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REGENERATION STATUS AND POPULATION STRUCTURE IN TERAI COMMUNITY FOREST: EVIDENCE FROM KALYANKOT COMMUNITY FOREST, KAPILVASTU DISTRICT, NEPAL

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Abstract

The regeneration status of a forest is an essential metrics to assess the regeneration potential and population structure of forests. In emerging nations like Nepal, however, human dependency on forests has had a negative influence on forest diversity and sustainability. This paper analyzes the regeneration status and its link with bio-physical aspects and human disturbances. The data were collected using a systematic random sampling method and sample plots were established using the fishnet tool in ArcGIS. An inventory survey of 96 plots was carried out with nested circular sample plots with a main radius of 1261 cm. The overall regeneration condition of the forest was found to be in good condition according to Community Forestry Inventory Guideline, 2004. The majority of the tree species were determined to have a sound quality and medium (II) grades in this study. In terms of the diameter class distribution, lower diameter classes (21-60 cm) comprised more adults than the upper diameter classes (61-120 cm). This study found no significant variations in the effects of biophysical factors, such as slope and aspect, on species regeneration. The study concludes the inadequate silvicultural management interventions in the forest. This information can be useful to devise systematic plans to promote good-quality regeneration and manage the factors that are likely to affect the overall regeneration. Further research focusing on other biophysical factors as well as social factors and their influence on regeneration including its management techniques is recommended.

Keywords: Biophysical variable, Diameter class distribution, Disturbances, Inventory, Seedlings

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Introduction

A forest area is comprised of different stages of species composition i.e. seedling, sapling, and tree. The seedling and sapling number in a forest indicates the regeneration status of that forest (Karyati *et al*., 2013). Enough number of tree species present in the forest indicates successful and satisfactory behavior (Pala *et al.*, 2013) and reflects the productive characteristics of the forest (Chauhan *et al.*, 2008). Natural regeneration is fundamental for forest ecosystem management as well as sustainability (Tesfaye *et al.*, 2010) which is essential for preserving and maintaining global biodiversity (Rahman *et al.*, 2011). Species diversity and forest structure are primarily determined by the regeneration of species over time and space as well as natural and anthropogenic disturbances (Munesh Kumar and Rajwar, 2009). The seedling and sapling population of the species determines the regeneration potential of the forest (Negi and Nautiyal, 2005). Enhancing natural regeneration in forest stands may also be the most economical strategy to create a diverse, productive stand (Pradhan *et al.*, 2019). The study of the regeneration potential and growth status of a species is essential to determine ecosystem stability in the long run (Malik and Bhatt, 2016).

Most of the rural populations highly depend on forest resources which leads to forest degradation through the activities like harvesting timber and non-timber forest products, fodder and firewood collection, and domestic grazing (Chapagain et al., 2021). In developing countries like Nepal, human dependency on forest resources challenges biodiversity conservation (Mishra et al., 2004). A healthy forest possesses good regeneration status and predicts good future regenerations (Poudel and Devkota, 2021). However, natural as well as human-induced activities may alter the species diversity, population structure, and composition of the forest ecosystems (Dutta and Devi, 2013). Human disturbances, crown cover, geographical features (slope, aspect, and altitude), soil quality, and climatic condition of the area are the most influential factors to affect the population structure of a forest (Bose et al., 2016; Sapkota et al., 2009a).

Successful natural regeneration can be an achievement for long-term forest management and its sustainability (Malik and Bhatt, 2016; Saikia and Khan, 2013). Regeneration along with species richness and diversity is important for the assessment of forests for sustainability, conservation of the species, ecological significance, and policy formation (Kacholi, 2014; R. S. Tripathi and Khan, 2007). Though natural regeneration is a slow process, it has a significant role in maintaining a stable age structure in forests (Mwavu and Witkowski, 2009), and its improvement is the most cost-effective way in achieving a productive stand with rich species (Liira *et al.,* 2011). Hence, the study of the diverse characteristics of the forest affecting natural regeneration is essential (Mousavi *et al.,* 2011). An understanding of the age distribution of a forest population explains its reproductive potential and predicts its future (Thakur *et al.,* 2021). Community Forestry Inventory Guideline 2004 is a common policy tool for assessing regeneration and yield regulation which is mainly focused on sustainable management of the community forest in Nepal (Sharma, 2017). In forest management, regeneration studies show not only the current state of the forest but also clues about future changes in forest composition.

Nepal's forest is a habitat for several species thus improvement of regeneration status is vital to improve the status of degraded forests (Chikanbanjar *et al.,* 2020). As the lowland forests of Nepal are comprised of diverse wild flora and fauna (Paudel and Bhattarai, 2011), sustainable management plan to improve the regeneration is very important. The literature review reveals that there are very limited studies related to the regeneration status in lowland terai forests. Kapilvastu as a district representing lowland terai forest of Nepal and situated in the Terai Arc Landscape (TAL) of Nepal has no such study carried out to date. Thus, a study related to an assessment of population structure reflecting regeneration condition of the forest is very essential that can indicate the entire lowland terai forests of Nepal. Hence, this study was carried out with the objectives to (i) assess the overall population structure (ii) analyze the current regeneration status and (iii) analyze the factors affecting the regeneration. The results of this study are expected to be useful to the wider policy groups for developing essential plans and procedures to improve the regeneration status as well as the overall forest condition in the lowland forests of Nepal. Therefore, research and studies on regeneration provide insights into its current structure and composition contributing further forest management planning and conservation strategies such as seedling and sapling manipulation through minimization of grazing and crown cover regulation.

Materials and methods

Study area

Kalyankot Community Forest is situated in the southern part of the Kapilvastu district of Nepal (*Figure 1*). The district lies between latitude 27°32′N and longitude 83°3′E at an altitudinal range of 93 to 1491 masl. Geographically, it has plain low lands of Terai and low chure hills with a humid, subtropical climate. Its average annual temperature ranges from 25°C to-19°C with a maximum of 43°C in the summer to a minimum of 4.5°C in the winter. The community forest goes up to 240m from the mean sea level and is surrounded by the Chirai river in the east; Gangate river in the west; Kalyankot (Chure Area) in the north and Indreni community forest in the south. Kalyankot is rich in wild flora and fauna. *Shorea robusta* (Sal), *Anogeissus latifolia* (Banjhi), *Terminalia tomentosa* (Sajh), *Dalbergia latifolia* (Satisal), *Tectona grandis* (Teak), *Eucalyptus camuldensis* (Safeda), *Madhuca longifolia* (Mahuwa) are the dominant tree species in the forest.

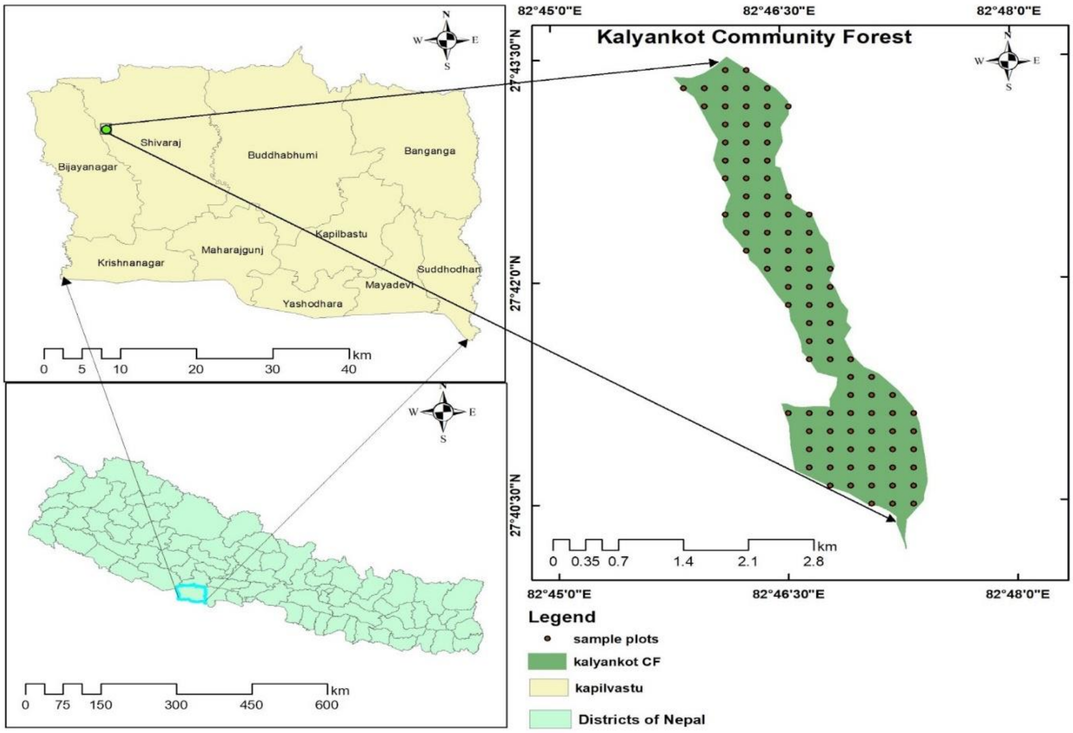

Figure 1: Map of the study area

Data collection

Sampling

The data were collected using a systematic random sampling method. Sample plots were distributed systematically using the fishnet tool in the Arc toolbox function of ArcGIS 10. 8. If the fishnet was created beyond the boundary, a clipping tool was used to locate the sample plots within the forest boundary and the GPS coordinates of the sample plots were extracted. Each plot was located in the field with the help of a Garmin eTrex 10 device. The sampling intensity of 1% was taken for inventory. The total number of sample plots and plot-to-plot distance was calculated as per the Community Forest Inventory Guidelines, 2004 using the following formulae:

$$N = (A * SI\% * 10000)/P$$

Where, N= No of Sample Plots

A= Area of Forest

SI= Sampling Intensity

P= Plot Size

$$D = \sqrt{A} * 10000/(N + 1)$$

Where, D= Plot to Plot Distance

A= Area of Forest

N= No of Sample Plots

The circular plots were established for forest inventory. Trees were measured in 500 m^2 (r= 12.61m) and poles were measured in 100 m^2 (r= 5.64m) plots. The established regeneration (saplings) was measured in the nested concentric circular plot of 25 m^2 (r= 2.82 m) and the young regeneration (seedlings) was measured in the nested concentric circular plots of size 10 m^2 (r= 1.78 m).

Forest inventory

The inventory data were collected in the field from 14th to 21st January 2022. The extracted GPS coordinates of the sample plots were inserted in the Garmin GPS and each plot was located in the field. A total of 95 sample plots were surveyed with a 225 m distance between each sample plot. The plots were laid in a concentric and nested way in the field. Measurements (counting the number of individuals of each species) were made in the order of seedlings, saplings, and adults (trees/poles). The young regenerations (seedlings) were considered plants with a height between 30 cm to 100 cm height. The established regenerations (saplings) were considered as plants of height> 100 cm and DBH up to 9.9 cm. Poles and Trees were considered as the plants with DBH 10 cm to 29.9 cm and ≥ 30cm from 1.3 m above the ground level. In addition, canopy cover, aspect, slope, and human disturbances were recorded to find out the relationship between regeneration status and plot variables. The canopy cover (%) for each plot was estimated visually from the center of the plot following Zobel *et al.* (1987). The disturbance parameters such as grazing, trampling, forest fire, exposed ground, etc. were observed in and around the plot to determine the disturbances following (Haq *et al.*, 2019).

Data analysis

A regression analysis was performed by SPSS 25 to determine the relationship between regeneration and plot variables. Based on extrapolation per ha basis, the density of adults, seedlings, and saplings were computed for the whole forest. Densities (numbers per hectare) of seedlings and saplings of each species were also analyzed to determine the regeneration status of the forest following the community forestry inventory guideline. As per the Community Forestry Inventory Guidelines 2004 (Department of Forest, 2004), the forest condition can be regarded as: (i) 'Good' if the numbers of seedlings and saplings per hectare exceed 5,000 and 2,000 respectively, (ii) 'Medium' if the numbers of seedlings and saplings per hectare lie between 2,000–5,000 and 800–2,000 respectively, and (iii) 'Poor' if the numbers of seedlings and saplings per hectare lie below 2,000 and 800 respectively. The regeneration category of the species was assessed using (Tiwari *et al.,* 2019) as: (a) 'Good' if seedling > sapling> adults, (b) 'Fair' if seedling > sapling ≤ adults, (c) 'Poor' if a species survives only in the sapling stage but not as seedlings, (d) 'None' if a species has no seedlings and saplings, and (e) 'New' if the species has only seedlings and saplings.

Therefore, the regeneration potential of each category was assessed by counting the total number of species in each category of regeneration and dividing by the total number of species representing a value as a percentage of the total species for each forest regeneration category.

$$Regeneration\ potential = \frac{Total\ number\ of\ species\ in\ each\ regeneration\ category}{Total\ number\ of\ species} * 100$$ (Pradhan *et al.,* 2019)

The tree quality was coded for tree state as: S: sound Tree, DD: Dead and Dying, D: Diseased, TC: Top Cut, L: Leaning and tree grade as: I: Generally straight and clear bole that can potentially yield at least 3 logs of 6 feet length, II: Generally straight bole that can yield at least 2 logs of 6 feet length, and III: Generally branched, crooked with/out hollow inside, and cannot yield any logs of commercial value.

Results

Adult quality

The highest percentage (81%) of the tree population i.e. 314 individuals were found to be in a sound state (without any damage to the tree), whereas 8% of trees were dead and dying, 5% were leaning trees, 4% were top cut and 2% were found diseased (*Figure 2*).

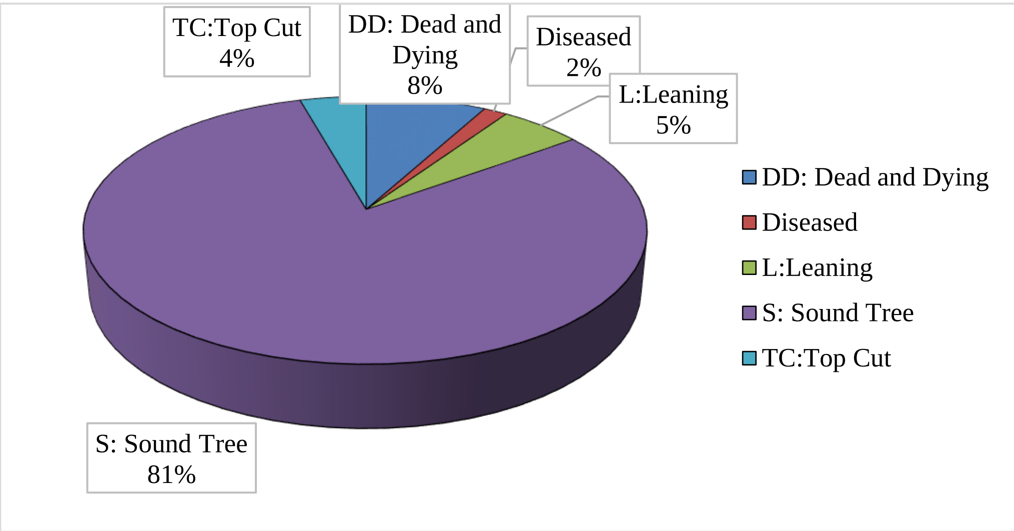

Figure 2: Different tree quality present inside the forest

Adult Grade

Figure 3 shows the wood quality of the tree expressed in Tree Grades i.e. Good (I), Medium (II), and Poor (III). Maximum numbers (44%) of the species were found to be of medium (II) grade followed by 33% of good (I) grade and 23% of poor (III) grade.

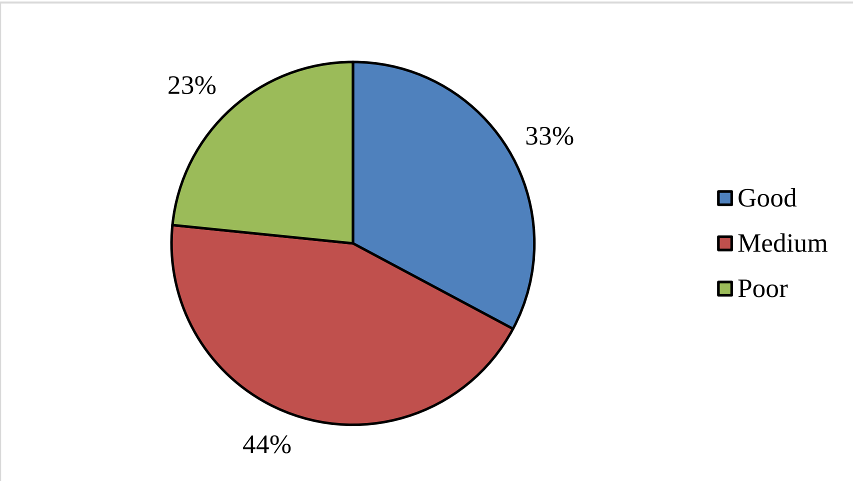

Figure 3: Wood quality of trees in terms of tree grade

DBH classes for Adults

A total of 637 tree individuals were recorded with various DBH classes. The overall population structure of tree species concerning DBH classes exhibited the tree individuals from lowest (10-20 cm) to highest (110-120 cm) DBH class. The highest number (177) of tree individuals were recorded in the DBH class of 20-30cm and the lowest (5) number of tree individuals were recorded in the DBH class of 10-20cm. The DBH class of 60-70cm and 70-80cm shared an equal (49) frequency of adults, whereas overall tree population structure varied with DBH classes (*Figure 4*).

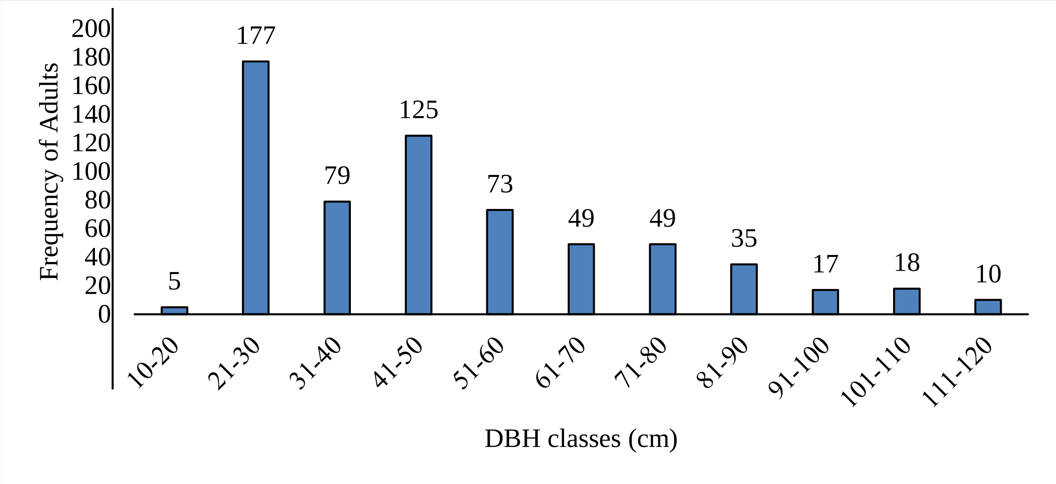

Figure 4: Distribution of individual trees in different DBH classes

Regeneration status of Kalyankot forest

In the entire sample plot of the community forest, the density of seedlings, saplings, and adults were 12756.69, 3063.95, and 305.65 individuals per ha, respectively (*Table 1*). The overall regeneration condition of the forest was found to be in good condition according to CF Inventory Guideline 2004, as the density of seedlings and saplings exceeded 5000 and 2000, respectively. *Shorea robusta, Bauhinia purpurea, Mallotus philippensis, Syzygium cumini,* and *Bauhinia variegata* were major species with a greater number of seedlings/ha. The major species with a greater number of saplings per hectare were *Shorea robusta, Bauhinia purpurea, Mallotus philippensis, Terminalia alata, and Bauhinia variegate* respectively. *Shorea robusta, Anogeissus latifolius, Buchanania latifolia, Mallotus philippensis,* and *Terminalia alata* were 5 major species with a greater density of adult/ha (*Table 1*).

Table 1: Regeneration status of the Kalyankot Community Forest

Scientific Name	Common Name	Family	Seedlings/ha	Saplings/ha	Adults/ha	Regeneration status category
Senegalia catechu (L. F.) P. J.H. Hurter & Mabb.	Khayar	Fabaceae	0	0	0.25	*None*
Adina cordifolia (Willd. ex Roxb.) Benth.	Karam	Rubiaceae	12.50	5	0	*New*
Aegle marmelos (L.) Correa	Bel	Rutaceae	0	0	0.50	*None*
Anogeissus latifolius (Roxb. ex DC.) Bedd.	Banjhi	Combrataceae	46.13	35	41.83	*Fair*
Bauhinia purpurea L.	Tanki, Maluka	Leguminosae	1756.25	678.33	0	*New*

Bauhinia variegata L.	Koiralo, Kachnar	Leguminosae	1059.23	71.67	0	*New*
Buchanania latifolia Roxb.	Pyar, Piyari	Anacardiaceae	268.75	48.33	37.03	*Good*
Careya herbacea Roxb.	Kumbhi	Lecythidaceae	43.75	0	2.38	*Fair*
Casearia graveolens Dalzell	Badkaule	Salicaceae	0	0	1.25	*None*
Cassia fistula L.	Rajbriksh a	Leguminosae	200.3	59.05	4.52	*Good*
Citrus limon (L.) Burm. f.	Nibuwa	Rutaceae	0	6.67	0	*Poor*
Colebrookea oppositifolia Sm.	Dhursule	Lamiaceae	62.5	25	0	*New*
Dalbergia latifolia Roxb.*	Satisal	Leguminosae	16.67	5	0.5	*Good*
Dillenia pentagyna Roxb.	Agai	Dilleniaceae	0	0	1.25	*None*
Diospyrus tomentosa Roxb.	Bidi pat	Ebenaceae	191.37	45.71	1.67	*Good*
Diploknema butyracea (Roxb.) H.J. Lam	Chyuree	Sapotaceae	0	0	0.25	*None*
Dysoxylum binectariferum (Roxb.) Hook.	Dhamina	Meliaceae	12.5	5	1	*Good*
Ehretia laevis Roxb.	Datrung	Ehretiaceae	12.5	5	0	*New*
Eucalyptus camaldulensis Dehn.	Masala, Safeda	Myrtaceae	25	16.67	0	*New*
Ficus benghalensis Linn.	Bar	Moraceae	0	0	0.25	*None*
Ficus hispida L.	Kharseto	Moraceae	66.67	17.50	0	*New*
Ficus neriifolia Sm.	Dudhilo	Moraceae	45.83	5	9.58	*Fair*
Ficus religiosa L.	Pipal	Moraceae	0	5	0	*Poor*
Garuga pinnata Roxb. Hook. f. ex Brandis	Dabdabe	Burseraceae	0	0	10.77	*None*
Lagerstroemia parviflora Roxb.	Bot Dhaiyaro	Lythraceae	0	3.33	6.55	*Poor*
Leucaena leucocephala Lam.) De Wit	Ipil Ipil	Leguminosae	20.96	8.33	0	*New*
Litsea monopetala (Roxb.) pers.	Kutmero	Lauraceae	10.42	4.17	0	*New*
Madhuca longifolia (Koeing) Macbride	Mahuwa	Sapotaceae	105.06	10	4.25	*Good*

Mallotus philippensis (Lam.) Mull.- Arg.	Rohini, Sindur	Euphorbiaceae	1335.42	536.67	28.24	*Good*
Phyllanthus emblica Linn.	Amala	Euphorbiaceae	0	4.17	2.29	*Poor*
Schleichera oleosa (Lour.) Oken	Kusum	Sapindaceae	146.73	16.43	4.25	*Good*
Semecarpus anacardium L.f	Bhalayo	Anacardiaceae	29.17	34.17	13.90	*Poor*
Shorea robusta Gaertn.	Sal	Dipterocarpaceae	5246.13	1163.1	90.92	*Good*
Syzygium cumini (L.) Skeels	Jamun	Myrtaceae	1145.83	18.1	3.46	*Good*
Tectona grandis L.f.	Teak, Sagawan	Verbenaceae	50	30	3.57	*Good*
Terminalia alata B. Heyne ex Roth	Saj	Combretaceae	750.89	180.95	18.57	*Good*
Terminalia bellirica Gaertn.) Roxb.	Barro	Combretaceae	44.64	13.10	13.83	*Fair*
Terminalia chebula Retz.	Harro	Combretaceae	32.74	4.17	2.79	*Good*
Vitis lanata Roxb.	Mahur	Vitaceae	0	3.33	0	*Poor*
Woodfordia fruticosa (L.) Kurz	Dhayaro	Lythraceae	18.75	0	0	*New*
	Total		12756.69	3063.95	305.65	
	Mean		319	77	8	
	SD		899	221.75	16.74	

Regeneration potential

Among 40 species observed at the site, 13 species showed good regeneration status, 4 species with fair regeneration, and 6 species showed poor regeneration. Among the remaining species, 10 of them showed new regeneration status while 7 species had no regeneration at all. The regeneration potential for the species under the category good, fair, poor, new, and none was 32%, 10%, 15%, 25%, and 18%, respectively (*Figure 5*).

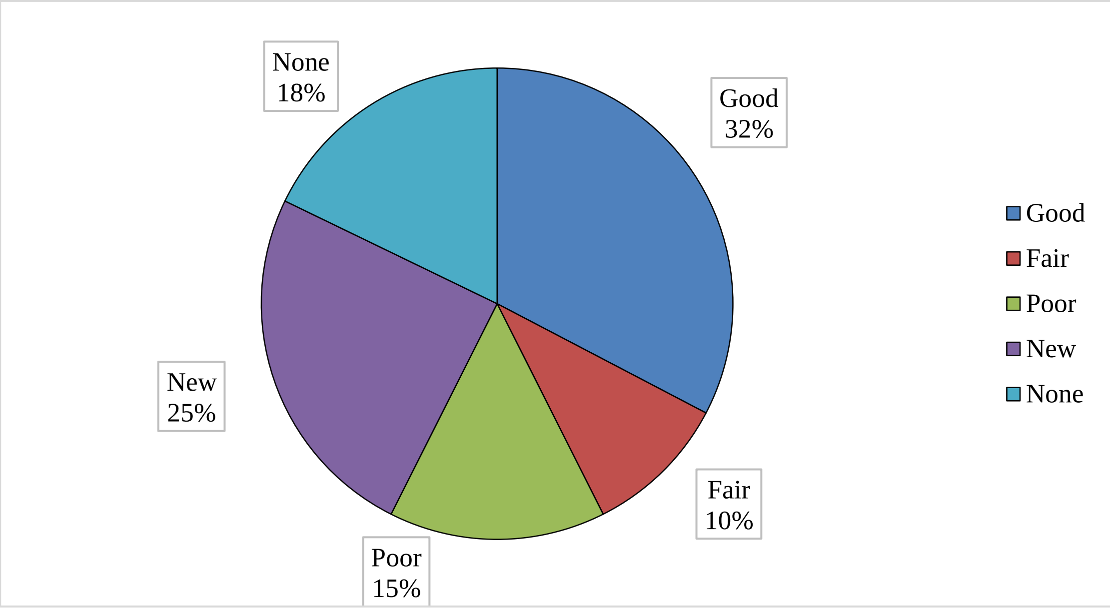

Figure 5: Regeneration status of species inside forest

Effect of biophysical variables on the regeneration

The majority of the crown cover range was of 0-30% (1744) followed by 30-60% (443) and least of the above 60% (221). Similarly, the highest number of plots were situated in the northern aspect (48) followed by southern (32), western (10) and the least in the eastern aspect (5). Furthermore, the majority of the regeneration were found in the disturbance-free plots from anthropogenic factors (1848) followed by human disturbance plots (560).

The regression analysis of the number of regeneration and two biophysical variables i.e. slope (*Figure 6*) and aspect were found not to be significant (p>0.05).

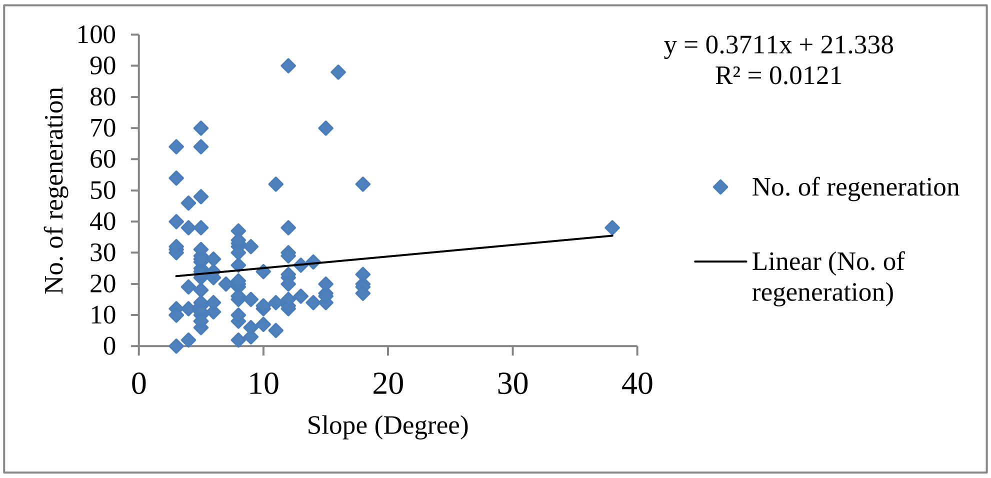

Figure 6: Linear regression between the number of regeneration and slope (in degree)

Simple linear regression was used to test if human disturbance predicted the regeneration frequency where, regeneration frequency = 27.58-7.58 (human disturbance). To confirm the level of their relationship, a t-test was performed for regeneration number and human disturbance which indicates that the human disturbance influences the number of regeneration but the effect is not very significant. *Table 2* ***Error! Reference source not found.*** shows that the overall regression was found statistically insignificant (R^2= 0.02, p > 0.10).

Table 2: Regression between human disturbance and number of regeneration

Regression Statistics	
Multiple R	0.15
R Square	0.02
Adjusted R Square	0.01
Standard Error	21.70
Observations	95

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1135.23	1135.23	2.40	0.12
Residual	93	43808.29	471.05		
Total	94	44943.53			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	27.58	2.65	10.40	2.90018E-17
Human Disturbance	-7.58	4.88	-1.55	0.12

Discussion

Our study found the mean of the seedlings, saplings and adults to be 319, 77 and 8 indicating the high presence of seedlings in the forest which is suitable from the forest sustainability. The results showed a high number of individuals in the lower dbh classes and a low number of individuals in the upper dbh classes which is similar to the finding of Khamyong *et al.* (2004). Higher frequency in the lower diameter class may be due to the restriction on felling of small-sized trees and prevailing appropriate environmental conditions, while the extraction of large-sized trees may be the reason for lower frequency in the higher diameter class (Sapkota *et al.,* 2009b; Sarkar and Devi, 2014). High frequency in the lower diameter class represents the sustainable, stable, and good regeneration condition of the forest (Awasthi *et al.,* 2015; Manna and Mishra, 2017) having a high resource utilization capacity (Naidu and Kumar, 2016). The majority of the tree species offered sound quality and the maximum numbers of the species were found to be of medium (II) grade, representing the productive forest which may be supported due to suitable environmental conditions and minimum disturbance factors (Sapkota *et al.,* 2009a).

The presence of *Shorea robusta, Bauhinia purpurea, Mallotus philippensis, Syzygium cumini, Bauhinia variegate* as dominant seedling species suggested a good ability for regeneration, which reflected the existing favorable environmental conditions. The study showed a greater number of seedlings per hectare than saplings which aligned with the finding of (Chikanbanjar *et al.*, 2020) that might be due to the presence of appropriate environmental attributes suitable for seedling establishment. Our results showed a higher regeneration potential of *Shorea robusta* which is consistent with the result of Joshi *et al.* (2019). Likewise, *S. robusta* was found to be the dominating tree species in the community forest which is similar to the finding of the inventory (Department of Forest Research and Survey/Forest Resource Assessment, 2014). The community forest's total capacity for regeneration was considered to be satisfactory, indicating high regeneration status; nevertheless, the unsatisfactory rate of 18% regeneration may have an impact on future population trends.

The regeneration potential of the forest is found highest in the good condition along with substantive poor and no regeneration potential. Tripathi and Shankar (2014) reported that Sal is always found to be a dominating species in the place of its existence to which our study agrees. There is a high number of seedlings, saplings, and poles of Sal in the forest. Moreover, some species such as *Garuga pinnata*, *Ficus benghalensis*, *Diploknema butyracea*, *Dillenia pentagyna*, *Casearia graveolens*, *Aegle marmelos*, and *Senegalia catechu* had no seedlings and saplings indicating the least regeneration potential. This could be because of insufficient microclimatic conditions within the forest cover, which in turn will affect tree species' ability to regenerate by seed. The composition of the species with no regeneration will also affect species composition of the forest in the future (Pradhan *et al.,* 2019). Low or inconsistent seed supply, a lack of suitable micro-sites, and/or variables affecting early seedling growth and survival might be the contributing factor to the absence of regeneration (Gärtner *et al.*, 2011).

Many studies have assessed the effects of environmental variables in the regeneration of the tree species. The regeneration of the species may vary due to climatic, edaphic, topographic, biological and anthropogenic factors. However, Nepali *et al.* (2021) explained no significance of the slope and aspect on species richness which commensurate to our finding as the number of regeneration did not vary significantly with the change in slope and aspect. Shah and Shah (2016) established a relationship between slope and the number of regeneration and concluded that rolling slopes had a higher number of regeneration than regular and steep slopes. In contrast, our study did not find any significance of slope on the number of regeneration. In general, anthropogenic factors and natural phenomena affect the regeneration of species (Poudel and Devkota, 2021). Minimal openings in the canopy cover allow higher light transitivity on the forest floor favoring the light-demanding species for the seedling recruitment process (Webb and Sah, 2003). An open canopy is favorable for abundant growth of the seedlings and saplings of light-demanding species like Sal (Gautam and Devoe, 2006). So, it is concluded that thinning activities should be conducted regularly for the proper growth of the seedlings and saplings. Similarly, the effect of human disturbances in the regeneration of the species was found statistically insignificant which may be due to sampling bias of the study. Furthermore, this study includes the limitation of smaller sample sizes for the study of effect of biophysical variables and anthropogenic factors which should be addressed by further in-depth studies for the scientific validation. However, the current research findings will help researchers to develop insights into the effects of plot variables in regeneration and assist in developing future management strategies for the community forest.

Conclusions

This study represents the overall regeneration condition of the forest to be in a good condition. The forest was found to have a higher seedling density, indicating that the population may be sustained if there is no adverse impact of potential increased human interferences in future. The total number of species observed in the forest was 40. The greater species count represents the more number of undesirable species prevalent in the forest changing the vegetation ecology which may be due to insufficient tending operations such as thinning and pruning. Thus, it is recommended to follow tending operations to increase forest productivity. This study helps policymakers about current population structure of lowland terai forests. This study prompts the decision makers to adopt silviculture system based sustainable forest management model to reap forest benefits in a sustainable way without changing vegetation ecology. Further research focusing on other biophysical and social parameters and their effects on regeneration including ways of improving regeneration quality and management techniques should be carried out.

Authorship contribution statement

V.T. Chhetri, S. Shrestha, and S. Parajuli collected field data, reviewed the literature, and prepared a draft manuscript. P. Jha conducted data analysis, edited and reviewed the manuscript for finalization.

Conflicts of interest: The authors declare no conflict of interest.

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