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Vegetation Composition and Biomass Production in Community Forest in Sikre VDC adjoining Shivapuri National Park, Kathmandu

Sudip Pandey[1] and Siddhartha Bajra Bajracharya[2]
[1]Nepal Academy of Science and Technology, Khumaltar, Lalitpur
[2]National Trust for Nature Conservation, Khumaltar, Lalitpur
e-mail:environ.sudip@gmail.com

Abstract

The present study describes the structural and floral composition of the vegetation of Sikre Village Development Committee (VDC) at Shivapuri National Park. Systematic sampling technique was used to analyze the vegetation of the forest. A quadrat size of 10mx10m was plotted at respective point for tree study and within 5mx5m plots for shrubs and 1mx1m for herbs analysis. The study recorded a total of 18 tree species from 13 families in the forest area. Among the trees, Uttis (*Alnus nepalensis* D. Don) and Chilaune [*Schima wallichii* (DC.) Korth.] were the most dominant species. The major shrubs of the forest areas comprised of Yurilo (*Hypericum uralum* Buch.-Ham. ex D. Don), Chutro (*Berberis aristata* DC.) and Angeri (*Melastoma melabathricum* L.). Among the herbs Bhui Amala (*Phyllanthus freternus* Webster), Unyu [*Dryopteris filix*-mas (L.) Schott.] and Banmara (*Eupatorium adenophorum* Spreng.) were dominant ones in forest ground. The aboveground biomass of tree species was found to be 4021.41kg/ha in which Dhalne katus [*Castanopsis indica* (Roxb.) Miq.] constituted the large percent of biomass of the forest. The estimated resources demand and supply showed the annual deficit of 112.038t/yr and the carbon stock was calculated to be 2.01t/ha. The Shannon Index of diversity was highest for tree (2.33) followed by shrub (2.22) and herb (2.17) respectively. The density of cut stumps and the density of lopping were 184/ha and 216/ha respectively, which showed that the anthropogenic pressure on community forest was prominent.

Key words: basal area, biomass, species diversity, systematic sampling

Introduction

Human impact has, to varying degree, led to a reduction in biodiversity in much of the forest areas of Nepal (Chaudhary & Kunwar 2002, Karki 1991). Conservation of such forests requires an understanding of the composition of the particular forest, the effects of past disturbances, and the present impact of neighboring land use on that forest (Geldenhuys & Murray 1993). In order to understand the phyto-sociological structure of the Himalayan forests, we need studies that deal with the distribution of individual plant species of various girth classes, association among species, pattern of dispersion and various indices of diversity (Longman & Jenik 1987).

Community forest (CF) appears to have stood the test of time, contributing to the welfare of the mass of rural poor in Nepal. By April 2009, about 1.6 million households or one-third of the country's population took part in the CF program, directly managing more than 1,000,000 ha or more than one-fourth of the country's forest area. Therefore, it is expected that community forestry will act as a focal point for village development, environmental stability and contribute to sustainable development of nation itself (Ojha & Pokharel 2005).

The objectives of this study were to determine the status of forests, sustainable demand and supply of

resources and diversity components of vegetation in community forests of Sikre VDC, Nuwakot, Nepal.

Methodology

Site description

Sikre VDC with an area of 15.31 km^2 (27^o 45' to 27^o 51' N and 85^o 21' to 85^o 23' E) is situated on the northern fringe of Shivapuri National Park (ShNP) **(**Fig. 1). The elevation varies from 831m to 2426m above the sea level. There were six community forests in Sikre managed by Community Forest User Group (CFUG) covering an area of 39.8 ha. These forests are comprised of upper mixed hardwood with lower mixed hardwood forest, chir pine forest and oak forest (Amatya 1993). Major species were *Schima wallichii*, *Castanopsis indica*, *Alnus nepalensis*, *Rhododendron arboreum*, *Pinus roxburghii*, *Quercus* sp. Some of the wildlife found in the forest were common leopard (*Panthera pardus*), langur (*Semnopithecus entellus*), rhesus monkey (*Macaca mulatta*) and jungle cat (*Felis chaus*). The average maximum temperature reaches up to 19.75^o C in summer and the average minimum temperature in winter reaches up to 10.02^o C. The maximum rainfall (691.70 mm) occurs in July and the amount of rainfall decreases considerably in winter.

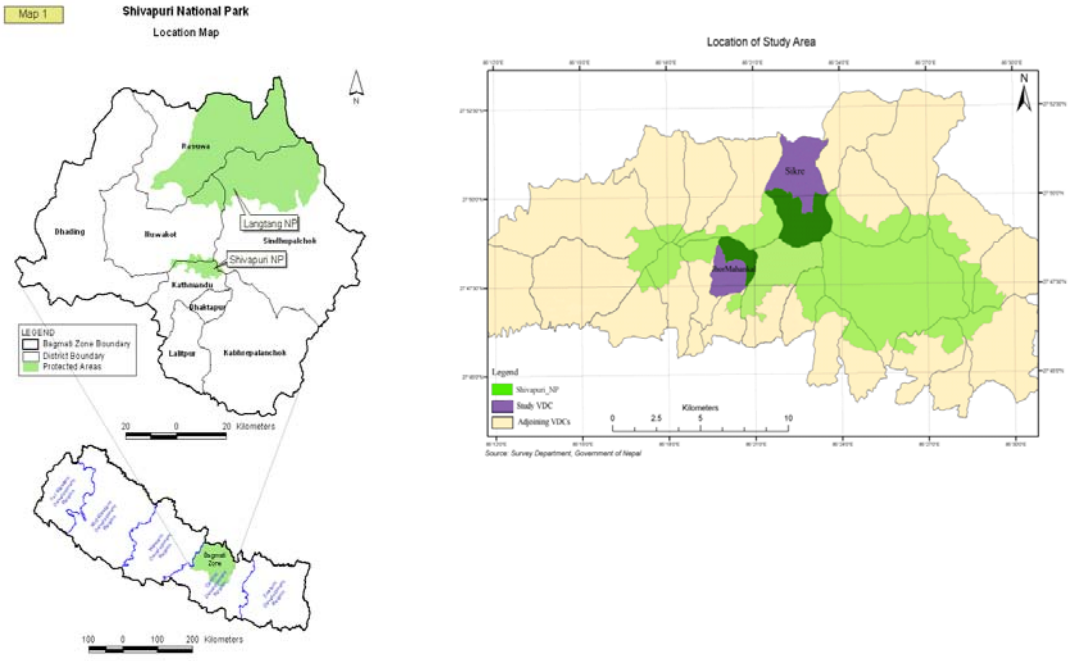

Fig. 1. Map showing the study area

Method of study

A field study was executed in community forests of Sikre VDC during the period of October to November 2008. We used systematic sampling with intensity of 0.5% to analyze the vegetation of the forest. The distance from first plot to the next was fixed according to the area of block of community forest and size of the sample plot. At each sampling point, altogether 10 plots were laid out.

Altogether 25 sampling plots of 10mx10m for trees, 50 sampling plots of 5mx5m for shrubs and 125 sampling plots of 1mx1m for herbs were plotted at respective point of study. In the places where the plots could not

be made, the tree species were counted and quantitative analysis was carried out.

All tree species that fell within 10mx10m plot and having a diameter at breast height (dbh) greater than 10cm were taken into account. Height and dbh of all trees were measured with the help of clinometer and dbh tape respectively. Sapling (greater than 1m height and having dbh less than 10cm) and seedling (height 30cm to 1m) were counted in sub-plots of 5mx5m and 5mx2m respectively inside sampling plots.

Number of cut stumps of tree species with height and circumference at top and lopping percent of tree species were noted in 10mx10m plots to quantify human interference, grazing pressure and management practice. Data were analyzed to calculate density and relative density; frequency and relative frequency; dominance and relative dominance following Kapur and Govil (2000). Importance Value Index (IVI) was calculated as the sum of relative basal area, relative density and relative frequency for trees whereas in case of shrub and herbs relative dominance and relative coverage were used respectively instead relative basal area.

For estimation of above ground biomass, a non-destructive method was used. The oven dry biomass of the tree components was calculated by using following biomass equation (NARMSAP & DoF 2000).

$$Ln (W) = a + bLn (d)$$

Where, W is above ground oven dry biomass of tree (kg), d is diameter at breast height (cm), and a, b are parameters estimated (NARMSAP & DoF 2000).

Shannon-Wiener's Index (Shannon & Weaver 1949) was calculated to measure species diversity. The Shannon-wiener's index is;

$$H = - \sum p_i Ln p_i$$

Where, H is the index number, s is the total number of species, p_i is the proportion of all individuals in the sample which belongs to species i, and Ln is the natural log, 2.718.

Specimens of all species were collected and the herbarium was prepared for identification. Some of the plants were identified using standard reference (Stainton 1988, Shrestha 1998) and others with the help of specimens deposited at TUCH.

Results

Vegetation composition

The study area contained natural as well as planted forest. It has a mixture of tall and medium height trees with a thick understorey of tangled shrubs and herbs, the composition varying according to soil and availability of water. The forest was dominated by *Alnus nepalensis*, *Pinus roxburghii* and *Schima wallichii*. *Alnus nepalensis* constituted 26.34% of the importance value (Table 1). Other important associated species were *Albizia julibrissin, Castanopsis indica, Eurya accuminata, Myrica esculenta, Lyonia ovalifolia,* etc. The understorey vegetation was composed of *Hypericum uralum, Berberis aristata, Melastoma melabathricum*. The ground vegetation was mainly represented by *Capillipedium assimile, Eupatorium adenophorum* and *Biden pilosa*.

Density and basal area

In the study area 18 tree species from 13 families were found. The total tree density was 840 stems/ha for tree and 2800 stems/ha for shrub. Similarly the total basal area was 689.23m^2/ha (Table 1). The density of different species ranged from 4 to 196 stems/ha and basal area between 0.70 to 266.15m^2/ha. *A. nepalensis* shared the highest density and higher basal area. The density of ground vegetation was found to be 669280 individuals/ha. The height classes of tree showed 46.60% of trees with height of less than 10m and there were no trees with height class greater than 31m (Fig. 3). The stand size classification showed high percent of poles (40.95%) and sapling of 38.09% (Fig. 2). These results showed that most of the stands are at intermediate stages of growth.

Biomass

The total living above ground biomass of trees was 4021.41kg/ha (Table 2). The highest above ground biomass in forest was contributed by *C. indica* (2190.7kg/ha) followed by *M. esculenta* (638.9kg/ha), and *S. wallichii* (229.79kg/ha). The carbon content of the forest can be calculated by multiplying the 0.5 conversion factors to above ground biomass (Brown *et al.* 1989). The mean carbon content of above ground biomass of the study area was found to be 2.01t/ha which is lower than that in Champadevi community forest of Kirtipur (24.72tC/ha) as revealed by the study conducted by Khanal (2007).

Table 1. Important value index of tree species

Tree species	D/ha	RD (%)	F (%)	RF (%)	BA (m^2/ha)	RBA	IVI
Albizia julibrissin	8	0.95	8	2.43	7.02	1.01	4.41
Alnus nepalensis	196	23.33	56	17.07	266.15	38.61	79.02
Castanopsis indica	48	5.71	16	4.87	24.45	3.54	14.14
Choerospondias axillaris	8	0.95	4	1.21	10.75	1.56	3.73
Engelhardia spicata	12	1.42	8	2.43	13.51	1.96	5.82
Eurya accuminata	36	4.28	24	7.31	5.09	0.73	12.34
Ficus semicordata	4	0.47	4	1.21	2.27	0.32	2.02
Luculia grantissima	8	0.95	8	2.43	0.70	0.10	3.49
Lyonia ovalifolia	28	3.33	8	2.43	6.16	0.89	6.66
Maesa chisia	32	3.80	8	2.43	6.86	0.99	7.24
Myrica esculenta	64	7.61	24	7.31	39.81	5.77	20.71
Pinus roxburghii	136	16.19	52	15.85	153.20	22.22	54.27
Pinus wallichiana	48	5.71	8	2.43	19.19	2.78	10.93
Prunus cerasoides	16	1.90	12	3.65	3.66	0.53	6.09
Pyrus pashia	8	0.95	8	2.43	2.15	0.31	3.70

D – Density, RD – Relative Density, F – Frequency, RF – Relative Frequency, BA – Basal Area, RBA – Relative Basal Area, IVI – Important Value Index, ha – Hectare

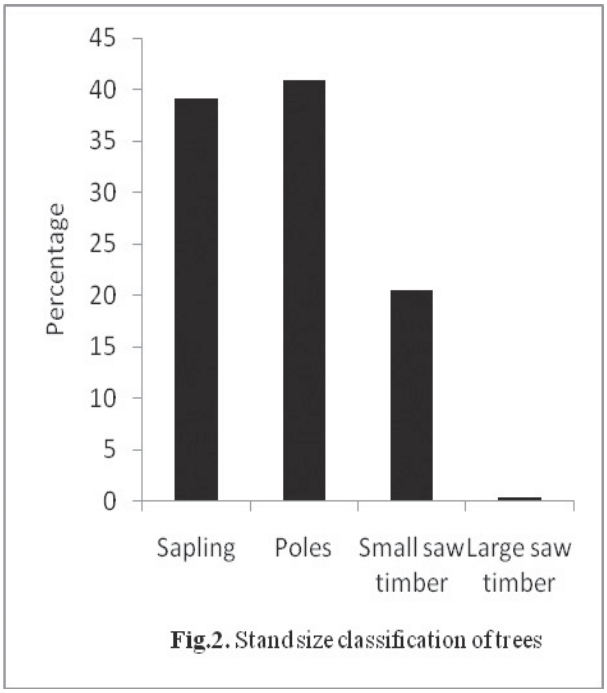

Fig.2. Stand size classification of trees

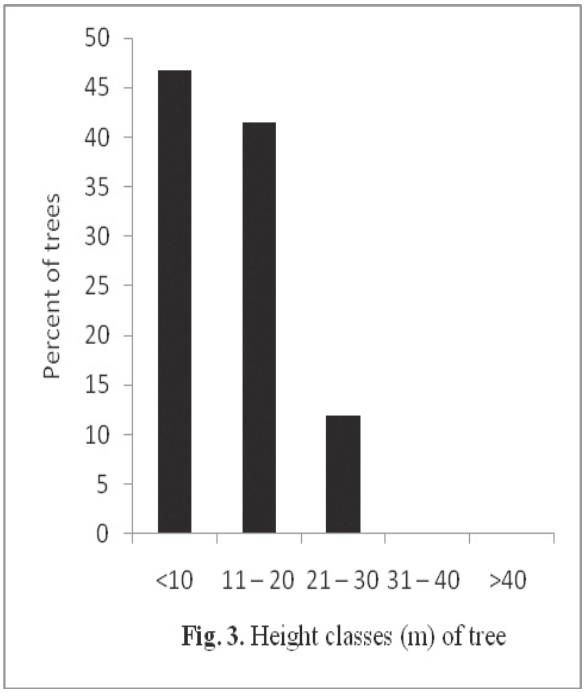

Fig. 3. Height classes (m) of tree

Table 2. Biomass of trees

Species	Total leaf biomass (kg/ha)	Total branch biomass (kg/ha)	Total stem biomass (kg/ha)	Total biomass (kg/ha)	Total biomass (%)
Albizia julibrissin	4.82	16.02	-	20.85	0.51
Alnus nepalensis	44.45	46.59	117.14	208.18	5.17
Castanopsis indica	251.3	483.7	1455.7	2190.7	54.47
Choerospondias axillaris	7.45	13.57	20.66	41.69	1.03
Engelhardia spicata	3.94	3.35	7.47	14.78	0.36
Eurya accuminata	7.32	9.94	49.43	66.70	1.65
Ficus semicordata	1.93	0.54	5.37	7.86	0.19
Luculia grantissima	4.06	7.40	11.27	22.75	0.56
Lyonia ovalifolia	1.73	13.82	6.18	21.73	0.54
Maesa chisia	21.93	39.97	60.84	122.75	3.05
Myrica esculenta	62.6	203.7	372.6	638.9	15.88
Pinus roxburghii	9.73	2.05	29.27	41.05	1.02
Pinus wallichiana	24.40	30.86	27.55	82.81	2.05
Prunus cerasoides	1.63	5.90	8.43	15.96	0.39
Pyrus pashia	0.85	3.10	4.43	8.38	0.20
Rhododendron arboreum	13.2	50	60.5	123.7	3.07
Schima wallichii	102.83	58.15	138.81	299.79	7.45
Syzygium cumini	16.57	30.20	45.97	92.75	2.30
Total	580.81	1018.93	2421.663	4021.416	100

Species diversity and dominance

The diversity of different forest components (trees, shrubs and herbs) was 2.33 for tree, 2.22 for shrubs and 2.17 for herbs (Table 3). An assessment of extent of dominance from the structural stand point has been made by computing the species importance value as an index. Only four species *A. nepalensis*, *P. roxburghii*, *S. wallichii* and *M. esculenta* comprised about 68.39% of the total importance value and the remaining percent were shared among 14 different species including dead trees. *A. nepalensis* constituted more than 26% of total importance value.

Table 3. Species diversity and dominance

Index	Shannon –Index (H)	Evenness (E)	Heterogeneity	Dominance (Do)
Tree	2.3317043	0.806714	0.193285	0.133605
Shrub	2.2225691	0.801622	0.198378	0.148277
Herb	2.1788686	0.676904	0.323096	0.178218

Discussion

The forest of the study area was mainly dominated by *A. nepalensis*, *S. wallichii* and *P. roxburghii*. However, Malla (2005) reported that *R. arboreum* as dominating species in Bishnubudanilkantha region and *C. indica* and *Quercus semicarpifolia* in Shivapuri Peak of Shivapuri National Park. It may be due to the different topography and edaphic factors (Krebs 1972). The value of total tree density was 840 stems/ha, which is similar to the finding of Kumpakha (2008) in the Sundarijal VDC of Shivapuri National Park. Generally the diversity of herb species is greater in rainy seasons and in summer low moisture content in the soil as well as the fire affect the diversity of herbs. The forest stands showed the high percent of poles (40.95%) and sapling which is similar to the findings of Amatya (1993). This indicates that the forest has been intensively used long time for various forest products.

The importance value was 79.02 for *A. nepalensis*. Sigdel (2008) obtained only 21.16 importance value for this species in Bishnubudanilkantha region. The higher

importance value in the present study compared to other species showed that these species are ecologically important to maintain the existing ecosystem. The average above ground biomass was 4021.41kg/ha in Sikre forest. *C. indica* (2190.7kg/ha) contributed the highest biomass. Based on potential resources supply and household demand of forest product from the community forest, the status of forest was found to be degraded and subjected to greater harvest. There was annual deficit of 112.038 t/yr of fuel wood at Sikre VDC. According to Pandey (1976 cited in Amatya 1993) 4216t ground grass (undergrowth) and 12,650t of tree leaves as fodder can be removed from the proposed BZ forest of ShNP whereas fuel wood consumption was estimated to be 18,750t/yr which was higher than yield from the forest (8,708 t/yr). As there was a shortage of fuel wood and fodder, plantation of fuel wood and fodder species should be given priority in the buffer zone to meet the need.

The total density 184/ha of cut stumps and 216/ha of lopping was observed in study area of the forest. Kumpakha (2008) obtained higher total density of cut stumps (426.667/ha) and lopping (1134.67/ha) in Sundarijal VDC of ShNP which showed that the human disturbances were found to be much lower in the study area. *S. wallichii* (40/ha), *M. chisia* (28/ha) and *A. nepalensis* (24/ha) were the most common cut stump species among other species. Household's fodder and fuel wood need might have been fulfilled by this.

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