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COMPOSITION AND DIVERSITY OF TREE SPECIES IN
NATIONAL PARK SADAR RANGE OF MADHUPUR TRACT
UNDER TANGAIL NORTH FOREST DIVISION



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FORESTRY AND WOOD TECHNOLOGY DISCIPLINE
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BANGLADESH

2015

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This dissertation has been prepared for the partial fulfillment of the requirements of Four (4) years professional B. Sc. (Hons.) degree in Forestry from Forestry and Wood Technology Discipline, Khulna University, Khulna, Bangladesh.

**FORESTRY AND WOOD TECHNOLOGY DISCIPLINE
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2014**


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FOREST DIVISION**

**PROJECT THESIS
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DECLARATION

I, Md. Sazib Uddin, declare this thesis paper is my own works; has been carried out under direct supervision of Dr. S.M. Feroz, Assistant Professor, Forestry and Wood Technology discipline, Khulna university, Khulna. It has not been submitted or accepted for a degree in any other university.

I, hereby, give consent for my thesis, if accepted, to be available for any kind of photocopying and for inter-library loans.

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*Dedicated
To My
Beloved Parents*

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APPROVAL

This thesis work is submitted to Forestry and Wood Technology discipline, Khulna University, Khulna, Bangladesh, in the partial fulfillment of the requirements for the 4 years professional B.Sc (Hons.) degree in Forestry and Wood technology. I have approved the style and format of the project thesis.

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ABSTRACT

The floristic composition, species diversity, and structural characteristics of woody species at National Park sadar range in Tangail North Forest Division, were investigated based on bitwise (National Park Sadar bit, Rajabari bit, Beribide bit, Lohoria bit, Gasabari bit) tree census. A total of 17 families, 19 genera, 21 species and 500 individuals were recorded in the study area. Dipterocarpaceae was the species rich family. *Shorea robusta* C.F. Gaertn was the most dominant species in terms of the highest IV in the total area and all bits. Other dominant species were *Grewia microcos* L, *Dillenia pentagyna* Roxb. The floristic composition was more or less similar among the bits. The maximum similarity was found between Beribaid bit and Rajabari bit (0.46). The highest species diversity (Shannon's index, $H'=1.72$) was found within Beri Baid bit where the number of individuals were 111 and number of species were 14 those were also maximum than other bits.

Key words: Floristic composition, Species diversity, Structural characteristics of species,

Species similarity.

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LIST OF ABBREVIATION

BBS	Bangladesh Bureau of Statistics
BFIDC	Bangladesh Forest Industrial corporation
CFW	Community Forest Worker
CCF	Chief Conservator of Forest
CBT	Community Based Tourism
CBTW	Community Based Tourism Worker
CMC	Co-management Committee
DFO	Divisional Forest Officer
DBH	Diameter at Breast Height
FAO	Food and Agricultural Organization
FSO	Forest Settlement Officer
FD	Forest Department
NGO	Non-Governmental Organization
RF	Reserved Forest

CHAPTER ONE
INTRODUCTION

1.0 Introduction

1.1 Background of the Study

Madhupur forest is located on the border of the Mymensingh and Tangail districts and covers areas of both districts. The current forest concentration remains mainly in two forest divisions like southern belt of Mymensingh Forest Division and northern parts of Tangail Forest Division. Madhupur forest is a part of Madhupur tract, which extends from the south western part of Mymensingh district in the north to the northern border of Dhaka district in the south (Banglapedia 2008).

Tangail North Forest Division is covered an area of 44292.40 acres or 17923.98 ha of forest situated in four ranges namely Madhupur, Aronkhola, Dokhola and Madhupur National Park Sadar (Alam *et al.* 2008). Madhupur forest is a tropical, moist, and deciduous type of forest. Actually, this forest is present in low land and flood plain based area. In our country, only this forest contains pure Sal (*Shorea robusta*) tree.

The natural and climatic condition of this region is very much suitable for growing pure Sal tree. Besides, this forest contains a huge variety of floral composition, different type of mammals, reptiles, avian and amphibians. The major part of this forest is covered with Sal tree. It houses a total of 176 species of plants including 73 trees, 22 shrubs, 1 palm, 8 grasses , 27 climbers and 45 herbs. Besides, there are a number of exotic species planted in the national park area. Existing faunal composition includes 21 species of mammals, 140 species of birds and 29 reptiles in this park (Gain 2004).

Madhupur National Park Sadar Range also contains a huge variety of floral composition and diversity of woody tree species but there is no enough study on this particular region about floral composition and diversity of woody tree species. To know approximate floral composition and diversity of woody tree species, I have studied on the particular region.

1.2 Objectives of the study

- To elucidate tree species composition and structure of Sal forest in the study site
- To quantify species diversity of the forest

1.3 Limitation of the study

- The study was limited to only one range of the Tangail North Forest Division. If the study were carried out whole the ranges then a wide range of information about woody species composition and diversity could be found.

CHAPTER TWO
LITERATURE REVIEW

2.1 LITERATURE REVIEW

The Sal (*Shorea robusta* C.F. Gaertn) forest of Bangladesh is a part of the tropical moist deciduous forests, locally known as the inland Sal forest (Rashid *et al.* 1995). Madhupur Sal forest is the largest patch, which has a high economical and ecological significance in the central part of Bangladesh (Rahman *et al.* 2010). This is located in the greater districts of Dhaka, Tangail, Mymensingh and Netrokona. In addition to 'Sal' (*Shorea robusta*) stands of timber value, these forests are composed of many medicinal plants like Hartaki (*Terminalia chebula*), Bohera (*Terminalia belerica*), Arjune (*Terminalia arjuna*) and Kurchi (*Holarrhena antidysentrica*) (Khan 1990).

Biological diversity is a key issue in nature conservation and species diversity is an important component of biological diversity. Tree species diversity is fundamental to overall forest biodiversity because trees provide resources and habitats for almost all other forest species (Southwood 1977; Huston 1994; Jones *et al.* 1994; Whitmore 1998; Takeda and Abe 2001; Huang *et al.* 2003). Species diversity measurements play a central role in ecology and conservation biology (Feroz *et al.* 2009). Moreover woody species composition is considered a biodiversity indicator and an important attribute of forest ecosystems (e.g. Barbier *et al.* 2008), because woody plants provide resources and habitats for almost all other organisms. There are two main approaches to measuring species diversity, both of which incorporate information on the number of species (species richness) and the relative abundance of individuals within each species (evenness or equitability). The first approach constructs mathematical indices widely known as diversity indices, while the second compares observed patterns of species abundance with theoretical species abundance models (Hamilton 2005).

The biodiversity of Sal forests is very wide and interesting both from ecological and conservation point of view. Along with tree, shrub and herb, climber is an integrated part of its biodiversity (Alam 1995).

CHAPTER THREE
MATERIALS AND METHODS

3.0 Materials and methods

3.1 Study site

Madhupur forest is a tropical, moist, and deciduous type of forest. Madhupur National Park (MNP) is located at 24°45'N Latitude and 90°05' E Longitude, on the Tangail-Mymensingh main road, encompass a Gazette notified area of 8,436 ha. and is under the territorial jurisdiction of Tangail Forest Division (Fig 1). Actually, this forest is present in low land and flood plain based area. In our country, only this forest contains pure Sal (*Shorea robusta*) tree. The Park was established by the Forest Department in 1962 and formally notified in Gazette in 1982. At present, the tract of Madhupur forest (MF) consists an area of 45,565.18 acres out of which 2,525 acres are reserved and 4,304 acres land are under the process to be declared as reserved forest. For the purpose of biodiversity conservation, Government declared Madhupur Garh which is also known as 'Madhupur National Park' comprising an area of 20,837.23 acres by a gazette, notifying on 24th February 1982. Out of that, 20,244.23 acres are under Madhupur upazila of Tangail district and 593.00 acres are under Muktagacha upazila of Mymensingh district (Ahmed 2008). Madhupur National Park has four ranges, ten bits, and one nursery center (IPAC 2009). The present study site, Madhupur National Park sadar range is one of them and total area is 11936.14 acres. It has five bits (National Park Sadar bit, Rajabari bit, Beribide bit, Lohoria bit, Gasabari bit). Among these bits national park sodar bit is the largest bits in area (Fig 2).

3.2 Sampling plot:

A total of fifty plots (each plot size: 10m×10m) has been sampled in five bits of National Park range in Tangail North Forest Division. Ten sample plots were selected from each bit following purposive sampling method. Trees (dbh \geq 5 cm) were identified to species name and their dbh and height were measured.

3.3 Climate:

The climatic conditions are moderate. The temperature ranges from 15°C to 37°C during January-February and April-May. The weather becomes hot during March-April. Mean annual rainfall is about 250 cm and the maximum is within the months of June and September (FAO/UNDP 1992). Mean relative humidity is high throughout the year and does not fall below 65% (BBS 2003). There are four distinctively identifiable seasons in a year despite the traditional six seasons of the Bengali calendar:

- A. The Winter Season; December to February
- B. The unsettled period of pre Summer Monsoon: March to May
- C. The Summer Monsoon: June to September
- D. The retreating Monsoon: October to November

3.4 Topography and Land Form:

The Madhupur forms a slightly elevated tract with maximum height of about 18 m (60 feet) from the surrounding plain. The flat ridges of the forest run north to south forming irregular mass of high lands with gentle slopes. These high lands or "chalias" are intercepted by depressions in the form of long and narrow valleys or "baid"s. These baid lands are cultivated with paddy. Unfortunately, many chala lands had been cleared earlier by local inhabitants and utilized homestead and gardens for banana, jute and vegetables (Hassan 1999).

3.5 Data analysis:

3.5.1 Species dominance

Dominance of species was defined by the importance value (%) of the species:

$$IV = \left(\frac{n_i}{\sum_{i=1}^Q n_i} \times 100 + \frac{a_i}{\sum_{i=1}^Q a_i} \times 100 + \frac{f_i}{\sum_{i=1}^Q f_i} \times 100 \right) / 3$$

where n_i is the number of individuals of the i th species, a_i is the basal area at a height at DBH of the i th species, f_i is the number of quadrats in which the i th species appeared and Q is the total number of quadrats.

3.5.2 Floristic similarity

The similarity of floristic composition among bits was calculated using the Jaccard's similarity index based on presence and absence data by the application of Multivariate statistical analysis (ter Braak & Šmilauer 2002).

The value of index is 1.0 when the number of individuals belonging to a species is the same for the two sites for all species, i.e. floristic composition is completely the same in the two sites, and is 0.0 when they have no common species.

3.5.3 Species diversity and Equitability index J'

The following Shannon's index H' (MacArthur and MacArthur 1961) and Equitability index J' (Pielou 1969, 1975) were used to measure woody species diversity. The Shannon index is calculated from the equation:

$$H' = \sum_{i=1}^s \frac{n_i}{N} \log_2 \frac{N}{n_i}$$

Where n_i is the number of individual of i th species, N is the total number of individual.

Therefore, the ratio of observed diversity to maximum diversity can be used to measure evenness (J'):

$$J' = \frac{H'}{H'_{\max}} \quad (H'_{\max} = \log_2 S)$$

The maximum diversity (H'_{\max}) that could possibly occur in a situation where all species had equal abundances, in other words if ($H'_{\max} = \log_2 S$). As a heterogeneity measure the equitability index takes into account the degree of evenness in species abundances. None the less, it is possible to calculate a separate evenness measure.

The value of the equitability index is less than 1. The value would be 1 when the relative abundances of individuals of all species in a community are the same. This circumstance is naturally or biologically impossible.

CHAPTER FOUR

RESULTS

4.0 Results

4.1 Species composition

A total of 500 individuals were encountered from 21 species, 19 genera and 17 families (Table 1). Dipterocarpaceae was the species rich family and Sal (*Shorea robusta* C.F. Gaertn) is the major species in terms of the largest number of individuals.

4.2 Species dominance

The plots contained 500 woody individuals, which belong to 21 species, 19 genera and 17 families (Table 1). Table 2 shows list of the importance value (IV%) of 21 woody species in order of species rank in the study area. The most species-rich family was Dipterocarpaceae. *Shorea robusta* C.F. Gaertn was the most dominant species in terms of the highest IV (59.81%) and the second most dominated species is Ajuli (*Dillenia pentagyna* Roxb) in regards to the IV(9.86%) in the total Range and in all bits (Table 2).

4.3 Floristic similarity among bits

Table 3 shows floristic similarity among bits. The highest floristic similarity was found between Lohorie bit and Beribaid bit (similarity index = 0.46) as well as Beribaid bit and Rajabari bit (similarity index = 0.46). The lowest similarities were found between National park and Gasabari bit (similarity index = 0.18) and between Gasabari bit and Beribaid bit (similarity index = 0.18). Fig 3 shows the highest similarity was found between Beribaid bit and Rajabari bit but lowest

was found between (Lohorie bit + Beribaid bit+ Rajabari bit+ National Park bit) and Gasabari bit.

4.4 Woody species diversity of the National Park range at Tangail North Forest Division

Table 4 shows species diversity indices for National Park range at Tangail North Forest Division. Maximum diversity indices are found in Beri Baid bit ($H'=1.72$) where the number of species is 14 also maximum than other bits. The lower diversity indices are found in Rajabari bit ($H'=1.34$) where the number of individuals are 92 and species are 8. Overall species diversity for the range is ($H'=2.01$) as well as equitability indices is ($J'=0.45$) where the total number of individual were 500 and the number of species 21.

4.5 Structural characteristics of woody species of the National Park range at Tangail North Forest Division

There were five diameter classes ($0 < D \leq 5$, $5 < D \leq 10$, $10 < D \leq 15$, $15 < D \leq 20$, and $D > 20$) in the total range (**Table 5**). Based on the diameter class-wise stem density, mean height, basal area, were respectively 22 /ha, 6.73 m, and $0.03 \text{ m}^2/\text{ha}$ for the diameter class $0 < D \leq 5$. 170 /ha, 9.73m, and $0.95 \text{ m}^2/\text{ha}$ for the diameter class $5 < D \leq 10$. 360 /ha, 13.75 m, and $4.56 \text{ m}^2/\text{ha}$ for the diameter class $10 < D \leq 15$. 278 /ha, 18.40m, and $6.80 \text{ m}^2/\text{ha}$ for the diameter class $15 < D \leq 20$. 168 /ha, 20.76, and $9.45 \text{ m}^2/\text{ha}$ for the diameter class $D > 20$. The value of species diversity are respectively 1.68, 2.26, 2.16, 1.40 and 1.06 for the diameter classes ($0 < D \leq 5$, $5 < D \leq 10$, $10 < D \leq 15$, $15 < D \leq 20$, and $D > 20$). The highest diversity was found at $5 < D \leq 10$ diameter class. The value of stem density is the highest in class $10 < D \leq 15$ (360/ha) and lowest in class $0 < D \leq 5$ (22/ha). The value of height is the highest in class $D > 20$ (20.76m) and lowest in class

$0 < D \leq 5$ (6.73m). The value of basal area is highest in class $D > 20$ ($9.45 \text{ m}^2/\text{ha}$) and lowest in class $0 < D \leq 5$ ($0.03 \text{ m}^2/\text{ha}$).

CHAPTER FIVE

DISCUSSION

5.0 DISCUSSIONS

Bangladesh is rich in field crops, fruits, nuts and forest plants covering a wide array of species, genera and families (Valilov 1926). Some of these species, especially fruit and timber yielding plants, are very common and distributed all over the country. The present investigation indicating that some of the common plant species are also present in the Madhupur sal forest which are similar to those of others (Chowdhury 1991, 1996; Talukder 1999).

There were recorded 500 individual trees of 21 species under 17 families from the study area. More importantly from the outcome it was evident that almost all the families at the forests were represented by single genera and the maximum number of genera by single species (Table 1). Each indicating the poor diversity at family and genus levels. This situation demands urgent attention to enrich the plant diversity at genera and species levels to avoid the risk of extinction of single species or genera with single species.

Shorea robusta C.F. Gaertn was the most dominant species, because it appeared with the highest and tremendously high importance values respectively in the total area and all bits (Table 2). *Dillenia pentagyna* Roxb, *Grewia microcos* L, *Acacia auriculiformis* Willd., *Semecarpus anacardium* L.f, *Albizia lebbek* (L) Benth, and *Anaikota* are the most associated species of *Shorea robusta* C.F. Gaertn because they found in almost all bits with considerably high importance values.

Zanthoxylum rhetsa (Roxb.) DC, *Mallotus philippensis* (Lamk.) Muell.-Arg, *Miliusa velutina* (Dunal) Hk.f.&Thoms, *Careya arborea* Roxb., *Adina cordifolia*(Roxb.) Hook. f. ex Brandis, *Bauhinia acuminata* Linn., *Schleichera oleosa* (Lour.) Oken , *Lagerstroemia parviflora* (L.) Roxb. *Aphanamixis polystachya* (Wall.) R. N. Park. had very low importance value which

indicates that these species may not be strongly associated species of *Shorea robusta* C.F. Gaertn.

In case of basal area highest basal area was found for the Rajabari bit as well as lowest for Gasabari bit (Fig 2). Density of the woody species was uppermost in Gasabari bit and second uppermost was Beribaid and others were almost similar (Fig 3).

Species similarity among the bits was more or less the same. The maximum similarity was found between Beribaid bit and Rajabari bit (Fig 3) as well as Lohorea and Beribaid bit (Table 3). It indicates that the species compositions in Beribaid bit, Rajabari bit, Lohorea bit were almost the same. Maximum diversity as well as minimum equitability was found within Beri Baid bit (Table 4). It indicates that species richness was higher in Beri Baid bit than others bits.

According to the structural characteristics of woody species diversity of the study sites, the highest diversity was found at $5 < D \leq 10$ diameter class. It indicates that species richness is more than others at $5 < D \leq 10$ diameter class. The value of stem density was the highest in class $10 < D \leq 15$ (360/ha) and lowest in class $0 < D \leq 5$ (22/ha). The value of mean height was the highest in class $D > 20$ (20.76m) and lowest in class $0 < D \leq 5$ (6.73m). The value of basal area was the highest in class $D > 20$ ($9.45 \text{ m}^2/\text{ha}$) and lowest in class $0 < D \leq 5$ ($0.03 \text{ m}^2/\text{ha}$) (Table 5). These indicates that the number of individual is fewer at $0 < D \leq 5$ diameter class. So small woody species are fewer in the study sites because the Madhupur Sal forests are considered to face a severe threat for their existence due to high anthropogenic disturbances occurred inside and outside the boundary (Rahman *et al.* 2009).

CHAPTER SIX
CONCLUSION

6.0 Conclusions

The result of the present study provide a complete view of species composition, species diversity, species similarity and structural characteristics of woody species of the National Park Range in Tangail North Forest Division. It will be helpful for us to know the present condition of the forest. The information would also be important for the management activities those are essential for biodiversity conservation including flora and fauna. Such study is indispensable to continue all ranges in Tangail North forest division as well as other parts of Bangladesh where Sal forest exists.

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TABLES AND FIGURES

Table 1: Total number of plant species of National Park Sadar Range by genus and family

Sl. No	Family	No of Genus
1	Dipterocarpaceae	1
2	Dilleniaceae	1
3	Malvaceae.	1
4	Mimosaceae	1
5	Anacardiaceae	1
6	Fabaceae	1
7	Lythraceae	2
8	Lamiaceae	1
9	Bignoniaceae	1
10	Combretaceae	2
11	Rutaceae	1
12	Euphorbiaceae	1
13	Annonaceae	1
14	<i>Rubiaceae</i>	1
15	Caesalpinoideae	1
16	Sapindaceae	1
17	Miliaceae	1

Table 2: Twenty one dominant species in order of species rank determined by the importance value (IV) in the total Range.

Species Rank	Local name	Scientific name	IV%					
			Total Range	Beri Baid Bit	Raja Bari Bit	Gasabari Bit	Lohorie Bit	National Park Sadar Bit
1	Sal	<i>Shorea robusta</i> C.F. Gaertn	59.81	52.80	63.05	58.72	54.52	63.07
2	Ajuli	<i>Dillenia pentagyna</i> Roxb	9.86	1.97	17.45	3.37	13.70	11.16
3	Datoi	<i>Grewia microcos</i> L	4.81	6.65	0.0	0.0	10.13	6.01
4	Akashmoni	<i>Acacia auriculiformis</i> Willd.	4.17	0.0	0.0	23.70	0.0	0.0
5	Behula	<i>Semecarpus anacardium</i> L.f	4.16	2.00	2.98	5.99	10.10	0.0
6	koroi	<i>Albizia lebbek</i> (L.) Benth	2.67	1.78	2.46	0.0	2.20	6.57
7	Anaikota		2.67	3.26	7.59	0.0	1.71	0.0
8	Banorhola	<i>Duabanga sonneratioides</i>	1.92	2.77	0.0	0.0	4.08	2.06
9	Gamar	<i>Gmelina arborea</i> (Roxb.) DC	1.44	0.0	0.0	8.21	0.0	0.0
10	Uja		1.24	2.50	1.90	0.0	0.0	0.0
11	Bon Sonalu	<i>Stereospermum suaveolens</i> (Roxb.) DC	1.10	0.0	0.0	0.0	0.0	5.87
12	Bohera	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	0.96	1.96	2.58	0.0	0.0	0.0
13	Bajna	<i>Zanthoxylum rhetsa</i> (Roxb.) DC.	0.87	3.99	0.0	0.0	0.0	0.0
14	Sinduria	<i>Mallotus philippensis</i> (Lamk.) Muell.-Arg	0.81	3.47	0.0	0.0	0.0	0.0
15	Gandhi gazari	<i>Miliusa velutina</i> (Dunal) Hk.f.&Thoms	0.81	0.0	0.0	0.0	3.53	0.0
16	Gadhila	<i>Careya arborea</i> Roxb.	0.52	0.0	0.0	0.0	0.0	2.81
17	Haldu	<i>Adina cordifolia</i> (Roxb.) Hook. f. ex Brandis	0.52	2.32	0.0	0.0	0.0	0.0
18	kanchon	<i>Bauhinia acuminata</i> Linn.	0.46	0.0	0.0	0.0	0.0	2.44
19	Joinagota	<i>Schleichera oleosa</i> (Lour.)Oken	0.41	1.73	0.0	0.0	0.0	0.0
20	Sidha	<i>Lagerstroemia parviflora</i> (L.) Roxb.	0.39	0.0	1.98	0.0	0.0	0.0
21	Pitraj	<i>Aphanamixis polystachya</i> (Wall.) R. N. Park.	0.39	12.75	0.0	0.0	0.0	0.0

Table 3: Floristic Similarity among the bits

	National park	Rajabari	Lohorie	Gasabari
Beribaid	0.29	0.46	0.46	0.18
National park		0.23	0.45	0.18
Rajabari			0.45	0.3
Lohorie				0.3

Table 4: Diversity indices for National Park Sador Range

Name of Range	Name of Bit	Per sample area		H'	J'
		No of trees	No of species		
National Park	National Park Sador Bit	90	8	1.67	0.55
	Beri Baid Bit	111	14	1.72	0.45
	Raja Bari Bit	92	8	1.34	0.44
	Gasabari Bit	117	5	1.52	0.65
	Lohorie Bit	90	8	1.60	0.53
Total Range		500	21	2.01	0.45

Table 5: Structural characteristics species based on diameter class

Diameter class(cm)	$0 < D \leq 5$	$5 < D \leq 10$	$10 < D \leq 15$	$15 < D \leq 20$	$D > 20$
No. of species	4	16	17	13	6
Stem density /ha	22	170	360	278	168
Mean height(m)	6.73	9.73	13.75	18.40	20.76
Basal area(m ² /ha)	0.03	0.95	4.56	6.80	9.45
Diversity index	1.68	2.26	2.16	1.40	1.06

Fig 1: Location of Madhupur Sal Forest



Source: <http://macomputer.org>

Fig 2: Area of every individual bit in hectors

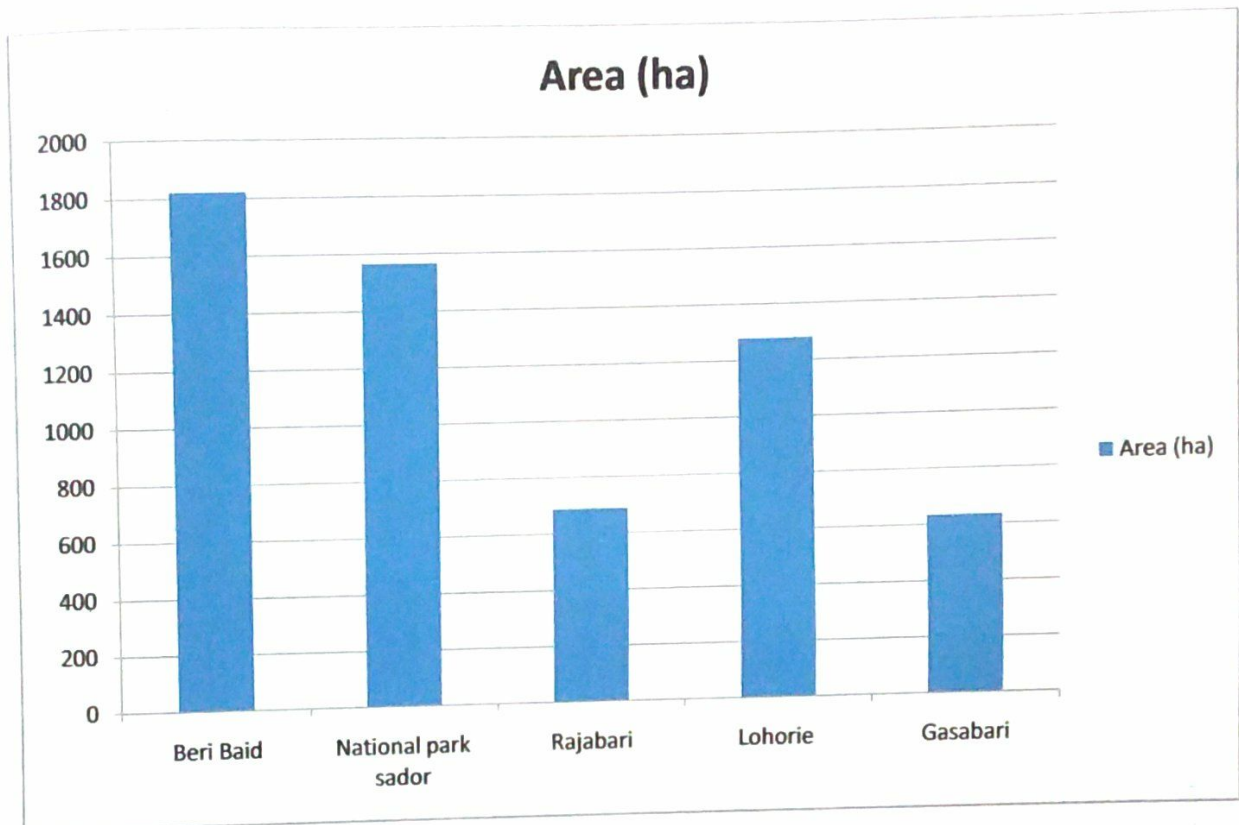
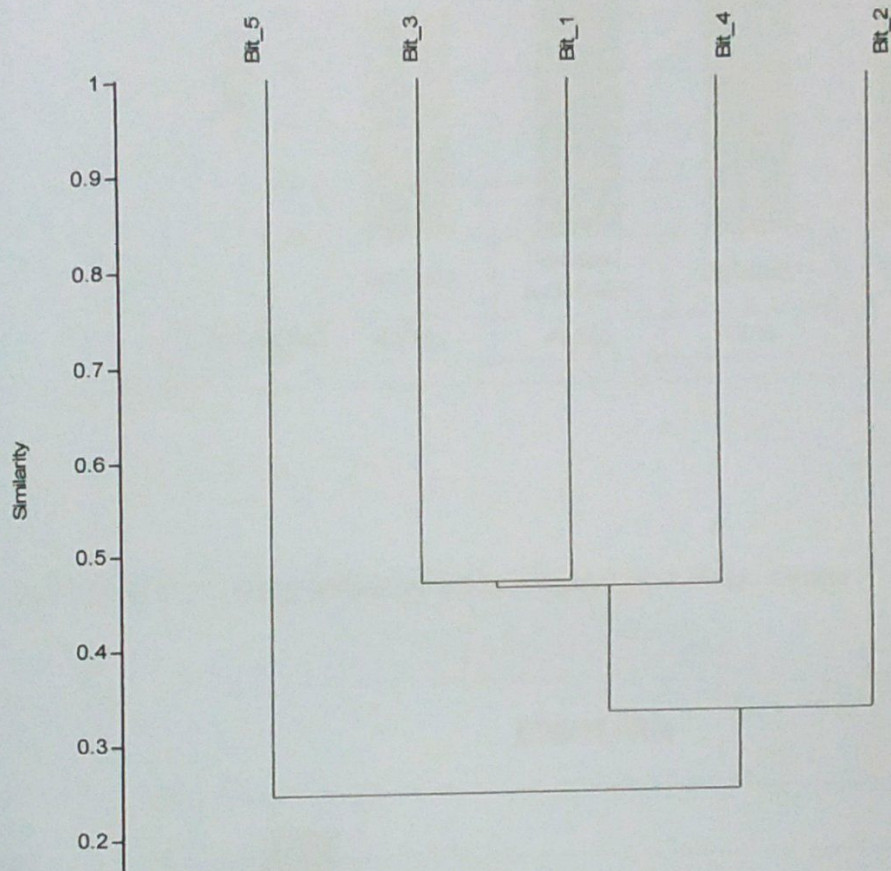


Fig 3: Floristic similarity among bits (Jaccard similarity)



Here,
Bit 1=Beribaid
Bit 2=National park
Bit 3=Rajabari
Bit 4=Lohorie
Bit 5=Gasabari

Fig 4: Basal area for every individual bits in National park Sadar Range

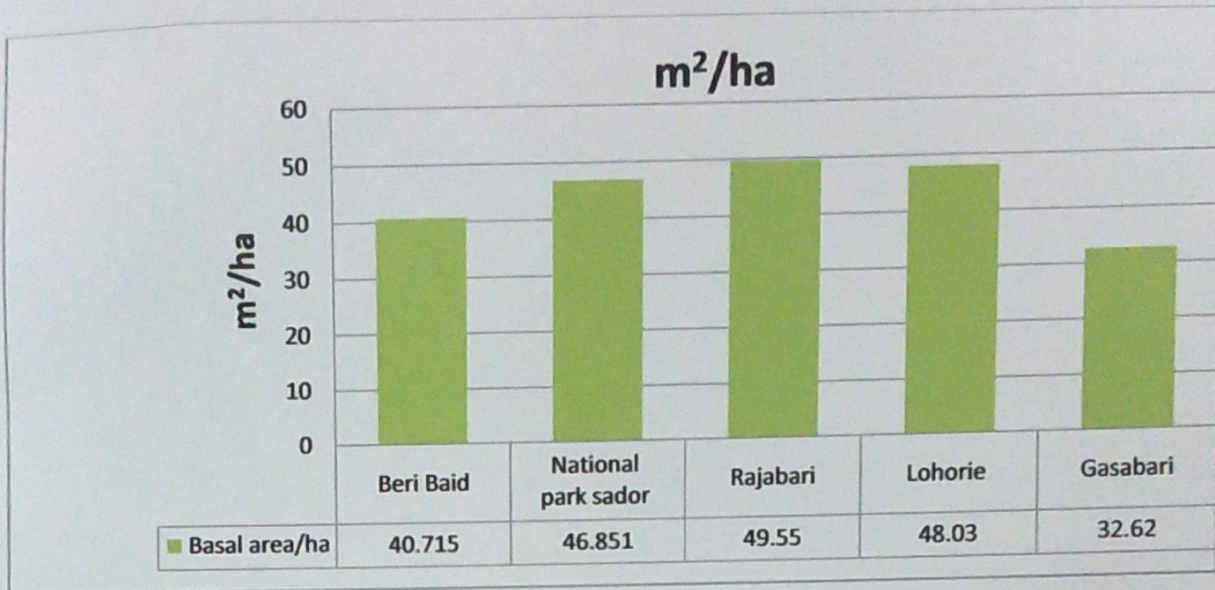


Fig 5: Density for every individual bit in National park Sadar Range

