PLANT DIVERSITY AND REGENERATION OF TWO COMMUNITY FORESTS IN BUFFER ZONE OF BANKE NATIONAL PARK, WESTERN NEPAL

A THESIS SUBMITTED FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER'S DEGREE IN BOTANY

BY

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September, 2023

DECLARATION

I, Bishal B.K, hereby declare that the work enclosed here is entirely my own, except where stated otherwise by reference or acknowledgement, and has not been published or submitted elsewhere, in whole or in part, for the requirement for any other degree or professional qualification. Any literature, data or works done by others and cited within this thesis has been given due acknowledgement and listed in the reference section.

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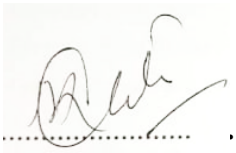
RECOMMENDATION

This is to recommend that the Master's thesis entitled **"Plant Diversity and Regeneration of Two Community Forests in Buffer Zone of Banke National Park, Western Nepal"** is carried out by "Bishal B.K" T.U. registration number "5-2-1084-34-2013" under our supervision. The entire work is based on original scientific investigations and has not been submitted for any other degree in any institutions. We therefore, recommend this thesis work to be accepted for the partial fulfilment of M.Sc. Degree in Botany.



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The thesis work submitted by Bishal B.K (T.U. registration no : 5-2-1084-34-2013) entitled **"Plant Diversity and Regeneration of Two Community Forests in Buffer Zone of Banke National Park, Western Nepal"** to Department of Botany, Amrit Campus, Tribhuvan University has been accepted for the partial fulfilment of the requirement for Master's Degree in Botany.

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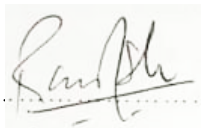

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ABSTRACT

Community structure and regeneration are the most important factor for the sustainable management of a forest. The study was focused on the plant species diversity, regeneration and dependency of people on the forest resources for their livelihood in the buffer zone of Banke National Park (BaNP). The study was conducted at two sites Taradevi and Jaljala Community forests. Random stratified rectangular quadrat method was applied for vegetation analysis. Altogether 60 quadrats were laid on both community forests with 15 quadrats at each residential and natural area of two community forests. Settlement sampling on the buffer-zone was considered about 200 m far from the settlement areas, and the distance between the two quadrats was about 100m far. Similarly, sampling at natural area was also laid about 100m apart from each quadrate. To estimate regeneration of trees 60 quadrats of 20 ×20 m^2 was considered, and 3 sub-plots for shrubs 5×5m^2 with the 20×20 m^2 and for herbs 3 sub-quadrats 2×2m^2 with in each plots of shrubs were laid. Based on high IVI value in Taradevi community forest, at natural area *Shorea robusta* is mostly dominant tree species whereas shrubs like *Clerodendrum viscosum, Murraya koenigii,* and herbs like *Imperata Eragrostis sp* is dominant species. But at settlement area *Shorea robusta* and *Mallotus phillippensis* are dominant tree species whereas shrubs like *Urena lobata, Murraya koenigii,* and herbs like *Imperata cylindrical* is dominant species. Similarly, at Jaljala community forest, at natural area *Shorea robusta, Mallotus phillippensis* are mostly dominant tree species whereas shrubs like *Desmodium sp., Murraya koenigii,* and herbs like *Imperata cylindrica* is dominant species. But at settlement area *Shorea robusta, Mallotus phillippensis* is dominant tree species whereas shrubs like *Clerodendrum viscosum, Urena lobata,* and herbs like *Eragrostis cynosuroides, Achyranthus aspera* are dominant species. It was found that in both community forests the most dominant species is *Shorea robusta.* Jaljala community forest is found to be more diversified than Taradevi community forest. Both community forests show the good regeneration status of the community forests in the buffer zone, the potential for forest regeneration is in the proper sequence. The seedling, sapling and tree density and density diameter curve showed reversed J-shape curve indicating the the satisfactory regeneration status of both community forest.

Keywords: Importance value index, DBH class, diversity indices, settlement, Shannon-Weiner

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LIST OF ABBREVIATIONS

BaNP	Banke National Park
BZ	Buffer Zone
BZCFs	Buffer Zone Community Forests
˚C	Degree Celsius
CFUGS	Community Forest User Group
DBH	Diameter at Breast Height
DFRS	Department of Forest Research and Survey
DNPWNC	Department of National Parks and Wildlife Conservation
DoF	Department of Forest
Ds	Simpson's Diversity Index
FAO	Food and Agricultural Organization
GoN	Government of Nepal
H	Shannon Wiener Index
Ha	Hectare
IBM	International Business Machine
IS	Index of Similarity
IUCN	International Union for Conservation of Nature
IVI	Importance Value Index
JCF	Jaljala Community Forest
Kg	Kilogram
Km	Kilometer
m	Meter
mm	Millimeter

MoFSC	Ministry of Forest and Soil Conservation
NA	Natural Area
NP	National Park
NTFPs	Non-Timber Forest Products
p^H	Potential of Hydrogen
PAs	Protected Areas
RA	Relative Abundance
RD	Relative Density
RF	Relative Frequency
SA	Settlement Area
SPSS	Statistical Package for Social Science
TCF	Taradevi Community Forest
UNEP	United Nations Environment Programme
WHO	World Health Organization
WLR	Wildlife Reserve
%	Percentage

CHAPTER 1: INTRODUCTION

1.1Buffer zone, Community Structure and Regeneration

Community forest is also one of the main sites in species richness and its abundance due to its vast topographical features along with altitudinal ranges as well as horizontal ranges from East to West. Community forest structure and its composition can be understand easily with the status of tree population, regeneration pattern and diversity of planning, management and conservation activities (Malik and Bhatt, 2015; Mishra *et al*., 2013). A species ignored may not be useful for next (Upreti, 1991). For the betterment of the community structure NP, WLR and other PAs (Gorkhali, 1991) were carried out. Future community forest structure will be result by different physical and biological over long period of time (Veblen, 1992.

Banke National Park (BaNP) of western Nepal ecologically is rich in flora and fauna. Department of National Park and wild life (DNPWC) has designed and authorized buffer zone and allowed people of buffer zone to use forest resources (Hein and Mehta, 2000). Buffer zone (BZ) is considered as one of the main efforts for the sustainable management of the protected areas (Hales, 1989). It is also main site for species richness and its abundance due to its vast topographical features. There was different conservation and management efforts initiated at buffer zone of BaNP like establishment of fire zone, boundary of buffer zone, afforestation, and scientific plantation of trees are carried out for the conservation (Fisher, 1995).

Wells and Brasden (1993) defined buffer zone as "*an area adjacent to park area designed to give protection to the park and provides valuable benefits to local people*". In this way, the main aim of buffer-zone is to conserve important areas and to eliminate the negative impacts of local people activities near protected areas. Hence, based on this the conservation effort has been initiated by separating the buffer-zone. It averts the negative effect of environment and generates new concept for the conservation science in terms of biodiversity, structure and productivity. It provides the improvement of forest coverage with well flourished woody and leafy plants, food and habitat to wildlife. Due it this reason plants and animals migrates in response to their buffer-zone by increasing high biodiversity area. Dewan (2006) had also studied about the policies and legal frameworks of buffer-zone management in Nepal and had

identified the problems in relation to management of buffer-zones. Mostly buffer-zone is now altered due to grazing, burning (Sharma, 1996), fuel wood and fodder collection, agricultural shifting practices and burning process by Government policy and activities (Joshi *et al*. 2000). Deforestation of forest, biodiversity loss, alternation of forest ecosystem process and its functions (Kharnley and Poe, 2007) are also affecting the buffer-zone at different places. Integrated approaches to buffer-zone to conserve natural resources from surrounding people (Orsdol, 1987) was adopted based Congress in Bali, Indonesia (1982). These areas, where some activities are also permitted to produce alien plant species, were established to give parks protection and to benefit the local population (IUCN/UNEP). It is commonly acknowledged that local participation in the management of protected areas contributes to human peace, the sustainability of natural resources and the well-being of park visitors (Anon, 1993). Due to this activity it is now widely accepted as protective technique by reducing the conflicts (Oli, 1998) local people use natural resources periphery to protected area (Mishra, *et al*., 1990). Hence, it has been declared by GoN as buffer-zone to the local people for sustainable use of fodder, timber, firewood, grassland to uplift their socio-economic conditions so that local people get opportunity to sustainable use of the forest resources to uplift lift their livelihood (Pain *et al*., 2002). Buffer-zone, being considered as one of the main principle and practices for conservation (Webel, 1995) area, plays the significant role for the protection and conservation of the national park too. This strategy creates harmony among local people. Similarly, existing buffer-zone policy, periphery to protected area, can utilize 30-50% of income for community development (Dewan, 2006). By creating the balance ecosystem through reduction of grazing effect, sustainable use of fodder using scientific management technique for conservation of flora and fauna, buffer zones are maintained (Basnet, 2002). This shows viable method for the conservation of protected areas and National Parks (Nepal and Weber, 1994). Similarly, different abiotic components (Veetas, 2000) like wind velocity, humidity, precipitation, temperature, rainfall etc are the major components to create species diversity and regeneration.The concept of BZ was introduced by NPWC to guarantee public engagement in biodiversity protection improvement and better natural resource management. Along with protecting the community forest from residential and commercial zones, community development, income generation, and natural calamities, the BZ offers the local community a facility for use and a consistent supply of NTFPS.

Biodiversity is closely linked to livelihoods and economic well being of many rural peoples who directly and indirectly depends upon natural resources. In Nepal, national park and wildlife reserve Act 1973 it was initiated mainly focusing landscape, habitat and conservation. Afterwards buffer-zone management regulations (1996) it also included biodiversity conservation strategy and included the areas outside protected areas.

Composition of the forest depends upon the potentiality of regeneration of the tree species within the forest stand (Henle *et al*., 2004). Natural regeneration is the phenomenon of re-growing or reproduction of plant through their juvenile (Acharya and Shrestha, 2011). The process of renewal, restoration and re-growth that makes organism and ecosystem resilient to fractional fluctuation or event or damage is called regeneration. Regeneration is more effective in younger trees than mature plants (Dong and Jia, 1991; Becerra *et al*., 2004; Zhang *et al*., 2015). It is a cost- effective natural process by which plants re-establish themselves and this strategy help the plants to maintain their diversity and genetic identity (Hanief *et al*., 2016). Regeneration is an important process for the existence of species in a community under a varied environmental condition (Khumbongmayum *et al*., 2005). Regeneration of forest trees has important indication for the conservation and management of natural forests (Tripathi and Khan, 2007).

The regeneration status indicates the health and vitality of the forest and a healthy forest ensures good future regeneration (Awasthi *et al*., 2015). It is the most important mechanism to maintain a plant species stable age structure and regeneration status in a community, which are directly or indirectly influenced by altitude, climate, and edaphic factors (Singh & Singh, 1992; Uma, 2001). Numerous known and unknow environmental parameters, such as temperature, soil type, seed quality, nutrient composition, pH, biotic factors (Singh *et al*., 1987), light (Tyagi *et al*., 2011), and biotic factors (Singh *et al*., 1987), will affect the capacity for regeneration. Light is one of the main important factors for shoot regeneration in some plant species (Reuveni and Evenor, 2007). But light also has the inhibitory effect in some plants for root and shoot regeneration (Bellini *et al*., 2014 and Nameth *et al*., 2013). For particular ecosystem various natural and anthropogenic activities such as drought, forest fire, diseases outbreak, deforestations, over exploitation of resources, grazing, fragmentation and industrialization affect the forest diversity and regeneration (DFRS, 2010-2012 and

2011-2013). Population structure of a species in a forest carry its regeneration pattern behavior by the reproductive strategy (Singh and Singh, 1992) which shows the better developmental pattern of any community (Zhang *et al*., 2007), species composition and stability in future (Napit, 2015). Seedling and sapling determines the regeneration of a tree species to survive and grow (Good and Good, 1972). The presence of sufficient number of seedlings, saplings and young trees of different age groups from young to old (Chauhan *et al*., 2008) show better regeneration. It is found that natural regeneration by coppice is possible from human disturbance (Marvi and Mohaje, 2005). A population with sufficient number of seedlings and saplings represents satisfactory regeneration behavior, while inadequate number of seedlings and saplings of species in a forest indicates poor regeneration (Tripathi and Khan, 2007). Fast growing regeneration strategies up to 6m after 5 years from seed (Javkson, 1999) can be found in tropical forest. The shrinking of regeneration pattern usually cause to change in species composition as well (Sapkota *et al*., 2009). If the distribution of diameter class is such that maximum number of individuals is present at seedling stage and then decreases subsequently at the next level, the model is called as reverse J shaped curve. This illustrates the good regeneration pattern of the forest (Chauhan *et al*., 2008). Undisturbed old-growth forests with sustainable regeneration are found to have a reverse J- shaped size class distribution (Parker and Peet, 1984). A bell-shaped size class distribution has been attributed to disturbed forest, where regeneration is hampered (Saxena *et al*., 1984). Usually, decline in shoot regeneration in mature plants reduced due to reduced plants hormones. Forest disturbance and recovery strongly influences the ecosystem in large scale. High coverage of grass and presence of some invasive species on forest show high competition and negative effect among species. Its disturbance effects can be found on succession pattern due to their intensity, density, frequency (Turner *et al*., 1998, Smith and Urban 1988). So, it needs to be removed of grass coverage and invasive species (Jalai, *et al*., 1980) for better seedling and sapling. Hence, regeneration is the most important aspect for sustainable forest management (Gould, *et al*., 2006) and its regeneration patterns vary on residential and natural. Kohalpur of Banke district is undergoing rapid urbanization and buffer-zone under this municipality is facing various problems. Due to this reason it is required to balance and conserve the biodiversity for fulfillment the needs of present and future generation people needs.

This study aims to explore the community structure and regeneration two community forests of Buffer zone of Banke National Park Nepal. For this, two community forests sites along the settlement and natural areas of buffer zone were selected. The density, IVI, species diversity index, regeneration pattern was studied in Rapti Sonari rural municipality, Banke National Park in Banke district Western Nepal.

1.3 Justification

Despite this, there haven't been any particular studies or increasing concerns in the Terai's buffer zone, which is regarded to be a biodiverse area. The negative effects of these pressures are exploiting the species diversity, seedlings, and saplings in buffer-zone areas of these community forests due to encroachment for agricultural land, human settlement, rearing and caring for livestock for fodder, grazing, timber, and medicinal collection, etc. As these buffer zone seems to be highly diversified ofr not along residential area and natural area. So, this study aim to examine the plant diversity and regeneration pattern in BZ community forest whuich might helpful for the conservation and management of plants at BZ areas.

1.4. Research Questions

i. If the biodiversity of buffer zone is properly maintained at settlement and natural areas?
ii. What is the regeneration pattern at two community forests of Buffer Zone?

1.5. Objectives

The general objective is to study plant diversity and regeneration pattern at settlement and natural sites of Jaljala and Taradevi community forest.

The specific objectives are:

i. To analyze the plant diversity at settlement and natural area of two community forests.

ii. To estimate regeneration patterns of tree species at settlement and natural community forests.

1.6. Limitations:

i. Soil analysis and forest management policies were not studied.

CHAPTER 2: LITERATURE REVIEW

2.1. Community Structure and Regeneration

Natural regeneration is the phenomenon of re-growing or reproduction of plant through their juvenile (Acharya and Shrestha, 2011). In Nepal if forest have seedling >5000 and sapling >2000 per hectare regeneration is said to be good, (DOF, 2004). Study of regeneration pattern in Sal forests from various parts of Nepal has found that regeneration status of Sal was higher than the other associated species. The density of *Shorea robusta* has been reported higher than associated species in community forest of Western, Nepal (Dumre, 2017). Similiarly, the number of seedling and sapling were reported higher than other tree species in Sal forest of Western, Nepal (Timilsina *et al*., 2007). Napit (2015) and Awasthi *et al*., (2015) found that the regeneration status of *Shorea robusta* was higher than other associated species in forest of Banke National Park and Rupandehi respectively.

In the Sal forest of Baglung district, Central Nepal, Sharma *et al*. (2020) discovered that the regeneration status of Sal was higher in the disturbed site than the undisturbed site. In Nepalese Sal forests, which are managed under three major management regimes protected area, state-managed forest, and buffer zone community forest. Chapagain *et al*. (2021) compared the impact of disturbance. They discovered that regeneration was lower in protected area and state-managed forest compared to buffer zone community forests. According to Bhatta (1994), buffer-zone is an indirect form of compensation. He discovered that agricultural and fodder conflicts were consuming the resources, resulting in animal losses and harassment of the local population. It demonstrates the enormous contribution made by the local population to the conservation of forest natural resources as an important natural resource. It demonstrates the major contribution made by the local population for the conservation and management efforts of buffer zones for future need.

Researchers Malla and Acharya *et al*. (2018) studied how tropical forests regrew and gave examples of how overgrazing, tree-cutting, and fire harm the regrowth of forests. As a result, it is possible to preserve the enhanced environmental conditions that will promote the regeneration of Sal forests. Regeneration could help sustain the well-balanced Sal forest by carrying out a variety of procedures in tropical forests. In order

to promote social sustainability, environmental conditions and resource use should be considered in relation to a number of variables, including soil quality, elevation, slope, and use in agriculture and forestry. Removal of litters on controlled activity enhances the germination of seedling and its survival of some timber species on understory forest. Manvel R. Guariguata (2000) found that survival capacity of seedling is more in understory forest. But he found no clear correlation between seed longevity in soil and germination capacity. High tree diversity show the seed stage for suite pioneer of tree with co-existence of moist tropical forest and light also play significant role for species composition after abandoned in areas. Small seeded, shade intolerant species are negatively affected in seed germination due to leaf litter fall.

Prabhu Budhathoki (2004) analyzed strengths and weaknesses of buffer zone policy and the efforts to put policy into practice are examined and discussed. The analysis of buffer zone practices reveals for better integration of conservation and development objectives, empowerment and equity in benefit sharing and gender issues need to be adequately incorporated in buffer zone policy and programme implementation.

Bhusal (2012) had well studied on the buffer-zone management of Nepal. He explained by sharing the program of financial and technical support from the various partners has greatly associated the basic buffer-zone community to develop community needs and it has positively changed people perception towards conservation and protection of parks. According to Ebregt (2000) buffer-zone has emerged as relatively new integrated development approach to nature conservation. It sees the important tool in conserving areas of ecological importance while addressing the developmental issues of the people in surrounding of it. It also shows the long term prospective as well as continuous monitoring and evaluating as the tool for feedback. These may further help in management. Craigl, L. and Shofer (1999) had examined the pertinent legal and social concerns of the buffer-zone which could helps in remedy of impacts of natural resources. Based on human activities buffer-zone, diversity can only be managed by strict rules and regulation among local people. This action leads further protection of impact of natural resources. Sharma et al., (2020) studied the speciesdiversit of community forest in central Nepoal sand found that the disturbed site had number of species than the undusterbed sited of the forest. Tthe density of seedlings, saplings and trees, were found higher in the disturbed site than the undisturbed site of the forest.

CHAPTER 3: MATERIALS AND METHODS

3.1. Study Area

The study region was at Banke national park in Banke district, Western Nepal. The Sal mixed woodland in Banke National Park's buffer zone extends over 34,300 hectares and served as the site of the studies. Rapti Sonari Rural Municipality served as the study locations (Figure 3.1). The Rapti Sonari Rural Municipality is situated at 28°02'40" N and 81°57'19" E and has a total area of 1041.73 km^2. It has a climate that is dry in the winter and humid in the summer because it is 250 meters above sea level.

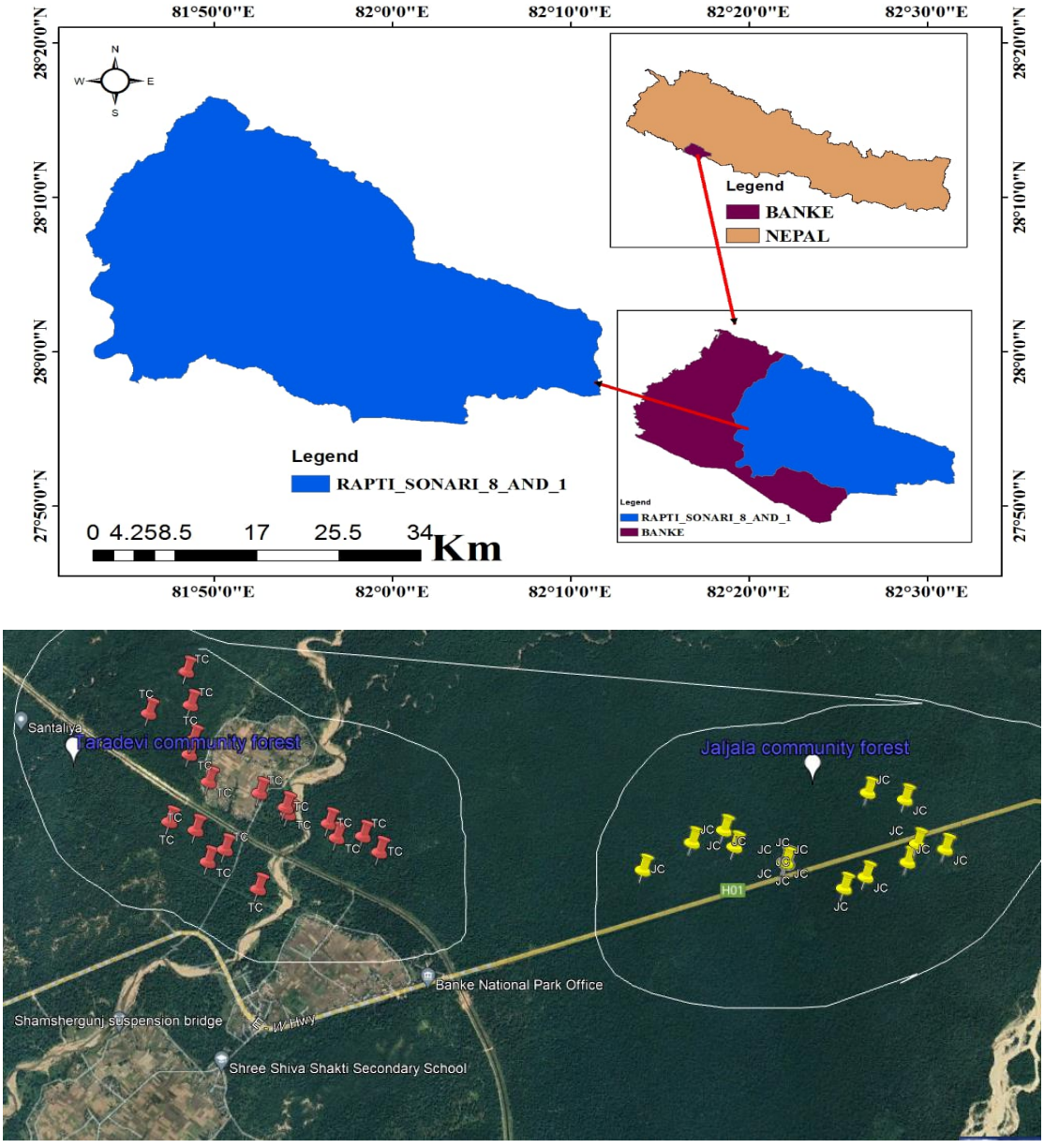

Figure 3.5: Map of study area and sampling plots in TCF and JCF

3.1.1. Study site

The study was conducted at Taradevi buffer zone community forest (TCF) and Jaljala buffer zone community forest (JCF) of Rapti Sonari rural municipality, Banke district. The total number of house holds at Jaljala and Taradevi community forest is 323 and 380 respectively (sources: Five years field survey of community forest 2021). The study area TCF and JCF covers an area of 116 and 102 ha respectively buffer zone of Banke National Park.

3.2. Climate and Hydrology

Rapti Sonari rural municipality is located at 250 to 350 m above sea level. The study area is characterized by tropical climate. The average annual maximum and minimum temperature of this area is 32.08 ˚C and 20.75 ˚C respectively. The area experiences the maximum average monthly temperature during May with 41˚C and minimum during January with 22˚C. The minimum average monthly temperature ranges from 10 to 30 ˚C at the study area. Wet season in Rapti Sonari starts from May and lasts till August. The mean annual precipitation was 190.18 mm with the highest precipitation recorded in August followed by September, July respectively. Very low precipitation occurred during November, December and January (Figure 3.2). The average annual relative humidity of the area is 49.67% (Figure 3.3).

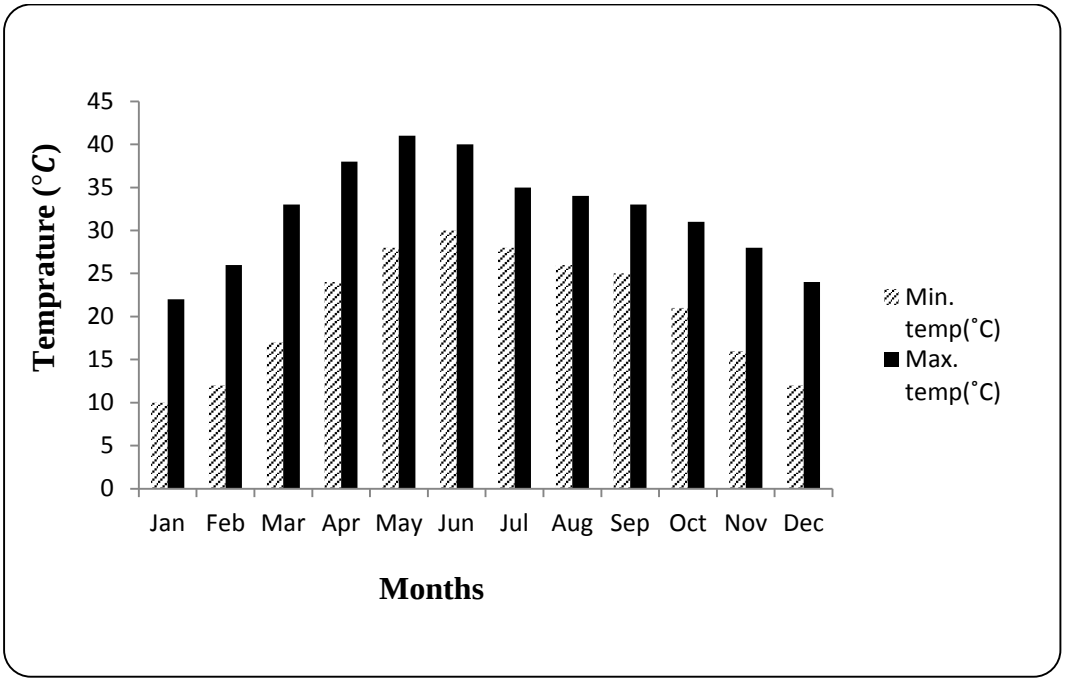

Figure 3.6: Minimum and maximum temperature of study area. (Source: Department of Hydrology and Meteorology, Babarmahal, Government of Nepal).

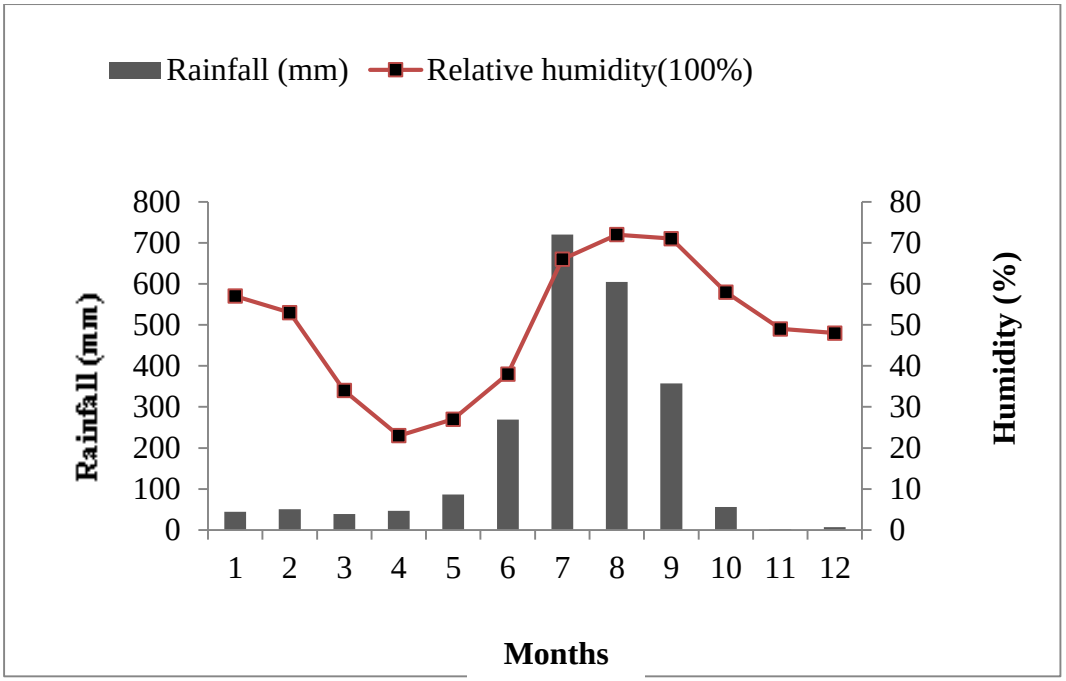

Figure 7.3 : Average of five years (2016-2021) climatic graph showing average monthly minimum and maximum temperature, humidity and rainfall of Nepalgunj weather forecast station (source: Department of Hydrology and Meteorology, Babarmahal, Government of Nepal).

3.3. Research Methodology

3.3.1. Research Design

Vegetation sampling was done by stratified random sampling using square quadrat in the month of November, 2020 (from November 20 to November 30). Stratified random sampling method was used in the sampling plots, the forest blocks designated by the CFUGS were considered for plot. Total number of plots to be sampled was proportionately distributed among the forest based on residential and non-residential areas. Altogether 60 sampling plots were laid with 30 quadrats in each two community forests. Further from each 30 quadrates, 15 sub-quatdrats were laid for each settlement and natural area of both community forests. Sampling plots in the settlement areas of the buffer-zone were about 200m distance away from the market or houses and about 50m distance apart from roadsides. Similarly, sampling plots at natural areas were within 100-150m apart and at settlement area 100m far between two quadrats. To estimate the regeneration of tree 15 quadrats of 20 ×20 m^2 was established at each residential and natural area for each community forests. All tree species were recorded

inside each plot. The height of trees for all individuals at the height of >1.37m with DBH ≥10cm at breast was measured by DBH tape for measurement of diameter of trees. Quadrats of 20 ×20 m^2 were laid for the study of trees. Within each 20×20 m^2 plots, three sub plots of 5 ×5m^2 were laid for shrubs and within each 5×5 m^2 sub-plots three sub-plots of 2×2 m^2 were laid for herbs altogether 30, 90 and 270 quadrats were laid for trees, shrubs and herbs respectively in each two community forests (Figure 3.4). Similarly, for the regeneration study of tree species were counted in 20 ×20 m^2 plots.

3.3.2. Field Sampling

Different plant species from each sample plots were recorded from November 20 to November 30, 2020. The names of the known plant species were recorded on notebook but the unknown species were collected and their herbarium was prepared for identification. For the identification of plant species, different literature of Shrestha (1998), Duthie (1903-1929), Hara *et al*. (1972, 1982), Polonium and Stainton (1984) and Rajbhandari, *et al*., (2011) were used. Based on local name, the unknown plants were also identified following the books of Shrestha (1998).

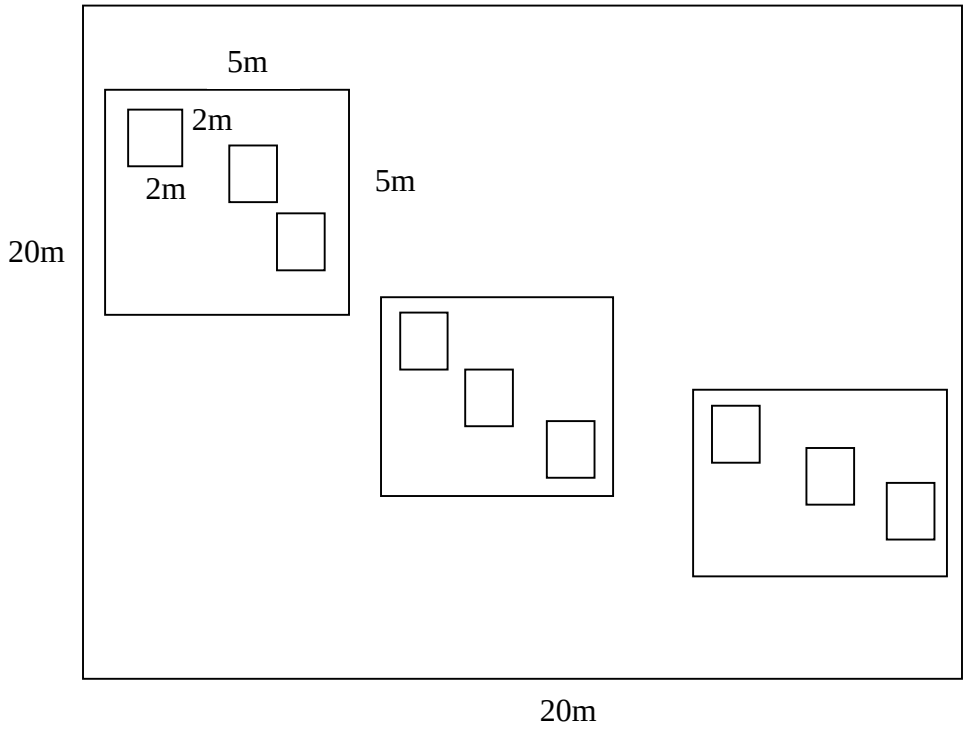

Figure 3.8: Outline of vegetation of sampling

Individual s of tree specuies were divided into three stages: trees (DBH>10 cm), saplings (DBH< 10 cm, height >30 cm) and seedling (height<30 cm) (Sundryal and

Sharma 1996). Based on DBH differences of 5 cm, all tree species were categorized into several size classes, which were then established to study regeneration patterns. The quadrat for shrubs species with height >15 cm and <1.37 (Thapa Magar and Shrestha, 2015). Similarly, for herbs height with < 15 (Thapa Magar and Shrestha, 2015) was considered. Geographical location (latitude, longitude and elevation) of each plot was recorded using altimeter and GPS from the center of the plot. Canopy cover for each plot was estimated by visual estimation method from center of the plot.

3.3.3. Plant Diversity and Vegetation Analysis

For the vegetation analysis different parameter such as frequency, relative frequency, density, relative density, coverage, relative coverage of each species and their importance value index (IVI) were calculated.

Plant diversity indices (Simpson, 1949; Shannon and Weiner, 1963) were also calculated using the formulae given in Zobel *et al.*, (1987).

$$\text{Density} = \frac{\text{Total no.of individuals of a species}}{\text{Total no.of quadrat studied}} \times \frac{1}{\text{area of quadrat}}$$

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

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

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

$$\text{Abundance (A)} = \frac{\text{Total no. of individual species}}{\text{Total no.of quadrat in which species occured}}$$

$$\text{Relative Abundance (RA)} = \frac{\text{Abundance of individual species}}{\text{Total abundance of all species}} \times 100\%$$

$$\text{Simpson's index (D)} = \frac{\sum n(n-1)}{N\,(N-1)}$$

$$\text{Simpson's index of diversity (Ds)} = 1\text{-}D$$

$$\text{Shannon Weiner index (H)} = -\sum \text{Pi (Ln Pi)}$$

Where,

Pi=Proportion of individual species

3.2.4. Importance Value Index (IVI)

Importance value index (IVI) is a measure of how important a species is in a given plant community. In this research work, IVI was calculated using the following formula.

Important value index (IVI) = RD + RF + RA

Where,

RD = Relative density

RF = Relative frequency

RA = Relative abundance

3.2.5. Plant Diversity Index

Plant diversity was calculated based on Shannon diversity index and Simpson diversity index. Shannon diversity index was calculated using the following formula (Shannon and Weiner 1963).

$H = -\sum pi \times \ln pi$

Where, H = Shannon's diversity index

Pi = Species proportion (based either on species count or species basal area)

Ln = natural logarithm

Simpson's diversity index (Ds) was calculated from the Simpson's index (D) using the following formula (Simpson 1949)

Simpson's index (D) = $\Sigma\ (n-1)\ /(N-1)$

Where, N = total number of individual species

n = number of individuals of a particular species

Since the higher value of D indicates less diversity and low value indicates high diversity, the Simpson's index (D) is substracted from 1 to provide positiveness in the result i.e higher the value more is the diversity and less the value lower is the diversity, which was called as Simpson's Diversity index (Ds) and it ranges from 0 to 1.

Ds = 1-D

3.2.6. Index of Similarity (IS)

Inter-specific association can be evaluated by calculating the index of similarity. It gives the degree of similarity between any two stands, which depends on the quantitative characters of species common to both stands. It is utilized to compare two existing groups. It was calculated by applying the formula given by Sorenson's index (Sorenson, 1948).

$$IS = \frac{2C}{A+B} \times 100$$

Where,

A = Total number of species in one sample

B = Total number of species in another sample

C = Total number of common species in both the sample

3.2.7. Forest Regeneration

To estimate the regeneration status of forest, density of seedling, sapling and tree of each species were determined separately following the method described by Zobel *et al*., (1987). Density was estimated by following equation;

$$\text{Density (stem/ha)} = \frac{\text{Total no.of individual of each species in each life form}}{\text{Total number of plots studied} \times \text{size of plot}(m^2)} \times 10000$$

3.2.8. Statistical Analysis

The calculation of density, frequency, abundance and importance value index (IVI), species diversity, bar diagrams were performed in Excel 2019.

CHAPTER 4: RESULTS

4.1 General vegetation of both community forests

Altogether140 plant species among them 37 herbs, 75 shrubs and 28 trees were recorded in JCF and total 138 plant species among 39 herbs, 61 shrubs and 38 trees were recorded in TCF (Appendix 1). The most dominant life form of herbs in JCF *Eragrostis cynosuroides, Achyranthus aspera, Cynodon dactylon* and *Imperata cylindrica* where in TCF were *Eragrostis cynosuroides, Imperata cylindrica, Achyranthus aspera* and *Elephantopus scaber.* At settlement sites of both communmty forests the most dominant herbs were *Eragrostis cynosuroides and Imperata cylindrical* at JCF and TCF rtespectively but at natural sites dominant herb species was *I. cylindrical* in both JCF and TCF. The most dominant shrubs in JCF were *Clerodendrum viscosum, Murraya koenigii, Urena lobata* and *Flemingia macrophylla* where in TCF were *C. viscosum, Urena lobata* and *Rubus ellipticus.* At settlement sites of both communmty forests the most dominant shrubs were *Clerodendrum viscosum* but at natural sites the most dominant shrubs were *M. koenigii* and *Clerodendrum viscosum* in both JCF and TCF respectively.

The most dominant trees in JCF were *S. robusta* and TCF were *S. robusta, Mallotus phillippensis* and *Leucaena leucocephalia* where at TCF the dominant trees were *S. robusta, Lagerstroemia parviflora* and *Bauchania latifolia.*At both settlement sites and natural sites of both communmty forests the most dominant trees was *Shorea robusta.*

4.2 Vegetation Analysis

4.2.1 Importance Value Index (IVI) for herbs and spaling

At Jaljala community forest (JCF) herb like *Eragrostis cynosuroides* had highest IVI value i. e. 47.42 and *Ophioglossum sp.* had lowest IVI value i. e. 0.6 at settlement area. Similarly, *Imperata cylindrica* had highest IVI value i. e.38.87 and *Centella asiatica* had lowest IVI value i. e 1.09 at natural area. In JCF, seedling of *Shorea robusta* had higher IVI value than other associated species in both sites. Seedling of *Mallotus phillippensis, Schleriachera oleosa, Diospyros lanccifolia, Dillenia pentagyna* and *Syzygium cumini* were most dominated in settlement area whereas seedling of *Mallotus*

phillippensis, Diospyros lanccifolia and *Schleriachera* was most dominated in natural area (Table 1).

At Taradevi community forest (TCF) herb like *Imperata cylindrica* had highest IVI value i. e. 88.8and *Achyranthus bidentata* had lowest IVI value i. e. 1.13 at settlement area. Similarly, *Imperata cylindrica* had highest IVI value i. e. 118.74 and *Tinospora cordifolia* had lowest IVI value i. e. 0.89 at natural area. In TCF, seedling of *Shorea robusta* had higher IVI value than other associated species in both sites. Seedling of *Mallotus phillippensis, Schleriachera oleosa, Diospyros lanccifolia, Dillenia pentagyna* and *Syzygium cumini* were most dominated in settlement area whereas seedling of *Mallotus phillippensis, Dillenia pentagyna* and *Schleriachera* was most dominated in natural area.

Table 1: IVI of herbs and seedling at JCFand TCF

S.N.	**Herbs**	**JCF**		**TCF**	
	Name of plants species	**IVI(SA)**	**IVI(NA)**	**IVI(SA)**	**IVI(NA)**
1	*Eragrostis cynosuroides (Retz.)*	47.42	18.65	22.14	23.38
2	*Achyranthus aspera*	43.14	22.62	70.59	9.45
3	*Cynodon dactylon*	39.31	25.53	7.77	3.04
4	*Imperata cylindrical*	30.76	38.87	88.8	118.74
5	*Elephantopus scaber L*	25.85	25.19	27.92	4.68
6	*Evolvus nummularius*	15.25	26.61	16.94	19.01
7	*Cyperus cyperoides*	13.43	18.25	4.06	
8	*Achyranthus bidentata*	7.28	4.58	1.13	
9	*Phoenix loureiri var humilis*	7.06	7.39	1.97	3.01
10	*Desmodium dichotomum*	2.19			
11	*Mimosa rubicaulis*	1.11			
12	*Centella asiatica L.*		1.09		

13	*Tinospora cordifolia*				0.89
14	*Cissampelos pareira*				1.02
15	*Euphorbia hrita*				1.03
16	*Ophioglossum sp*	0.6		2.69	4.32
17	*Parthenium hysterophorus*				1.22
18	*Degetaria sp*	0.59			0.99
S.N	**Seedling**				
1	*Shorea robusta*	101.33	112.88	112.72	133.73
2	*Dillenia pentagyna*	9.80	8.06	13.55	14.80
3	*Schleriachera oleosa*	12.91	10.05	7.24	11.40
4	*Buchanania latifolia*		3.01	2.90	4.13
5	*Mallotus phillippensis*	52.34	36.65	51.35	28.50
6	*Cassia fistula*	6.31	7.61	3.29	3.96
7	*Syzygium cumini*	8.86	6.89	13.13	9.96
8	*Diospyros lanccifolia*	12.49	10.50	10.82	3.36
9	*Lyonia villosa*				0.99
10	*Ficus hispid*			1.17	
11	*Butea monosperma*			1.17	
12	*Morus alba*			1.42	
13	*Pterocarpus masupium*	0.92			

At Jaljala community forest (JCF) shrub like *Clerodendrum viscosum* had highest IVI value i. e. 32.95and *Osyris wightiana* had lowest IVI value i. e. 0.59 at settlement area. Similarly, *Murraya koenigii* had highest IVI value i. e. 18.16 and *Calotropis gigantean*

had lowest IVI value i. e. 0.58 at natural area. In JCF, sapling of *Shorea robusta* had higher IVI value than other associated species in both sites. Saplings of *Mallotus phillippensis, Cassia fistula* and *Dillenia pentagyna* were most dominated in settlement area whereas saplings of *Mallotus phillippensis*, *Dillenia pentagyna* and *Cassia fistula* was most dominated in natural area (Table 2)

At Taradevi community forest (TCF) shrub like *Clerodendrum viscosum* had highest IVI value i. e. 40.30 and *Carissa caranda* had lowest IVI value i. e. 0.61 at settlement area. Similarly, *Clerodendrum viscosum* had highest IVI value i. e. 40.56 and *Asparagus racemose* had lowest IVI value i. e. 0.69 at natural area. In TCF, sapling of *Shorea robusta* had higher IVI value than other associated species in both sites. Sapling of *Mallotus phillippensis*, *Albizia procera* and *Schleriachera oleosa* were most dominated in natural area whereas sapling of *Mallotus phillippensis, Albizia procera* and *Dillenia pentagyna* was most dominated in settlement area.

Table 2: IVI of shrubs and sapling at JCFand TCF

Shrubs		**JCF**		**TCF**	
SN	**Name of plant species**	**IVI (NA)**	**IVI(SA)**	**IVI (NA)**	**IVI(SA)**
1	*Calotropis gigantean*	0.58	10.92	10.96	11.36
2	*Cassia occidentalis*	0.96			
3	*Catunaregam spinosa*	5.30	3.48	11.86	16.25
4	*Clerodendrum viscosum*	8.67	32.95	40.56	40.30
5	*Desmodium gangeticum*		0.99		
6	*Flemingia macrophylla*	11.88	12.23	9.72	11.54
7	*Mimosa rubicaulis*	1.28			
8	*Murraya koenigii*	18.16	8.03	19.96	18.57
9	*Osyris wightiana*		0.59		
10	*Phoenix aquilis*	11.67	1.34	10.64	8.08
11	*Rubus ellipticus*	10.19	3.67	28.82	9.19

12	*Solanum xanthocarpum*	0.96			
13	*Urena lobata*	15.48	25.93	17.12	34.61
14	*Jatropa curcas*				1.63
15	*Justicia adhatoda*				1.52
16	*Carissa caranda*				0.61
17	*Asparagus racemose*			0.69	
S.N	**Saplings**				
1	*Albizia procera*	2.21			
2	*Cassia fistula*	11.64	6.47	18.37	9.18
3	*Dillenia pentagyna*	24.79	5.44		7.57
4	*Ficus racemosa*		2.44		
5	*Ficus semicordata*		3.24		
6	*Mallotus phillippensis*	75.27	47.92	70.25	93.32
7	*Myrasine semeserrata*	3.31			
8	*Oroxylum indicum*		2.44		
9	*Schleriachera oleosa*	3.31	5.88	3.93	
10	*Shorea robusta*	141.45	163.72	94.94	130.99
11	*Phyllanthus emblica*			3.93	

In Taradevi community forest (TCF), *Shorea robusta* was most dominated in both settlement and natural areas with highest value of IVI i.e. 116.86 and 93.90. Other associated species like *Butea monosperma, Mangifera indica, Melia azedaracha* and *Buchanania latifolia* were restricted in settlement area and *Albizia julibrissin Mallotus phillippensis* and *Buchanania latifolia* were restricted only in natural area (Table 3).

In Jaljala community forest (JCF) *Shorea robusta* had highest IVI value i.e. 42.78 in natural and *Lagerstroemia parviflora* had highest IVI i.e. 82.49 value in the setttlement area other associated species like; *Wendlandia puberula, Eugenia operculata,* and *Buchanania latifolia* were restricted in natural area and *Mangifera indica, Spondias amara* and *Terminalia alata* in settlement area.

Table 3: IVI of trees at TCF and JCF

Trees		**TCF**		**JCF**	
SN	**Name of Plant species**	**IVI(NA)**	**IVI(SA)**	**IVI(NA)**	**IVI(SA)**
1	*Buchanania latifolia*	21.61	7.09	12.87	9.39
2	*Eugenia operculata*			2.51	
3	*Lagerstroemia parviflora*	24.42	9.18	11.10	11.48
4	*Leucaena leucocephalia*	21.74	9.39	20.76	14.91
5	*Mallotus phillippensis*	16.81	20.27	24.52	42.99
6	*Mangifera indica*		2.02		1.83
7	*Shorea robusta*	93.90	116.86	42.78	82.49
8	*Spondias amara*				3.26
9	*Terminalia alata*	21.74	20.82	22.82	8.21
10	*Wendlandia puberula*			2.51	
11	*Wrightia tomentosa*				8.43
12	*Albizia julibrissin*	2.77			
13	*Butea monosperma*		2.02		
14	*Melia azedaracha*		4.87		

4.2.2. Species diversity

At TCF the Shannon-Wiener diversity index (H) and Simpson's diversity index (Ds) value of herbs, shrubs and trees seems to be higher in natural areas than in settlement

areas (Table 4, Figure 4.1, 4.2), Similarly, in JCF the Shannon's Wiener diversity index (H) and Simpson's diversity index (Ds) value of herbs, shrubs and trees also seems to be higher in natural areas than in settlement area.

Table 4: Shannon Wiener index and Simpson index of herbs, shrubs and trees at TCF and JCF

Life forms	Forest part	Shannon's Wiener diversity index (H)		Simpson's diversity index (Ds)	
		TCF	JCF	TCF	JCF
Herbs	SA	1.94	2.38	0.73	0.88
	NA	2.09	2.85	0.78	0.93
Shrubs	SA	0.31	3.5	0.96	0.97
	NA	3.29	3.71	0.96	0.97
Trees	SA	1.48	2.03	0.53	0.74
	NA	1.89	2.79	0.72	0.9

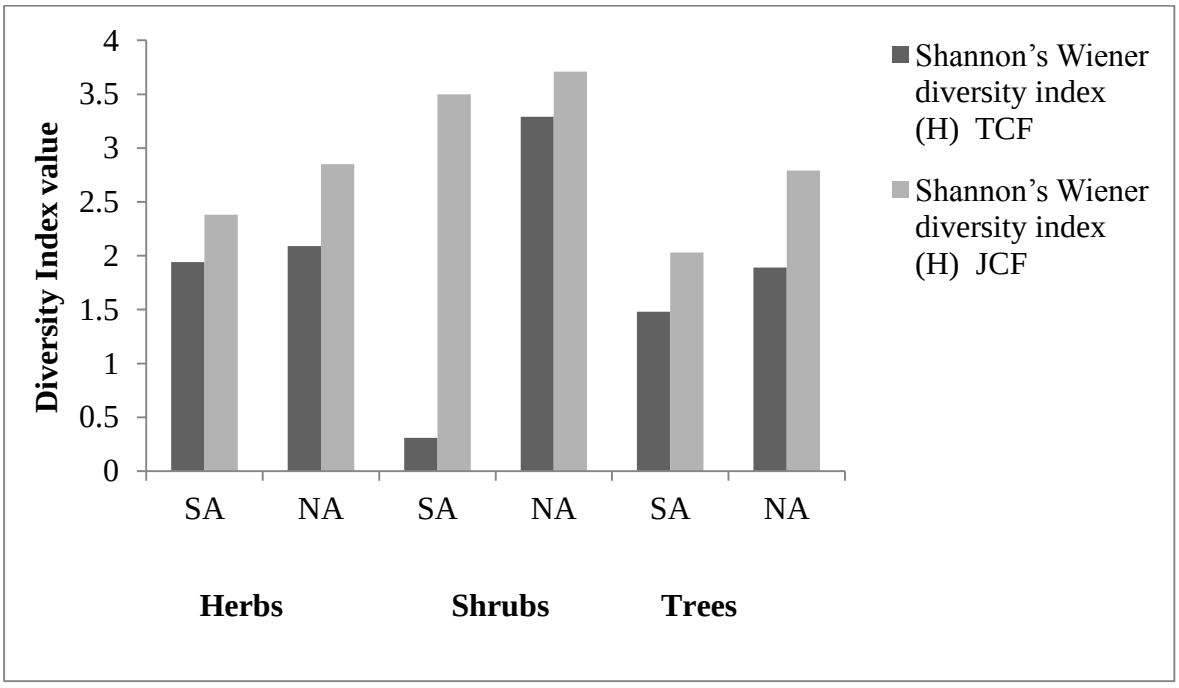

Figure 4.1: Comparison of Shannon-Wiener diversity index between at TCF and JCF at settlement area (SA) and Natural area (NA)

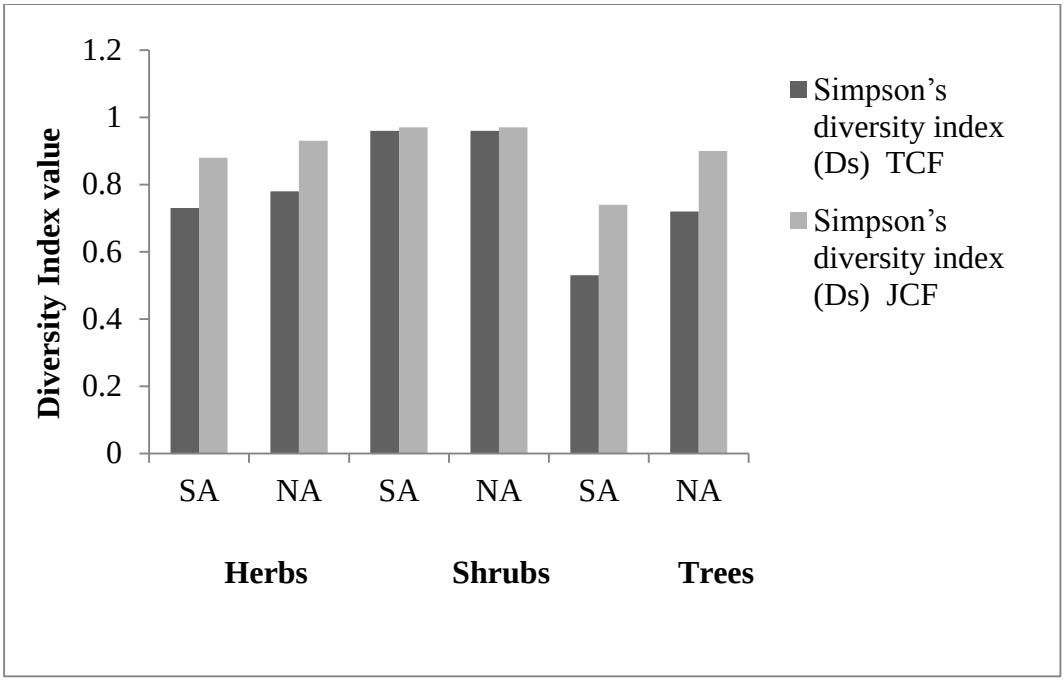

Figure 4.2: Comparison of Simpson's diversity index between TCF and JCF at settlement area (SA) and Natural area (NA)

The value of Shannon's Wiener diversity index (H) obtained for herbs, shrubs and trees were higher at natural areas than at settlement areas of JCF. Similarly the Simpson's diversity index (Ds) calculated for herbs and trees were also higher at natural areas than at settlement areas of JCF (Table 5, Figure 4.1 and 4.2).

Table 5: Similarity index between Taradevi community forest and Jaljala community forest.

Life forms	**TCF-RCF at Natural area**	**TCF-RCF at Settlement area**	**TCF-RCF**
Herbs	28.35	35.89	30.61
Shrubs	30.63	33.33	38.05
Trees	31.91	38.88	77.66

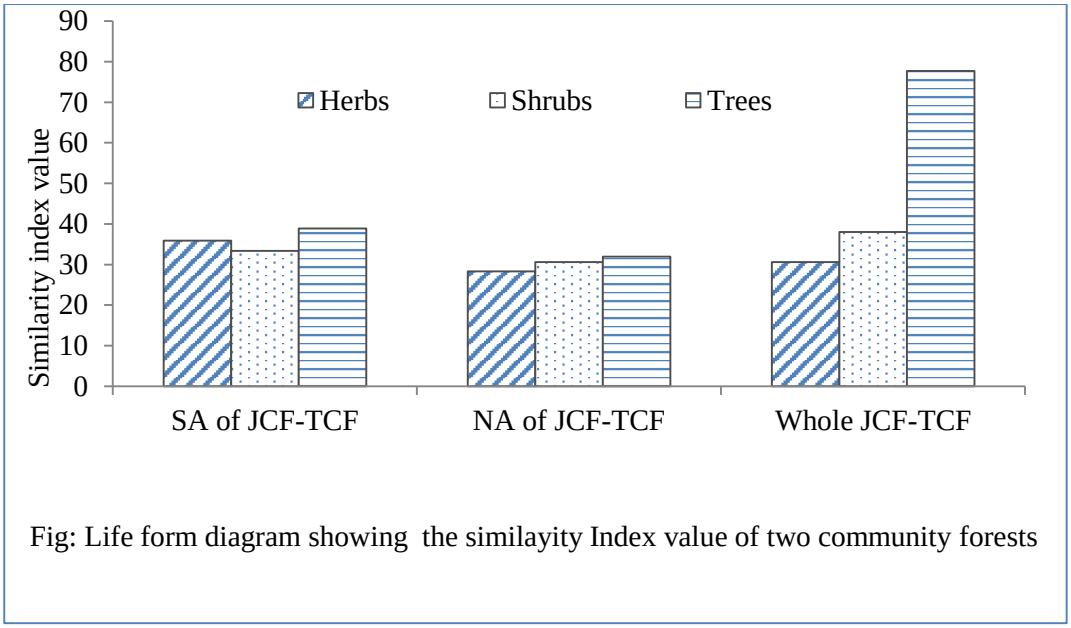

Fig: Life form diagram showing the similayity Index value of two community forests

Figure 4.3: Similarity index of two community forests

4.2.3. Forest Regeneration

In Taradevi community forest, the number of seedling were 8173 stem/ha at natural area and 7990 stem/ha at the settlement area. Similarly, at settlement areas the number of saplings were 2517 stem/ha and trees 1373 stem/ha where as at natural area the number of sapling and trees were 396 and 885 stem/ha respectively (Appendix 2). So, this community forest shows good regeneration pattern at both natural and and settlement areas (Figure 4.4).

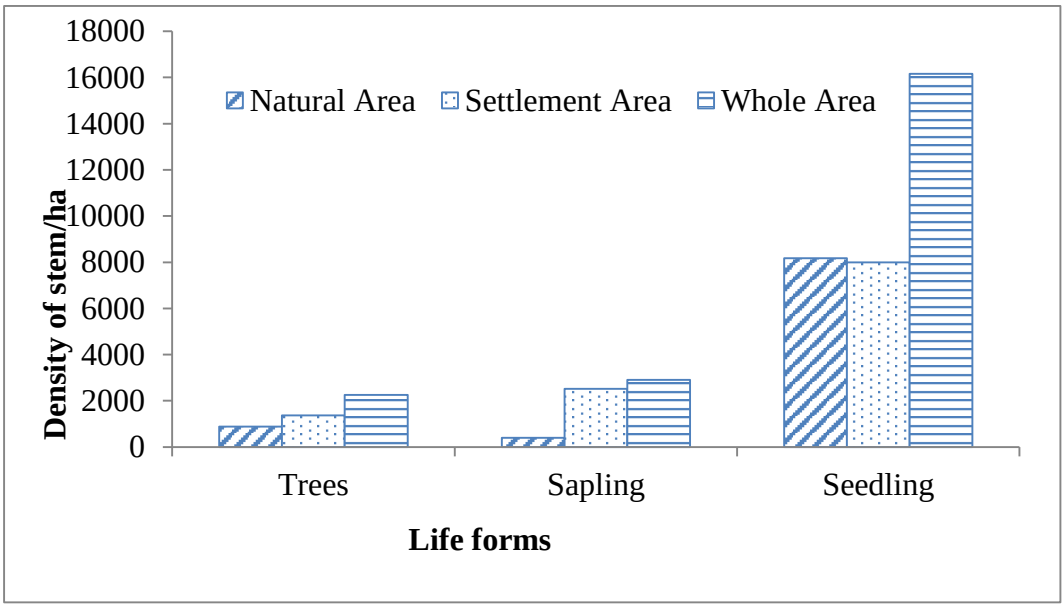

Figure 4.4: Life forms diagram to show the regeneration status of all species in natural area, settlement area and whole area of Taradevi Community forest.

In Jaljala community forest, the number of seedlings, saplings and trees were 3603, 533, 562 stem/ha respectively at natural area where the number of seedlings, saplings and trees were 6965, 1807 and 1387 stem/ha respectively at settlement area (Figure 4.7). So, this community forest shows good regeneration pattern at settlement but not at natural areas.

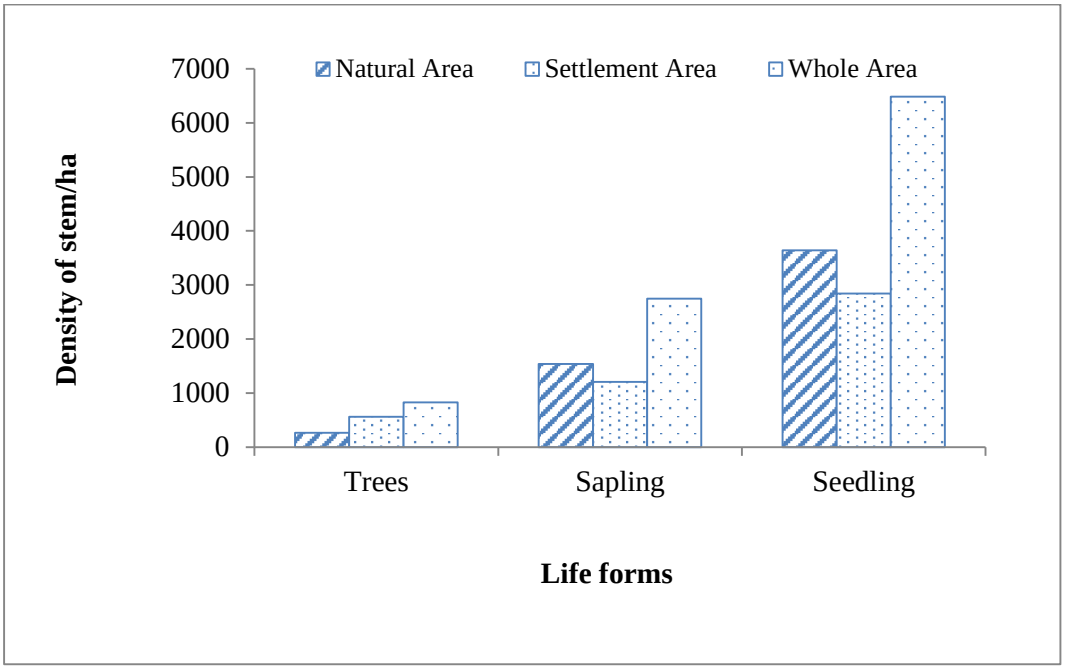

Figure 4.5: Life forms diagram to show the regeneration status of *Shorea robusta* in Taradevi Community forest

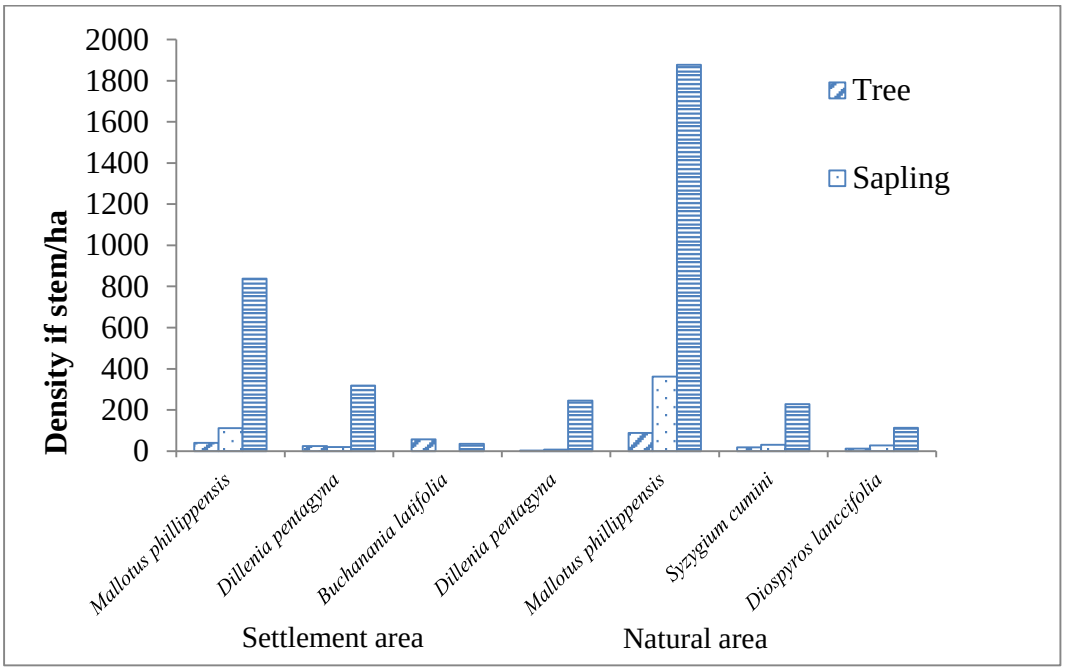

Figure 4.6: Regeneration status of co-dominant species at settlement and natural area forest in Taradevi Community Forest.

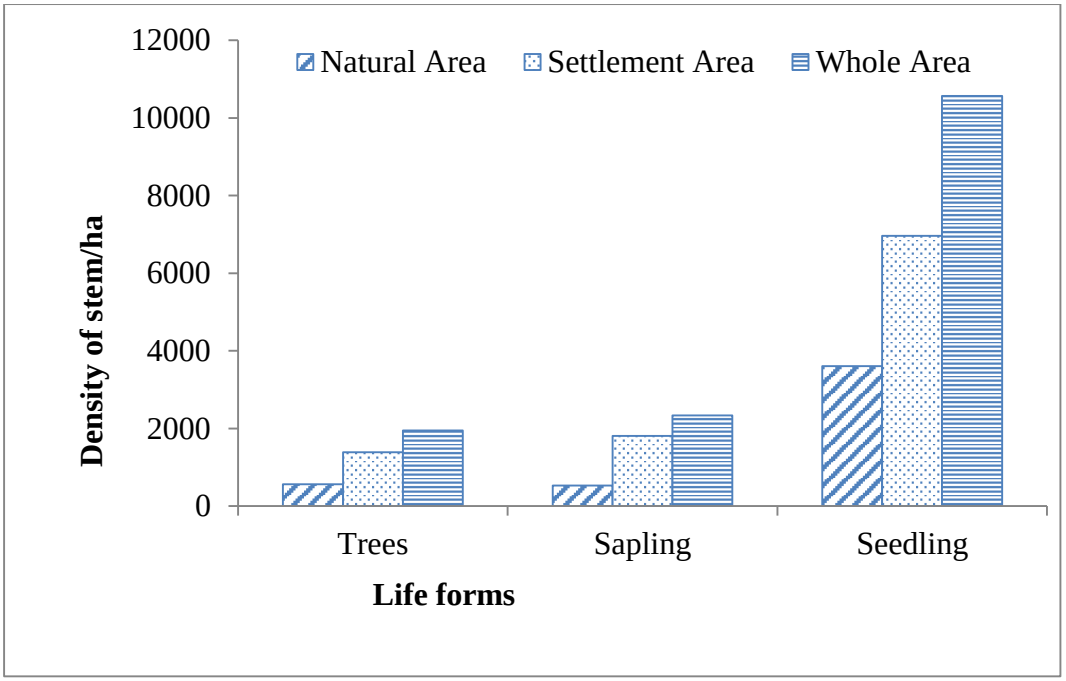

Figure 4.7: Regeneration status of all species in natural, settlement and whole area of Jaljala Community forest.

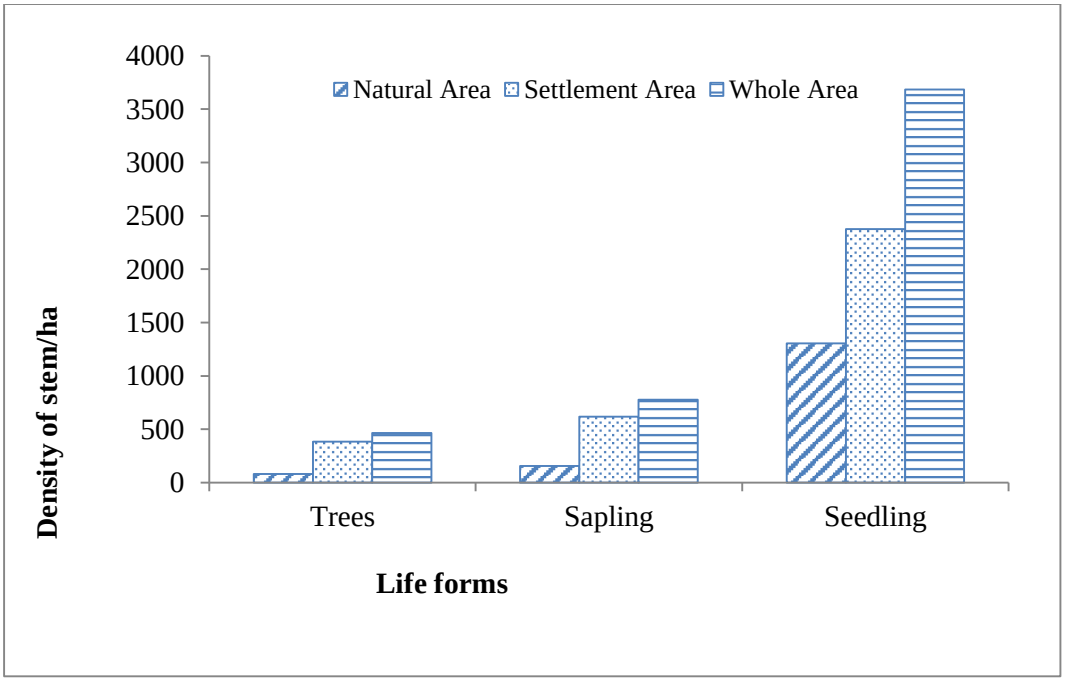

Figure 4.8: Regeneration status of *Shorea robusta* at Jaljala Community forest

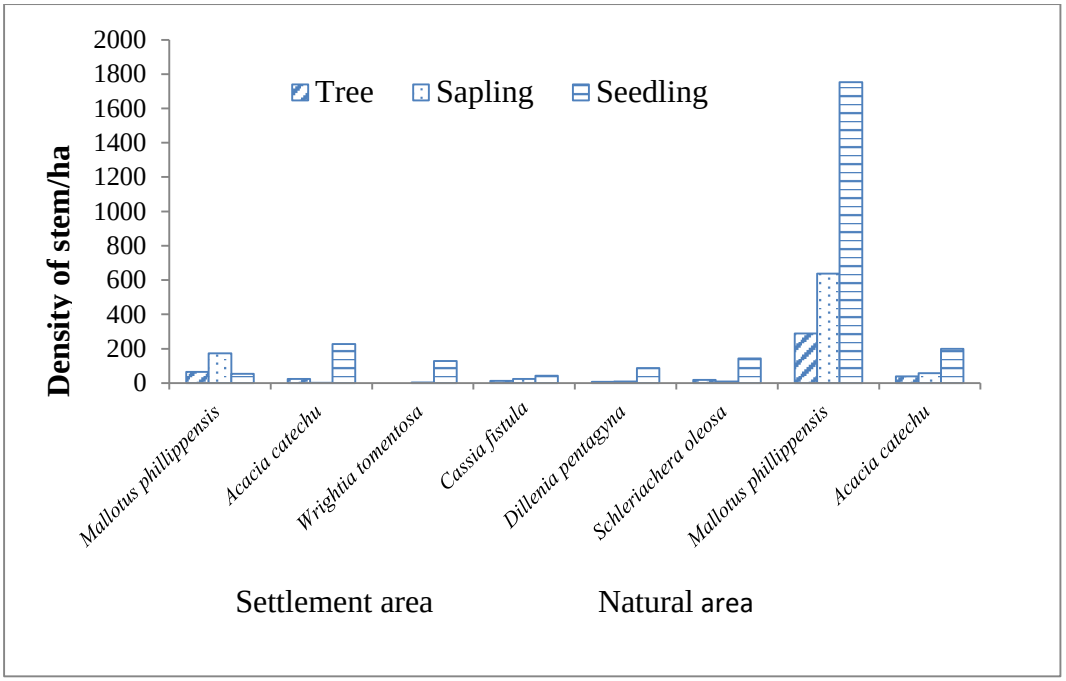

Figure 4.9: Regeneration status of co-dominant species of settlement and natural area forest in Jaljala Community Forest.

4.2.3.1 Main dominant plant species of trees, sapling and seedling of TCF

In Taradevi community forest (TCF), the total density of tree, sapling and seedling of all species in setttlement area were 1373 stem/ha, 2517 stem/ha, 7990 stem/ha respectively whereas in natural area tree, sapling and seedling were found to be 885 stem/ha, 396 stem/ha, 8173 stem/stem (Figure 4.4). The density of tree, sapling and seedling *Shorea robusta* were found to be higher than other associated species in both settlement and natural areas (Figure 4.5)**.** Similarly, the density of tree, sapling and seedling of co-dominated associated species *Mallotus phillippensis* (88 stem/ha, 362 stem/ha, 1878 stem/ha), *Syzygium cumini* (18 stem/ha, 30 stem/ha, 228 stem/ha) in residential area whereas density (tree, sapling and seedling of co-dominated associated species *Mallotus phillippensis* (40 stem/ha, 111stem/ha, 838 stem/ha), *Dillenia pentagyna* (25 stem/ha, 20 stem/ha, 318 stem/ha) were found in natural areas (Figure 4.6).

4.2.3.2 Main dominant plant species of trees, sapling and seedling of JCF

In Jaljala community forest (JCF), the total density of tree, sapling and seedling of all species in settlement area were 1387 stem/ha, 1807stem/ha, 6965 stem/ha respectively whereas in natural area tree, sapling and seedling were found to be 562 stem/ha, 533

stem/ha, 3603 stem/stem (Figure 4.7). The density of tree, sapling and seedling *Shorea robusta* were found to be higher than other associated species in both settlement and natural areas (Figure 4.8).. Similarly, the density of tree, sapling and seedling of co-dominated associated species *Mallotus phillippensis* (288 stem/ha, 638 stem/ha, 1753 stem/ha), *Diospyros lanccifolia* (43 stem/ha, 30 stem/ha, 172 stem/ha), *Acacia catechu* (38stem/ha, 58stem/ha, 200 stem/ha) in settlement area whereas density (tree, sapling and seedling of co-dominated associated species *Mallotus phillippensis* (65 stem/ha, 173 stem/ha, 540 stem/ha), *Acacia catechu* (23 stem/ha, 2 stem/ha, 53 stem/ha) were found in natural areas (Figure 4.9)

4.2.4. Density Diameter Relationship

In TCF, density of DBH class 10-15 cm was found to be highest in natural areas followed by 15-20 cm and 20-25 cm was the lowest density of DBH class is 30-35 (Figure 4.10). Similarly, the density of DBH class10-15 cm was found to be highest in settlement areas followed by 20-25 cm and 15-20 cm and the lowest density of DBH class is 30-35 (Appendix 3).

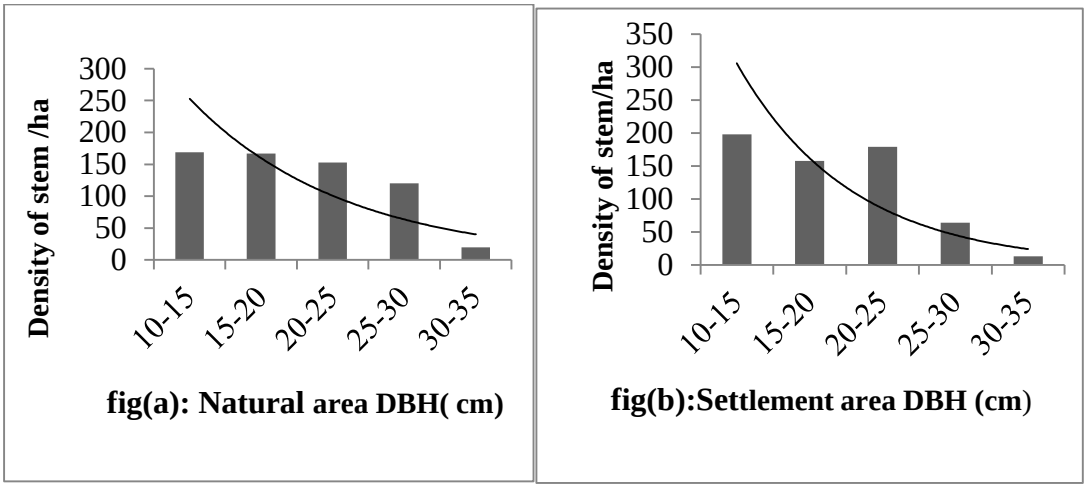

Figure 4.10: Density diameter relationships of trees in Taradevi community forest

In JCF, density of DBH class 10-15 cm was found to be highest in natural areas followed by 20-25 cm and 15-20 cm and the lowest density of DBH class is 30-35 cm (Figure 4.11). Similarly the density of DBH class10-15 cm was found to be highest in settlement areas followed by 15-20 cm and the lowest density of DBH class is 30-35cm.

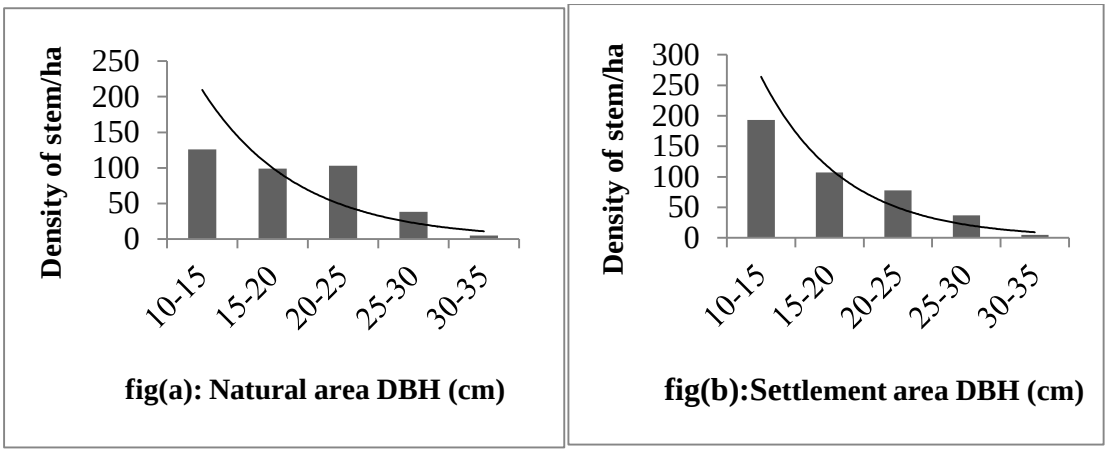

Figure 4.11: Density diameter relationship of trees in Jaljala community forest

CHAPTER 5: DISCUSSION

5.1. Community Structure and Regeneration

The understanding of the community structure and regeneration dynamics is important for the effective forest management and conservation. Natural regeneration of plant species plays significant role for the sustainable management of tropical forests (Medjibe *et al.,* 2014). The IVI of any species illustrates the dominance of the species in a mixed population of any forests. The present study showed that the *Imperata cylindrica* was the most dominant herb in the natural where as *Achyranthus aspera* was dominant in settlement area of both the community forest. The reason be in dominant to the buffer zone due to high tolerance capoacity of of different soil conditions (Ahmad *et al.,* 2020). Similarly, it can adopt poor nutrient soils, dry soils and genetic adaptation to fire (Hozmueller and Jose, 2012) and favourable environment created by human activities. But the distribution of other plant species like *Ophioglossum, Degetaria* and *Tinospora cordifolia* plant species were found less in natural site, which might be to lack of disturbance and mobility. In similar research *Eragrostis cyanosuroides, Cyperus rotundus* and *Eulaliopsis binnata* were reported with higher IVI in forest of Banke National Park and found that due to favourable climatic conditions, biogeography, habitat, soil and p^H and other several factors that causes the diversity of herbs (Napit, 2015).

Among the shrub, *Clerodendrom viscosum* was found the most dominant shrub followed by *Urena lobata* and *Murrya Koenigii* in both site of both JCF and TCF due to favourable conditions like warm and humid near by rivers and pollinators and other insects (Gokula *et al*. 201). *Clerodendrom viscosum* was reported shrub with highest IVI in Shankarnagar community forest, Rupandehi (Dumre, 2017) and *Murrya Koenigii* also showed high IVI value at Thano forest western Nepal (Mandal *et al.,* 2014). *Cassia caranda* is less dominant species found in the settlement areas due to lo colonizial and endophytic effects (Tenguria and Firodiya, 2015).

Among the tree, Shorea robusta was the highly dominant tree species in both natural (93.9 IVI value, 42.78IVI value) and settlement (116.86 IVI value, 82.49 IVI value) of TCF as well as JCF respectively. Similar dominance of Sal tree results was also found in central low land of (Chapagain et al., 2021). Acccording to Patel *et al*. (2019) the

reason for high IVI value of *Shorea robusta* as compared to other trees because long lived trees have ability to tolerate the environmental competition. High IVI value of a species indicates its dominance and ecological success in the community due to its good successful regeneration and ability to compete with other species (Naima *et al*, 2018). It indicates that the *Shorea robusta* was the most important and highly dominant tree species in Taradevi and Jaljala community forest.

Based on high IVI values other tree species next to *Shorea robusta* was *Mallotus phillippensis* in settlement area of both community forest which might be due to the excellent their density, biomass, seed dispersal capacity, good power of regeneration and higher ecological amplitude (Tripathi *et al*., 2017). Similar kind of dominance was also observed in community managed tropical forest in Nawalparasi, Nepla (Pathak and Baniya, 2017). *Lagerstroemia parviflra* and *Termanilia alata* were dominant in both natural of both community forests because the people are not allowed to use plants as fodder to their livestock due to frequent monitoring of foredt by BZUC and might be due to succession, climate, stability and primary productivity (Rahbek, 2005; Singh and Rawat, 2012). The high frequency of *Shorea robusta* reveled by Bhadra *et al.*, (2010) associated with *Lagerstroemia parviflra* and *Termanilia alata* at Janahit Mahakali community forest of Kanchanpur. The present study showed that Shannon-Wiener diversity index and Simpson's diversity index value was higher for herbs and shrubs than tree. The Simpson's diversity index was similar in both settlement and natural areas for herbs, shrub and trees in TCF and JCF whereas Shannon-Wiener diversity index was higher in JCF as compared to TCF. The diversity of herbs and shrubs was larger than that of trees, which may be because the diversity of trees can influence the diversity of herbs by changing resource availability and environmental factors important to plants in the herb layer (Beatty, 2003; Barbier et al., 2008). Similar results were reported by Niroula (2004) and Basyal (2011) in community forest of Ilam, Chitwan and Palpa respectively. Li *et al*.,(2018) also investigated the different life form of herbs and shrubs of tropical forest in South west China and found that herbs and shrubs have high diversity value over trees due to faster growth rates and short life spans and can colonize easily in disturbed and open areas.

In TCF, the Simpson's diversity index was found to be higher at natural area for herbs and shrubs but lower for treess. Similarly Shannon Wiener diversity index was noted greater in natural area for herbs and shrubs but lower for trees. The result showed that

the diversity of herbs, shrubs and trees was higher which is quite similar to the result of Vockenhuber et al., (2011). This similar pattern was shown of herbs and shrubs as dominant had reported by the Paul (2008). However the persent study shows the lower value compared to the (Unyial, 2010). However the better species richness of herbs and shrubs might be the open canopy. The similarity index was found higher in trees followed shrubs between JCF and TCF. Similar findings were estimated in studied at tropical wet evergreen forests National Park northern India (Arunachalam *et al*., 2003). The difference in similarities between the settement and natural area sections of JCF and TCF suggests that there have been changes in the species richness due to disturbances that have changed the microenvironment and influence on the composition of understory plant communities providing shade.

The density of seedling and sapling was found higher in settlement areas which are possibly due to less removal of bedding herbs (Poudyal *et al*., 2017) and caring practices of user groups and than at natural areas in both TCF and JCF. This result is consistent with findings of Sapkota et al., (2009). In comparison to to the trees both community forest of settlement areas found relatively less no of trees than natural area of TCF. But at TCF of natural area is comparatively high than natural area of JCF. Besides this the regeneration was also reported to be better at natural areas as there are no agricultural activities (Londo *et al.,* 2020). This might be the more demand of trees to access the fodder for their livestocks and construction purposes. Similar findings were reported by Gautam et al., (2016) and Chapagain et al., (2021). The regeneration of *S. robusta, Mallotus phillippensis* and *Syzygium cumini* were found higher as compared to other tree species at settlement areas whereas at natural area regeneration of *S. robusta, Mallotus phillippensis* and *Dillenia pentagyna* at TCF. However, *S. robusta* seedling, sapling and tree was highest than other tree species. Similar result of regeneration was found in woodyplants in tropical dry deciduous forest Singh (2011). Similarly, among trees *S. robusta* seedling, sapling and tree were highest. *S. robusta* was found to be the dominant species, which is similar to the findings of the Terai forest inventory during 2010−2012 (DFRS, 2015). The regeneration was affected by many factors such as species richness, canopy cover, soil p^H and nitrogen (Bhatta and Devkota, 2020). According to Johnson *et al*., (2016) *S. robusta* has capacity to produce high no of seeds per plant, have high germination rate, reproductive potential and can colonize easily in stressful areas as well (Boussouka *et al*., 2020). The canopy cover is

the primary criteria for determining the condition of forest regeneration allows enough light to penetrate the forest understory and creates a dry, light environment that is ideal for the plentiful growth of *Shorea robusta* seedlings and saplings. *S. robusta* beimg light loving plant (Champion and Seth, 1968; Kayastha, 1985) , presence of a warm, humid environment in the research area was a major factor in the highest being dominant species The temperature of the ground, which speeds up the decomposition of litter (Sapkota et al., 2009), created favorable conditions for enhanced regeneration. The high dominance of *S. robusta* in community forest was 36 also reported by Poudel (2000), Poudel and Shah (2015).

Regeneration status of forest is said to be good if forest has seedling > 5000 per hectare and sapling > 2000 per hectare (DOF, 2004). We may conclude that these forests seedling regeneration potential is good and satisfactory in both settlement and natural areas since the density of RCF seedlings is comparable to the abovementioned criteria. The density of saplings, however, is lower than the criteria mentioned above, which may be because all seedlings are unable to withstand extreme environment and compete with other herbaceous plants. Similarly, low sapling in natural areas is due to the need of arable land and livestock farming near by people living near that place. The other reason may be looping of other forest components and might be due to dependent of population for fodder for their livestock in comparison to settlement area. Similar findings in the regeneration of Shorea robusta in the Palpa district were reported by Basyal et al. (2011). The distribution of trees during girth classes reflects how efficiently the growing forest will utilize its resources (Naidu and Kumar, 2016). Due to high seedling densities and competition from other herbaceous plants, the density of sapling is lower than it should be. (Naidu and Kumar, 2016) also discussed how the use of resources caused differences in plant thickness. The plant's low density may be the result of livestock owners removing tree branches for fodder. The distribution of trees across different diameter classes reflects how effectively the expanding forest is utilizing its resources.

The DBH size class distribution diagram in this study demonstrated that some species may be better suited to utilize resources and expanding in the forest environment (Sristi and Sukkhi, 2018). Soil, moisture, and light availability all have an impact on plant species diversity and the DBH relationship (Nahamasu *et al*., 2016). In this study, the size class distribution diagram showed that the density of smaller diameter was higher

than the density of large diameter indicating the reverse J-shaped structure in both site of two community forests. The forest user group's prohibition on cutting small trees may be the reason for the higher stem density in the smaller diameter classes, while the removal of old, large-sized trees for various uses, including the construction of homes and furniture, may be the reason for the lower stem density in the larger diameter classes.Similar results were previously reported by Sapkota et al. (2009) and Sarkar and Devi (2014). Sustainable regeneration is shown by a reverse J-shaped curve (Vetaas, 2000). The higher density of trees with smaller diameter classes than those with larger diameter classes also indicates that the forest is in a sustainable, stable, and good regeneration state Manna and Mishra (2017).

CHAPTER: 6 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

This study's findings support the conclusion that the TCF and JCF buffer zone regions exhibitexcellent biodiversity and are well-maintained. In both the settlement and natural areas of the community forests of Jaljala and Taradevi, *Shorea robusta* was the most prevalent tree species, demonstrating the diversity of species. In settlement area of buffer zone in JCF and TCF, the species diversity was in the right order and was almost identical. In both of the community forests in the buffer zone, the potential for forest regeneration is in the proper sequence. Sal was the dominant species in the study forest therefore it produced more seedlings, saplings, and trees than other related species. Since the research area shows reversed J-shape, the regeneration is in the proper order. Due to the nearby area's rapid population expansion, more fuel, timber, and fodder are being used. Despite the fact that this study provides a clearer image of the forest structrure and regeneration at the buffer zone community forest of Banke National Park which still has to be improved.

6.2 RECOMMENDATIONS

Following are the recommended from the present study for the betterment and management of community Forests

- Inadequate practices for the preservation and protection of plants species in setttlementl areas of forests are not adequate hence buffer zone authorities need to increase capacity and presence of law near settlement areas.
- Environmental conservation educational porogramm should be launched near by community without discrimination.
- Transparency should be maintained among the users group.
- No better ethnobotanical study and resource use patterns of the forest, invasive species are not studied and unkown.

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APPENDICES

Appendix 1. IVI value of herbs, shrubs and trees at both JCF and TCF

Jaljala community forest		**Natural area**	**Herbs**				
SN	**Local Names**	**Botanical Names**	**Family**	**R.F (%)**	**RD %**	**R.C (%)**	**IVI**
1	Siru	*Imperata cylindrica*	Poaceae	9.03	11.39	18.45	38.87
2		*Evolvus nummularius*	Convolvaceae	9.36	9.74	7.50	26.61
3		*Crysopogon fulvus*	Poaceae	8.03	6.83	11.11	25.97
4	Dubo	*Cynodon dactylon*	Poaceae	8.70	8.48	8.36	25.53
5		*Elephantopus scaber L*	Asteraceae	8.70	11.26	5.23	25.19
6	Datuwan	*Achyranthus aspera*	Amaranthaceae	8.03	8.23	6.36	22.62
7		*Eragrostis cyanosuroides*	Poaceae	5.35	9.36	3.94	18.65
8		*Cyperus cyperoides*	Compositate	7.02	4.81	6.42	18.25
9	Chari amilo	*Oxalis corniculata*	Oxalidaceae	5.69	6.07	3.51	15.27
10		*Eragrostis tenella*	Poaceae	4.35	3.80	3.72	11.87
11		*Melinis minutiflora*	Poaceae	3.01	3.29	4.10	10.40
12	Amriso	*Thysanolaena maxima*	Poaceae	3.01	2.02	4.85	9.89
13	Thakal	*Phoenix loureiri var humilis*	Palmaceae	3.68	2.15	1.56	7.39
14		*Achyranthus bidentata*	Amaranthaceae	2.34	1.27	0.97	4.58
15	Munja	*Phragmites karka (Retz.)*	Poaceae	1.34	1.01	1.67	4.02
16	Babiyo	*Eulaliopsis binnata*	Poaceae	1.34	1.01	1.62	3.97
17	Kalo kuro	*Bidens pilosa*	Compositate	1.00	0.76	2.10	3.87
18	Chyo phool	*Plumera rubra*	Apocynaceae	1.00	0.76	1.67	3.43

19		*Tracheospermum lucidum*	Apocynaceae	1.34	1.14	0.81	3.29
20	Mothe	*Cypressus rotundus*	Compositate	1.34	1.01	0.86	3.21
21		*Microstegium vimineum*	Poaceae	0.67	1.27	1.13	3.07
22		*Ageratum hostonianum*	Asteraceae	0.67	1.39	0.54	2.60
23		*Capillipedium assimile*	Poaceae	1.00	0.63	0.59	2.23
24		*Cyperus fibrystils L.*	Cyperaceae	0.67	0.51	1.02	2.20
25		*Dipsacus mitis*	Dipsacaceae	0.67	0.38	0.27	1.32
26		*Ipomea fistulosa*	Convolvaceae	0.67	0.25	0.32	1.25
27	Ghod tapre	*Centella asiatica L.*	Apiaceae	0.33	0.38	0.38	1.09
28		*Commelina benghalensis*	Commelinaceae	0.33	0.25	0.38	0.97
29		*Vetiveria zizanioides*	Poaceae	0.33	0.13	0.16	0.62
30		*Cynotis cristata*	Commelinaceae	0.33	0.13	0.16	0.62
31		*Dandelion sp.*	Asteraceae	0.33	0.13	0.11	0.57
32		*Heteropogon contortus L.*	Poaceae	0.33	0.13	0.11	0.57

Taradevi community forest settlement site				**Herbs**			
SN	**Local Names**	**Botanical Names**	**Herbs**	**R.F (%)**	**R.D (%)**	**R.C (%)**	**IVI**
1	Siru	*Imperata cylindrica*	Poaceae	16.53	36.13	36.13	88.80
2	Datuwan	*Achyranthus aspera*	Amaranthaceae	16.53	27.03	27.03	70.59
3		*Elephantopus scaber L*	Asteraceae	12.40	7.76	7.76	27.92
4		*Eragrostis cyanosuroides*	Poaceae	12.40	4.87	4.87	22.14
5		*Ageratuum houstoniaum*	Asteraceae	8.26	5.97	5.97	20.20
6	Bhere dubo	*Evolvus nummularius*	Convolvaceae	7.44	4.75	4.75	16.94
7	Chari amilo	*Oxalis corniculata*	Oxalidaceae	7.02	2.04	2.04	11.10

8	Munja	*Phragmites karka (Retz.)*	Poaceae	2.07	3.59	3.59	9.25
9	Dubo	*Cynodon dactylon*	Poaceae	4.55	1.61	1.61	7.77
10		*Ipomea fistulosa*	Convolvaceae	1.24	1.92	1.92	5.08
11	Mothe	*Cypressus rotundus*	Compositate	2.07	1.34	1.34	4.74
12		*Cyperus cyperoides*	Compositate	2.48	0.79	0.79	4.06
13		*Ophioglossum sp*	Ophioglossaceae	1.65	0.52	0.52	2.69
14		*Eragrostis tenella*	Poaceae	1.65	0.46	0.46	2.57
15	Thakal	*Phoenix loureiri var humilis*	Palmaceae	1.24	0.37	0.37	1.97
16		*Melinis minutiflora*	Poaceae	0.83	0.49	0.49	1.80
17		*Achyranthus bidentata*	Amaranthaceae	0.83	0.15	0.15	1.13
18		*Acmella sp.*	Asteraceae	0.41	0.15	0.15	0.72
19		*Heteropogon contortus L.*	Poaceae	0.41	0.06	0.06	0.53

Taradevi community forest natural site			**Herbs**				
SN	**Local Names**	**Botanical Names**		**R.F (%)**	**R.D (%)**	**R.C (%)**	**IVI**
1	Siru	*Imperata cylindrical*	Poaceae	22.98	49.82	45.93	118.74
2		*Acmella ciliate*	Asteraceae	6.21	10.05	9.99	26.26
3		*Eragrostis cyanosuroides*	Poaceae	11.80	5.89	5.70	23.38
4		*Eragrostis tenella*	Poaceae	7.45	5.74	6.21	19.41
5	Bhere dubo	*Evolvus nummularius*	Convolvaceae	5.59	6.25	7.17	19.01
6	Datuwan	*Achyranthus aspera*	Amaranthaceae	3.73	2.23	3.50	9.45
7	Chari amilo	*Oxalis corniculata*	Oxalidaceae	3.11	2.80	2.87	8.78
8		*Panicum maximum*	Poaceae	2.48	1.72	2.38	6.59
9		*Crtalaria prostate*	Fabaceae	3.73	1.01	0.80	5.53

10		*Elephantopus scaber L.*	Asteraceae	2.48	1.01	1.19	4.68
11	Bhende kuro	*Barleria cristata*	Acanthaceae	1.86	1.08	1.55	4.49
12		*Crysopogon fulvus*	Poaceae	1.86	1.36	1.14	4.37
13		*Ophioglossum sp.*	Ophioglossaceae	3.11	0.65	0.57	4.32
14	Dakhle khar	*Apluda mutica*	Poaceae	1.86	1.29	1.06	4.22
15	Ukuche jhar	*Rungia pectinata*	Acanthaceae	1.86	0.72	1.32	3.90
16		*Ageratum houstoniaum*	Asteraceae	1.24	1.72	0.31	3.28
17	Dubo	*Cynodon dactylon*	Poaceae	1.24	1.08	0.73	3.04
18	Thakal	*Phoenix loureiri var humilis*	Palmaceae	1.86	0.50	0.65	3.01
19	Sarpa makai	*Arisaema sp.*	Araceae	0.62	0.86	0.93	2.41
20	Mothe	*Cypressus rotundus*	Compositate	1.24	0.36	0.80	2.40
21		*Ruellia beddomei L.*	Acanthaceae	1.24	0.50	0.57	2.31
22		*Heteropogon contortus L.*	Poaceae	0.62	0.50	1.04	2.16
23		*Heteropogon sp .*	Poaceae	1.24	0.50	0.39	2.13
24	Banmara	*Parthenium hysterophorus*	Asteraceae	0.62	0.29	0.31	1.22
25		*Capillipedium assimile*	Poaceae	0.62	0.29	0.26	1.17
26	Titepati	*Artimisia indica*	Asteraceae	0.62	0.14	0.28	1.05
27		*Euphorbia hrita*	Euphorbiaceae	0.62	0.07	0.34	1.03
28	Babiyo	*Eulaliopsis binnata*	Poaceae	0.62	0.14	0.26	1.02
29	Batule paat	*Cissampelos pareira*	Menispermaceae	0.62	0.22	0.18	1.02
30	Banso	*Degetaria sp*	Poaceae	0.62	0.22	0.16	0.99
31		*Melinis minutiflora*	Poaceae	0.62	0.14	0.21	0.97
32		*Tinospora cordifolia*	Menispermaceae	0.62	0.14	0.13	0.89
33		*Commelina benghalensis*	Commelinaceae	0.62	0.07	0.10	0.80
34		*Dipsacus mitis*	Dipsacaceae	0.62	0.07	0.08	0.77

SN	***Jaljala settlement buffer Zone(***		**Plants family**	**Shrubs**			
	Local Names	*Botanical Names*		R.F (%)	R.D (%)	RA %	IVI
1	*Titepati*	*Clerodendrum viscosum*	Lamiaceae	5.49	18.51	8.95	32.95
2	*Nalu kuro*	*Urena lobata*	Malvaceae	6.17	13.82	5.94	25.93
3		*Ageratina adenophora*	Asteraceae	5.21	8.39	4.27	17.88
4		*Hyptis suaveolens*	Lamiaceae	0.41	1.85	11.95	14.21
5	*Dabare*	*Flemingia macrophylla*	Fabaceae	4.39	4.89	2.96	12.23
6		*Calotropis gigantea*	Apocynaceae	4.25	4.11	2.56	10.92
7	*Khunkhune*	*Flemingia strobilifera*	Fabaceae	4.94	3.24	1.74	9.92
8	*Biskapre/Dalle kuro*	*Sida cordata*	Malvaceae	5.08	3.04	1.63	9.74
9		*Xanthium stramarium*	Asteraceae	3.57	3.46	2.57	9.60
10		*Sonanum torvum*	Solanaceae	4.39	3.24	1.96	9.58
11		*Niloful**	Acanthaceae	1.92	3.01	4.16	9.10
12		*Desmodium heterocarpon*	Fabaceae	1.65	2.70	4.35	8.70
13		*Reinwardtia indica*	Linaceae	3.70	2.72	1.95	8.38
14		*Chhitaina**	Fabaceae	3.84	2.48	1.71	8.03
15	*Murraya/ Asare*	*Murraya koenigii*	Rutaceae	2.88	2.68	2.47	8.03
16		*Phyllanthus parvifolius*	Euphorbiaceae	3.70	2.43	1.74	7.88
17		*Desmodium sp.*	Fabaceae	3.70	3.64	0.43	7.77
18	*Maainn*	*Xeromphis spinosa*	Rubiaceae	4.53	1.72	1.01	7.25
19		*Sida spinosa*	Malvaceae	3.57	1.79	1.33	6.68

20		*Caryopteris foetidia*	Verbenaceae	2.88	1.74	1.60	6.23
21		*Costu speciosus*	Costaceae	2.33	1.38	1.58	5.29
22		*Phlogacanthus thyrsiformis*	Acanthaceae	1.37	1.14	2.20	4.71
23		*Holarrhena pubescens*	Apocynaceae	2.74	0.96	0.93	4.63
24		*Lantana camara*	Verbenaceae	1.65	1.05	1.69	4.39
25		*Caryopteris foetidia*	Verbenaceae	0.14	0.20	3.89	4.22
26		*Rubus ellipticus*	Rosaceae	1.78	0.76	1.13	3.67
27		*Catunaregam spinosa*	Rubiaceae	0.96	0.67	1.85	3.48
28	*Rani dhangreo*	*Woodfordia fructicosa*	Lythraceae	2.06	0.60	0.78	3.44
29		*Ziziphus jujube*	Rhamnaceae	1.10	0.49	1.19	2.78
30		*Triumfetta rhomboida*	Fabaceae	0.41	0.31	2.02	2.74
31		*Smilax zeylanica*	Smilaceae	1.23	0.45	0.96	2.64
32		*Sida cordifolia*	Malvaceae	0.96	0.45	1.23	2.64
33		*Cyclea species*	Menispermaceae	0.82	0.38	1.22	2.43
34		*Indigofera pulchella*	Fabaceae	0.14	0.09	1.73	1.95
35		*Parulo**	Fabaceae	0.96	0.25	0.68	1.88
36	*Banmara*	*Eupatorium odoratum*	Asteraceae	0.82	0.25	0.79	1.86
37		*Thespesia lampas*	Malvaceae	0.14	0.07	1.30	1.50
38	*Pharsa*	*Grewa sapida*	Malvaceae	0.27	0.11	1.08	1.47
39		*Datura stramonium*	Solanaceae	0.69	0.16	0.60	1.45
40	*Thakal*	*Phoenix aquilis*	Palmaceae	0.69	0.13	0.52	1.34
41	*Rudelo*	*Pogostemon benghalensis*	Lamiaceae	0.27	0.09	0.86	1.23
42		*Ardisia macrocarpa*	Primulaceae	0.27	0.09	0.86	1.23
43		*Typha latifolia*	Typhaceae	0.27	0.09	0.86	1.23

44	*Ander*	*Ricinus communis*	Euphorbiaceae	0.14	0.04	0.86	1.05
45		*Carissa caranda*	Apocynaceae	0.27	0.07	0.65	0.99
46	*Karauti*	*Carissa spinarum*	Apocynaceae	0.27	0.07	0.65	0.99
47		*Desmodium gangeticum*	Fabaceae	0.27	0.07	0.65	0.99
48		*Cayratia trifolia*	Vitaceae	0.27	0.07	0.65	0.99
49		*Ziziphus rugosa*	Rhamnaceae	0.14	0.02	0.43	0.59
50		*Hellicteres isora*	Malvaceae	0.14	0.02	0.43	0.59
51		*Osyris wightiana*	Santalaceae	0.14	0.02	0.43	0.59

Taradevi community forest settlement site		**Shrubs**					
SN	**Local Names**	**Botanical Names**	**Plants family name**	**RF%**	**RD %**	**RA(%)**	**IVI**
1	Titepati	*Clerodendrum viscosum*	Lamiaceae	6.52	22.77	11.00	40.30
2	Nalu kuro	*Urena lobata*	Malvaceae	6.99	19.04	8.59	34.61
3	Murraya/ Asare	*Murraya koenigii*	Rutaceae	5.59	8.30	4.68	18.57
4		*Catunaregam spinosa*	Rubiaceae	5.28	6.87	4.10	16.25
5		*Sida spinosa*	Malvaceae	4.81	6.40	4.19	15.41
6	Rani dhangreo	*Woodfordia fructicosa*	Lythraceae	0.78	2.67	10.83	14.27
7	Dabare	*Flemingia macrophylla*	Fabaceae	5.43	3.86	2.24	11.54
8		*Reinwardtia indica*	Linaceae	5.43	3.84	2.23	11.50
9		*Calotropis gigantea*	Apocynaceae	5.75	3.63	1.99	11.36
10		*Triumfetta rhomboidea*	Malvaceae	5.28	3.18	1.90	10.36

11		*Rubus ellipticus*	Rosaceae	5.12	2.52	1.55	9.19
12	Thakal	*Phoenix aquilis*	Palmaceae	4.19	2.22	1.67	8.08
13	Biskapre/ Dalle kuro	*Sida cordata*	Malvaceae	4.35	1.92	1.39	7.66
14	Khunkhu ne	*Flemingia strobilifera*	Fabaceae	3.26	1.47	1.42	6.16
15		*Lantana camara*	Verbenaceae	3.26	1.15	1.11	5.53
16		*Phlogacanthus thyrsiformis*	Acanthaceae	0.78	0.85	3.47	5.10
17	Galeni	*Leea asiatica*	Leeaceae	3.11	0.94	0.95	5.00
18		*Ardisia macrocarpa*	Primulaceae	1.86	0.85	1.44	4.16
19	Tapre/Ch hakun	*Cassia tora*	Fabaceae	0.62	0.58	2.92	4.12
20		*Sonanum torvum*	Solanaceae	2.17	0.66	0.96	3.79
21		*Ziziphus jujube*	Rhamnaceae	0.16	0.17	3.47	3.79
22		*Ficus hederaceae*	Moraceae	1.40	0.70	1.59	3.69
23		*Ipomea quamoclit*	Convolvulace ae	0.16	0.15	3.03	3.34
24		*Thespesia lampas*	Malvaceae	1.40	0.55	1.25	3.20
25		*Acacia nilotica*	Fabaceae	2.02	0.43	0.67	3.11
26	Bhate seti/Dhus ure	*Colebrookea oppositifolia*	Lamiaceae	1.55	0.51	1.04	3.10
27		*Xanthium stramarium*	Asteraceae	1.09	0.43	1.24	2.75
28		*Chhitaina**	Fabaceae	1.40	0.41	0.91	2.72
29		*Phyllanthus parvifolius*	Euphorbiaceae	1.24	0.38	0.97	2.60
30		*Holarrhena pubescens*	Apocynaceae	1.40	0.36	0.82	2.58

31	Dalle Kuro	*Sida cordifolia*	Malvaceae	0.93	0.36	1.23	2.52
32		*Duranta erecta*	Verbenaceae	1.09	0.36	1.05	2.50
33		*Parthenium hysterophorus*	Aseteraceae	0.31	0.19	1.95	2.45
34	Dahicha mle	*Callicarpa macrophyllum*	Verbenaceae	0.16	0.11	2.17	2.43
35	Rudelo	*Pogostemon benghalensis*	Lamiaceae	0.78	0.21	0.87	1.86
36		*Parulo**	Fabaceae	0.78	0.21	0.87	1.86
37	Sajiwan	*Jatropa curcas*	Euphorbiaceae	0.47	0.15	1.01	1.63
38	Asuro	*Justicia adhatoda*	Acanthaceae	0.16	0.06	1.30	1.52
39		Desmodium heterocarpon	Fabaceae	0.78	0.13	0.52	1.42
40		*Ageratina adenophora*	Asteraceae	0.31	0.09	0.87	1.26
41		*Cyclea species*	Menispermaceae	0.16	0.04	0.87	1.06
42		*Curcuma zedoaria*	Zingiberaceae	0.31	0.06	0.65	1.02
43		*Ziziphus rugosa*	Rhmanaceae	0.31	0.04	0.43	0.79
44	Besram	*Ipomea carnea*	Convolvulaceae	0.31	0.04	0.43	0.79
45	Pharsa	*Grewa sapida*	Malvaceae	0.16	0.02	0.43	0.61
46		*Hellicteres isora*	Malvaceae	0.16	0.02	0.43	0.61
47		*Carissa caranda*	Apocynaceae	0.16	0.02	0.43	0.61
48		*Hedychium gardnerianum*	Zingiberaceae	0.16	0.02	0.43	0.61
49		*Boerhavia diffusa*	Nyctaginaceae	0.16	0.02	0.43	0.61

Taradevi community forest natural site			Shrubs				
SN	**Local Names**	**Botanical Names**	**Plants family name**	**R.F (%)**	**R.D (%)**	**RA (%)**	**IVI**
1	Titepati	*Clerodendrum viscosum*	Lamiaceae	6.48	22.50	11.58	40.56
2		*Rubus ellipticus*	Rosaceae	5.26	14.42	9.14	28.82
3	Murraya/ Asare	*Murraya koenigii*	Rutaceae	8.70	8.13	3.12	19.96
4	Nalu kuro	*Urena lobata*	Malvaceae	5.47	7.24	4.42	17.12
5		*Sida spinosa*	Malvaceae	5.87	6.45	3.67	15.99
6		*Triumfetta rhomboidea*	Malvaceae	7.29	3.73	1.71	12.73
7		*Boerhavia diffusa*	Nyctaginaceae	3.04	4.60	5.05	12.69
8		*Catunaregam spinosa*	Rubiaceae	5.06	4.10	2.70	11.86
9	Khunkhune	*Flemingia strobilifera*	Fabaceae	5.47	3.67	2.24	11.38
10		*Calotropis gigantean*	Apocynaceae	4.86	3.62	2.48	10.96
11	Thakal	*Phoenix aquilis*	Palmaceae	6.07	2.95	1.62	10.64
12	Dabare	*Flemingia macrophylla*	Fabaceae	3.64	3.17	2.90	9.72
13		*Sonanum torvum*	Solanaceae	3.85	1.88	1.63	7.36
14	Biskapre/Dalle kuro	*Sida cordata*	Malvaceae	2.23	1.74	2.61	6.57
15		*Thespesia lampas*	Malvaceae	1.62	1.51	3.12	6.25
16		*Sambucus hookeri*	Sambucaceae	0.81	1.01	4.16	5.98
17	Galeni	*Leea asiatica*	Leeaceae	3.64	1.04	0.95	5.63
18		*Lantana camara*	Verbenaceae	1.82	1.26	2.31	5.40
19		*Niloful**	Acanthaceae	2.43	0.81	1.12	4.36
20		*Chrozophora rottleri*	Euphorbiaceae	0.20	0.22	3.70	4.12
21		*Reinwardtia indica*	Linaceae	1.82	0.79	1.44	4.05
22		*Ardisia macrocarpa*	Primulaceae	1.42	0.67	1.58	3.67
23		*Xanthium stramarium*	Asteraceae	0.81	0.50	2.08	3.39

24		*Cyclea species*	Menispermaceae	1.62	0.53	1.10	3.25
25		*Clerodendrum indicum*	Lamiaceae	0.40	0.28	2.31	3.00
26		*Ziziphus rugosa*	Rhmanaceae	1.82	0.39	0.72	2.93
27		*Jassminium grandiflorium*	Verbenaceae	0.40	0.25	2.08	2.74
28	Rudelo	*Pogostemon benghalensis*	Lamiaceae	1.01	0.39	1.29	2.70
29		*Hedychium gardnerianum*	Zingiberaceae	0.81	0.36	1.50	2.68
30		*Phlogacanthus thyrsiformis*	Acanthaceae	0.61	0.31	1.69	2.61
31		*Duranta erecta*	Verbenaceae	1.62	0.28	0.58	2.48
32	Desmodium	*Desmodium heteropogon*	Fabaceae	0.40	0.20	1.62	2.22
33		*Heynea trijuga*	Meliaceae	0.20	0.11	1.85	2.16
34		*Ziziphus jujube*	Rhamnaceae	0.40	0.14	1.16	1.70
35		*Annona squamosal*	Annonaceae	0.61	0.17	0.92	1.70
36		*Desmodium sp.*	Fabaceae	0.20	0.08	1.39	1.67
37	Pharsa	*Grewa sapida*	Malvaceae	0.40	0.11	0.92	1.44
38		*Holarrhena pubescens*	Apocynaceae	0.20	0.06	0.92	1.18
39		*Parulo**	Fabaceae	0.20	0.06	0.92	1.18
40		*Hyptis suaveolens*	Lamiaceae	0.20	0.06	0.92	1.18
41		*Caryopteris foetidia*	Verbenaceae	0.20	0.06	0.92	1.18
42		*Cissampelos pareira*	Menispermeaceae	0.20	0.06	0.92	1.18
43	Tapre/Chhakun	*Cassia tora*	Fabaceae	0.40	0.06	0.46	0.92
44	Kurilo	*Asparagus racemose*	Asparagaceae	0.20	0.03	0.46	0.69

Taradevi Natural buffer Zone			Trees				
SN	**Local name**	**Botanical Name**	**Plants Family**	**RF%**	**RD %**	**RA %**	**IVI %**
1	Sal	*Shorea robusta*	Dipterocarpaceae	14.56	50.47	28.87	93.90
2	Botdhairo	*Lagerstroemia parviflora*	Lythraceae	10.68	7.72	6.02	24.42
3	Dabdabe	*Lannea grandis*	Anacardiaceae	9.71	6.59	5.65	21.95
4	Saj	*Terminalia alata*	Combretaceae	10.68	6.21	4.85	21.74
5	Ipil ipil	*Leucaena leucocephalia*	Fabaceae	10.68	6.21	4.85	21.74
6	Pyar	*Buchanania latifolia*	Anacardiaceae	9.71	6.40	5.49	21.61
7	Rohini	*Mallotus phillippensis*	Euphorbiaceae	5.83	4.52	6.46	16.81
8	Tantari	*Dillenia pentagyna*	Dilleniaceae	5.83	2.82	4.04	12.69
9	Bhalyo	*Semecarpus anacardium*	Anacardiaceae	4.85	2.26	3.88	10.99
10	Raibrikshya	*Cassia fistula*	Fabaceae	1.94	1.69	7.27	10.91
11	Kumbhi	*Careya arborea*	Myrtaceae	2.91	1.51	4.31	8.73
12	Tandu	*Diospyros lanccifolia*	Ebenaceae	2.91	1.32	3.77	8.00
13	Barro	*Termanilia bellirica*	Combretaceae	2.91	0.56	1.62	5.09
14	Seto Siris	*Albizia procera*	Fabaceae	0.97	0.38	3.23	4.58
15	Masala	*Eucalyptus citriodora*	Myrtaceae	0.97	0.38	3.23	4.58
16	Kusum	*Schleriachera oleosa*	Sapindaceae	1.94	0.38	1.62	3.93
17	Jamun	*Syzygium cumin*i	Myrtaceae	0.97	0.19	1.62	2.77
18	Khayer	*Acacia catechu*	Fabaceae	0.97	0.19	1.62	2.77
19	Patke Siris	*Albizia julibrissin*	Fabaceae	0.97	0.19	1.62	2.77

Taradevi community forest settlement				Trees			
SN	**Local name**	**Botanical Name**	**Plants Family**	**RF (%)**	**RD (%)**	**RA (%)**	**IVI**
1	Sal	*Shorea robusta*	Dipterocarpaceae	14.71	67.84	34.31	116.86
2	Saj	*Terminalia alata*	Combretaceae	12.75	5.10	2.97	20.82
3	Rohini	*Mallotus phillippensis*	Euphorbiaceae	6.86	6.43	6.97	20.27
4	Dabdabe	*Lannea grandis*	Anacardiaceae	10.78	3.76	2.59	17.14
5	Sissoo	*Dalbergia sissoo*	Fabaceae	0.98	1.58	11.97	14.53
6	Aamba	*Pisidium guajava*	Myrtaceae	1.96	1.58	5.98	9.52
7	Ipil ipil	*Leucaena leucocephalia*	Fabaceae	6.86	1.21	1.32	9.39
8	Botdhairo	*Lagerstroemia parviflora*	Lythraceae	4.90	1.70	2.58	9.18
9	Bel	*Aegle marmelos*	Rutaceae	1.96	1.33	5.06	8.36
10	Raibriksh ya	*Cassia fistula*	Fabaceae	2.94	1.46	3.68	8.08
11	Jamun	*Syzygium cumini*	Myrtaceae	3.92	1.33	2.53	7.79
12	Pyar	*Buchanania latifolia*	Anacardiaceae	3.92	1.09	2.07	7.09
13	Barro	*Termanilia bellirica*	Combretaceae	3.92	0.85	1.61	6.38
14	Karma	*Adina cordifolia*	Rubiaceae	3.92	0.85	1.61	6.38
15	Tandu	*Diospyros lanccifolia*	Ebenaceae	1.96	0.85	3.22	6.03
16	Harro	*Terminalia chebula*	Combretaceae	3.92	0.49	0.92	5.33
17	Kusum	*Schleriachera oleosa*	Sapindaceae	1.96	0.61	2.30	4.87

18	Bakaino	*Melia azedaracha*	Meliaceae	1.96	0.61	2.30	4.87
19	Simal	*Bombax ceiba*	Bombaceae	2.94	0.36	0.92	4.23
20	Vellar	*Trewia nudiflora*	Euphorbiaceae	1.96	0.36	1.38	3.71
21	Bhalyo	*Semecarpus anacardium*	Anacardiaceae	1.96	0.24	0.92	3.12
22	Tantari	*Dillenia pentagyna*	Dilleniaceae	0.98	0.12	0.92	2.02
23	Mango	*Mangifera indica*	Anacardiaceae	0.98	0.12	0.92	2.02
24	Palas	*Butea monosperma*	Fabaceae	0.98	0.12	0.92	2.02

Jaljala community forest Natural			**Trees**				
SN	**Local name**	**Botanical Name**	**Plants Family**	**RF (%)**	**RD (%)**	**RA (%)**	**IVI**
1	Sal	*Shorea robusta*	Dipterocarpaceae	10.64	24.03	8.11	42.78
2	Rohini	*Mallotus phillippensis*	Euphorbiaceae	7.09	11.57	5.86	24.52
3	Saj	*Terminalia alata*	Combretaceae	9.22	9.79	3.81	22.82
4	Ipil ipil	*Leucaena leucocephalia*	Fabaceae	9.22	8.31	3.24	20.76
5	Mahuwa	*Madhuca longifolivar indica*	Spotaceae	0.71	2.97	15.02	18.70
6	Pyar	*Buchanania latifolia*	Anacardiaceae	6.38	4.15	2.34	12.87
7	Khayer	*Acacia catechu*	Fabaceae	2.84	4.15	5.26	12.25
8	Botdhairo	*Lagerstroemia parviflora*	Lythraceae	4.96	3.56	2.57	11.10
9	Dabdabe	*Lannea grandis*	Anacardiaceae	4.96	3.56	2.57	11.10

10	Tandu	*Diospyros lanccifolia*	Ebenaceae	3.55	3.26	3.30	10.11
11	Bhalyo	*Semecarpus anacardium*	Anacardiaceae	4.26	2.97	2.50	9.73
12	Kari	*Bridelia retusa*	Phyllanthaceae	4.26	2.97	2.50	9.73
13	Karma	*Adina cordifolia*	Rubiaceae	4.26	2.08	1.75	8.08
14	Raibrikshya	*Cassia fistula*	Fabaceae	3.55	2.08	2.10	7.73
15	Jamun	*Syzygium cumini*	Myrtaceae	2.13	2.08	3.50	7.71
16	Aamba	*Pisidium guajava*	Myrtaceae	0.71	0.89	4.51	6.11
17	Vellar	*Trewia nudiflora*	Euphorbiaceae	0.71	0.89	4.51	6.11
18	Aamala	*Phyllanthus emblica*	Euphorbiaceae	1.42	1.19	3.00	5.61
19	Barro	*Termanilia bellirica*	Combretaceae	2.13	1.19	2.00	5.32
20	Masala	*Eucalyptus citriodora*	Myrtaceae	2.13	1.19	2.00	5.32
21	Sissoo	*Dalbergia sissoo*	Fabaceae	1.42	0.89	2.25	4.56
22	Bar	*Ficus benghalensis*	Moraceae	1.42	0.89	2.25	4.56
23	Tantari	*Dillenia pentagyna*	Dilleniaceae	2.13	0.89	1.50	4.52
24	Bohori	*Kydia calycina*	Malvaceae	2.13	0.89	1.50	4.52
25		*Elaeodendron glaucum*	Celastraceae	2.13	0.89	1.50	4.52
26	Sadan	*Desmodium oojeinensis*	Fabaceae	0.71	0.59	3.00	4.31
27	Koiralo	*Bauhinia variegata*	Fabaceae	1.42	0.59	1.50	3.51
28	Harro	*Terminalia chebula*	Combretaceae	1.42	0.59	1.50	3.51

29	Tilka	*Wendlandia puberula*	Rubiaceae	0.71	0.30	1.50	2.51
30	Seto Siris	*Albizia procera*	Fabaceae	0.71	0.30	1.50	2.51
31	Kyamuna	*Eugenia operculata*	Myrtaceae	0.71	0.30	1.50	2.51

Jaljala community forest settlement buffer Zone				**Trees**			
SN	**Local name**	**Botanical Name**	**Family**	**RF (%)**	**RD (%)**	**RA (%)**	**IVI**
1	Sal	*Shorea robusta*	Dipterocarpaceae	10.14	46.02	26.33	82.49
2	Rohini	*Mallotus phillippensis*	Euphorbiaceae	9.46	20.79	12.74	42.99
3	Ipil ipil	*Leucaena leucocephalia*	Fabaceae	8.11	3.97	2.84	14.91
4	Khayer	*Acacia catechu*	Fabaceae	2.03	2.76	7.91	12.70
5	Tandu	*Diospyros lanccifolia*	Ebenaceae	4.73	3.12	3.83	11.68
6	Botdhairo	*Lagerstroemia parviflora*	Lythraceae	6.08	2.76	2.64	11.48
7	Bhalyo	*Semecarpus anacardium*	Anacardiaceae	6.08	2.52	2.41	11.01
8	Pyar	*Buchanania latifolia*	Anacardiaceae	5.41	1.92	2.06	9.39
9	Dudhe kuro	*Wrightia tomentosa*	Apocynaceae	4.05	1.80	2.58	8.43
10	Dabdabe	*Lannea grandis*	Anacardiaceae	2.70	1.80	3.87	8.37
11	Saj	*Terminalia alata*	Combretaceae	4.73	1.56	1.91	8.21
12	Kusum	*Schleriachera oleosa*	Sapindaceae	2.03	1.32	3.78	7.13

13	Sadan	*Desmodium oojeinensis*	Fabaceae	2.70	1.32	2.84	6.86
14	Karma	*Adina cordifolia*	Rubiaceae	3.38	1.08	1.86	6.32
15	Jamun	*Syzygium cumini*	Myrtaceae	2.70	1.08	2.32	6.10
16	Harro	*Terminalia chebula*	Combretaceae	4.05	0.84	1.20	6.10
17	Mahuwa	*Madhuca longifoliavar indica*	Spotaceae	4.05	0.84	1.20	6.10
18	Raibriksh ya	*Cassia fistula*	Fabaceae	2.70	0.96	2.06	5.73
19	Sissoo	*Dalbergia sissoo*	Fabaceae	1.35	0.48	2.06	3.89
20	Tantari	*Dillenia pentagyna*	Dilleniaceae	2.03	0.48	1.37	3.88
21	Bar	*Ficus benghalensis*	Moraceae	2.03	0.48	1.37	3.88
22	Bel	*Aegle marmelos*	Rutaceae	1.35	0.36	1.55	3.26
23	Kari	*Bridelia retusa*	Phyllanthaceae	1.35	0.36	1.55	3.26
24	Amoora	*Spondias amara*	Anacardiaceae	1.35	0.36	1.55	3.26
25	Simal	*Bombax ceiba*	Bombaceae	1.35	0.24	1.03	2.62
26	Aamala	*Phyllanthus emblica*	Euphorbiaceae	1.35	0.24	1.03	2.62
27	Barro	*Termanilia bellirica*	Combretaceae	0.68	0.12	1.03	1.83
28	Kumbhi	*Careya arborea*	Myrtaceae	0.68	0.12	1.03	1.83
29	Vellar	*Trewia nudiflora*	Euphorbiaceae	0.68	0.12	1.03	1.83
30	Mango	*Mangifera indica*	Anacardiaceae	0.68	0.12	1.03	1.83

Appendix 2. Regeneration status of all trees at JCF and TCF

Taradevi community forest Natural site	**Trees**			
Botanical Name	**Plants family**	**Tree**	**SP**	**SD**
Shorea robusta	Dipterocarpaceae	268	1536	3640
Dillenia pentagyna	Dilleniaceae	15	117	191
Termanilia bellirica	Combretaceae	3	2	14
Lagerstroemia parviflora	Lythraceae	41	5	0
Schleriachera oleosa	Sapindaceae	2	3	91
Buchanania latifolia	Anacardiaceae	34	0	21
Mallotus phillippensis	Euphorbiaceae	24	664	503
Cassia fistula	Fabaceae	9	13	19
Myrasine semeserrata	Myrsinaceae	0	3	5
Desmodium oojeinensis	Fabaceae	0	9	35
Bombax ceiba	Bombaceae	0	0	3
Careya arborea	Myrtaceae	8	0	19
Aegle marmelos	Rutaceae	0	3	45
Syzygium cumini	Myrtaceae	1	0	55
Diospyros lanccifolia	Ebenaceae	7	0	12
Bauhinia vahlii	Fabaceae	0	0	47
Acacia catechu	Fabaceae	1	0	20
Wrightia tomentosa	Apocynaceae	0	12	34
Pisidium guajava	Myrtaceae	0	0	12
Zizipus mauritiana	Rhamnaceae	0	2	3
Terminalia alata	Combretaceae	33	0	5
Leucaena leucocephalia	Fabaceae	33	0	0
Albizia julibrissin	Fabaceae	1	0	0

Lyonia villosa	Ericaceae	0	0	1
Wendlandia puberula	Rubiaceae	0	0	1
Lannea grandis	Anacardiaceae	35	0	0
Zizipus jujuba	Anacardiaceae	0	2	0
Butea parviflora	Fabaceae	0	4	56
Phyllanthus emblica	Euphorbiaceae	0	0	7
Semecarpus anacardium	Anacardiaceae	12	0	1
Bauhinia variegata	Fabaceae	0	0	14
Grevilla robusta	Protaceae	0	0	10
Grewia sclerophylla	Malvaceae	0	0	2
Delonix regia	Fabaceae	0	0	3
Albizia procera	Fabaceae	2	1	10
Casearia tomentosa	Samydaceae	0	0	1
Eucalyptus citriodora	Myrtaceae	2	0	7
Adina cordifolia	Rubiaceae	0	0	2
Sapium insigne	Euphorbiaceae	0	0	8
Trewia nudiflora	Euphorbiaceae	0	0	7

Taradevi community forest settlementl site	**Family**			
Botanical Name	Plants family			
		Tree	SP	SD
Shorea robusta	Dipterocarpaceae	559	1209	2843
Dillenia pentagyna	Dilleniaceae	1	5	147
Termanilia bellirica	Combretaceae	7	0	0
Lagerstroemia parviflora	Lythraceae	14	0	0
Schleriachera oleosa	Sapindaceae	5	6	47

Buchanania latifolia	Anacardiaceae	9	0	9
Mallotus phillippensis	Euphorbiaceae	53	217	1127
Cassia fistula	Fabaceae	12	5	13
Desmodium oojeinensis	Fabaceae	0	2	52
Bombax ceiba	Bombaceae	3	4	4
Aegle marmelos	Rutaceae	11	0	25
Syzygium cumini	Myrtaceae	11	18	137
Diospyros lanccifolia	Ebenaceae	7	16	68
Wrightia tomentosa	Apocynaceae	0	0	104
Pisidium guajava	Myrtaceae	13	6	39
Zizipus mauritiana	Rhamnaceae	0	0	3
Terminalia alata	Combretaceae	42	0	0
Leucaena leucocephalia	Fabaceae	10	2	0
Lannea grandis	Anacardiaceae	31	0	0
Phyllanthus emblica	Euphorbiaceae	0	0	2
Semecarpus anacardium	Anacardiaceae	2	0	0
Bauhinia variegata	Fabaceae	0	0	11
Grevilla robusta	Protaceae	0	0	24
Grewia sclerophylla	Malvaceae	0	4	0
Albizia procera	Fabaceae	0	0	7
Casearia tomentosa	Samydaceae	0	0	3
Holeptelia integrefolia	Ulmaceae	0	0	7
Eucalyptus citriodora	Myrtaceae	0	1	38
Adina cordifolia	Rubiaceae	7	0	0
Trewia nudiflora	Euphorbiaceae	3	5	9
Dalbergia sissoo	Fabaceae	13	0	5
Oroxylum indicum	Bignoniaceae	0	1	0

Ficus hispid	Moraceae	0	6	2
Albizia lebbek	Fabaceae	0	0	47
Terminalia chebula	Combretaceae	4	0	0
Melia azedaracha	Meliaceae	5	0	16
Mangifera indica	Anacardiaceae	1	0	0
Butea monosperma	Fabaceae	1	0	2
Morus alba	Moraceae	0	0	3
Ficus semicordata	Moraceae	0	2	0
Ficus racemosa	Moraceae	0	1	0

Jaljala community forest Natural site				
Botanical Name	Plants family	Tree	SP	SD
Shorea robusta	Dipterocarpaceae	81	157	1306
Dillenia pentagyna	Dilleniaceae	3	0	30
Termanilia bellirica	Combretaceae	4	0	0
Lagerstroemia parviflora	Lythraceae	12	0	0
Schleriachera oleosa	Sapindaceae	0	1	45
Buchanania latifolia	Anacardiaceae	14	0	5
Mallotus phillippensis	Euphorbiaceae	39	104	324
Cassia fistula	Fabaceae	7	14	26
Desmodium oojeinensis	Fabaceae	2	0	23
Bombax ceiba	Bombaceae	0	1	9
Careya arborea	Myrtaceae	0	0	2
Aegle marmelos	Rutaceae	0	0	24
Syzygium cumini	Myrtaceae	7	5	26
Diospyros lanccifolia	Ebenaceae	11	4	41

Acacia catechu	Fabaceae	14	1	136
Wrightia tomentosa	Apocynaceae	0	2	77
Pisidium guajava	Myrtaceae	3	0	1
Terminalia alata	Combretaceae	33	4	6
Leucaena leucocephalia	Fabaceae	28	3	0
Wendlandia puberula	Rubiaceae	1	0	1
Lannea grandis	Anacardiaceae	12	0	0
Phyllanthus emblica	Euphorbiaceae	4	1	9
Semecarpus anacardium	Anacardiaceae	10	0	3
Bauhinia variegata	Fabaceae	2	0	5
Delonix regia	Fabaceae	0	1	0
Albizia procera	Fabaceae	1	0	1
Eucalyptus citriodora	Myrtaceae	4	5	17
Adina cordifolia	Rubiaceae	7	1	8
Trewia nudiflora	Euphorbiaceae	3	7	2
Dalbergia sissoo	Fabaceae	3	0	2
Terminalia chebula	Combretaceae	2	3	1
Ficus benghalensis	Moraceae	3	0	0
Bridelia restusa	Phyllanthaceae	10	2	20
Kydia calycina	Malvaceae	3	0	1
Ficus auriculata	Moraceae	0	0	7
Garuga pinnata	Burseraceae	0	0	3
Pterocarpus masupium	Fabaceae	0	0	1
Madhuca longifoliavar indica	Spotaceae	10	0	0
Eugenia operculata	Myrtaceae	1	3	0
Elaeodendron glaucum	Celastraceae	3	1	0

Botanical Name	**Plants family**	**Jaljala community forest settlement buffer Zone**		
		Tree	SP	SD
Shorea robusta	Dipterocarpaceae	383	619	2377
Dillenia pentagyna	Dilleniaceae	4	5	53
Termanilia bellirica	Combretaceae	1	0	5
Lagerstroemia parviflora	Lythraceae	23	0	0
Schleriachera oleosa	Sapindaceae	11	0	86
Buchanania latifolia	Anacardiaceae	16	12	0
Mallotus phillippensis	Euphorbiaceae	173	383	1052
Cassia fistula	Fabaceae	8	6	17
Desmodium oojeinensis	Fabaceae	11	0	76
Bombax ceiba	Bombaceae	2	0	1
Careya arborea	Myrtaceae	1	0	5
Aegle marmelos	Rutaceae	3	0	27
Syzygium cumini	Myrtaceae	9	0	57
Diospyros lanccifolia	Ebenaceae	26	18	103
Acacia catechu	Fabaceae	23	35	120
Wrightia tomentosa	Apocynaceae	15	4	115
Pisidium guajava	Myrtaceae	0	0	6
Terminalia alata	Combretaceae	13	0	0
Leucaena leucocephalia	Fabaceae	33	0	0
Wendlandia puberula	Rubiaceae	0	0	1
Lannea grandis	Anacardiaceae	15	0	0
Phyllanthus emblica	Euphorbiaceae	2	0	9
Semecarpus anacardium	Anacardiaceae	21	2	0
Albizia procera	Fabaceae	0	0	1

Eucalyptus citriodora	Myrtaceae	0	0	34
Adina cordifolia	Rubiaceae	9	0	4
Trewia nudiflora	Euphorbiaceae	1	0	2
Dalbergia sissoo	Fabaceae	4	0	1
Terminalia chebula	Combretaceae	7	0	0
Melia azedaracha	Meliaceae	0	0	1
Mangifera indica	Anacardiaceae	1	0	0
Ficus benghalensis	Moraceae	4	0	0
Bridelia restusa	Phyllanthaceae	3	0	18
Kydia calycina	Malvaceae	0	0	1
Pterocarpus masupium	Fabaceae	0	0	1
Madhuca longifoliavar indica	Spotaceae	7	0	0
Leucaena leucocephala	Fabaceae	0	0	4
Spondias amara	Anacardiaceae	3	0	2

S.N	**Regeneration status at natural area in Taradevi Community forest**			
	Name of plant species	Seedling(stem/ha)	Sapling(stem/ha)	Tree(stem/ha)
		Natural area	Natural area	Natural area
1	*Shorea robusta*	6067	256	447
2	*Dillenia pentagyna*	318	20	25
3	*Termanilia bellirica*	23	0	5
4	*Lagerstroemia parviflora*	0	1	68
5	*Schleriachera oleosa*	152	1	3
6	*Buchanania latifolia*	35	0	57
7	*Mallotus phillippensis*	838	111	40
8	*Cassia fistula*	32	2	15

9	*Myrasine semeserrata*	8	1	0
10	*Desmodium oojeinensis*	58	2	0
11	*Bombax ceiba*	5	0	0
12	*Careya arborea*	32	0	13
13	*Aegle marmelos*	75	1	0
14	*Syzygium cumini*	92	0	2
15	*Diospyros lanccifolia*	20	0	12
16	*Bauhinia vahlii*	78	0	0
17	*Acacia catechu*	33	0	2
18	*Wrightia tomentosa*	57	2	0
19	*Pisidium guajava*	20	0	0
20	*Zizipus mauritiana*	5	0	0
21	*Terminalia alata*	8	0	55
22	*Leucaena leucocephalia*	0	0	55
23	*Albizia julibrissin*	0	0	2
24	*Lyonia villosa*	2	0	0
25	*Wendlandia puberula*	2	0	0
26	*Lannea grandis*	0	0	58
27	*Zizipus jujuba*	0	0	0
28	*Butea parviflora*	93	1	0
29	*Phyllanthus emblica*	12	0	0
30	*Semecarpus anacardium*	2	0	20
31	*Bauhinia variegata*	23	0	0
32	*Grevilla robusta*	17	0	0
33	*Grewia sclerophylla*	3	0	0
34	*Delonix regia*	5	0	0
35	*Albizia procera*	17	0	3

36	*Casearia tomentosa*	2	0	0
37	*Eucalyptus citriodora*	12	0	3
38	*Adina cordifolia*	3	0	0
39	*Sapium insigne*	13	0	0
40	*Trewia nudiflora*	12	0	0

S.N	**Regeneration status at settlement area in Taradevi Community forest**			
	Name of plant species	Seedling(stem/ha)	Sapling(stem/ha)	Tree(stem/ha)
		Settlement area	settlement area	settlement area
1	*Shorea robusta*	4738	2015	932
2	*Dillenia pentagyna*	245	8	2
3	*Termanilia bellirica*	0	0	12
4	*Lagerstroemia parviflora*	0	0	23
5	*Schleriachera oleosa*	78	10	8
6	*Buchanania latifolia*	15	0	15
7	*Mallotus phillippensis*	1878	362	88
8	*Cassia fistula*	22	8	20
9	*Desmodium oojeinensis*	87	3	0
10	*Bombax ceiba*	7	7	5
11	*Aegle marmelos*	42	0	18
12	*Syzygium cumini*	228	30	18
13	*Diospyros lanccifolia*	113	27	12
14	*Wrightia tomentosa*	173	0	0
15	*Pisidium guajava*	65	10	22
16	*Zizipus mauritiana*	5	0	0
17	*Terminalia alata*	0	0	70

18	*Leucaena leucocephalia*	0	3	17
19	*Lannea grandis*	0	0	52
20	*Phyllanthus emblica*	3	0	0
21	*Semecarpus anacardium*	0	0	3
22	*Bauhinia variegata*	18	0	0
23	*Grevilla robusta*	40	0	0
24	*Grewia sclerophylla*	0	7	0
25	*Albizia procera*	12	0	0
26	*Casearia tomentosa*	5	0	0
27	*Holeptelia integrefolia*	12	0	0
28	*Eucalyptus citriodora*	63	2	0
29	*Adina cordifolia*	0	0	12
30	*Trewia nudiflora*	15	8	5
31	*Dalbergia sissoo*	8	0	22
32	*Oroxylum indicum*	0	2	0
33	*Ficus hispid*	3	10	0
34	*Albizia lebbek*	78	0	0
35	*Terminalia chebula*	0	0	7
36	*Melia azedaracha*	27	0	8
37	*Mangifera indica*	0	0	2
38	*Butea monosperma*	3	0	2
39	*Morus alba*	5	0	0
40	*Ficus semicordata*	0	3	0
41	*Ficus racemosa*	0	2	0

S.N	**Regeneration status at natural area in Jaljala Community forest**			
	Name of plant species	Seedling(stem/ha)	Sapling(stem/ha)	Tree(stem/ha)
		Natural area	natural area	Natural area
1	*Shorea robusta*	2177	262	135
2	*Dillenia pentagyna*	50	0	5
3	*Termanilia bellirica*	0	0	7
4	*Lagerstroemia parviflora*	0	0	20
5	*Schleriachera oleosa*	75	2	0
6	*Buchanania latifolia*	8	0	23
7	*Mallotus phillippensis*	540	173	65
8	*Cassia fistula*	43	23	12
9	*Desmodium oojeinensis*	38	0	3
10	*Bombax ceiba*	15	2	0
11	*Careya arborea*	3	0	0
12	*Aegle marmelos*	40	0	0
13	*Syzygium cumini*	43	8	12
14	*Diospyros lanccifolia*	68	7	18
15	*Acacia catechu*	227	2	23
16	*Wrightia tomentosa*	128	3	0
17	*Pisidium guajava*	2	0	5
18	*Terminalia alata*	10	7	55
19	*Leucaena leucocephalia*	0	5	47
20	*Wendlandia puberula*	2	0	2
21	*Lannea grandis*	0	0	20
22	*Phyllanthus emblica*	15	2	7
23	*Semecarpus anacardium*	5	0	17
24	*Bauhinia variegata*	8	0	3
25	*Delonix regia*	0	2	0
26	*Albizia procera*	2	0	2

27	*Eucalyptus citriodora*	28	8	7
28	*Adina cordifolia*	13	2	12
29	*Trewia nudiflora*	3	12	5
30	*Dalbergia sissoo*	3	0	5
31	*Terminalia chebula*	2	5	3
32	*Ficus benghalensis*	0	0	5
33	*Bridelia restusa*	33	3	17
34	*Kydia calycina*	2	0	5
35	*Ficus auriculata*	12	0	0
36	*Garuga pinnata*	5	0	0
37	*Pterocarpus masupium*	2	0	0
38	*Madhuca longifoliavar indica*	0	0	17
39	*Eugenia operculata*	0	5	2
40	*Elaeodendron glaucum*	0	2	5

S.N	**Regeneration status at settlement area in Jaljala Community forest**			
	Name of plant species	Seedling(stem/ha)	Sapling(stem/ha)	Tree(stem/ha)
		settlement area	settlement area	Settlement area
1	*Shorea robusta*	3962	1032	638
2	*Dillenia pentagyna*	88	8	7
3	*Termanilia bellirica*	8	0	2
4	*Lagerstroemia parviflora*	0	0	38
5	*Schleriachera oleosa*	143	0	18
6	*Buchanania latifolia*	0	20	27
7	*Mallotus phillippensis*	1753	638	288
8	*Cassia fistula*	28	10	13
9	*Desmodium oojeinensis*	127	0	18
10	*Bombax ceiba*	2	0	3
11	*Careya arborea*	8	0	2

12	*Aegle marmelos*	45	0	5
13	*Syzygium cumini*	95	0	15
14	*Diospyros lanccifolia*	172	30	43
15	*Acacia catechu*	200	58	38
16	*Wrightia tomentosa*	192	7	25
17	*Pisidium guajava*	10	0	0
18	*Terminalia alata*	0	0	22
19	*Leucaena leucocephalia*	0	0	55
20	*Wendlandia puberula*	2	0	0
21	*Lannea grandis*	0	0	25
22	*Phyllanthus emblica*	15	0	3
23	*Semecarpus anacardium*	0	3	35
24	*Albizia procera*	2	0	0
25	*Eucalyptus citriodora*	57	0	0
26	*Adina cordifolia*	7	0	15
27	*Trewia nudiflora*	3	0	2
28	*Dalbergia sissoo*	2	0	7
29	*Terminalia chebula*	0	0	12
30	*Melia azedaracha*	2	0	0
31	*Mangifera indica*	0	0	2
32	*Ficus benghalensis*	0	0	7
33	*Bridelia restusa*	30	0	5
34	*Kydia calycina*	2	0	0
35	*Pterocarpus masupium*	2	0	0
36	*Madhuca longifoliavar indica*	0	0	12
37	*Leucaena leucocephala*	7	0	0
38	*Spondias amara*	3	0	5

Appendix 3: Density and DBH class of TCF and JCF

DBH	TCF natural Species no.
10-15	169
15-20	167
20-25	153
25-30	120
30-35	20

DBH	TCF Settlement Species no.
10-15	198
15-20	158
20-25	179
25-30	64
30-35	13

DBH	JCF Natural Species no.
10-15	126
15-20	99
20-25	103
25-30	38
30-35	5

DBH	JCF settlement Species no.
10-15	193
15-20	107
20-25	78
25-30	37
30-35	5

PHOTOPLATES

Photo:1 Field visit with local people at TCF

Photo:2 Identifying the local name of plant species with local people at JCF

Photo:3 Selecting the plot for residential area at TCF