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Status of Tree Regeneration under Broom Grass Plantations in Tanahun Nepal

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ABSTRACT: Broom grass is a high value perennial and evergreen shrub that grows in hilly areas of Nepal including Tanahun district. Plantation of Broom grass because of its multiple benefits has been appreciated in Nepal and is practiced in most places. This research intends to identify regeneration status of trees species in Broom grass plantation area of Tanahun district. 110 sample plots were taken for the study and regeneration inventory were done. The result shows that 3509 seedlings regeneration per hectare and 1462 saplings per hectare saplings existed in Broom grass plantation area making total regeneration of 4971 per hectare. Altogether 37 species of tree regeneration were recorded from entire plots and the overall regeneration was found to be high in leasehold forest (5286 per ha), moderate in community forestry (4510 per ha) and low in private forest (3156 per ha).

KEYWORDS: Broom grass, Shifting cultivation, regeneration, community forest, leasehold forest

I. INTRODUCTION

Broom grass (*Thysanolaena maxima)* is an evergreen plant, which grows in bunch, up to three meter in height (Bisht, 1998). It is a perennial, high value cash crop that grows in hot and temperate climates in several hilly areas of Nepal (WWF, 2015). Its multipurpose use such as fuel, broom and fodder and capacity of soil stabilization, has made this plant favourite for rural communities (Bisht & Ahlawat, 1998; Chavez & Zagt, 2014 & WWF, 2015). Its tolerance to harsh environmental conditions makes it suitable to grow in wastelands, degraded lands where other plant species are unable to survive (Bisht & Ahlawat, 1998; WWF, 2015). Besides, its fibrous roots effectively checks soil erosion and landslides in steep slopes making it one of the bioengineering measures in erosion control (Kafle & Balla, 2008). The impact of Broom grass plantation on forest restoration was little known (WWF, 2015) and therefore, this study aims to analyse the status of regeneration of tree species in Broom grass plantation areas of Tahahun district.

II. RELATED WORK

Broom grass grows faster than most forest tree saplings and creates a very dense light-intercepting canopy (Balandie, 2008; Bisht & Ahlawat, 1998). The grass has amplitudes of benefits like reducing soil erosion and increasing ground fertility and providing source of income generation through broom which are widely marketed (Kotak, 2015; WWF,

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2015).Plantation of Broom grass due to its multiple benefits is popular and practiced in different parts of the country. Some of the successes to reduce the traditional shifting cultivation in Jhirubas of Palpa district and Hupsekot of Nawalaparasi district is due to the Leasehold Forestry Program of Government of Nepal, which was piloted since 2010 (WWF, 2013). Broom grass was planted in hundreds of hectares of degraded forest land in Palpa and Hupsekot (WWF, 2015). Similar interventions are initiated in Tanahun district, where shifting cultivation was prominent. The objective of this plantation was to stop the soil loss and increase greenery along with enhancing the livelihood benefits in the short term and enhance the forest cover in the long term (DFO Tanahun, 2015; WWF, 2015).

Broom grasses were planted in 49 leasehold forests in different Village Development Committees (VDCs) and municipality of Tanahun district (DFO Tanahun, 2015; WWF, 2015). According to data available from District Forest Office-Tanahun (2015) and Department of Forest (DOF) Broom grass were planted in 18 Leasehold Forests of Devghat VDC, 12 in Abukhairini VDC, 10 in Baidi VDC, four in Bhanu VDC, three in Dhorfirdi VDC and one each in Chimkeswori VDC and Byas Municipality. Likewise, in 13 Community Forests and few other private lands Broom grass were planted (DFO Tanahun, 2015 & DOF, 2012).

III. METHODS AND MATERIALS

Study Area

The research was conducted in Leasehold Forests (LFs) and Community Forests (CFs) and Private Forests (PFs) of Tanahun district, where Broom grass were planted earlier by various programs such as leasehold forestry program, Hariyo Ban I and DFOs, etc. Data were collected through regeneration inventory of sample plots within the Broom grass plantation areas. The inventory of forest tree regeneration in the Broom grass plantation sites was done using the Community Forestry Inventory Guidelines and similar research conducted by Thompson, 1983. The sites for inventory like Devghat, Abukhairini, Baidi, Dhorfirdi, Ghansikuwa and Bhanu VDCs and Byas Municipality were purposively selected based upon different forest management regimes and varying topography. Figure 1 show 110 sample plots in various VDCs of Tanahun district where regeneration inventory were conducted.

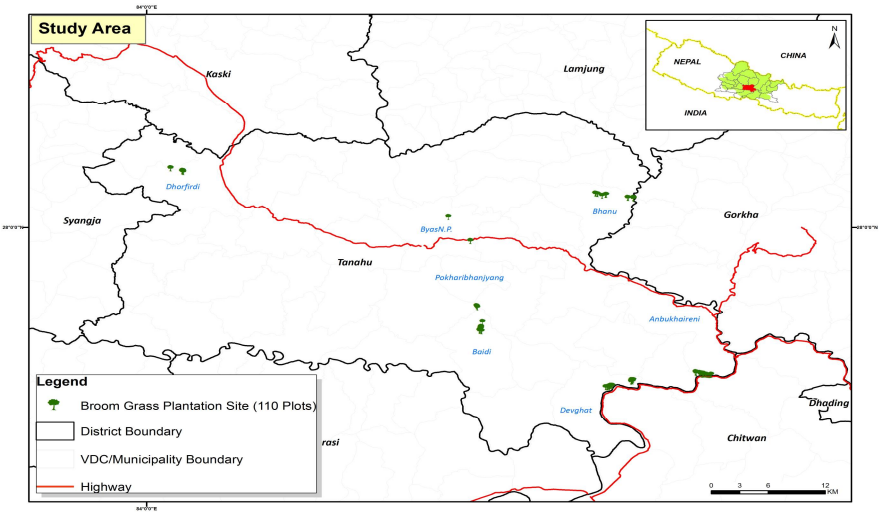

Figure 1: Map showing study area with sample plots

Sample plots

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Sampling intensity for regeneration of 0.25% was taken for maintaining accuracy (at least 0.1% sampling intensity is suggested by community forestry inventory guideline) which made up 110 sampling plots (DOF, 2004). Firstly, potential VDCs with variation in topographical and climatic factors were selected (cluster sample) in which sample plots were randomly laid in different potential forests. 110 sample plots of 5m X 5m quadrate were conducted in various sites. In each plot, all tree species less than 10 cm Diameter at Breast Height (DBH) were considered as regeneration and enumerated separately into seedlings (less than 1 m height) and saplings (more than 1 m height and less than 10 cm DBH) (Aryal, 2012; DOF, 2004). In each sample plot, the number of saplings and seedlings were counted using 5m X 5m quadrate and 5m X 2m quadrate respectively. Geographical Positioning System (GPS) coordinates along with detail information mentioned in the inventory format were recorded for each sample plot as done by Aryal, 2012 & Shrestha, 2014.

Design of inventory survey format

To get a general overview of the study area and to evaluate the relevance of the data collection formats and plot size, piloting of two plots was performed at the beginning of the field-work that was beyond 110 sample plots. A format for data collection on regeneration was revised using Forest Resource Inventory format prescribed by Community Forest Inventory Guideline. Details on the VDCs and sample plots collection are listed in table 1 which illustrates that different plot numbers existed in different VDCs based on the Broom grass plantation area. These sample plots were plotted in LFs, CFs and PFs and the elevation ranged from 245 meter to 1120 meter above sea level.

Table 1: List of VDCs and their sites visited

S.N.	VDC/ Municipality	No. of Plots	Location of plots in CF/LF/PF	Elevation
1	Devghat VDC	26	7 LF, 1 PF	283 m to 433 m
2	Abukhairini VDC	22	6 LF, 1 CF, 2 PF	245 m to 469 m
3	Baidi VDC	21	8 LF	289 m to 851 m
4	Byas Municipality	3	1 LF, 1 PF	543 m to 563 m
5	Dhorfirdi	12	3 LF	968 m to 1120 m
6	Ghasikuwa	3	1 CF	373 m to 445 m
7	Bhanu VDC	24	5 LF, 2 CF, 1 PF	403 m to 901 m
	Total	110		

CF: Community Forests, LF: Leasehold Forests, PF: Private Forests

Data analysis

Data analysis involved data listing, organizing data and explanatory data analysis. As data were derived from various sources at different levels and with variation in information, these were listed, compiled and organized using SPSS v20. Data were analyzed to find out the average number of forest tree regeneration that existed in the Broom grass plantation areas. Regeneration per hectare was calculated using following formula suggested by Community Forestry Inventory Guideline, 2004;

$$\textbf{Number of regeneration per ha} = \frac{\text{Average regeneration counts per plot X 10,000 (sq. m)}}{\text{Area of plot (sq. m)}}$$

Status of tree regeneration was analyzed according to VDC species wise and forest management regime and Standard Deviation of sample plots were analyzed to determine the variation of regeneration in different VDCs.

IV. RESULTS

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Status of Regeneration in Plantation site

The analysis of 110 sample plots showed that the tree regeneration in plantation area was 4971 per hectare among which 3509/ha were seedlings and 1462/ha were saplings. Based on community forestry inventory guidelines the number of regeneration represented satisfactory regeneration of the area.

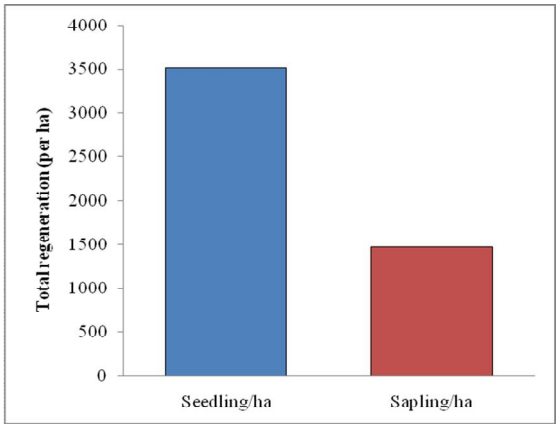

Figure 2: Total regeneration status from all plots

Regeneration status in different VDCs

Regeneration was found to be highest in Bhanu VDC (7425/ha) whereas it was found to be lowest in Baidi VDC (3276/ha). Maximum number of seedlings were found in Bhanu VDC (5542/ha) and minimum in Baidi VDC (2190/ha). Similarly, maximum saplings were found in Byas municipality (2133/ha) and minimum in Ghasikuwa VDC (533/ha). Regeneration number per hectare however were found to be varied in different VDCs. Devghat, Baidi, Byas and Ghasikuwa VDCs had lower number of regeneration while VDCs like Abukhairini, Dhorfirdi and Bhanu contained higher than average regeneration number per hectare. Mean regeneration number per plot was 7.16 and Standard Deviation calculated was 4.18 (n=110). This showed that the distribution of regeneration was not uniform throughout planted sites as illustrated in figure 3.

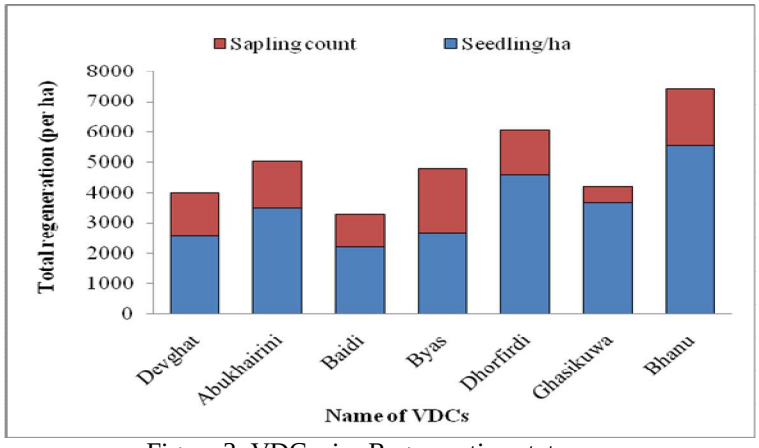

Figure 3: VDC wise Regeneration status

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Regeneration status according to Forest management types

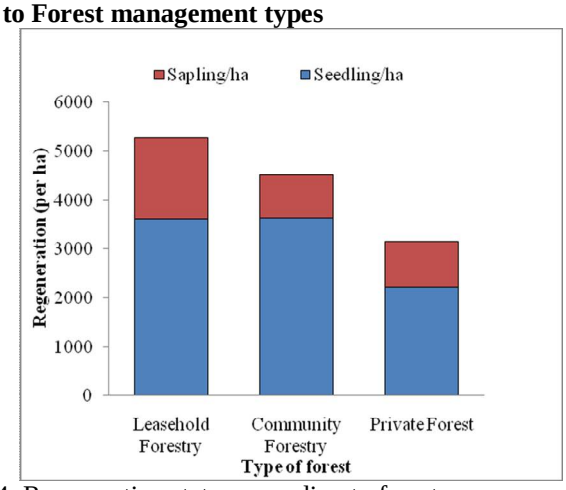

Figure 4: Regeneration status according to forest management regime

Out of 110 plots surveyed, 81 plots were surveyed in Leasehold forests, 20 plots in Community Forests and 9 plots in Private Forests. The seedlings were found to be similar in Community Forest (3650/ha) and Leasehold Forest (3617/ha) and comparatively lower in Private Forest (2222/ha) whereas saplings were found to be higher in Leasehold Forest (1669/ha) and lower in Community Forest (860/ha) and Leasehold Forest (933/ha). From the survey, the overall regeneration was found to be high in Leasehold Forest (5286/ha) moderate in Community Forest (4510/ha) and low in Private Forest (3156/ha) as shown in figure 4.

Occurrence of species wise regeneration

Altogether 37 species of regeneration were recorded from Tanahun district including 26 seedling species and 35 sapling species. The overall seedling occurrence in entire plots included higher number of Chilaune (*Schima wallichii*) (71) whereas Bakaino (*Melia azadirach*), Kafal (*Myrica esculenta*), Kankane, Padke (*Albizia odoratissima*), Seto Siris (*Albizia procera*) and Simal (*Bombax ceiba*) were found least in number (1).
Likewise, sapling species of Chilaune (*Schima wallichii*) was found to be highest (73) whereas Bel (*Aegle marmelos*), Chhatiun (*Alstonia scholaris*), Dabdabe (*Garuga pinnata*), Dhobini (*Mussaenda roxburghii*), Guili/Guyalo (*Callicarpa macrophylla*), Kankane, Karam (*Adina cardifolia*), Khalluk, Mango (*Magnifera indica*), Putalikath (*Neolitsea umbrosa*) and Simal (*Bombax ceiba*) were found in least number (1) in entire sample plots.
The regeneration of Chilaune (*Schima wallichii)* was found to be highest (911/ha) whereas the regeneration of Bel (*Aegle marmelos*), Chhatiun (*Alstonia scholaris*), Dabdabe (*Garuga pinnata*), Dhobini (*Mussaenda roxburghii*), Guyalo (*Callicarpa macrophylla*) and Putalikath (*Neolitsea umbrosa*) were found to be lowest (4/ha).

V. DISCUSSION

According to Community Forestry Inventory Guideline regeneration of 2000 to 5000 number of seedlings per hectare or 800 to 2000 numbers of saplings per hectare are considered satisfactory. This study showed that the total number of regeneration of seedlings and saplings were 3509 and 1462 per hectare respectively which signifies that the regeneration (both seedlings and saplings) in the area was considerably satisfactory.
Altogether 37 different species were observed in entire sample plots. In terms of variance 35 different species of saplings and 26 species of seedlings were observed throughout the sample plots. Species wise analysis suggested that species such as *Schima wallichii, Euphorbiaceae spp, Shorea robusta, Castanposis indica, Anogeissus latifolius* occurred frequently throughout the sample plots. *Lithocarpus elegans, Neolitsea umbrosa, Aegle marmelos, Aesandra*

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butyracea, Garuga pinnata, Mussaenda roxburdhii, Ficus racemosa, Callicarpa macrophylla, Syzigium cumini, Myrica esculenta, etc were recorded in fewer plots (1 or 2 plot only).

It was observed that the regeneration (both seedlings and saplings) existed very few in number or none in those areas where Broom grass were very good in condition that already gave good broom production. Members from respective forest user groups mentioned that they have taken good care of Broom grass plantation area through weeding of entire other species. It was observed that the Broom grass was tall and dense and restricted the light penetration through the crown of Broom grass thereby retarding the growth and regeneration of tree species.

It was also observed that plantation site with good Broom grass had more number of saplings compared to seedlings and which was because their seedlings existed together with Broom grass plantation that turned into saplings. Broom grass area were managed through cleaning and clearing of weeds which also considered weeds to any species except Broom grass like Tejpat (*Cinnamomum tamala*), Chiuri (*Diploknema butyracea*), Orange (*Citrus sinensis*) and Champ (*Michelia champaca*) and cleared at least twice a year. In contrast it was observed that some of the plantation sites where the condition of Broom grass was not good the regeneration of tree species was found to be significantly higher in number.

VI. CONCLUSION

Broom grass has contributed to its maximum in terms of greenery maintenance, erosion control, economic benefits to villagers and increase occurrence of wild lives Barren lands, forests with invasive species such as *Lantana camara* and *Mikania micrantha* were cleared and planted with broom (WWF, 2015). Although tree species regeneration was observed satisfactory in Broom grass plantation sites with variation in different VDCs this could be improved if the user groups are made aware about long term importance of tree regeneration. Local user group maintained Broom grass plantation by regular weeding and clearing of weeds including tree regeneration which reduced number of regeneration in Broom grass plantation area, however abandoned Broom grass plantation sites had dense regeneration.

Local users expected financial and technical supports for up scaling similar activities in their forests. Post-plantation supports were also expected for managing the plantation area. Restoring of forest cover in such areas can thus be made more effective by developing mechanism which can motivate forest users to manage their Broom grass plantation and also taking care of the regeneration of forest tree species. A continuous monitoring and post-plantation support will bring a win-win situation for Broom grass and forest restoration.

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