Forest Research and Training Centre
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ASSESSING THE STATUS OF FOREST REGENERATION UNDER SILVICULTURE SYSTEM BASED FOREST MANAGEMENT (A CASE STUDY FROM NAWALPUR DISTRICT)

BACKGROUND

Silviculture is the art and science of producing, tending, and manipulating forest stands. It encompasses activities such as regenerating the forest, maintaining tree growth, and harvesting trees to satisfy the landowner's objectives (Web and Gautam, 2001). Forest management considers the entire forest as the primary unit, while the silviculture centers on individual stands of trees. The silvicultural system provides a framework for carrying out various operations. The Government of Nepal began promoting Scientific Forest Management as an application of appropriate silviculture system and forest management principles through design of systematic compartment of fixed rotation age. This follows primarily the shelter wood silviculture system with very high intensity logging , leaving only 15 to 30 mature mother tree per hectare. This system integrates specific harvesting, regeneration, and stand tending methods to ensure sustained benefits. The Government of Nepal has initiated the Irregular Shelterwood System in Dumkibash-Arunkhola block forest of Nawalpur district for better conservation and sustained yield since the fiscal year 2073/74. Therefore, it is important to conduct detailed documentation, and analysis of vegetation of the area which will serve as temporal important source information to the forest department, researcher, and other concern stakeholders.

OBJECTIVES

•To analyze the plant community structure and distribution pattern

• To assess the species diversity and density of regeneration.

MATERIALS AND METHODS

Shape and size of sample plot

Systematic random sampling methods was used to generate sample plots across the study area using the ArcGIS 10.6 Fishnet tool. Rectangular plots with 500 m^2 were laid for the tree and vegetation study and several sub plots were established within each plot for specific purposes: 100 m^2 for pole ,25 m^2 for sapling and 1 m^2 was established for counting regeneration. Plot coordinates were then uploaded to a GPS device for the on site navigation of sample plots

Measurement of seedlings

Seedling, referring to the plants below 1.3 m. height were surveyed in four plots of size 1m^2 laid on four cardinal directions of 100 m^2 plots. All the seedling within that plots were counted and recorded on data collection sheet.

Measurement of the sapling

Saplings, those over 1.3 meter height and DBH under 10 cm were counted in the plot with 5.64 m radius. Heights and DBH were measured using Abney's Level and diameter tape. The first sapling was measured in North from the center of plot and gradually measurement proceeded in clockwise direction. The diameter of each saplings were measured exactly at 1.3 m (at breast height) from ground level and recorded accordingly in the field data sheet.

Measurement of trees and Poles

All the trees having the diameter at breast height equal or greater than 30 cm are considered as trees. Within a 500 square meter plot delineated by a 12.62-meter radius, tree quantification and measurements were conducted. Sapling height and diameter at breast height were measured using Abney's Level and Diameter tape. Similarly, Poles are also considered as young tree with DBH between 10-29.9 cm were also measured.

MATERIALS AND METHODS

In both managed and control area, the plant community structure were studied and For each species, calculations of basal area, density, and frequency were performed to ascertain the Importance Value Index (IVI).

Basal area: Basal area refers to the ground penetrated by the stems. It is one of the characters that determine the dominance. Basal area of a species in each sampling plot was obtained by the summation of Basal area of all individuals of a species.

Basal Area (m^2) = $\frac{\pi(DBH)^2}{4}$

Likewise, species in all the sampled plots were ranked according to the importance value index (IVI) which is a statistical quantity that gives the overall picture of the importance of the species in the vegetative community. It was obtained by the summation of relative density (RD), relative frequency (RF) and relative basal area (RBA).

$$Relative\ Density = \frac{Density\ of\ the\ species}{Total\ density\ of\ all\ speceis} \times 100$$

$$Relative\ Frequency = \frac{Frequency\ of\ occurence\ of\ the\ species}{Total\ frequency\ of\ all\ species} \times 100$$

$$Relative\ Basal\ Area = \frac{Sum\ of\ basal\ area\ of\ all\ individuals\ of\ a\ spps\ in\ the\ sample}{Total\ basal\ area\ of\ all\ the\ spps\ in\ the\ sample} \times 100$$

To measure the species diversity in different plots, the Shannon Wiener function of species (Shannon and Weiner 1963) diversity was calculated

$$H = -\sum pi \log pi$$

Where,

pi is the proportion of total number of individuals that occur in the species i. i.e. (ni /N).

ni is the number of the individuals of a species i and i = 1 to k.

k is the total number of the species.

N is the total number of individuals of all species in the sample.

RESULTS

Plant species composition and distribution pattern

The total number of species recorded in managed and control area were 11 and 18 respectively. The IVI of Sal was 150.52 for managed area and 140.58 for control area. In both the managed and control area, IVI of Sal (*Shorea robusta*) was found higher which indicates that the Sal is the dominant species. Sal is highly dominated in the managed area as compared to the control area.

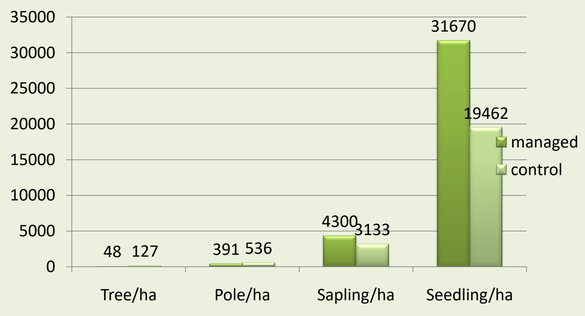

Fig 1: *Tree, Pole, Sapling and Seedling status in the study area*

Table 1: *Statistical comparison of regeneration between managed and control area*

Description	Control				T-test (P-value)
	mean (stem/ha)	SE	mean (stem/ha)	SE	
Sapling	3133	0.4	4300	0.4	2.20E-16
Seedling	19462	0.34	31670	0.21	3.50E-09

RESULTS

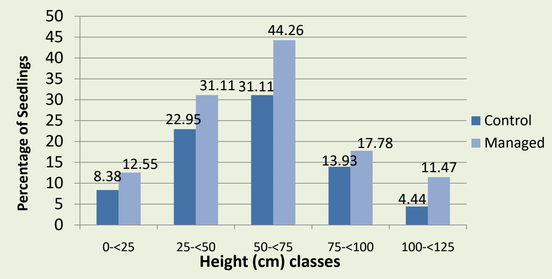

Fig 2: *Per ha distribution of Shorea robusta with different height class*

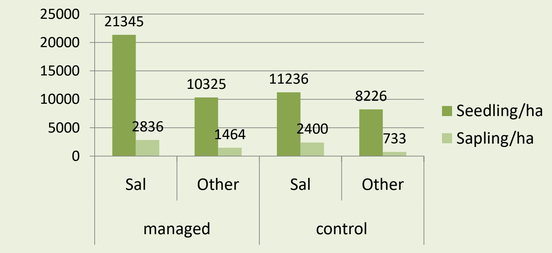

Fig 3: *Regeneration status of Shorea robusta in compare to other species*

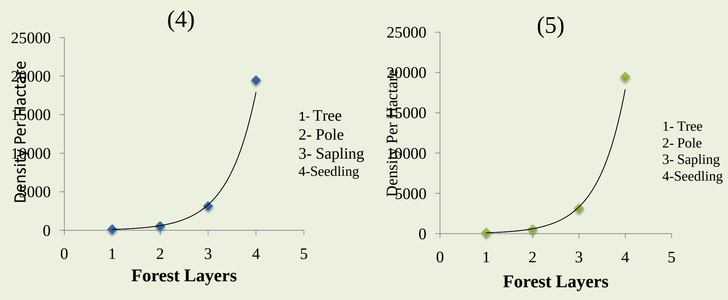

Fig 4: *Forest community characteristics of managed area*

Fig 5: *Forest community characteristics of control area*

Table 2: *Shannon Weiner's Diversity index in control and managed area*

Description	Variables	Control		Managed		Mann-Whitney U test
		Mean/plot	SE	Mean/plot	SE	
Shannon wiener Index (H)	Tree	0.46	0.07	0.31	0.07	0.57
	Pole	0.96	0.08	0.72	0.07	0.087
	Sapling	0.85	0.07	0.42	0.05	8.34E-06
	Seedling	0.98	0.05	0.73	0.06	0.0054

CONCLUSION

Sal (*S. robusta)* seems the most dominant species in the study area with significant high seedling and sapling in managed area. The population structure of the most common species of trees exhibited diverse patterns in both control and managed forest, revealing the overall species population dynamic within the forest indicating the good status.

The overall regeneration status showed the J-shaped curve with a higher percentage of species exhibiting good regeneration status. Similarly, the calculated IVI values of *Shorea robusta* in study area reveal the good status. In conclusion, the forest is rich in diversity with higher density of seedling, sapling and young trees showing a good regeneration potential that can be sustained for various felling period with proper management.

RECOMMENDATION

Among the different silvicultural systems, the irregular shelterwood system applied in lower region of Nepal can be a good model for promoting the sustainable regeneration and regulation of Shorea robusta as it is economically importance tree species for achieving economic prosperity from forestry sectors.

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