = \frac{\textbf{Total no.of individual of a species occured}}{\textbf{Total no.of quadrat studied}} \text{x} \frac{\textbf{1}}{\textbf{area of quadrat}}$$

Density per hectare = **Density × 10000**

$$\text{Relative Density} = \frac{\textbf{Density of individual species}}{\textbf{Total density of all species}} \text{ x } 100\%$$

Frequency

Frequency gives how frequently species occurs in the plot. It is given by;

$$\text{Frequency} = \frac{\textbf{No.of quadrat in which species occured}}{\textbf{Total no.of quadrat studied}} \text{ x } 100\%$$

$$\text{Relative Frequency} = \frac{\textbf{Frequency of individual species}}{\textbf{Total frequency of all species}} \text{ x } 100\%$$

Coverage

Coverage shows the how much has species cover in the area. It is given by;

$$\text{Average Coverage} = \frac{\textbf{Total coverage of species}}{\textbf{Area of quadrate x Total no of quadrat}} \text{ x } 100\%$$

$$\text{Relative Coverage} = \frac{\textbf{Coverage of individual species}}{\textbf{Total coverage of all species}} \text{ x } 100\%$$

Importance Value Index (IVI)

Importance Value Index for each plant determines the plant importance in the community and was calculated using following formula:

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

Where RD, RF and RC refer to the acronym of parameters as mentioned above.

3.7. Statistical Analysis

Raw data was entered in MS Excel and their density, frequency, abundance, IVI for the calculation of species. Calculation of medicinal plants and its uses were tabulated in MS Excel. Categorization of plant species were done into medicine, fodder, food, firewood, religion, bedding by using MS Excel. By using MS Excel, uses of plant species were categories and its collection time as well as its weight was calculated. By using MS Word list of priority species were listed and entry of those species was done by the help of MS Excel.

4 RESULT

The study area lies on Central Nepal in Chandrapur municipality of Rautahat district which is located in tropical region. Janachahana Community forest (JCCF) was established after the degradation of National forest which consist of *Shorea robusta, Semecarpus anacardium, Dillenia pentagyna* and some portion is riverine forest containing *Dalbergia sisso, Acacia catechu* etc. Altogether 137 plant species were reported in present study, among them 113 species from JCCF, 76 species from National forest and 52 species from both sites is common. Among the plant species found in National forest maximum were from Asteraceae (6), Fabaceae (5), Poaceae (4), Myrtaceae (3) followed by other family and in Community forest were from Fabaceae (15), Moraceae (9), Poaceae (9), Asteraceae (7), Malvaceae (6) followed by others families (**Annex 4).**

4.1. Diversity indices

Based on both Simpson and Shannon-Weaver diversity indices, plant diversity was high in JCCF than in National forest **(Table 1).** Trees and shrubs diversity was higher in JCCF than in National forest whereas herbs diversity is comparatively higher in National forest (**Table 1**). Shrubs and herbs were more evenly distributed than trees in National forest whereas trees and herbs were more evenly distributed than shrubs species in JCCF (**Table 1**).

Table 1: Diversity indices of plant in Community Forest and National Forest

Forest types		**National Forest**			**Community Forest**		
Diversity indices	Symbol	Trees	Shrubs	Herbs	Trees	Shrubs	Herbs
Simpson diversity index	1-D	0.71	0.45	0.916	0.904	0.73	0.91
Shannon index	H	1.96	0.674	2.88	3.03	1.616	2.88
Evenness	E	0.555	0.613	0.76	0.721	0.276	0.74

Beta diversity means the ratio of species between two different places. Similarly, Beta diversity between the JCCF and National forest types was moderate according to Sorenson coefficient (CC = 55.02% and their difference coefficient 44.98%) **(Table 2).**

Table 2: Beta diversity

Category	**Net**	**Total**
Number of Common species in both Forests (C)	52	52
Number of species in community forest (A)	61	113
Number of species in National forest (B)	24	76
Sorenson`s Coefficient(CC)	55.2	
Difference coefficient	44.98	

4.2. Ecological parameters

List of Ecological parameter are in **Annex 6** and **Annex 7**

4.2.1. Density

Comparison of 15 plant species of National forest, *Shorea robusta* has occupied maximum density whereas *Schleichera oleosa* has occupied least density (**Figure 3**).

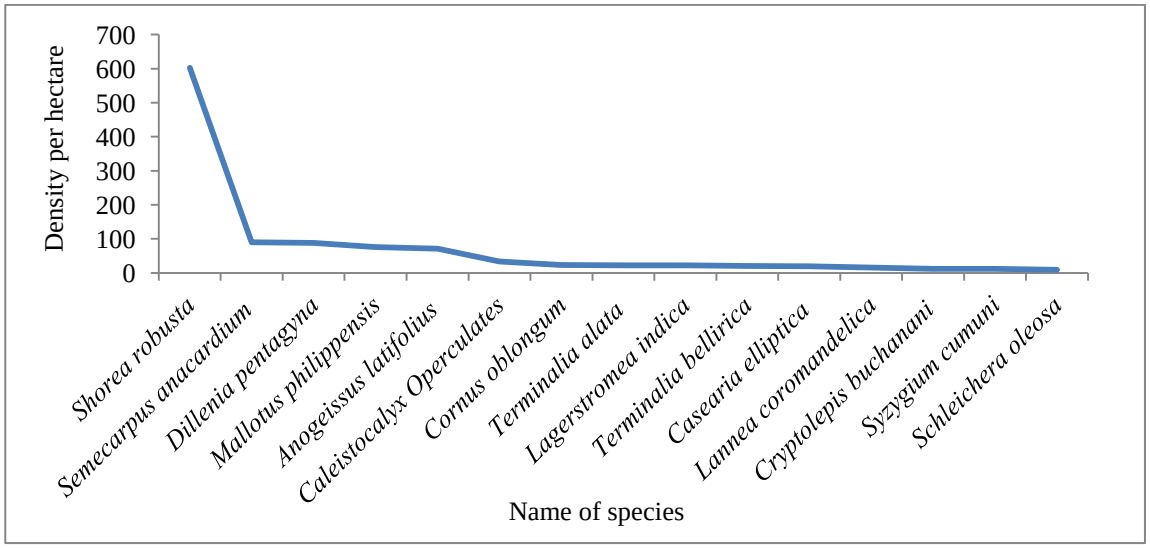

Figure 3: Density of trees in National Forest

JCCF was dominated by both wild and cultivated plant species. Among wild species, *Dalbergia sissoo* occupied maximum density whereas *Mitragyna parviflora* occupied least density (**Figure 4**). Whereas among cultivated plant, *Ficus hispida* was at the highest density but *Ficus lacor* occupies at bottom density (**Figure 5**).

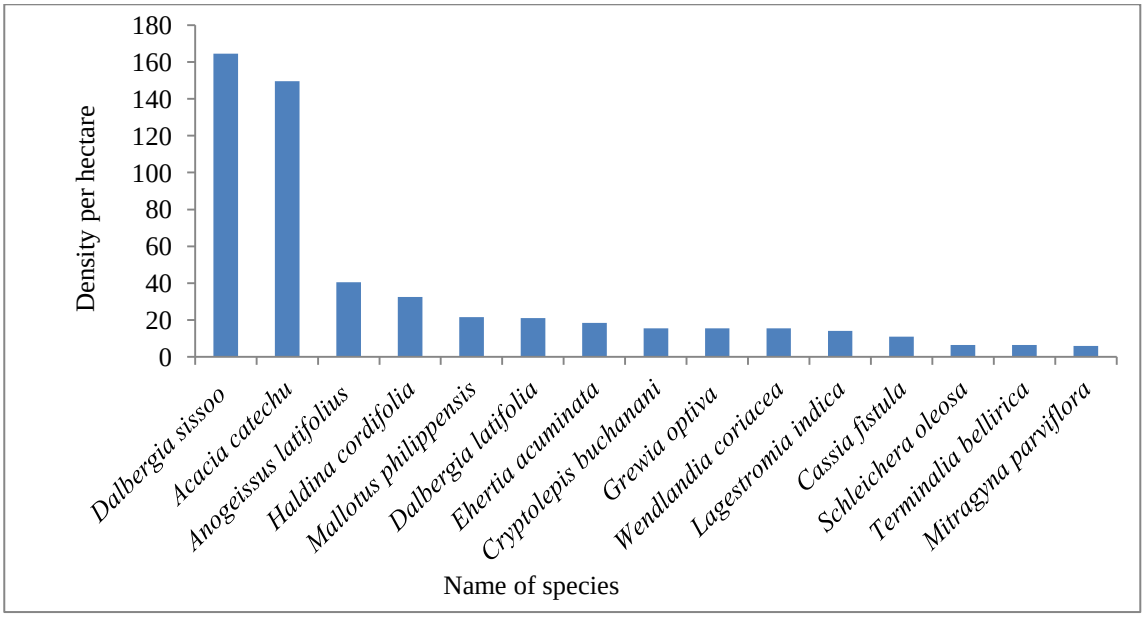

Figure 4: Density of wild trees in Janachahana Community Forest

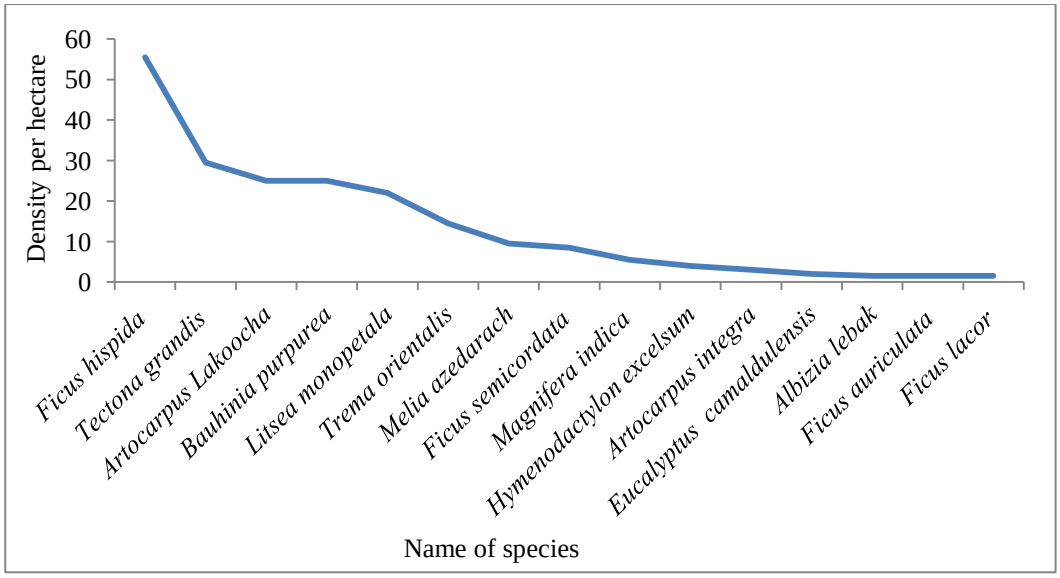

Figure 5: Density of cultivated trees in Janachahana Community Forest

Among the shrub species in National forest, *Leea crispa* is shrub having highest density whereas *Asparagus racemosus* has lowest density (**Figure 6**). *Leea crispa* has maximum regeneration in National forest

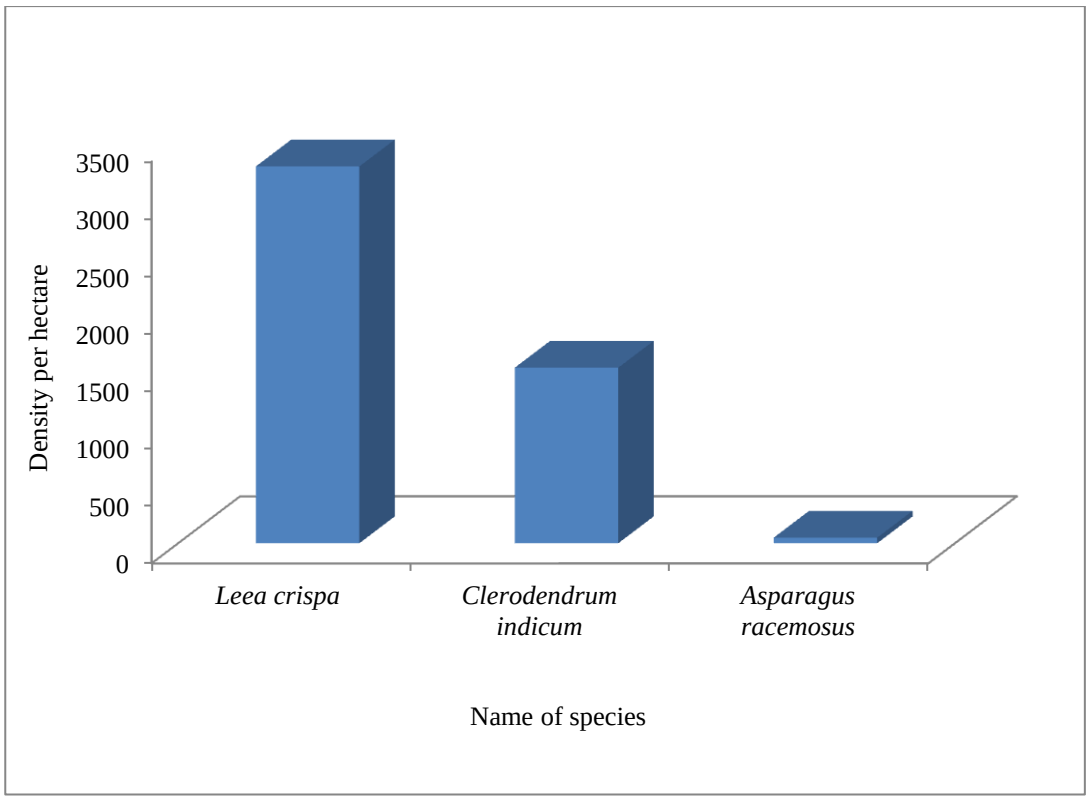

Figure 6: Density of shrubs in National Forest

Among the shrubs in JCCF, *Clerodendrum indicum* scored the highest density whereas *Wendlandia coriacea* scored the lowest value (**Figure 7**). Plant species like *Clerodendrum indicum* is used for livestock bedding purposes because of their high density.

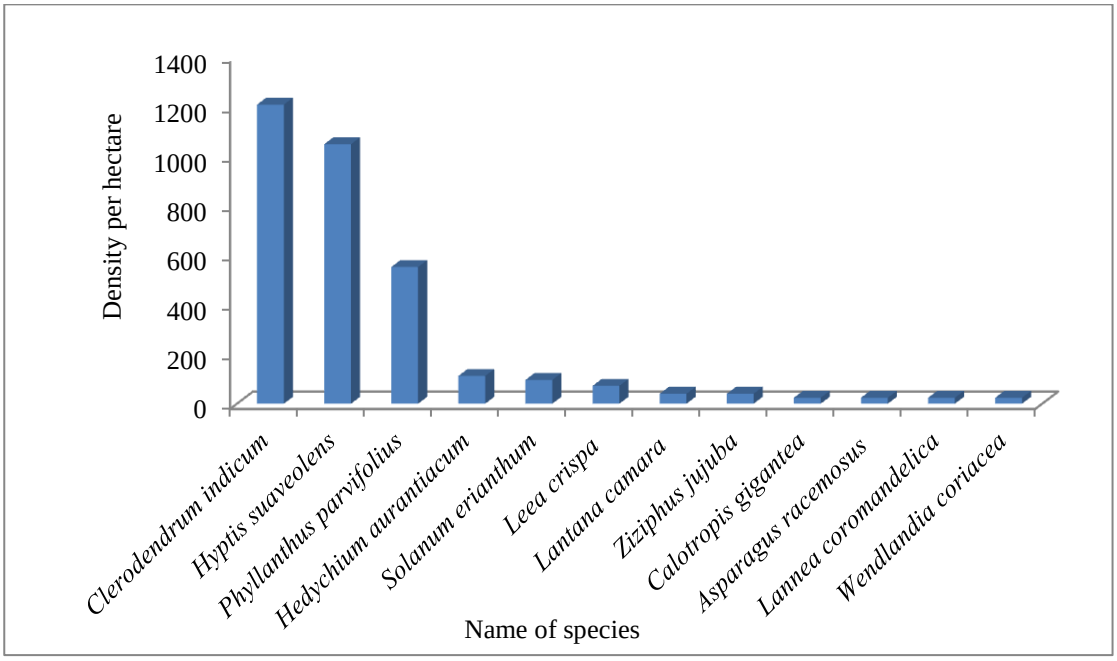

Figure 7: Density of shrubs in Janachahana Community Forest

Among herbs in National forest, *Steria glauca* has highest density whereas *Floscopa scandens* has lowest density in National forest (**Figure 8**). *Curciligo orchoides* one of the endangered herb species, was found in sampling site.

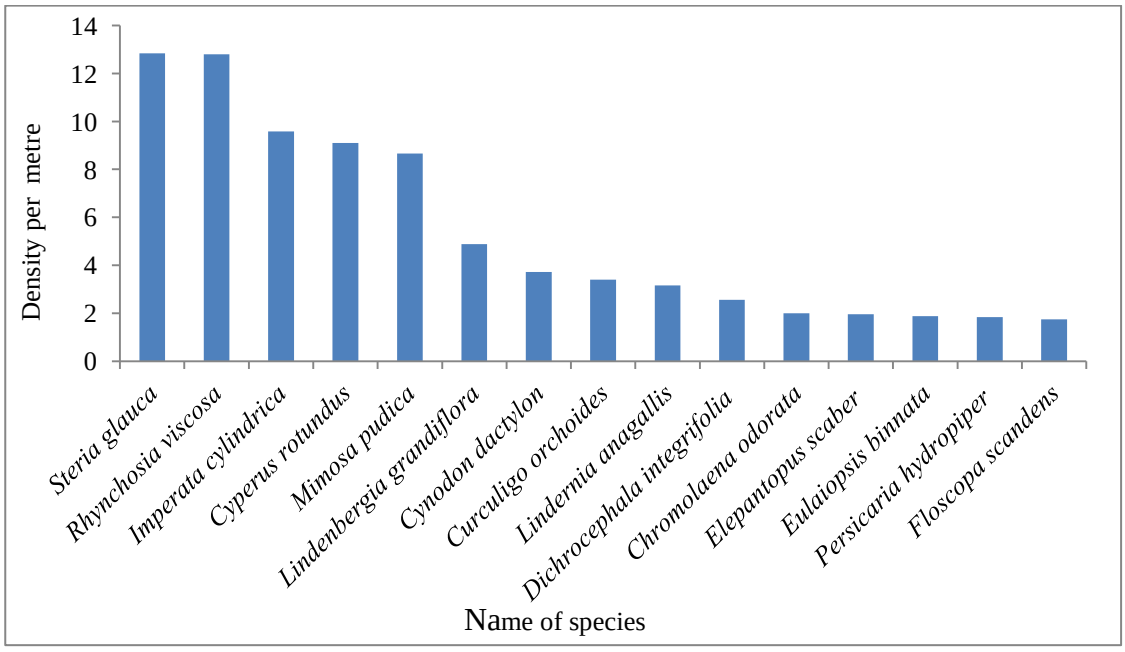

Figure 8: Density of herbs in National Forest

Among herbs, *Steria glauca* has highest density and *Dichrocephala integrifolia* species has lowest density (**Figure 9**). *Steria glauca* and *Imperata cylindrica* has occupied dense area in JCCF.

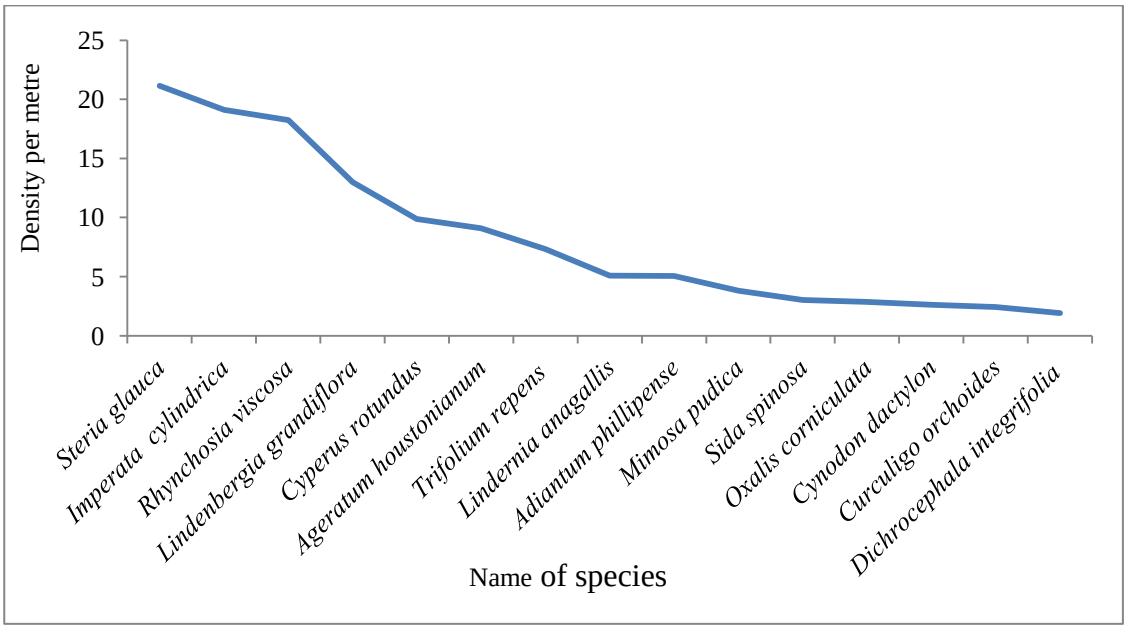

Figure 9: Density of herbs in Janachahana Community Forest

4.2.2 Importance value index

Comparison of IVI of 15 plant species of National forest, *Shorea robusta* has scored maximum importance value in every study site whereas *Schleichera oleosa* has occupied least importance value (**Figure 10).**

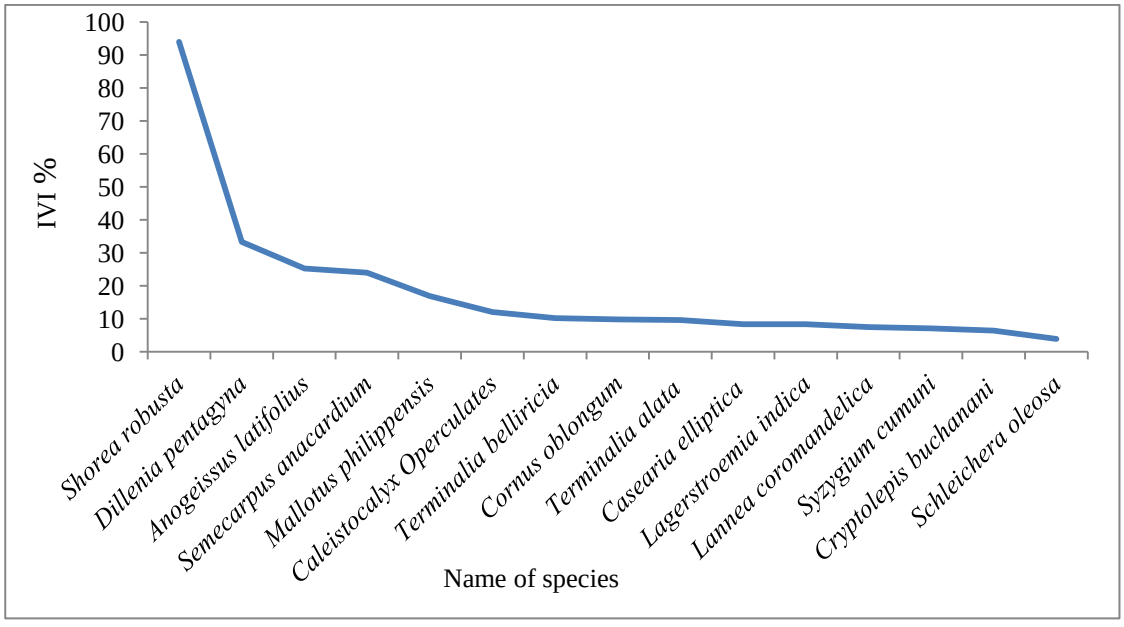

Figure 10: IVI of trees in National Forest

Among the tree species, *Dalbergia sissoo* has highest importance value whereas that of *Mitragyna parviflora* has lowest importance value in the wild species of JCCF (**Figure 11**).

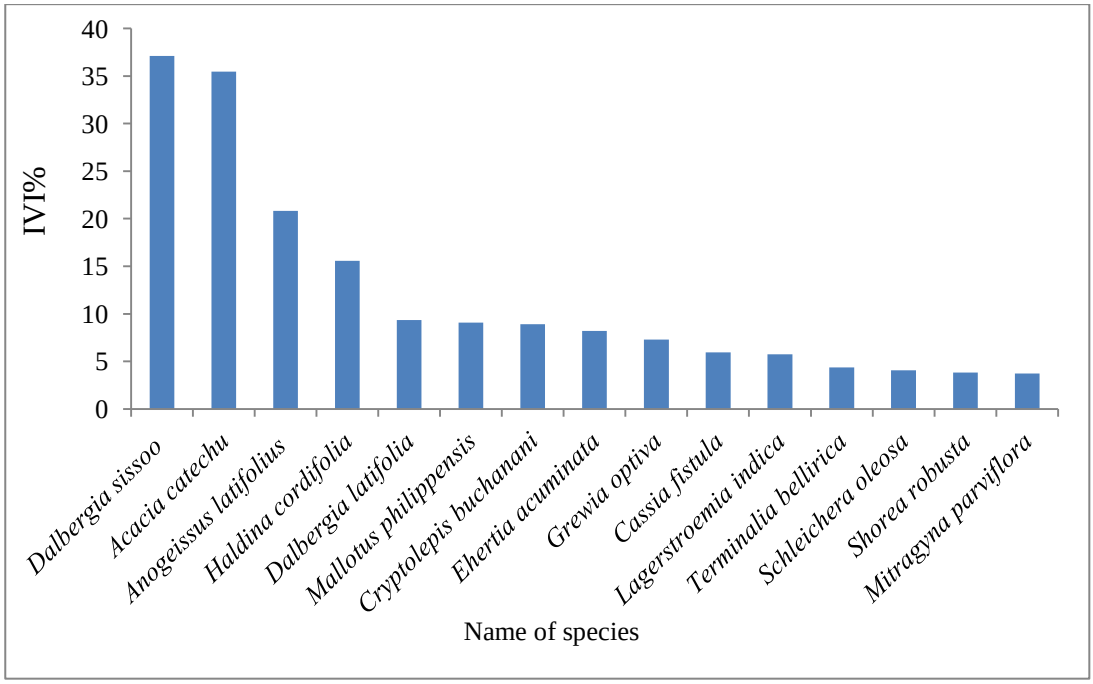

Figure 11: IVI of Wild tree species in Janachahana Community Forest

However, among cultivated plant species *Ficus hispida* found highest importance value index and *Bridelia retusa* scored the least value in JCCF (**Figure 12**).

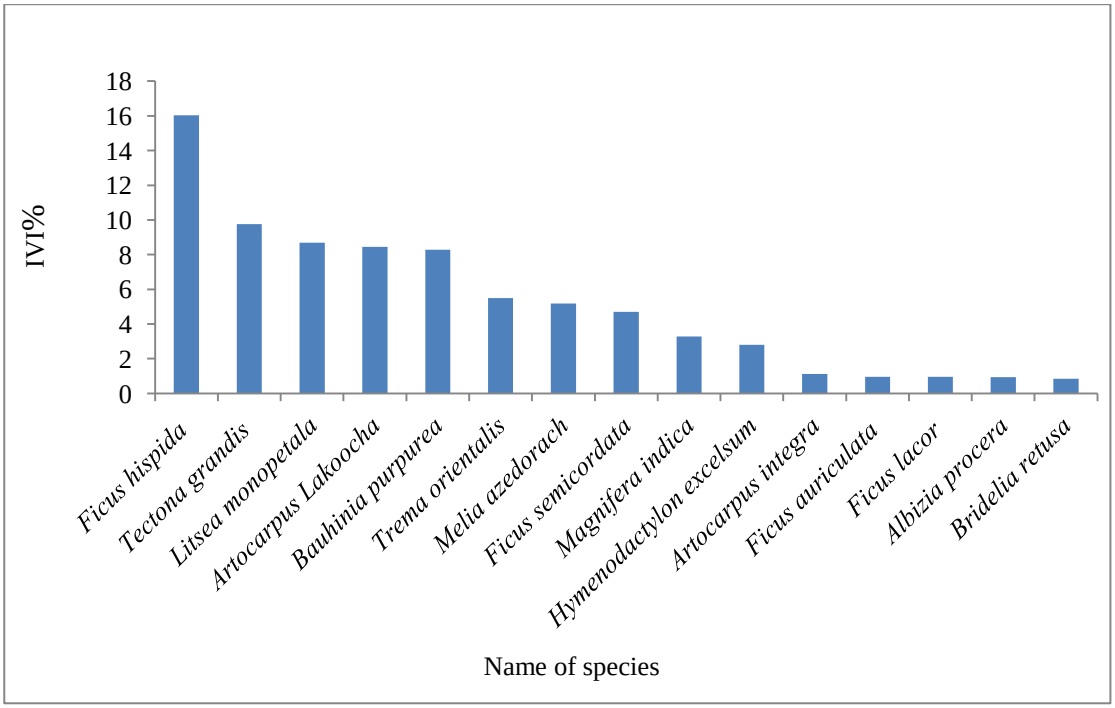

Figure 12: IVI of Cultivated tree species in Janachahana Community Forest

Among the shrub species in National forest, *Leea crispa* scored highest importance value which has maximum regeneration whereas *Asparagus racemosus* has lowest value (**Figure 13).**

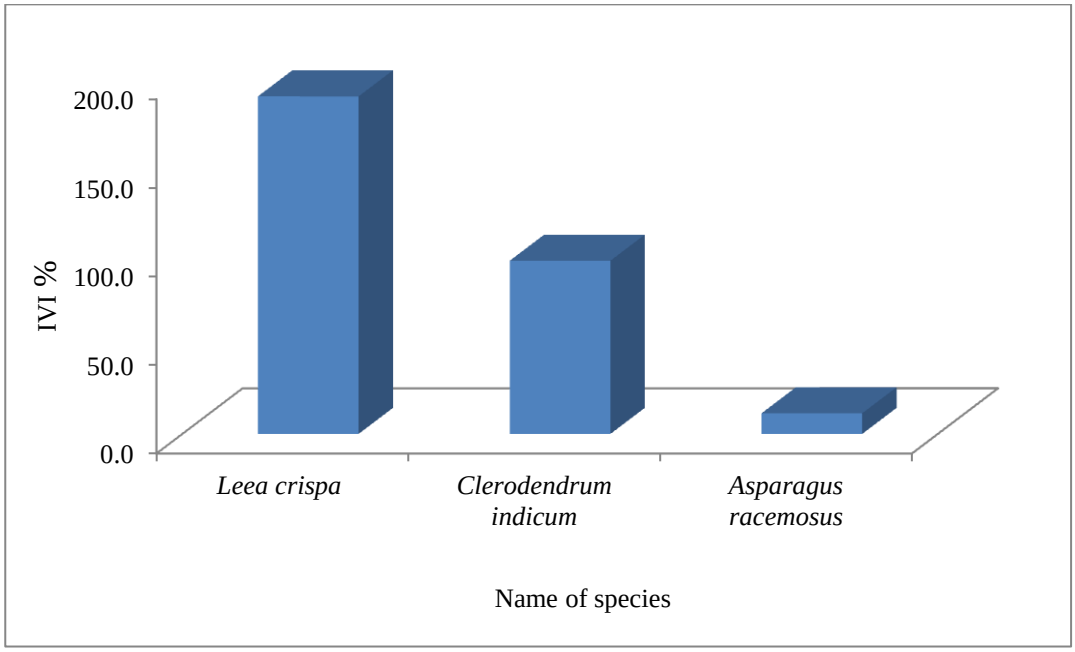

Figure 13: IVI of shrubs in National Forest

Among the shrub species in JCCF, *Clerodendryin indicum* scored the highest value of IVI among wild species but *Thysanolaena maxima* scored good value among cultivated species (**Figure 14 &Figure 15**).

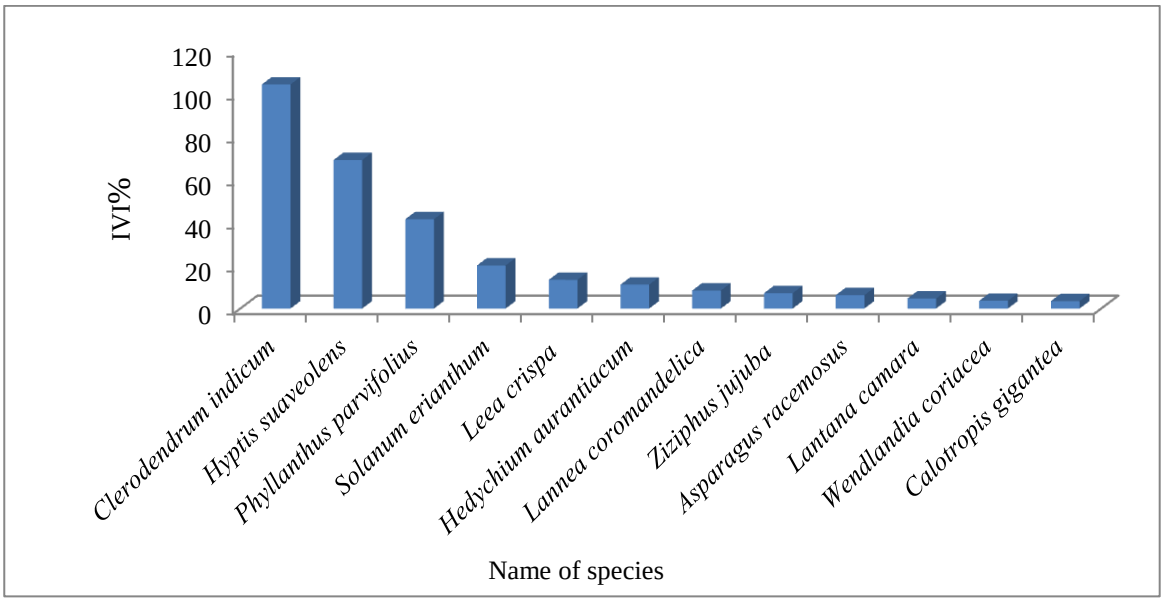

Figure 14: IVI of wild shrub species of Janachahana Community Forest

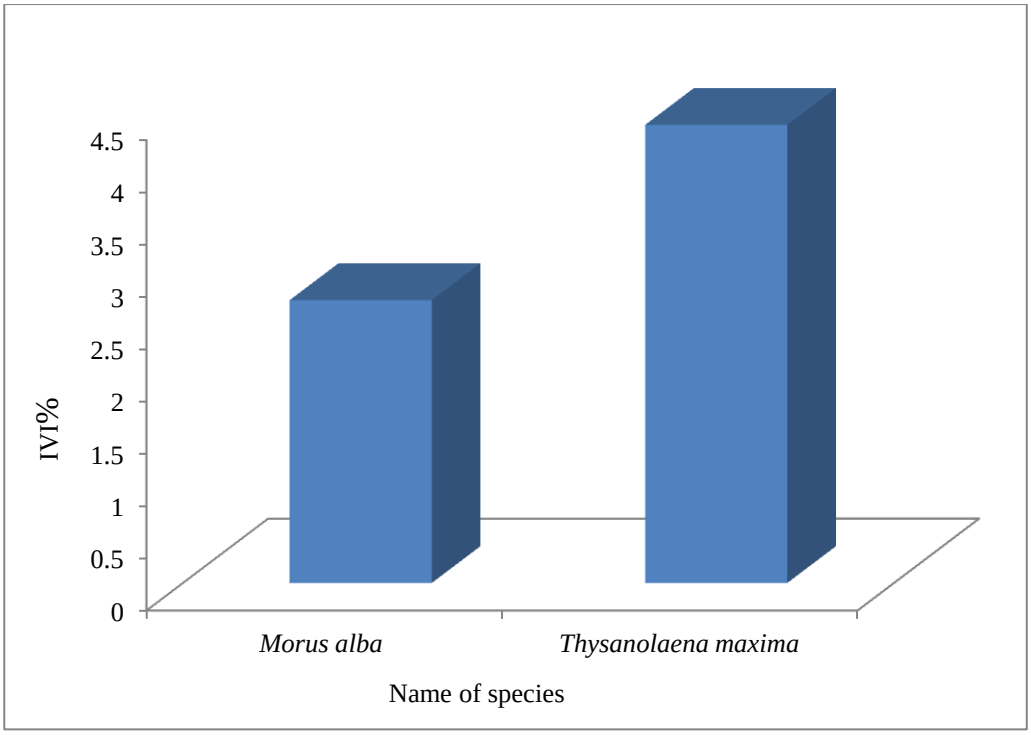

Figure 15: IVI of cultivated shrubs species of Janachahana Community Forest

Among herbs, *Steria glauca* has scored highest importance value and *Sida spinosa* has lowest importance value in National forest (**Figure 16**).

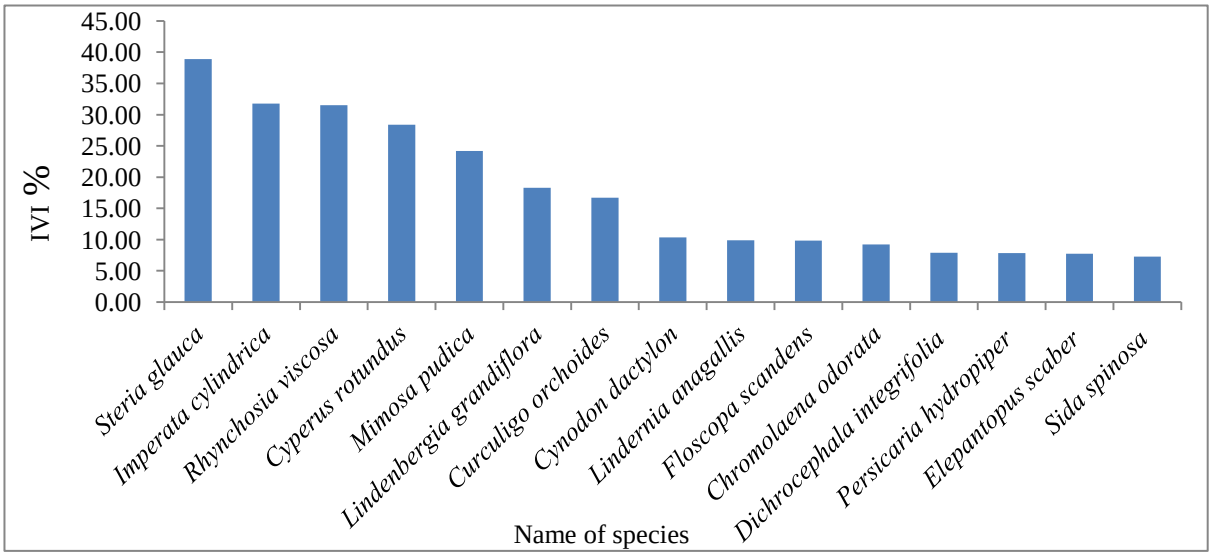

Figure 16: IVI of herbs in National Forest

Among herbs, *Steria glauca* has highest importance and *Achyranthes aspera* has lowest value in JCCF (**Figure 17**).

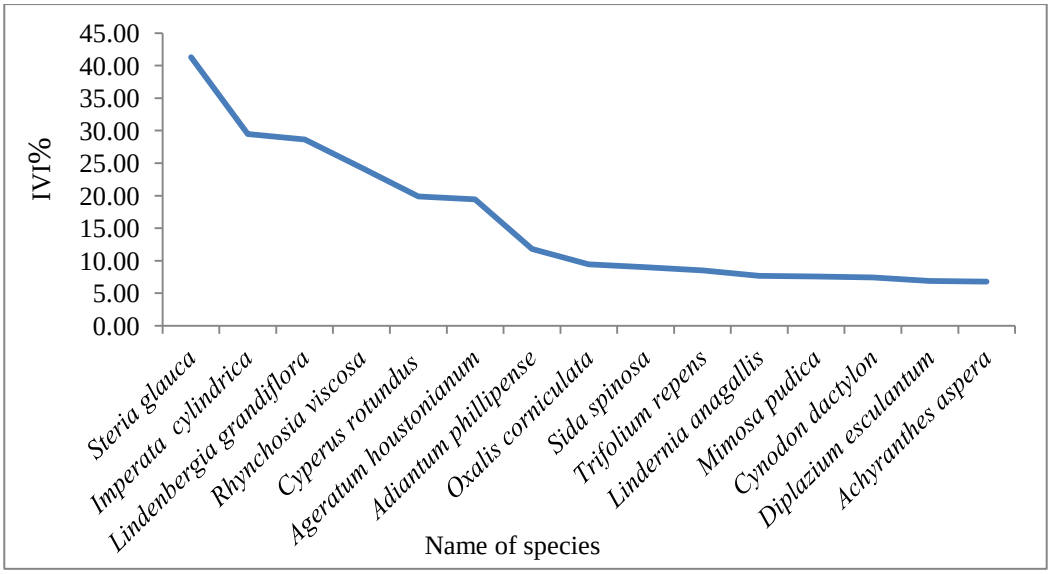

Figure 17: IVI of herbs of Janachahana Community Forest

4.3 Regeneration pattern

While studying the regeneration pattern of both forests, regeneration of National forest was good in comparison to Community forest. Total addition of Wild and cultivated species of JCCF showed less biodiversity than that of National forest. National forest has good regeneration pattern which gives clear vision of maximum number of seedling than that sapling and tree species. Wild species of JCCF showed poor regeneration pattern. Comparison between cultivated and wild species in JCCF, 28.65% of trees, 39.24% of saplings, 38.58% of seedlings were found to be of cultivated species whereas maximum percentage of trees, saplings and seedlings were of wild species (**Figure 18**).

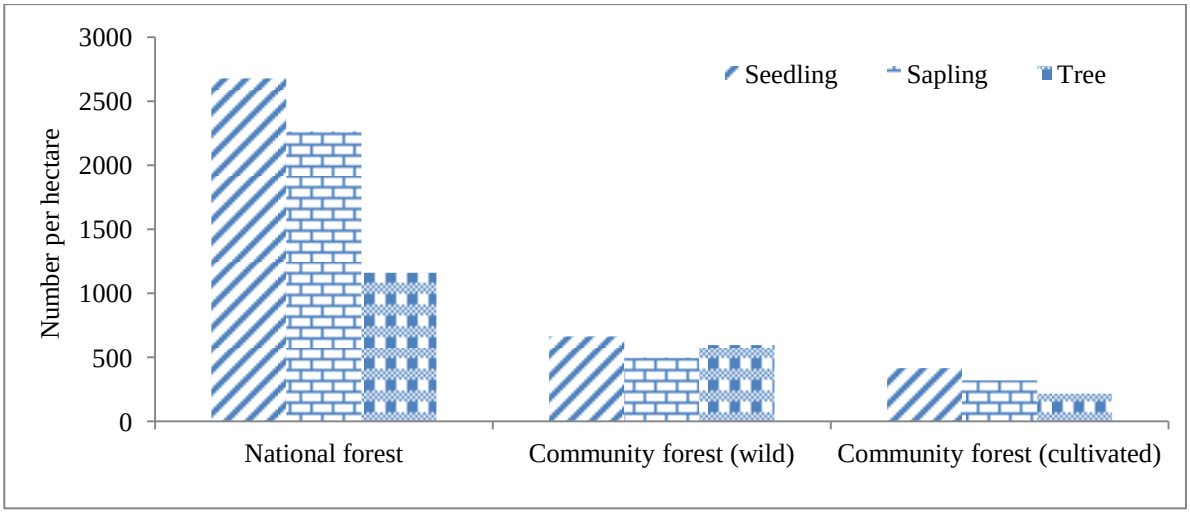

Figure 18: Regeneration of tree species in JCCF and National forest

In National forest, almost all species have good regeneration pattern and these species can be continue in the National forest as the seedling and sapling are more than tree except

Anogeissus latifolius, Cornus oblongum will be less in number (**Figure 19**). Ultimately in the coming future, *Shorea robusta* will occupies maximum area in National forest as seedling and sapling are maximum than that of trees.

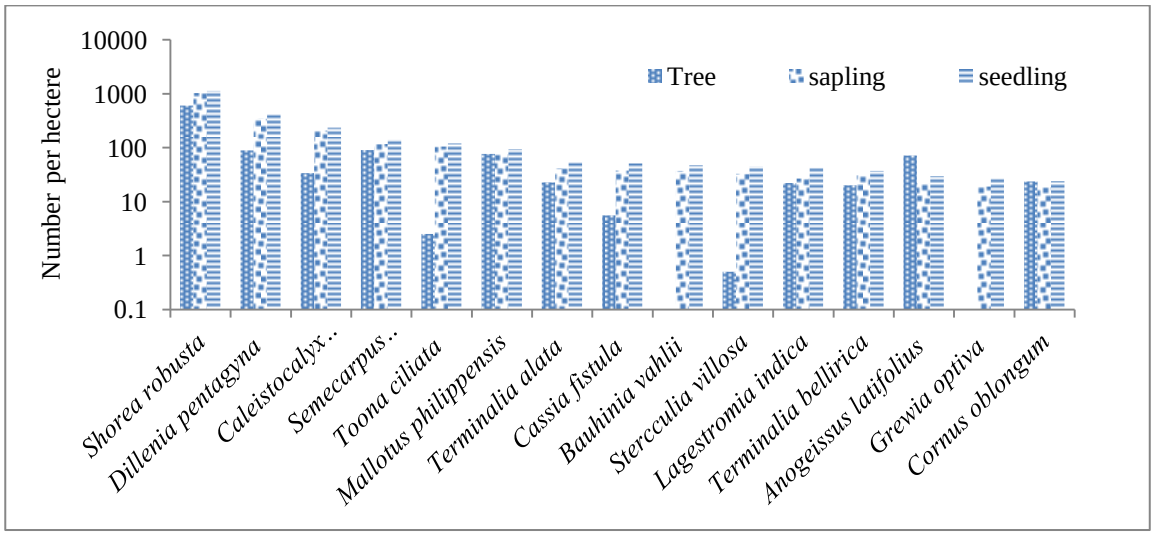

Figure 19: Regeneration of trees in National Forest

While comparison of regeneration pattern in JCCF, *Mallotus philippensis, Shorea robusta, Dillenia pentagyna, Schleichera oleosa, Lagerstroemia indica* has good regeneration pattern but that of *Dalbergia sissoo* is not good in JCCF among wild species (**Figure 20**). Regeneration pattern of *Dalbergia sissoo, Acacia catechu, Ehretia acuminata* and *Haldina cordifolia* did not show the usual pattern of regeneration and indicated their poor regeneration in JCCF.

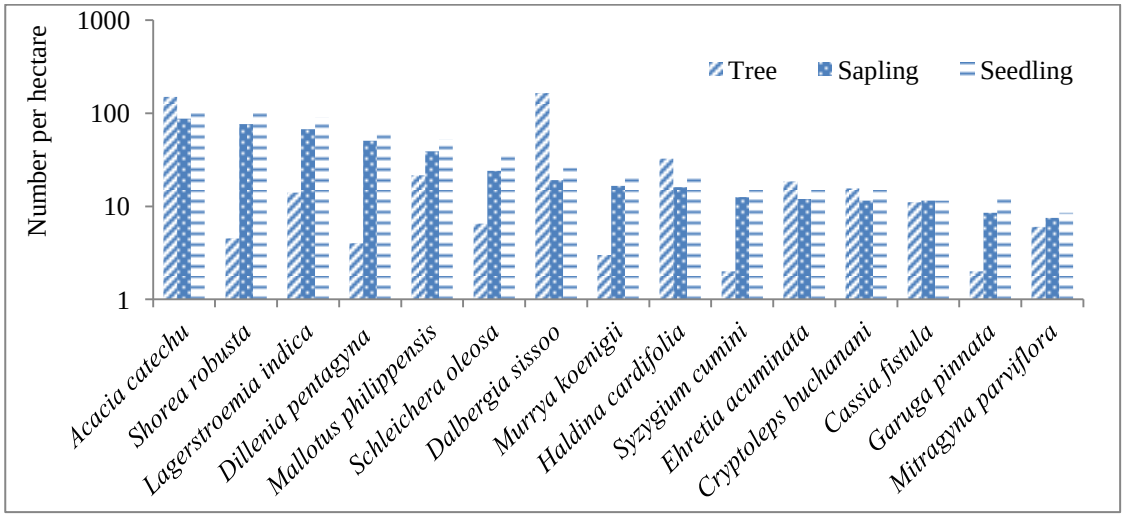

Figure 20: Regeneration of wild plant in Janachahana Community Forest

The planted tree species like *Melia azedarach, Litsea monopetala and Leucaena leucocephanla* in JCCF has good regeneration pattern and indicates their good dominance in

future. But the regeneration of planted species like *Ficus hispida, Artocarpus lakoocha and Tectona grandis* is not good, as the number of tree species are more than seedling and sapling. Seedlings and saplings of *Ficus semicordata, Magnifera indica, Artocarpus integra, Morus alba* and *Eucalyptus camaldulensis* were absent in the JCCF (**Figure 21**).

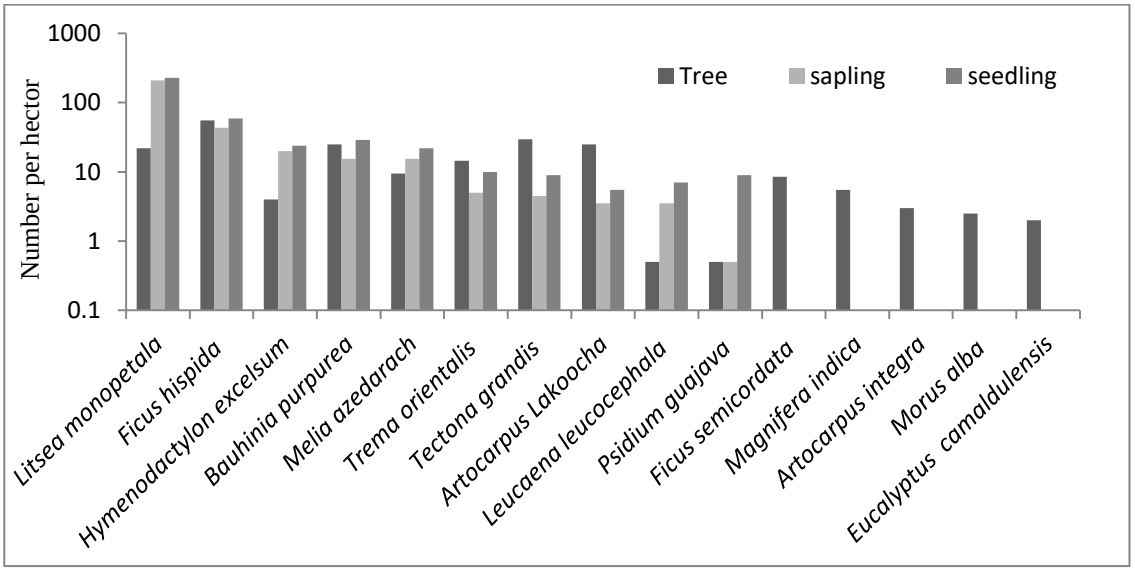

Figure 21: Regeneration of cultivated in Janachahana Community Forest

4.4 Ethnobotanical study of plants

Out of 137 species, 57 plant species were used for multiple purpose and 8 plant species were recorded for single purpose. Most of the plants recorded for ethnobotanical uses were from the family Fabaceae followed by Poaceae, Moraceae, Asteraceae, Myrtaceae, Combretaceae, and Phyllanthaceae. Mostly plants were used for food, fodder, firewood and bedding purpose, and some were having medicinal and religious value.

4.4.1 Medicinal uses

Altogether 31 plant species were recoded with medicinal value and were from various families. Among the 31 medicinal plants maximum belongs to Fabaceae (5), followed by Myrtaceae (3), Asteraceae (2), Amaranthaceae (2), Combretaceae (2), Phyllanthaceae (2), Apocynaceae (2). Single species recorded from families Rutaceae, Asparagaceae, Meliaceae, Bombacaceae, Apiaceae, Poaceae, Euphorbiaceae, Moringaceae, Piperaceae, Lamiaceae, Anacardiaceae, Dipterocarpaceae and Menisperaceae (**Annex 4)(Table 3).** *Syzygium cumuni* has been found to be used in curing maximum ailment like Diarrhoea, Diabetes, Dysentery, Indigestion, Sinusites, and Gastritis. Likewise other species *Agele marmelos* used for Fever, Gastritis, Dysentery, Ear disease, Constipation, *Centella asiatica* used for Diabetes, Cough, Gastritis, Asthma and Urine related diseases, *Pogostemon benghalensis* used for Cough,

Common cold, Fever, Clotting, *Alternatheria sessilis* used for Sinusitis, Stomach pain, Typhoid, Clotting, *Acacia catechu* used for Astringent, Remove blood clotting, Fracture, *Phyllanthus emblica* used for Common cold, Cough & Gastritis, *Psidium guajava* used for Dysentery, Diarrhoea, Gastritis, and *Terminalia chebula* used for Cough, Common cold and Gastritis (**Table 3).**

Table 3: Medicinal plants and its uses

Medicinal plants	Collection month	Ailments	Used parts
Acacia catechu	Always	Astringent , Remove blood clotting , Fracture	Stem
Achyranthes aspera	September/October	Piles, Typhoid	Seed
Aegle marmelos	February/March	Fever, Gastritis, Dysentery, Ear disease, Constipation	Seed & Leaf
Ageratum houstonianum	Always	Clotting Blood	Leaf
Alstonia scolaris	Always	Cattle become healthy, Urine of blood	Bark
Alternanthera sessilis	June/July	Sinusitis, Stomach pain, Typhoid and Clotting	Whole part
Antidesma bunius	Always	Lactation , Stomachache	Bark & Root
Asparagus racemosus	Always	Increase Lactation	Stem
Azadiractha indica	Always	Skin diseases	Leaf
Bombax ceiba	November/December	Dysentery	Stem
Caleistocalyx operculates	Always	Sinusites, Headache	Leaf
Cassia fistula	February/March	Diarrhoea, Dysentery	Seed
Centella asiatica	Always	Diabetes, Cough, Gastritis, Asthma and Urine related disease	Whole part
Chromolaena odorata	Always	Clotting Blood	Leaf
Dendrocalomous strictus	Always	Diarrhoea of goat	Leaf
Eucalyptus commundulunsis	Always	Visk	Leaf
Mimosa pudica	Always	Diabetis	Root
Mallotus philippensis		Diabetis	Seed
Moringa oleifera	May/June	Urine Diseases	Seed
Oroxylum indicum	January/February	Wound	Seed
Phyllanthus emblica	October/November	Common cold, Cough and Gastritis	Seed
Piper longum	October	Cough	Seed
Pogostemon benghalensis	Always	Cough, Common cold, Fever and Clotting	Leaf
Psidium guajava	June/July	Dysentery, Diarrhoea, Gastritis	Bark, leaf
Semecarpus anacardium	February/March	Skin diseases	Seed
Senna tora	October/November	Skin diseases	Stem
Shorea robusta	Always	Dysentry and Stomach pain	Seed
Syzygium cumuni	July/August	Diarrhoea, Diabetes, Dysentry, Digestion, Sinusites and Gastritis	Bark
Terminalia bellirica	October/November/ December	Clotting Blood	Seed
Terminalia chebula	June/July	Cough, Common cold and Gastritis	Seed

From the study of collection period for different plant species, maximum numbers of medicinal plants were known to be collected during winter season (**Table 4**).

Table 4: Seasonal collection of medicinal plants

Season	Medicinal plants collected
Spring	17
summer	16
Autumn	17
Winter	18

Plant parts like seeds of 37% (12 species) of the medicinal plants recorded have been found to be used as medicine. Similarly, leaves of 27% (9 species), bark of 12% (4 species), stem of 12% (4 species), root of 6% (2 species) and whole part of 6% (2 species) are recorded for medicinal purposes. Seeds of maximum plants species are used as they are found in particular season whereas the root and whole part are used least (**Figure 22**).

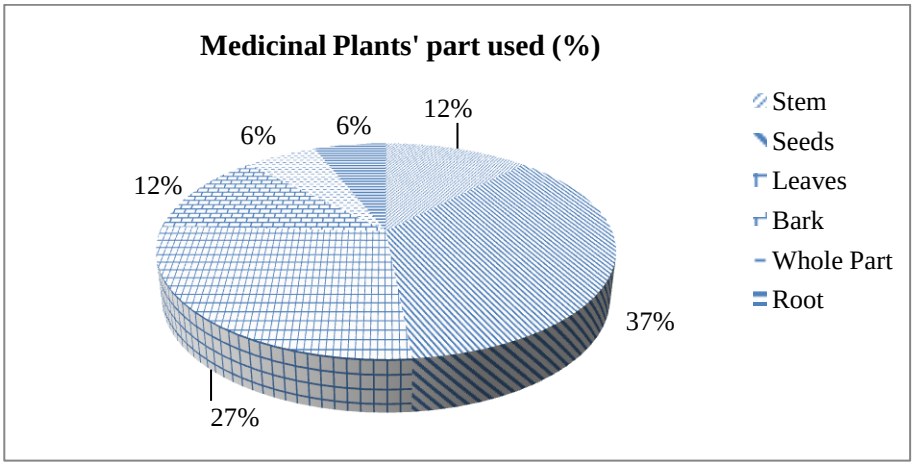

Figure 22: Parts used (in percentage) of Medicinal plants

The list of plants for each ailment is given in **Table 5.** Out of total 25 ailments, maximum number of 7 plants was found to be used for Gastritis, 5 plants for Blood clotting and 5 for Cough**.**

Table 5: List of Ailments and Plants used at Janachahana Community Forest

Ailment	Name of species	No of species
Asthma	*Centella asiatica*	1
Astringent	*Acacia catechu*	1
Cancer control	*Tinospora sinensis*	1
Wound	*Oroxylum indicum*	1
Clotting Blood	*Ageratum houstonianum, Alternantera sessilis, Chromolaena odorata, Pogostemon benghalensis, Terminalia alata*	5
Common cold	*Phyllanthus emblica, Pogostemon benghalensis, Terminala bellirica, Terminalia chebula*	4
Constipation	*Aegle marmelos*	1
Cough	*Centella asiatica, Phyllanthus emblica, Pogostemon benghalensis, Terminalia bellirica, Terminalia chebula*	5
Diabetes	*Centalla asiatica, Syzygium cumuni, Mallotus philippensis, Tinospora sinensis*	4

Diarrhoea	*Cassia fistula, Dendrocalomous Strictus, Psidium guajava, Syzygium cumuni*	4
Dysentery	*Bombax ceiba, Cassia fistula, Psidium Guajava*	3
Ear Diseases	*Aegle marmelos,*	1
Fever	*Aegle marmelos, Pogostemon benghalensis*	2
Fracture	*Acacia catechu*	1
Gastritis	*Aegle marmelos, Centella asitica, Phyllanthus emblica, Psidium guajava, Syzygium cumuni , Terminalia bellirica, Terminalia chebula*	7
Headache	*Caleistocalyx operculates*	1
Decrease blood pressure	*Alternanthera sessilis*	1
Jundice	*Tinospora sinensis*	1
Lactation	*Antidesma bunius, Asparagus racemosus*	2
Piles	*Achyranthes aspera*	1
Sinusitis	*Alternanthera sessilis, Caleistocalyx operculates, Syzygium cumuni*	3
Skin diseases	*Semecarpus anacardium*	1
Stomach Pain	*Alternanthera sessilis, Antidesma bunius, Terminalia bellirica*	3
Typhoid	*Achyranthes aspera, Alternatera sessilis*	2
Control bleeding with Urine	*Alstonia scolaris, Centella asitica, Moringa olifera, Tinaspora sinensis*	4

4.4.2 Fodder

Fodder plants *like Ficus hispida, Bridelia retusa, Glochidium velutinum, Artocarpus lakoocha, Trema orientalis, Litesea monopetala, Bauhinia purpurea, Leucaena leucocephala, Melia azedarach, Thysanolaena maxima* etc were found to be planted in JCCF as most of the local people were engaged in agricultural and livestock husbandary. Priority of plant species for fodder by the user groups are given in (**Annex 8**). Wild plants like *Dillenia pentagyna, Shorea robusta Mallotus phillipinsis* were used for fooder, religious and inflorescence respectively. Grasses like *Steria glauca, Imperata cylindrica, Thysanolaena maxima, Sorghum bicolor and Pennisetum purpurem* were found for fodder in JCCF. Fodder collection is done mainly from JCCF and was found to be about 30 kg per household daily.

Table 6: Used category and their collection

Use Category	Collection period	Weight(kg)	Average weight(kg)
Fodder	Daily	20 -40	30
Firewood	Twice a month	30 - 1500	765
Litter	Daily(winter season)	0 -60	30

4.4.3 Firewood

Some of the firewood plants like *Ficus hispida, Bridelia retusa, Glochidium velutinum, Artocarpus lakoocha, Trema orientalis, Litesea monopetala, Bauhinia purpurea, Leucaena leucocephala, Dillenia pentagyna, Shorea robusta, Eucalyptus camaldulensis, Dalbergia sissoo,* were also used for cooking purpose. People used maximum priority plants species of JCCF as they are using them for daily use (**Annex 8**). Firewood collection is mainly done

from National forest because of insuffient resource in JCCF. User group of JCCF collect nearly 765 kg firewood in every 15 days.

4.4.4 Litter

Litters are only allowed to collect during winter season for bedding of livestock. Most of the plants from JCCF and from National forest were used as litter. Plants like *Ficus hispida, Bridelia retusa, Glochidium velutinum, Artocarpus lakoocha, Trema orientalis, Litesea monopetala, Bauhinia purpurea, Haldinia cordifolia, Bombax ceiba, Mallotus philippensis, Dillenia pentagyna, Shorea robusta* were used for litter collection (**Annex 8**). Each household of JCCF collects nearly 30kg litter every day during winter season.

4.4.5 Other uses

Besides the use of plants species for fodder, firewood, litter collection some plants are used for other purposes. Maximum use of inflorescence of *Thysanolaena maxima* was found to be used for preparing broom. Leaves of *Shorea robusta are* highly used for preparing leaf plates (*tapari)* for religious ceremony. Leaves and inflorescence of *Solanum erianthum* have been found to be used for worship of god and goddess. Seeds of *Semecarpus anacardium* were found to be used especially for the ritual on the 11^{th} day of the new born baby. Young shoot of *Diplazium esculentum* was found to be used for preparing curry and fruit pulp of *Agele marmelos* were found to be used as Cold drinks. Cotton fibre from *Bombax ceiba* was found to be used for preparing quilt and pillow. Branches with fresh leaves of *Chromolaena odorata, Leea crispa, Diplazium esculentum, Clerodendrum indicum* were also found to be used for bedding purpose.

According to study, many plant species were traced with multiple use purposes i.e., 57 (Firewood, Medicine, Bedding, Religion, Food, Fodder) such as *Shorea robusta, Semecarpus anacardium, Chromolaena odorata, Leea crispa, Diplazium esculentum,* and *Caleistocalyx operculates.* While for the single use only 8 species i.e *Centella asiatica, Grewia optiva, Imperata cylindrica, Boerhavia diffusa, Solanum erianthum, Steria glauca* and *Antidesma bunius* were recorded (**Figure 23**) (**Annex 8**).

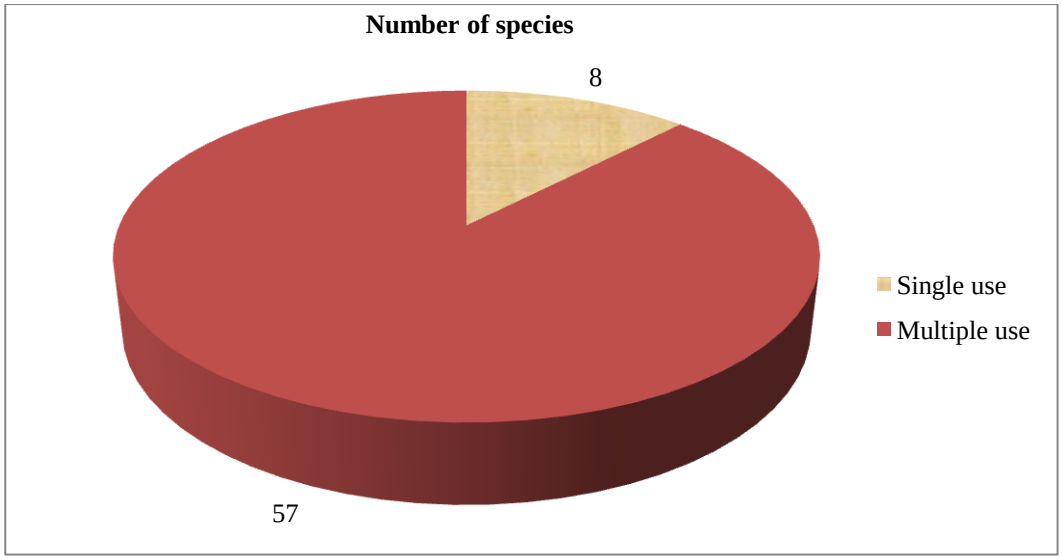

Figure 23: Species with use number

Although people has alternative source of energy such as Bio gas and LP gas, they were still collecting firewood for daily purpose. Plants were also documented for its use as fodder for domestic animal and their bedding (**Figure 24**) (**Annex 8**).

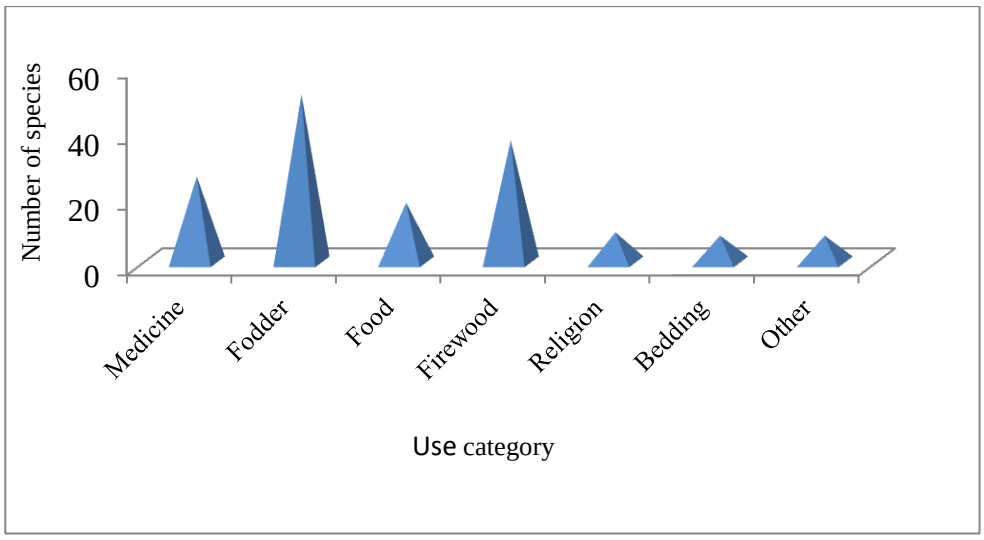

Figure 24: Number of plants species per category

4.5 Soil Parameter

When the soil samples of National and Community forest were compared, soil nitrogen ranged from 0.06 to 0.08% in National forest and in JCCF it ranged from 0.06 to 0.09%, which was quite low. Soil phosphorus below 30 kg/ha was considered to be low. In the present study it was found to be highly degraded in both national forest and JCCF at some sites (**Table 7**). Potassium content in national forest was high and ranged from 241 to 536kg/ha but in JCCF it was moderate and ranged from 187 to 227kg/ha. Organic content in

both national and JCCF was found to be low as it was less than 2.5% which may be due to litter collection (**Table 7**).

Table 7: Soil Table

S. No.	Forest type	Sample identification (0 - 15)	Nitrogen%	Phosphorus (P2O5) kg/ha	Potassium (K2O)kg/ha	Organic content (%)	Sand %	Silt %	Clay %	Soil texture
1	N F	Blackish Yellow	0.07	37.8	482.4	0.81	55.8	33.4	10.8	Sandy Loamy
2	N F	Blackish Yellow, with few gravels	0.06	2.06	469	0.7	49.8	31.4	18.8	Loamy
3	N F	Yellowish, with few gravels	0.08	2.06	455.6	0.88	55.8	31.4	12.8	Sandy loamy
4	N F	Yellowish, with few gravels	0.06	4.12	536	0.7	41.8	38.4	19.8	Loamy
5	N F	Yellowish, with more gravels	0.08	63.86	241.2	1	57.8	31.4	10.8	Sandy Loamy
6	C F	Blackish, with more gravels	0.06	65.92	201	0.68	55.8	35.4	8.8	Sandy loamy
7	C F	Yellowish, with more gravels	0.08	65.92	187.6	1	31.8	59.4	8.8	Loamy
8	C F	Yellowish, with medium gravels	0.07	2.06	187.6	0.8	23.8	71.4	4.8	Silt
9	C F	Yellowish, with more gravels	0.09	2.06	227.8	1.1	35.8	58.4	5.8	Silt
10	C F	Yellowish, with medium gravels	0.09	2.06	227.8	1.1	19.8	63.4	16.8	Silt

4.6 Invasive species

Altogether 10 (*Achyranthes aspera, Ageratum houstonianum, Ageratum conyzoides Mikenia micrantha, Senna tora, Lantana camara, Xanthium strumarium, Parthenium hysterophorus, Mimosa pudica, Chromolaena odorata*) invasive alian species (IAS) were encountered in JCCF and 5 (*Ageratum conyzoides, Achyranthes aspera, Mimosa pudica, Chromolaena odorata and Parthenium hysterophorus*) IAS in national forest (**Table 8**). All the IAS recorded in national forest was found near the trails constructed for bullcarts movements. The IAS in JCCF was along the foot trais mostly. Abundance of IAS was encountered at the pheripherial area of JCCF and national forest. Some of the invasive species were found inside the quadrate. All the invasive species are not harmful some of them are used as medicinal plants like *Ageratum conyzoides, Ageratum houstoniaum, Achyrantus aspera, Mimosa pudica, Chromolaena odorata* and for bedding like *Chromolaena odorata* as well as fodder for livestocks like *Ageratum conyzoides, Ageratum houstoniaum.*

Table 8: List of Invasive species

National forest	Community forest
Ageratum conyzoides	*Ageratum conyzoides*
Achyranthes aspera	*Achyranthes aspera*
Mimosa pudica	*Mimosa pudica*
Parthenium hysterophorus	*Parthenium hysterophorus*
Chromolaena odorata	*Chromolaena odorata*
	Ageratum houstonianum
	Xanthium strumarium
	Senna tora
	Lantana camara
	Mikenia micrantha

5 DISCUSSION

In the past the study area was over exploited as a result of it the forest was degraded and this degraded forest was converted into JanaChahana Community forest in 2053 B.S. The forest ecosystem of the study area was modified by human activity. Due to population growth, forest degradation has been reported in different parts of the world (Ellis and Ramankutty, 2008) especially for timber, fodder and grazing. Bradshaw et al., (2009) also reported the degradation of tropical forest due to the overharvesting, invasive species and climate change, leading to risk of extinction in near future.

5.1 Diversity indices

The present study revealed higher diversity of tree species in Community forest than in National forest, which might be due to active and effective management practice in the Community forest by local CFUGs. Users of Community forests are more focused on their day to day needs like fodder, firewood and litter, thus they prefered to grow timber and fodder trees. Putz and Blate (2001) also found the effective and well-operated forest management practice bringing change in biological diversity. Pandey et al., (2014) also reported higher tree diversity indices in Community forest than in National forest. Community forest user groups have introduced many species like *Ficus hispida, Tectona grandis, Pennisetum purpureum* and *Thysanolaena maxima* etc that are needed for daily purpose like food, firewood, fodder, and bedding.

5.2 Importance value index

In national forest, *Shorea robusta* has scored maximum importance value in every study site whereas *Schleichera oleosa* has occupied least importance value. But in JCCF *Dalbergia sissoo* has scored highest importance value and *Bridelia retusa has the* lowest IVI. In JCCF many plant species has been introduced as a result of which IVI of some introduced species like *Ficus hispida, Tectona grandis, Litsea monopetala, Artocarpus lakoocha* and *Bauhinia purpurea* have been found to be higher than that of native species. Because of the presence of introduced species like *Ficus hispida, Tectona grandis, Litsea monopetala, Artocarpus lakoocha* and *Bauhinia purpurea* the plant community has been modified in JCCF. In National forest, among the shrubs *Leea crispa* scored highest IVI and *Asparagus racemosus* has lowest IVI. Among the shrub species in Community forest, *Clerodendrum indicum* scored the highest value of IVI and *Thysanolaena maxima*, cultivated shrubs also scored good IVI. Among the herbs, *Steria glauca* has scored highest IVI in both national and JCCF. *Sida spinosa* has scored lowest IVI in National forest and *Diplazium esculentum* has scored lowest

IVI in JCCF. The introduced understorey plants in JCCF like *Pennisetum purpureum, Thysanolaena maxima, Morus alba, Sorghum bicolor* etc has completely changed the community structured. The introduction of various plants with mainly their fodder value in JCCF indicates that the user groups have used the forest resources for their livelihood to elevate poverty at the cost of native biodiversity degradation, as the IVI of some native species are less than the introduced species.

Shorea robusta, Semecarpus anacardium, Dellinia pentagyna has maximum density and maximum IVI in National forest as the forest is tropical forest that contains maximum number of these species. Density of *Dalbergia sissoo* and *Acacia catechu* were maximum in riverine forest of JCCF. Kozlowski (2002) have stated that the plant response to inundation vary from physical and chemical change in soil. Riverine forest may have increased due to inundations whereas other tree species have decreased which has been supported by Kozlowski (2002). Wittmann et al., (2004) has said that tree species distribution is associated to gradient of sediment deposition and to soil texture. Possibly the tree species like *Dalbergia sissoo* and *Acacia catechu* can withstand inundation condition and hence are dominant riverine forest.

Many plants like *Ficus hispida, Tectona grandis, Bauhinia purpurea, Litsea monopetala* etc and others in JCCF have maximum density due to its value for fodder, timber and firewood purpose. K.C. (2012) reported that the number and density of highly productive plant species have increased in community forest while other species have decreased. Similar condition is expected in JCCF. Among shrubs *Leea cripsa, Clerodendrum indicum, Asparagus racemosus* were found in National forest that had highly value for fodder, bedding and medicinal purpose and likewise *Clerodendrum indicum, Hyptis suaveolens, Morus alba* and *Thysanolena maxima* from JCCF were used for bedding, fodder purpose. Density of herbs is almost same in both forests as these species are least affected by human activities. The herbs like *Steria glauca, Imperata cylindrica and Cyperus rotundus,* mainly used for fodder, were recorded near the trails of the national forest whereas in JCCF they mostly appeared where the canopy cover was poor.

5.3 Regeneration

In National forest, almost all species have good regeneration pattern, except *Anogeissus latifolius, Cornus oblongum.* In most of the species the number of seedling and sapling are more than the tree, which indicates their good regeneration in National forest. Natural

regeneration of *Shorea robusta, Dillenia pentagyna, Caleistocalyx operculatus* are favoured because of climatic conditions, soil moisture and light intensity. Tyagi et al., (2011) also reported that soil moisture and light intensity increase the regeneration of *Shorea robusta*. Total regeneration of native trees in JCCF is not good in comparision to National forest which might be due to Silviculture practices as the user groups generally cut down the sapling or young pole sized trees which are of less economic value (K.C., 2012).

Some native species such as *Dalbergia sisso, Acacia catechu, Anogeissus latifolius, Haldinia cordifolia, Mallotus philippensis, Dalbergia latifolia* and other species were found to be regenerating naturally in JCCF. Similar finding was also reported by Shah (1996) and stated that the native species regenerates automatically in even in planted forest. In JCCF the regeneration of *Dalbergia sissoo, Acacia catechu* and *Haldina cordiflolia* wasnot satisfactory as the number of saplings and seedlings are less than the number of trees. These unsatisfactory trends in regeneration might be due to management practice in JCCF, where the user groups practices thinning, pruning and collection of fodder, litter and firewood. In JCCF the regeneration of planted trees like *Litsea monopetala, Melia azedarach, Leucaena leucocephala, Mallotus philippensis* and *Syzygium cumuni* were found to have good regeneration because of their fodder, timber and medicinal value and fast growing ability. But the regeneration of other planted species like *Ficus hispida, Artocarpus lakoocha, and Tectona grandis* is not satisfactory, as the number of tree species are more than the number of seedlings and saplings. Seedlings and saplings of *Ficus semicordata, Magnifera indica, Artocarpus integra, Morus alba* and *Eucalyptus camaldulensis* were absent in the JCCF. The greater number of saplings of native species like *Mallotus philippensis, Lagerstroemia indica, Shorea robusta, Dillenia pentagyna* and *Schleichera oleosa* in JCCF indicates that the composition of the native species in the forests will be retained (Swaine and Hall, 1988) along with introduced species in future.

5.4 Ethnobotany

Many plants reported with their uses as food, fodder, firewood, bedding, medicine and religious value. Jazib (2015) also reported similar finding. Species richness was highest in family Fabaceae for both ethno botanically important plants and medicinal plants. Medicinal species were known for the cure of different ailments. Mahwasane et al., (2013) also reported similar finding. Species were known to be collected throughout the year as different species has different useful part that has particular time of development and harvesting. Result is quiet supported by previous finding of Magar (2018).

Many medicinal species were collected for its seed and leaves that have specific composition of bio-active compounds for the cure of particular ailment. It was similar to Harris et al., 2007; Srithi et al., 2009; Thirumalai et al., 2009). Another finding describes the abundant knowledge among people for cure of gastritis using various plant species. Result is quiet supported by previous finding of Sood et al., (2001). Local people have grown fodder plants in community forest as they had engaged in agriculture and animal husbandry. Firewood seems highly collected twice a month as source of energy. Jazib (2015) supports the present outcome.

Other uses includes use of *Thysanolaena maxima* for preparing broom and leaves of *Shorea robusta* for making disposable plates (*tapari*) since many people has adopted its trade as income source. The area shows suitable environmental condition for their development as outcome reported by Jackson (1994), Thapa (2009). Mostly species were reported with multiple uses than single use, which indicates the importance of a species in local level. As plants have various parts they show different use for each of them. Result is quiet supported by previous finding of (Magar, 2018).

Soil in the different part of national forest were loamy and sandy loamy**,** however that of community forest were loamy, silt and sandy loamy (Jackson, 1994). There seems slight difference in nitrogen concentration in both areas however phosphorus and potassium shows high fluctuation within and in between the samples of the area. Similarly there seems slight variation in organic content, sand, silt and clay concentration among soil samples of the both area (Paudel and Sah, 2003). It shows the different level of degradation among the area and their soil structure supporting different life form. This finding was further supported by previous study of K.C. et al., (2013), Walworth (2011).

Community forest was reported with two times more number of invasive species than in national forest. It might due to adaptive feature and self equilibrium of the national forest whereas suitable space formed in the community forest for growth of invasive species. Invasive species are greater at the edge of community forest as it is younger forest (age), light availability and greater exposure to invader propagules as well as resistance of native species in national forest. It shows the similarity with the study made by Harper et al., (2005), Funk and McDaniel (2010), Flory and Clay (2006).

6 CONCLUSION AND RECOMMEDATIONS

6.1. Conclusion

Study area lies in the tropical region of the country in Rautahat district, Chandrapur municipality and the people are having traditional knowledge. The plant in the study area includes different life forms like Herbs, Shrubs, Trees and Climbers. Among them some of the plant species are used for single and some other for multiple uses for different purposes. Most of the plants species are used for firewood, fodder, medicinal plant and few of them were used for religious value.

During the IVI and Density calculation in Janachahana Community and National forest *Dalbergia sissoo* and *Shorea robusta* were respectively valuable. Maximum plants species were used for the gastritis as they were medicinal value. The priorities of plants were used for the fodder as their main occupation is agriculture and livestock. Shrubs and herbs were more evenly distributed than trees in National forest whereas trees and herbs were more evenly distributed than shrubs species in Janachahana Community forest. While studying the regeneration pattern of both forests, regeneration of National forest was good in comparison to Community forest. *Shorea robusta* has occupied maximum area in National forest as seedling and sapling are maximum than that of trees. While comparison of regeneration pattern in JCCF, *Mallotus philippensis, Shorea robusta, Dillenia pentagyna, Schleichera oleosa, Lagerstroemia indica* has good regeneration pattern but that of *Dalbergia sissoo* is not good in JCCF among wild species. The planted tree species like *Melia azedarach, Litsea monopetala and Leucaena leucocephanla* in JCCF has good regeneration pattern and indicates their good dominance in future. But the regeneration of planted species like *Ficus hispida, Artocarpus lakoocha and Tectona grandis* is not good, as the number of tree species are more than seedling and sapling. Seedlings and saplings of *Ficus semicordata, Magnifera indica, Artocarpus integra, Morus alba* and *Eucalyptus camaldulensis* were absent in the JCCF.

As the sampling site cannot include every area so some species number may be less in numbers. Different conservation activities as well as forestation activities has been done in that area to maximize the plant species and generate the economy so that people will be independent. As local people are involve in conservational work and they are the member of community forest user groups (CFUGs) so they are aware about the conservational and protection of the Janachahana Community and National forest. High biodiversity in Janachahana Community forest than in National forest might due to intended and purposeful

planting. Janachahana community forest is formed with aim of diversity and forest conservation along with additionally to provide service to local user. However, low diversity in National forest might be due to previous deforestation and low concern.

6.2 Recommendations

After the study in National and JanaChahana community forest following things should be done:

- Regular investigation of national forest is essential so that people cannot degrade forest illegally
- People of the area should be educated so that conservation of natural resources as well as medicinal plants can be done
- Local people should be aware about real importance of those resource beside its economic value i.e. Biological and aesthetic value.
- Legal provision should be made for the collection of plant, fodder, medicinal plants and other natural resources.
- Local people should be equally involved for the resource management.
- Rule should be followed according to the law and legislations.

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ANNEXES

Annex 1 Priority lists of species

Name of Plant species	Respondent												
	1	2	3	4	5	6	7	8	9	10	Fre	Sum	PN
Acacia catechu	16		2		8	6		20	15	3	7	70	32
Achyranthus aspera	18				14			16	7		4	55	23
Aegle marmelos				15	11	11	13				3	50	19
Ageratum houstonianum			17	16					16	13	4	62	27
Alstonia scolaris			11				11	12		17	4	51	21
Artocarpus lakoocha	1	17	5			1	2	2		5	7	33	4
Asparagus racemosus			10					11	11	19	4	51	20
Bauhinia purpurea	6	7		2	5	3	4	7	2	8	9	44	13
Bombax ceiba					18		10		14		3	42	10
Bridelia retusa				17						11	2	28	2
Centella asiatica					19	7	18		10		4	54	22
Chromolaena odorata	12	18						13	6	18	5	67	30
Clerodendrium indicum	10		13			9	12				4	44	15
Dalbergia sissoo	19	11		18		18		9	8		6	83	38
Dendrocalomous strictus	17		7	8			6			1	5	39	8
Dillenia pentagyna	11	13	15			10			13		5	62	26
Diplazium esculentum		20		14	2	5		17		16	6	74	33
Eucalyptus camaldulensis		10					16			20	3	46	16
Ficus hispida	5	1		1			3	4	5	2	7	21	1
Glochidium velutinum	3	5		13						12	4	33	3
Haldina cordifolia	9	12		12	17	4				9	6	63	28
Imperata cylindrica	15	9	4	6		12			20	10	7	76	34
Leea crispa		19	14			17	19		9		5	78	37
Leucaena leucocephala	13	6	6	10	6			10	19	7	8	77	35
Litesea monopetala	2	4	3	4	4	2	1	3	17	4	10	44	12
Melia azedarach	8	2	16	11	7				3		6	47	18
Mallotus philippensis			19		9	14					3	42	11
Oroxylum indicum					15		15		12		3	42	9
Phyllanthus emblica				20			17	8		15	4	60	25
Piper longum			8	9	1	15	8	18		6	7	65	29
Pleurotus ostreatus		16	12		3	16	9			14	6	70	31
Pogostemon benghalensis		15			20			5	4		4	44	14
Semecarpus anacardium						19		19	18		3	56	24
Shorea robusta	7				16		14				3	37	7
Solanum erianthum					12	8		15			3	35	6
Steria glauca	14	8	9	3		13					5	47	17
Terminalia bellirica			20	19		20	5	14			5	78	36
Thysanolaena maxima	20	14	18	7	10		20	6			7	95	39
Trema orientalis	4	3	1	5	13		7	1	1		8	35	5

[Fre: Frequency; PN: Priority number]

Annex 2 Sample Datasheet for Uses of Medicinal Plants

Medicinal plant	Month	What purpose	which Parts
…	…	..	..

Annex 3 Sample Datasheet for Use reports of Plants

Name of Respondent							
Age		**Family member**					
Occupation							
Name of Plants	**Use Category**						
	Medicine	**Fodder**	**Food**	**Firewood**	**Religion**	**Bedding**	**Other**

Annex 4 Family of plant species found in National and Community forest

Trees	**Families**	**Location**
Acacia catechu (L.f.) Willd	Fabaceae	CF
Acer oblongum Wall.ex.DC.	Sapindaceae	CF
Aegle marmelos (L.) Correa	Rutaceae	NF/CF
Alstonia scolaris (L) R. Br.	Apocynaceae	CF
Anogeissus latifolius (Roxb. ex DC.) Walp.	Combretaceae	NF/CF
Antidesma bunius (L.) spreng.	Phyllanthaceae	CF
Azadirachata indica A. Juss	Meliaceae	NF
Bauhinia vahlii Wight & Arn.	Fabaceae	NF
Bombax ceiba L.	Bombaceae	CF
Caleistocalyx operculates (Roxb.) Merr. & Perry	Myrtaceae	NF
Careya arborea Roxb.	lecythidaceae	NF/CF
Casearia elliptica Willd	Salicaceae	NF/CF
Cassia fistula L.	Fabaceae	NF/CF
Cornus oblongum (Wall.) Sojak	Cornaceae	NF
Cryptolepis buchanani Schultes.	Apocynaceae	NF/CF
Dalbergia latifolia Roxb.	Fabaceae	CF
Dalbergia sissoo Roxb.ex DC.	Fabaceae	CF
Desmodium oojeinense (Roxb.)	Fabaceae	CF
Diospyros malabarica (Desr.) Kostel.	Ebenaceae	NF
Dillenia pentagyna Roxb.	Dilleniaceae	NF/CF

Ehretia acuminate R. Br.	Boraginaceae	NF/CF
Ficus recemosa L.	Moraceae	NF/CF
Ficus religiosa L.	Moraceae	NF/CF
Garuga pinnata Roxb.	Burseraceae	NF/CF
Glochidion velutinum Wight	Phyllanthaceae	CF
Grewia optiva J.R Drumm.	Malvaceae	CF
Haldina cordifolia (Roxb.) Ridsdale	Rubiaceae	NF/CF
Hymenodactylon excelsum Roxb. Wall.	Rubiaceae	NF
Lagerstroemia indica L.	Lythraceae	NF/CF
Lagerstroemia parviflora Roxb.	Lythraceae	CF
Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	NF/CF
Mitragyna parviflora (Roxb.) Korth	Rubiaceae	NF/CF
Mallotus philippensis (lam.) Mull. Arg.	Euphorbiaceae	NF/CF
Murrya koenigii (L.) Jack	Rutaceae	CF
Oroxylum indicum (L.) Kurz	Fabaceae	CF
Persea odoratissima (Nees) Kosterm.	Lauraceae	NF/CF
Phyllanthus emblica L.	Phyllathaceae	NF/CF
Premna latifolia Roxb.	Lamiaceae	CF
Sarcococa coriacea (Hook.) Sweet.	Buxaceae	CF
Schleichera oleosa (Lour.) Oken	Spindaceae	NF/CF
Semecarpus anacardium L. f.	Anacardiaceae	NF/CF
Shorea robusta Gaertn.	Dipterocarpaceae	NF/CF
Sterculia villosa Roxb ex.Smith	Malvaceae	CF
Stereospermum personatum (Hassk.) Chatterjee	Bignoniaceae	CF
Stereospermum suaveolens (Roxb.) DC.	Bignoniaceae	CF
Swida oblonga (Wall). Sojak	Cornaceae	NF
Syzygium cumuni (L.) Skeels	Myrtaceae	NF/CF
Terminalia alata Heyne ex Roth	Combretaceae	NF/CF
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae	NF/CF
Terminalia chebula Retz.	Combretaceae	NF
Toona ciliata M.Roem.	Meliaceae	NF/CF
Trewia nudiflora L.	Euphorbiaceae	CF
Wendlandia coriacea (Wall.) DC.	Rubiaceae	CF
Woodfordia fruticosa (L.) Kurz	Lythraceae	NF
Xeromphis spinosa (Thunb.) Keay	Rubiaceae	NF
Cultivated Plants	**Families**	**Location**
Albizia lebak (L.) Benth.	Fabaceae	CF
*Albizia procera (*Roxb.) Benth	Fabaceae	CF
Artocarpus integra (Thumb.) Merr	Moraceae	CF
Artocarpus Lakoocha Wall.ex Roxb.	Moraceae	CF
Bauhinia purpurea L.	Fabaceae	CF
Bridelia retusa (L).Spreng.	Euphorbiaceae	CF

Eucalyptus camaldulensis Dehn.	Myrtaceae	CF
Ficus auriculata Lour.	Moraceae	CF
Ficus hispida L.	Moraceae	CF
Ficus lacor Buch-Ham.	Moraceae	CF
Ficus nerifolia Sm.	Moraceae	CF
Ficus semicordata Buch- Ham-ex Sm.	Moraceae	CF
Hymenodictyon excelsum (Roxb.) Wall.	Rubiaceae	CF
Kydia calycina Roxb.	Malvaceae	CF
Leucaena leucocephala (Lam).de Wit	Fabaceae	CF
Litsea monopetala (Roxb.)Pers.	Lauraceae	CF
Magnifera indica L.	Anacardiaceae	CF
Melia azedarach L	Meliaceae	CF
Nyctanthes arbor-tristis L.	Oleaceae	CF
Psidium guajava L.	Myrtaceae	CF
Tectona grandis L.f.	Lamiaceae	CF
Trema orientalis (L.) Blume	Cannabaceae	CF

Shrubs	**Families**	**Location**
Asparagus racemosus Willd.	Asparagaceae	NF/CF
Calotropis gigantea (L.) Dryand.	Apocynaceae	CF
Clerodendrum indicum (L.) Kuntze	Lamiaceae	NF/CF
Hedychium aurantiacum Roscoe	Zingiberaceae	CF
Hyptis suaveolens L. Poit.	Lamiaceae	CF
Lannea coromandelica (Hoult.) Merr.	Anacardiaceae	CF
Lantana camara L.	Verbenaceae	CF
Leea crispa Royen ex-L.	Vitaceae	NF/CF
Morus alba L.	Moraceae	CF
Phyllanthus parvifolius Buch- Ham ex D. Don	Euphorbiaceae	CF
Solanum erianthum D.Don.	Solanaceae	CF
Thysanolaena maxima (Roxb.) Kuntze	Poaceae	CF
Wendlandia coriacea (Wall.) DC.	Rubiaceae	CF
Ziziphus jujuba Mill.	Rhamnaceae	CF

Herbs	**Families**	**Location**
Abutilon indicum (L.) Sweet	Malvaceae	NF/CF
Achyranthus aspera L.	Amaranthaceae	NF/CF
Adiantum phillipense L.	Pteridaceae	NF/CF
Ageratum conyzoides L.	Asteraceae	NF/CF
Ageratum houstonianum Mill.	Asteraceae	CF
Arisaema constatm (Wall.) Mart.	Araceae	NF
Boerhavia diffusa L.	Nyctaginaceae	CF

Borreria latifolia (Aubl.) K. Schum	Rubiaceae	NF
Centella asiatica (L.) Urb.	Apiaceae	CF
Chromolaena odorata (Spreng) King & H.E. Robins.	Asteraceae	NF/CF
Cissus repens Lam.	Vitaceae	NF/CF
Colocasia esculenta (L.) Schoot	Araceae	NF
Curculigo orchioides Gaertn.	Hypoxidaceae	NF/CF
Cynodon dactylon (L.) Pers.	Poaceae	NF/CF
Cyperus rotundus L.	Cyperaceae	NF/CF
Dendrocalomous strictus (Roxb.) Nees	Poaceae	CF
Desmodium trifolium (L.) Dc.	Fabaceae	NF/CF
Dichrocephala integrifolia (L.f.) Kuntze	Asteraceae	NF/CF
Digitaria ciliaris (Retz.) Koeler	Poaceae	NF/CF
Diplazium esculantum (Retz.) Sw.ex Echrad.	Athyriaceae	CF
Eichhornia crassipes (Mart.) Solms	Pontederiaceae	NF
Elepantopus scaber L.	Asteraceae	NF
Eragrostis tenella (L.) P. Beauv. Ex Roem	Poaceae	CF
Eranthemum pulchelum Andrews	Acaranthaceae	CF
Eulaiopsis binnata (Retz.) C. E Hubb	Poaceae	NF
Euphorbia hirta (L.) Millsp.	Euphorbiaceae	NF/CF
Floscopa scandens Lour.	Commelinaceae	NF/CF
Gleichenia polypodiales (L.) Sm.	Gleicheniaceae	CF
Hedychium aurantiacum Roscoe	Zingiberaceae	NF
Hedychium ellipticum Buch Ham ex. Smith	Zingiberaceae	NF/CF
Imperata cylindrica (L.) P. Beauv.	Poaceae	NF/CF
Lepidagathis incurva Buch- Ham ex D. Don	Acanthaceae	NF
Lindenbergia grandiflora (Buch.-Ham. ex D.Don) Benth.	Orobanchaceae	NF/CF
Lindernia anagallis (Burm. F.) Pennell	Linderniaceae	NF/CF
Lygodium flexuosum L.Swartz	Lygodiaceae	NF/CF
Mimosa pudica L.	Fabaceae	NF/CF
Ophioglossium vulgatum L.	Ophioglossaceae	NF/CF
Oxalis corniculata L.	Oxalidaceae	CF
Parthenium hysterophorus L.	Asteraceae	NF/CF
Pennisetum purpureum Schumach	Poaceae	CF
Persicaria hydropiper (L.) Spach	Polygonaceae	NF/CF
Pogostemon benghalensis (Brum.f.)Kuntze	Lamiaceae	NF/CF
Rhynchosia viscosa (Roth) DC.	Fabaceae	NF/CF
Senna tora (L.) Roxb.	Fabaceae	NF
Selaginella chrysocaulos (Hook. & Grev.) Spring	Selaginellaceae	CF
Sida spinosa (L)	Malvaceae	NF/CF
Solanum surattense Burm. f.	Solanaceae	CF
Sorghum bicolor (L.) Moench.	Poaceae	CF
Spermacoce ocymoides Brum. f.	Rubiaceae	NF
Spilanthes oleracea L.	Asteraceae	NF/CF

Steria glauca (L.) P.Beauv.	Poaceae	NF/CF
Tridax procumbens L.	Asteraceae	CF
Trifolium repens L.	Fabaceae	CF
Triumfetta-pilosa Roth.	Tilaceae	NF/CF

Climbers

Climbers	Families	Location
Ampelocissus rugosa (Wall.) Planch.	Vitaceae	CF
Dioscorea bulbifera L.	Dioscoreaceae	CF
Lablab purpureus (L.) Sweet	Fabaceae	CF
Piper longum L.	Piperaceae	CF

*CF= Community Forest NF= National Forest

Annex 5 Classification of plants

S. No.	Division	Number of species
1	Angiosperm	132
2	Pteridophyte	5

Annex 6 **Ecological Parameters in National forest**

Trees	Sum	count	D	D p h	RD %	F	R F %	Total cover	C	R C%	IVI %
Aegle marmelos (L.) Correa	4	3	0.0002	2	0.17	6	0.80	20	0.10	0.22	1.19
Anogeissus latifolius (Roxb. ex DC.) Walp.	143	33	0.01	71.5	6.16	66	8.78	933	4.67	10.32	25.26
Azadirachata indica A. Juss	11	4	0.0006	5.5	0.47	8	1.06	42	0.21	0.46	2.00
Caleistocalyx operculates (Roxb.) Merr. & Perry	67	17	0.003	33.5	2.89	34	4.52	415	2.08	4.59	12.00
Careya arborea Roxb.	2	2	0.0001	1	0.09	4	0.53	11	0.06	0.12	0.74
Casearia elliptica Willd	38	16	0.002	19	1.64	32	4.26	220	1.10	2.43	8.33
Cassia fistula L.	11	6	0.0006	5.5	0.47	12	1.60	88	0.44	0.97	3.04
Cornus oblongum (Wall.) Sojak	47	17	0.002	23.5	2.02	34	4.52	290	1.45	3.21	9.75
Cryptolepis buchanani Schultes.	24	15	0.001	12	1.03	30	3.99	122	0.61	1.35	6.37
Dillenia pentagyna Roxb.	176	45	0.01	88	7.58	90	11.97	1239	6.20	13.71	33.26
Diospyros malabarica (Desr.) Kostel.	1	1	0.0001	0.5	0.04	2	0.27	5	0.03	0.06	0.36
Ehretia acuminate R. Br.	8	6	0.0004	4	0.34	12	1.60	58	0.29	0.64	2.58
Ficus recemosa L.	2	1	0.0001	1	0.09	2	0.27	10	0.05	0.11	0.46
Ficus religiosa L.	4	3	0.0002	2	0.17	6	0.80	66	0.33	0.73	1.70

Garuga pinnata Roxb.	3	1	0.0002	1.5	0.13	2	0.27	15	0.08	0.17	0.56
Haldina cordifolia (Roxb.) Ridsdale	8	6	0.0004	4	0.34	12	1.60	64	0.32	0.71	2.65
Hymenodactylon excelsum Roxb. Wall.	3	3	0.0002	1.5	0.13	6	0.80	16	0.08	0.18	1.10
Lagerstroemia indica L.	44	16	0.002	22	1.90	32	4.26	194	0.97	2.15	8.30
Lannea coromandelica (Houtt.) Merr.	31	15	0.002	15.5	1.34	30	3.99	189	0.95	2.09	7.42
Mitragyna parviflora (Roxb.) Korth	9	2	0.0005	4.5	0.39	4	0.53	66	0.33	0.73	1.65
Mallotus philippensis (lam.) Mull. Arg.	152	17	0.01	76	6.55	34	4.52	520	2.60	5.75	16.82
Persea odoratissima (Nees) Kosterm.	7	1	0.0004	3.5	0.30	2	0.27	25	0.13	0.28	0.84
Phyllanthus emblica L.	4	3	0.0002	2	0.17	6	0.80	29	0.15	0.32	1.29
Schleichera oleosa (Lour.) Oken	18	7	0.0009	9	0.78	14	1.86	112	0.56	1.24	3.88
Semecarpus anacardium L. f.	180	27	0.01	90	7.76	54	7.18	813	4.07	8.99	23.93
Shorea robusta Gaertn.	1205	48	0.06	602.5	51.92	96	12.77	2649	13.25	29.30	93.99
Swida oblonga (Wall.) Sojak	1	1	0.0001	0.5	0.04	2	0.27	7	0.04	0.08	0.39
Syzygium cumuni (L.) Skeels	23	15	0.001	11.5	0.99	30	3.99	183	0.92	2.02	7.00
Terminalia alata Heyne ex Roth	45	17	0.002	22.5	1.94	34	4.52	278	1.39	3.08	9.54
Terminalia bellirica (Gaertn.) Roxb.	40	20	0.002	20	1.72	40	5.32	285	1.43	3.15	10.20
Terminalia chebula Retz.	2	2	0.0001	1	0.09	4	0.53	14	0.07	0.15	0.77
Toona ciliata M.Roem.	5	4	0.0003	2.5	0.22	8	1.06	35	0.18	0.39	1.67
Woodfordia fruticosa (L.) Kurz	1	1	0.0001	0.5	0.04	2	0.27	17	0.09	0.19	0.50
Xeromphis spinosa (Thunb.) Keay	2	1	0.0001	1	0.09	2	0.27	10	0.05	0.11	0.46
Total	2321	376	0.12	1160.5	100	752	100	9040	45.2	100	300

*D= Density, D p h= Density per hectare, RD= Relative Density, F= Frequency, RF= Relative Frequency, C=Coverage, RC= Relative Coverage, IVI= Importance Value Index

Shrubs	**Sum**	**count**	**D**	**D p h**	**RD %**	**F**	**R F %**	**Total cover**	**C**	**R C%**	**IVI %**
Asparagus racemosus Willd.	6	4	0.005	48	0.99	8	7.41	27	2.16	3.24	11.63
Clerodendrum indicum (L.) Kuntze	191	18	0.15	1528	31.47	36	33.33	275	22	32.97	97.77
Leea crispa Royen ex-L.	410	32	0.33	3280	67.55	64	59.26	532	42.56	63.79	190.59
Total	607	54	0.49	4856	100	108	100	834	66.72	100	300

*D= Density, D p h= Density per hectare, RD= Relative Density, F= Frequency, RF= Relative Frequency, C=Coverage, RC= Relative Coverage, IVI= Importance Value Index

Herbs	Sum	count	D	RD %	F	RF %	Total cover	C	RC%	I V I %
Ageratum conyzoides L.	4	1	0.08	0.09	2	0.32	1	2	0.03	0.44
Abutilon indicum (L.) Sweet	6	1	0.12	0.13	2	0.32	1	2	0.03	0.49
Achyranthus aspera L.	1	1	0.02	0.02	2	0.32	3	6	0.09	0.44
Adiantum phillipense L.	27	2	0.54	0.61	4	0.65	17	34	0.51	1.77
Arisaema constatm (Wall.) Mart.	12	2	0.24	0.27	4	0.65	5	10	0.15	1.07
Boerhavia diffusa L.	3	1	0.06	0.07	2	0.32	2	4	0.06	0.45
Chromolaena odorata (Spreng) King & H.E. Robins.	100	12	2	2.24	24	3.88	102	204	3.07	9.20
Cissus repens Lam.	2	1	0.04	0.04	2	0.32	1	2	0.03	0.40
Colocasia esculenta (L.) Schoot	8	3	0.16	0.18	6	0.97	12	24	0.36	1.51
Curculigo orchioides Gaertn.	170	20	3.4	3.81	40	6.47	213	426	6.42	16.70
Cynodon dactylon (L.) Pers.	186	9	3.72	4.17	18	2.91	108	216	3.25	10.34
Cyperus rotundus L.	455	31	9.1	10.21	62	10.03	271	542	8.17	28.41
Desmodium trifolium (L.) Dc.	15	1	0.3	0.34	2	0.32	5	10	0.15	0.81
Dichrocephala integrifolia (L.f.) Kuntze	128	10	2.56	2.87	20	3.24	59	118	1.78	7.89
Digitaria ciliaris (Retz.) Koeler	5	1	0.1	0.11	2	0.32	15	30	0.45	0.89
Eichhornia crassipes (Mart.) Solms	1	1	0.02	0.02	2	0.32	3	6	0.09	0.44
Elepantopus scaber L.	98	7	1.96	2.20	14	2.27	108	216	3.25	7.72
Eulaiopsis binnata (Retz.) C. E Hubb	94	8	1.88	2.11	16	2.59	82	164	2.47	7.17
Euphorbia hirta (L.) Millsp	26	3	0.52	0.58	6	0.97	23	46	0.69	2.25
Floscopa scandens Lour.	87	15	1.74	1.95	30	4.85	101	202	3.04	9.85
Hedychium aurantiacum Roscoe	63	6	1.26	1.41	12	1.94	54	108	1.63	4.98
Hedychium ellipticum (Buch- Ham.ex. Smith	5	1	0.1	0.11	2	0.32	15	30	0.45	0.89
Imperata cylindrica (L.) P. Beauv.	479	29	9.58	10.75	58	9.39	386	772	11.63	31.76
Lepidagathis incurva Buch- Ham ex D. Don	60	1	1.2	1.35	2	0.32	75	150	2.26	3.93
Lindenbergia grandifolia (Buch-Ham ex D.Don) Benth.	244	23	4.88	5.47	46	7.44	178.5	357	5.38	18.30
Lindernia anagallis (Burm. F.) Pennell	158	12	3.16	3.54	24	3.88	81	162	2.44	9.87
Lygodium flexuosum L.Swartz	12	5	0.24	0.27	10	1.62	8	16	0.24	2.13
Mimosa pudica L.	433	19	8.66	9.72	38	6.15	275.5	551	8.30	24.16
Ophioglossium vulgatum L.	13	1	0.26	0.29	2	0.32	3	6	0.09	0.71
Parthenium hysterophorus L.	16	1	0.32	0.36	2	0.32	5	10	0.15	0.83

Persicaria hydropiper (L.) Spach	92	10	1.84	2.06	20	3.24	84.5	169	2.55	7.85
Pogostemon benghalensis (Brum.f.)Kuntze	2	1	0.04	0.04	2	0.32	8	16	0.24	0.61
Rhynchosia viscosa (Roth) DC.	640	25	12.8	14.36	50	8.09	301	602	9.07	31.52
Senna tora (L.) Roxb.	21	3	0.42	0.47	6	0.97	39	78	1.18	2.62
Sida spinosa (L)	84	6	1.68	1.88	12	1.94	114.5	229	3.45	7.28
Spermacoce ocymoides Brum. f.	11	2	0.22	0.25	4	0.65	16	32	0.48	1.38
Spilanthes oleracea L.	17	1	0.34	0.38	2	0.32	13	26	0.39	1.10
Steria glauca (L). P. Beauv.	642	29	12.84	14.40	58	9.39	502	1004	15.13	38.91
Triumfetta-pilosa Roth.	37	4	0.74	0.83	8	1.29	28	56	0.84	2.97
Total	4457	309	89.14	100	618	100	3319	6638	100	300

*D= Density, RD= Relative Density, F= Frequency, RF= Relative Frequency, C=Coverage, RC= Relative Coverage, IVI= Importance Value Index

Annex 7 Ecological Parameters in Community Fores

Trees	**Sum**	**count**	**D**	**D p h**	**RD %**	**F**	**R F %**	**Total cover**	**C**	**R C%**	**IVI %**
Acacia catechu (L.f.) Willd	299	24	0.01	149.5	18.5	48	6.42	745	3.73	10.58	35.46
Acer oblongum Wall.ex. DC.	9	6	0.0005	4.5	0.6	12	1.6	51	0.26	0.72	2.88
Aegle marmelos (L.) Correa	2	2	0.0001	1	0.1	4	0.53	13	0.07	0.18	0.84
Alstonia scolaris (L) R. Br.	1	1	0.0001	0.5	0.1	2	0.27	25	0.13	0.35	0.68
Anogeissus latifolius (Roxb. ex DC.) Walp.	81	22	0.004	40.5	5.0	44	5.88	700	3.50	9.94	20.82
Antidesma bunius (L.) spreng.	2	2	0.0001	1	0.1	4	0.53	32	0.16	0.45	1.11
Bombax ceiba L.	11	7	0.0006	5.5	0.7	14	1.87	80	0.40	1.14	3.69
Careya arborea Roxb.	1	1	0.0001	0.5	0.1	2	0.27	7	0.04	0.10	0.43
Casearia elliptica Willd	3	1	0.0002	1.5	0.2	2	0.27	24	0.12	0.34	0.79
Cassia fistula L.	22	11	0.001	11	1.4	22	2.94	116	0.58	1.65	5.95
Cryptolepis buchanani Schultes.	31	13	0.002	15.5	1.9	26	3.48	248	1.24	3.52	8.91
Dalbergia latifolia Roxb.	42	12	0.002	21	2.6	24	3.21	249	1.25	3.54	9.34
Dalbergia sissoo Roxb.ex DC.	329	22	0.02	164.5	20.3	44	5.88	768	3.84	10.90	37.11
Desmodium oojeinense (Roxb.)	1	1	0.0001	0.5	0.1	2	0.27	7	0.04	0.10	0.43
Dillenia pentagyna Roxb.	8	7	0.0004	4	0.5	14	1.87	80	0.40	1.14	3.50
Ehretia acuminate R. Br.	37	13	0.002	18.5	2.3	26	3.48	172	0.86	2.44	8.20
Ficus recemosa L.	4	3	0.0002	2	0.2	6	0.8	24	0.12	0.34	1.39
Ficus religiosa L.	2	2	0.0001	1	0.1	4	0.53	13	0.07	0.18	0.84
Garuga pinnata Roxb.	4	3	0.0001	2	0.2	6	0.8	24	0.12	0.34	1.39

Glochidion velutinum Wight	9	5	0.0005	4.5	0.6	10	1.34	61	0.31	0.87	2.76
Grewia optiva J.R Drumm.	31	12	0.002	15.5	1.9	24	3.21	153	0.77	2.17	7.30
Haldina cordifolia (Roxb.) Ridsdale	65	18	0.003	32.5	4.0	36	4.81	474	2.37	6.73	15.56
Lagerstroemia indica L.	28	7	0.001	14	1.7	14	1.87	150	0.75	2.13	5.73
Lagerstroemia parviflora Roxb.	1	1	0.0001	0.5	0.1	2	0.27	20	0.10	0.28	0.61
Lannea coromandelica (Houtt.) Merr.	7	3	0.0004	3.5	0.4	6	0.8	63	0.32	0.89	2.13
Mitragyna parviflora (Roxb.) Korth	12	6	0.0006	6	0.7	12	1.6	96	0.48	1.36	3.71
Mallotus philippensis (lam.) Mull. Arg.	43	10	0.002	21.5	2.7	20	2.67	265	1.33	3.76	9.09
Murrya koenigii (L.) Jack	6	2	0.0003	3	0.4	4	0.53	18	0.09	0.26	1.16
Oroxylum indicum (L.) Kurz	1	1	0.0001	0.5	0.1	2	0.27	4	0.02	0.06	0.39
Persea odoratissima (Nees) Kosterm.	1	1	0.0001	0.5	0.1	2	0.27	5	0.03	0.07	0.40
Phyllanthus emblica L.	1	1	0.0001	0.5	0.1	2	0.27	6	0.03	0.09	0.41
Premna latifolia Roxb.	1	1	0.0001	0.5	0.1	2	0.27	5	0.03	0.07	0.40
Sarcococa coriacea (Hook.) Sweet.	1	1	0.0001	0.5	0.1	2	0.27	7	0.04	0.10	0.43
Schleichera oleosa (Lour.) Oken	13	8	0.0007	6.5	0.8	16	2.14	80	0.40	1.14	4.08
Semecarpus anacardium L. f.	1	1	0.0001	0.5	0.1	2	0.27	10	0.05	0.14	0.47
Shorea robusta Gaertn.	9	7	0.0005	4.5	0.6	14	1.87	99	0.50	1.41	3.83
Sterculia villosa Roxb ex.Smith	1	1	0.0001	0.5	0.1	2	0.27	10	0.05	0.14	0.47
Stereospermum personatum (Hassk.) Chatterjee	1	1	0.0001	0.5	0.1	2	0.27	8	0.04	0.11	0.44
Stereospermum suaveolens (Roxb.) DC.	2	2	0.0001	1	0.1	4	0.53	10	0.05	0.14	0.80
Syzygium cumuni (L.) Skeels	4	2	0.0002	2	0.2	4	0.53	25	0.13	0.35	1.14
Terminalia alata Heyne ex Roth	10	4	0.0005	5	0.6	8	1.07	93	0.47	1.32	3.01
Terminalia bellirica (Gaertn.) Roxb.	13	8	0.0007	6.5	0.8	16	2.14	101	0.51	1.43	4.38
Toona ciliata M.Roem.	5	2	0.0003	2.5	0.3	4	0.53	39	0.20	0.55	1.40
Trewia nudiflora L.	5	4	0.0003	2.5	0.3	8	1.07	24	0.12	0.34	1.72
Wendlandia coriacea (Wall.) DC.	31	1	0.002	15.5	1.9	2	0.27	66	0.33	0.94	3.12
Cultivated Plant	**Sum**	**count**	**D**	**D p h**	**RD %**	**F**	**R F %**	**Total cover**	**C**	**R C%**	**IVI %**
Albizia lebak (L.) Benth.	3	1	0.0002	1.5	0.19	2	0.27	15	0.08	0.21	0.67
*Albizia procera (*Roxb.) Benth	2	2	0.0001	1	0.12	4	0.53	19	0.10	0.27	0.93
Artocarpus integra (Thumb.) Merr	6	2	0.0003	3	0.37	4	0.53	15	0.08	0.21	1.12

Artocarpus Lakoocha Wall.ex Roxb.	50	11	0.003	25	3.09	22	2.94	170	0.85	2.41	8.44
Bauhinia purpurea L.	50	10	0.003	25	3.09	20	2.67	178	0.89	2.53	8.29
Bridelia retusa (L).Spreng.	2	2	0.0001	1	0.12	4	0.53	13	0.07	0.18	0.84
Eucalyptus camaldulensis Dehn.	4	1	0.0002	2	0.25	2	0.27	20	0.10	0.28	0.80
Ficus auriculata Lour.	3	1	0.0002	1.5	0.19	2	0.27	36	0.18	0.51	0.96
Ficus hispida L.	111	14	0.006	55.5	6.86	28	3.74	383	1.92	5.44	16.04
Ficus lacor Buch-Ham.	3	2	0.0002	1.5	0.19	4	0.53	16	0.08	0.23	0.95
Ficus nerifolia Sm.	3	1	0.0002	1.5	0.19	2	0.27	15	0.08	0.21	0.67
Ficus semicordata Buch-Ham-ex Sm.	17	10	0.0009	8.5	1.05	20	2.67	69	0.35	0.98	4.70
Hymenodictyon excelsum (Roxb.) Wall.	8	6	0.0004	4	0.49	12	1.6	50	0.25	0.71	2.81
Kydia calycina Roxb.	1	1	0.0001	0.5	0.06	2	0.27	10	0.05	0.14	0.47
Leucaena leucocephala (Lam).de Wit	1	1	0.0001	0.5	0.06	2	0.27	4	0.02	0.06	0.39
Litsea monopetala (Roxb.)Pers.	44	12	0.002	22	2.72	24	3.21	195	0.98	2.77	8.69
Magnifera indica L.	11	6	0.0006	5.5	0.68	12	1.6	70	0.35	0.99	3.28
Melia azedarach L	19	7	0.0001	9.5	1.17	14	1.87	151	0.76	2.14	5.19
Nyctanthes arbor-tristis L.	1	1	0.0001	0.5	0.06	2	0.27	5	0.03	0.07	0.40
Psidium guajava L.	1	1	0.0001	0.5	0.06	2	0.27	5	0.03	0.07	0.40
Tectona grandis L.f.	59	11	0.003	29.5	3.64	22	2.94	224	1.12	3.18	9.77
Trema orientalis (L.) Blume	29	8	0.001	14.5	1.79	16	2.14	110	0.55	1.56	5.49
Total	1619	374	0.08	809.5	100	748	100	7043	35.22	100	300

*D= Density, D p h= Density per hectare, RD= Relative Density, F= Frequency, RF= Relative Frequency, C=Coverage, RC= Relative Coverage, IVI= Importance Value Index

Shrubs	**Sum**	**count**	**D**	**D p h**	**RD %**	**F**	**R F %**	**Total cover**	**C**	**R C%**	**IVI %**
Asparagus racemosus Willd.	3	2	0.002	24	0.73	4	4.08	10	0.8	1.40	6.21
Calotropis gigantea (L.) Dryand.	3	1	0.002	24	0.73	2	2.04	5	0.4	0.70	3.47
Clerodendrum indicum (L.) Kuntze	151	16	0.12	1208	36.83	32	32.65	249	19.9	34.78	104.26
Hedychium aurantiacum Roscoe	14	2	0.01	112	3.41	4	4.08	26	2.08	3.63	11.13
Hyptis suaveolens L. Poit.	131	5	0.10	1048	31.95	10	10.20	193	15.4	26.96	69.11
Lannea coromandelica (Hoult.) Merr.	3	3	0.002	24	0.73	6	6.12	11	0.88	1.54	8.39
Lantana camara L.	5	1	0.004	40	1.22	2	2.04	10	0.8	1.40	4.66
Leea crispa Royen ex-L.	9	3	0.01	72	2.20	6	6.12	36	2.88	5.03	13.35
Phyllanthus parvifolius Buch- Ham ex D. Don	69	5	0.06	552	16.83	10	10.20	104	8.32	14.53	41.56
Solanum erianthum D.Don.	12	6	0.01	96	2.93	12	12.24	35	2.8	4.89	20.06
Wendlandia coriacea	3	1	0.002	24	0.73	2	2.04	6	0.48	0.84	3.61

(Wall.) DC.											
Ziziphus jujuba Mill.	5	2	0.004	40	1.22	4	4.08	13	1.04	1.82	7.12
Cultivated Plants	**Sum**	**count**	**D**	**D p h**	**RD %**	**F**	**R F %**	**Total cover**	**C**	**R C%**	**IVI %**
Morus alba L.	1	1	0.001	8	0.24	2	2.04	3	0.24	0.42	2.70
Thysanolaena maxima (Roxb) Kuntze	1	1	0.001	8	0.24	2	2.04	15	1.2	2.09	4.38
Total	410	49	0.33	3280	100	98	100	716	57.3	100	300

*D= Density, D p h= Density per hectare, RD= Relative Density, F= Frequency, RF= Relative Frequency, C=Coverage, RC= Relative Coverage, IVI= Importance Value Index

Herbs	**Sum**	**count**	**D**	**RD %**	**F**	**RF %**	**Total cover**	**C**	**RC%**	**I V I %**
Abutilon indicum (L.) Sweet	1	1	0.02	0.01	2	0.33	3	6	0.05	0.40
Achyranthus aspera L.	75	11	1.5	1.06	22	3.67	115	230	2.06	6.78
Adiantum phillipense L.	253	12	5.06	3.56	24	4	237	474	4.24	11.80
Ageratum conyzoides L.	85	3	1.7	1.20	6	1	108	216	1.93	4.13
Ageratum houstonianum Mill.	455	20	9.1	6.41	40	6.67	357	714	6.39	19.46
Boerhavia diffusa L.	28	2	0.56	0.39	4	0.67	41	82	0.73	1.79
Centella asiatica (L.) Urb.	10	5	0.2	0.14	10	1.67	13.5	27	0.24	2.05
Chromolaena odorata (Spreng) King & H.E. Robins.	52	9	1.04	0.73	18	3	77	154	1.38	5.11
Cissus repens Lam.	1	1	0.02	0.01	2	0.33	0.5	1	0.01	0.36
Curculigo orchioides Gaertn.	121	3	2.42	1.70	6	1	81	162	1.45	4.15
Cynodon dactylon (L.) Pers.	131	7	2.62	1.85	14	2.33	181	362	3.24	7.42
Cyperus rotundus L.	494	19	9.88	6.96	38	6.33	369	738	6.60	19.89
Dendrocalomous strictus (Roxb.) Nees	1	1	0.02	0.01	2	0.33	15	30	0.27	0.62
Desmodium trifolium (L.) Dc.	61	4	1.22	0.86	8	1.33	27	54	0.48	2.68
Dichrocephala integrifolia (L.f.) Kuntze	96	3	1.92	1.35	6	1.00	52	104	0.93	3.28
Digitaria ciliaris (Retz.) Koeler	6	1	0.12	0.08	2	0.33	3	6	0.05	0.47
Diplazium esculantum (Retz.) Sw.ex Echrad.	72	8	1.44	1.01	16	2.67	178	356	3.19	6.87
Eragrostis tenella (L.) P. Beauv. Ex Roem	1	1	0.02	0.01	2	0.33	1	2	0.02	0.37
Eranthemum pulchelum Andrews	51	5	1.02	0.72	10	1.67	64	128	1.15	3.53
Euphorbia hirta (L.) Millsp.	34	5	0.68	0.48	10	1.67	21	42	0.38	2.52
Floscopa scandens Lour.	43	7	0.86	0.61	14	2.33	58	116	1.04	3.98
Gleichenia polypodiales (L.) Sm.	18	2	0.36	0.25	4	0.67	42	84	0.75	1.67
Hedychium ellipticum Buch Ham ex. Smith	13	2	0.26	0.18	4	0.67	39	78	0.70	1.55
Imperata cylindrica (L.) P. Beauv.	956	16	19.12	13.46	32	5.33	596	1192	10.66	29.46

Lindenbergia grandiflora (Buch.-Ham. ex D.Don) Benth.	649	26	12.98	9.14	52	8.67	605	1210	10.83	28.63
Lindernia anagallis (Burm. F.) Pennell	254	6	5.08	3.58	12	2	118	236	2.11	7.69
Lygodium flexuosum L.Swartz	53	11	1.06	0.75	22	3.67	76	152	1.36	5.77
Mimosa pudica L.	191	11	3.82	2.69	22	3.67	68	136	1.22	7.57
Ophioglossium vulgatum L.	17	1	0.34	0.24	2	0.33	20	40	0.36	0.93
Oxalis corniculata L.	143	14	2.86	2.01	28	4.67	156	312	2.79	9.47
Parthenium hysterophorus L.	1	1	0.02	0.01	2	0.33	0.5	1	0.01	0.36
Pennisetum purpureum Schumach	10	2	0.2	0.14	4	0.67	5	10	0.09	0.90
Persicaria hydropiper (L.) Spach	51	5	1.02	0.72	10	1.67	64	128	1.15	3.53
Pogostemon benghalensis (Brum.f.)Kuntze	13	6	0.26	0.18	12	2	41	82	0.73	2.92
Rhynchosia viscosa (Roth) DC	913	16	18.26	12.86	32	5.33	343	686	6.14	24.33
Selaginella chrysocaulos (Hook. & Grev.) Spring	3	1	0.06	0.04	2	0.33	1	2	0.02	0.39
Sida spinosa (L)	151	12	3.02	2.13	24	4	160.5	321	2.87	9.00
Solanum surattense Burm. f.	1	1	0.02	0.01	2	0.33	2	4	0.04	0.38
Sorghum bicolor (L.) Moench.	82	2	1.64	1.15	4	0.67	112	224	2.00	3.83
Spilanthes oleracea L.	54	2	1.08	0.76	4	0.67	52	104	0.93	2.36
Steria glauca (L.) P.Beauv.	1057	30	21.14	14.89	60	10	917	1834	16.41	41.30
Tridax procumbens L.	30	2	0.6	0.42	4	0.67	15	30	0.27	1.36
Trifolium repens L.	367	2	7.34	5.17	4	0.67	149	298	2.67	8.50
Triumfetta-pilosa Roth.	2	1	0.04	0.03	2	0.33	5	10	0.09	0.45
Total	7100	300	142	100	600	100	5589	11178	100	300

*D= Density, RD= Relative Density, F= Frequency, RF= Relative Frequency, C=Coverage, RC= Relative Coverage, IVI= Importance Value Index

Annex 8 Use Categories of Species

Name of Plants	Common name of plants	Family	Use category
Acacia catechu (L.f.) Willd	*Khayar*	Fabaceae	M/Fod/Fw
Achyranthus aspera L.	*Datiwan*	Amaranthaceae	M/Fod
Aegle marmelos (L.) Correa	*Bel*	Rutaceae	M/Fod/F/R
Ageratum houstonianum Mill.	*Gandhe*	Asteraceae	M/Fod/B
Albizia lebak (L.) Benth.	*Siris*	Fabaceae	Fod/Fw
Alstonia scolaris (L)R.Br	*Chatiwan*	Apocynaceae	M/Fw
Alternanthera sessilis (L.) DC	*Bhringiraj*	Amaranthaceae	M/R
Anogeissus latifolius (Roxb. ex DC.) Walp.	*Bhajhi*	Combretaceae	Fod/Fw/O
Antidesma bunius (L.) spreng.	*Archale*	Phyllanthaceae	M/Fod
Artocarpus Lakoocha Wall.ex Roxb.	*Badhar*	Moraceae	Fod/F/Fw
Asparagus racemosus Willd.	*Kurilo*	Asparagaceae	M/Fod/F
Azadiractha indica A.Juss.	*Neem*	Meliaceae	M/F/Fw

Bauhinia purpurea L.	*Taki*	Fabaceae	Fod/F/Fw
Boerhavia diffusa L.	*Khadkaule*	Nyctaginaceae	Fod
Bombax ceiba L.	*Simal*	Bombacaceae	M/Fod/Fw/O
Bridelia retusa (L).Spring	*Gayo*	Euphorbiaceae	Fod/F/Fw
Caleistocalyx operculates (Roxb.) Merr. & Perry	*Khyamun*	Myrtaceae	M/Fod
Careya arborea Roxb.	*Khumbi*	Lecythidaceae	Fod/Fw
Cassia fistula L	*Rajbrichya*	Fabaceae	M/Fw
Centella asiatica (L.) Urb.	*Ghodtapre*	Apiaceae	M
Chromolaena odorata (Spreng) King & H.E. Robins.	*Seto banmara*	Asteraceae	M/B
Clerodendrum indicum (L.) Kuntze	*Bhati*	Lamiaceae	Fod/B
Dalbergia sissoo Roxb.ex DC.	*Sisso*	Fabaceae	Fod/Fw/O
Dendrocalomous strictus (Roxb) Nees	*Bash*	Poaceae	Fod/Fw/R
Desmodium oojeinense (Roxb.)	*Sadhan*	Fabaceae	Fod/Fw
Dillenia pentagyna Roxb.	*Tatari*	Dilleniaceae	Fod/Fw/B/O
Dioscorea bulbifera L.	*Githa*	Dioscoreaceae	Fod/F/B/O
Diplazium esculantum (Retz.) Sw.ex Echrad.	*Niuro*	Athyriaceae	Fod/F
Eucalyptus camaldulensis Dehn.	*Sapata(masala)*	Myrtaceae	Fod/F/O
Ficus hispida L.	*Dhungra*	Moraceae	Fod/Fw
Ficus recemosa L.	*Dhumri*	Moraceae	Fod/Fw/R
Garuga pinnata Roxb.	*Gingad*	Burseraceae	Fod/Fw/O
Glochidion velutinum Wight	*Kalikath*	Phyllanthaceae	Fod/Fw
Grewia optiva J.R Drumm.	*Shyalfosra*	Malvaceae	Fod
Haldina cordifolia (Roxb.) Ridsdale	*Karam*	Rubiaceae	Fod/Fw/O
Imperata cylindrica (L.) P. Beauv.	*Siru*	Poaceae	Fod
Lagerstroemia indica L.	*Asare*	Lythraceae	Fod/Fw
Leea crispa Royen ex-L.	*Galini*	Vitaceae	Fod/B
Leucaena leucocephala (Lam).de Wit	*Ipilipi*	Fabaceae	Fod/Fw
Litsea monopetala (Roxb.)Pers.	*Kutmero*	Lauraceae	Fod/Fw
Melia azedorach L	*Bakaino*	Meliaceae	M/Fod/Fw
Mitragyna parviflora (Roxb.) Korth	*Tikuli karam*	Rubiaceae	Fod/Fw
Mallotus philippensis (lam.) Mull. Arg.	*Sindhure*	Euphorbiaceae	Fod/B
Moringa oleifera Lam.	*Sajiwan(sitalcini)*	Moringaceae	M/F
Morus alba L.	*Tuth*	Moraceae	Fod/F/Fw
Oroxylum indicum (L.) Kurz	*Tatalo*	Bignoniaceae	M/R
Phyllanthus emblica L.	*Amala*	Phyllanthaceae	M/F/Fw/R
Piper longum L.	*Pipla*	Piperaceae	M/B
Pleurotus ostreatus (Jacq. ex Fr) P. Kumm.	*Chyau*	Agaricaceae	F
Pogostemon benghalensis (Brum.f.)Kuntze	*Rudilo*	Lamiaceae	M/B
Psidium guajava L.	*Amba*	Myrtaceae	M/Fod/F/Fw
Schleichera oleosa (Lour.) Oken	*Kusum*	Sapindaceae	Fod/F/Fw
Semecarpus anacardium L. f.	*Bhalayo*	Anacardiaceae	M/Fod/Fw/R
Shorea robusta Gaertn.	*Sal*	Dipterocarpaceae	M/Fod/Fw/R
Smilax aspera L.	*Kukur daino*	Smilaceae	M/F

Solanum erianthum D.Don.	*Dhursul*	Solanaceae	R
Steria glauca (L.) P.Beauv.	*Banso*	Poaceae	Fod
Stereospermum personatum (Hassk.) Chatterjee	*Padari*	Bignoniaceae	Fod/Fw
Syzygium cumuni (L.) Skeels	*Jamun*	Myrtaceae	M/Fod/F/Fw
Terminalia alata Heyne ex Roth	*Saj*	Combretaceae	Fod/Fw/O
Terminalia bellirica (Gaertn.) Roxb.	*Barro*	Combretaceae	M/Fod/F/Fw
Terminalia chebula Retz.	*Harro*	Combretaceae	M/Fod/Fw
Thysanolaena maxima (Roxb.) Kuntze	*Amriso*	Poaceae	Fod/O
Tinospora sinensis (Lour.) Merr.	*Gurjo*	Menispermaceae	M/F
Trema orientalis (L.) Blume	*Kuyal*	Cannabaceae	Fod/Fw

*M = Medicine, Fod = Fodder, F = Food, Fw = Firewood, B = Bedding, O = Other

Photoplate 1: Useful plant products

Forest product used for firewood

Forest product used for fooders

Plants used as fodder

Dalbergia latifolia (Timber+fodder)

Shorea robusta (Timber + leaf + medicine)

Dillenia pentagyna (Fodder)

Photoplate 2: Invasive Species

Mikenia micarantha

Lantana camara

Parthenium hysterophorus

Photoplate 3: Some plants from field

Chromolaena odorata

Alstonia scholaris

Semecarpus anacardium

Photoplate 4: Medicinal species and interview

Asparagus racemosus

Pogostemon bengalensis

Discussion with JCCF members

Photoplate 5: Interviews

Interview with elder man

Interview with local respondents

Interview with local families