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Status and distribution of Sandalwood (*Santalum album*) in Nepal: A study of Pyuthan district

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ABSTRACT

Most of Sandalwood species occur in East Asia, Australia and South Asia including India, Sri Lanka and Nepal at the foot hills of the Himalayas. The Sandalwood is apparently confined to the elevation below 1200 m. and is exotic species for Nepal. There is one species *Santalum album* in Nepal which is cultivated in private lands and found in KanyaKurmari Community Forest in pyuthan district of Nepal. But its distribution is not sufficiently known. So, the research entitled "*Status and Distribution of S. album*" was carried in Pyuthan district of Nepal with the objective to assess the status, distribution and associate species and explore the value of this species to the rural livelihood. Data were collected from both primary and secondary sources. Primarily sources include Rapid vegetation assessment and GIS mapping for the assessment of status and distribution of *S. album*. Secondary data were collected through different published and unpublished documents. Collected data were analyzed using statistical tools and computer software. The research gave the natural status, distribution and better associate species of sandal wood in Pyuthan district. This species is distributed in Pyuthan Municipality ward number 10 and 11. This research gave the associated and preferred species for the development of *S. album*. Regeneration of species of study area is uniformly distributed. Raju and Nundhiki are good associated species of *S. album*. The government should initiate its management and cultivation in Community Forest and Private land. The awareness and cooperation with stakeholders is recommended for the betterment of livelihood.

Key words: *Santalum album*, association, values, plantation, natural regeneration, Nepal

1. INTRODUCTION

Sandalwood (*Santalum album*) is very valuable and commercially important tree species localized in some part of the mid-western development region in Nepal. The species is recognized due to its fragrance and significant social and economic values (Brandis, 1978; Shiddamallayya et al. 2015; Felicity Rusakanika and Munyarads Stray, 2015). It is largely distributed in the Southern India especially in Karnataka, Kerala and Tamilnadu (India) and Sri Lanka and other parts of the south-eastern Asia (Brandis, 1978; Hari Shankar Lal et al. 2014). However, it is supposed to be introduced there from Java, Indonesia (Neil, 1990; Gusti Ngurah Sudiana, 2013). *S. album* is not considered as the indigenous species in Nepal. It has been reported from Gorkha (Majupuria & Joshi, 1988) and Pyuthan.

Its main component '*Santalol*' of Sandal wood has antimicrobial property and used in aromatherapy. A bulk of it is used in the perfume and toiletries industry. Traditionally, sandalwood oil used to treat skin diseases, acne, dysentery, and in number of other conditions. In traditional Chinese medicine, its oil is considered an excellent painkilling agent, alleviate itching and inflammation, cools, calms and cleans the blood. The medicinal properties of sandalwood exist in the oil, which can either be pressed from the wood or extracted with alcohol or water. It relieves fever, thirst, burning sensation and stops sweating. It is good for fever or rejuvenates the skin to natural state harmed by overexposure to the sun, and it awakens the intelligence. Besides these, it is used in heart care, anti-dandruff shampoo, anti-wrinkle cream, baby cream, baby powder and chayvanprasha. The heartwood of Sandalwood is also used for making wood crafts and decorative furniture.

Particularly in Nepal and India, the tree has religious and ritual significances, as the paste produced from its heartwood is often used in Lord Shiva temples on "Shivalingas". A vast majority of Hindus wear a small mark of this paste on their forehead right above the middle of the eyes to keep the pituitary gland cool (Shankaranarayana, 1998). The heart wood and sapwood are powdered together to produce incense of joss sticks used in religious ceremonies.

There are two main commercial species of Sandalwood in the world: Australian Sandalwood (*Santalumspicatum*) and Indian Sandalwood (*Santalum album*). Annual global demand of Sandalwood was estimated to be 6,000 tons in 2006 (Shankaranarayana, 1998). To fulfill this demand, Western Australia exports about 2000 tons annually (Shankaranarayana, 1998). The extremely high demand and reduced supply of Sandalwood is driving its price up all around the world. Sandalwood from Mysore region of southern India is generally considered to be of the highest quality available. The price of Indian Sandalwood fetches two third better prices than Australian Sandalwood. Other species are found in the Pacific region and Australia. The natural resource of Pacific sandalwood species has been heavily exploited since the early 19th century (Shineberg, 1967), and on some islands, the resource has been practically exhausted (Nor, 1982; Neil, 1986; Barrance, 1989). Some confusion exists over the taxonomy of these species due to variations in appearance and habit. For example, *S. insulare* from French Polynesia and *S. marchionense* from the Marquesas may be varieties of the same species (Neil, 1986).

Sandalwood has not enlisted as endangered flora by CITES but IUCN and the Government of India have included Indian Sandalwood trees in the list of endangered species in recent Years. The government of Indian has attempted to curb its possible extinction through limiting the exportation of sandalwood. Therefore, export of timber from India is totally banned except for handicraft pieces of Sandalwood up to 50g weight (Brandis, 1978).

The sandalwood forests are drastically declining due to over exploitation, low natural regeneration and failure of reforestation in throughout the world (Jeeva et al., 1998). Most of the existing sandalwood populations are very sparsely distributed. They are devoid of large girth class trees due to illicit felling, hacking, forest fire and encroachments (GoN, 2014).

Despite profuse seed germination in Sandalwood, the population density is relatively poor due to abiotic and biotic interferences. The sandalwood trees have been ruthlessly felled and removed by smugglers due to high market demands both in the local and international arena. These activities have selectively removed trees possessing large dimensions and quality heartwood, resulting in narrowing of the gene pool leaving population of trees with mostly sapwood. The magnitude of illicit removals has been so intense that sandalwood has now been enlisted as a 'Vulnerable' species by the International Union for Conservation of Nature (IUCN) (IUCN, 1998). Extensive extraction of heartwood has severely decimated the natural stands of the tree in the forests and has rendered many populations fragmented (Rao et al., 2007).

Since much of the sandalwood wealth and natural sandal wood forests have been lost, the remaining sandal trees need to be protected effectively and natural sandalwood areas are to be preserved (Swaminathan et al., 1998). In the early stages of seedling development, sandalwood derives nutrition from the relatively large seed reserves and later, the formation of host attachment becomes critical for seedling survival and growth (Barrett and Fox, 1997). The selection of appropriate hosts is vital to ensure successful sandalwood plantation (Radomiljac, 1998). Failure of Regeneration is due to poor understanding of the host-parasite relationship and edaphic factors which is one of the main causes of sandalwood depletion (Surendran et al., 1998). The hemi-parasitic nature of sandalwood and Silvicultural techniques to establish it is still not known completely.

There are some localized distributions of the Sandalwood in Pyuthan district of Nepal. The above-mentioned information about its host-parasite relationship, its distribution patterns, the promoting or limiting factors of the Sandalwood and biotic as well as abiotic pressure upon it is not clearly studied in Nepal. So, this research aimed to conduct comprehensive local assessment of sandalwood seeking its best associate species. This study focused to find out the present status and distribution of Sandalwood and its associated species. The findings of the research will help both government organizations (GOs) and international non-governmental organizations (INGOs) to launch the conservation, management and sustainable utilization of sandalwood for the income generation of local people and community forestry user groups. The detail information about the distribution pattern and local status will be very helpful for the decision makers, District Forest Officials and its owners to take the appropriate decision on its better use and sustainable management. They can be benefited by knowing the existing status of sandalwood which could be a very good option in their forest to generate income and can be replicated in other CFUGs of similar nature. The study was conducted to assess the current status, distribution pattern and associations of Sandalwood in Pyuthan district of Mid-western Nepal.

2. METHODS AND MATERIALS

Study area

Pyuthan is the district which has the highest number of Sandalwood for long times in Nepal (Figure 1). Therefore, Pyuthan is selected as the district for the study of Sandalwood.Within the district, the study area was selected by considering availability of Sandalwood in natural forest area. In consultation with the District Forest Office and other stakeholders (CFUGs, FECOFUN), a community forest in the vicinity of the Municipality, which has the natural distribution of the Sandalwood was selected for this study.

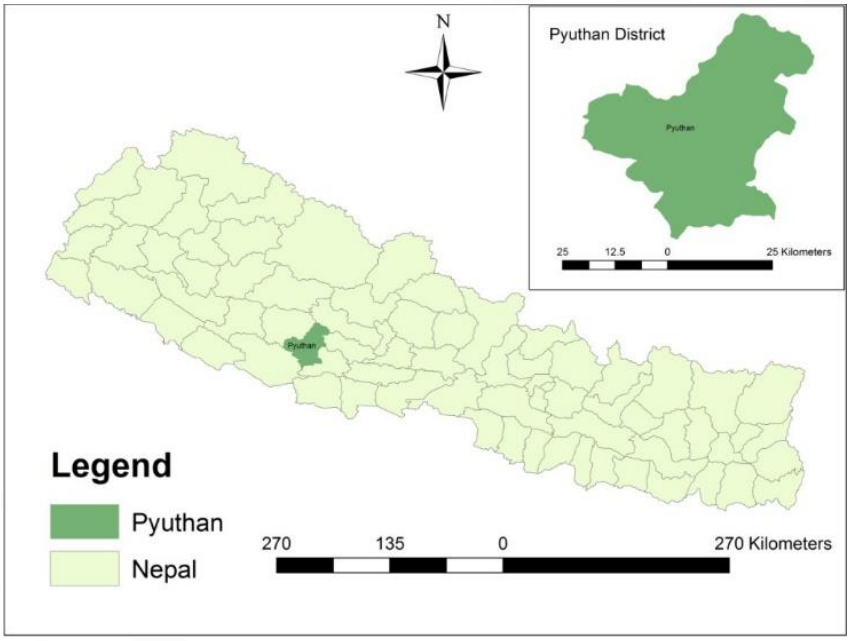

Figure 1 Location of Pyuthan District in Nepal

To meet the intended objectives of the study and after reconnaissance survey, discussion with District Forests Office, District Development Committee and other related stakeholders, KanyaKumari Community Forest User Group of Pyuthan district was selected for this study. It is located in Pyuthan Municipality ward number 10 and 11.

The KanyaKumari CF was established in 2070 BS. It is situated in Pyuthan district of Mid-Western Development Region of the Nepal. It covers 201.64 ha (Fig 3, 4 & 5). *S. album* is found only in the area of 9.18 ha in this forest. A total of 250 households have been managing this forest. They have conserved Sandalwood and associated species to obtain direct and indirect benefit from the forest. Major species of this CF are Sandalwood (*Santalum album*), Baidaro (*Lagerstroemia parviflora*), Tilko, Dhairo (*Woodfordia fruiticosa*), Khote Sallo (*Pinus roxburghii*), Seto Siris (*Albizia procera*), Amaro, Nundhiki (*Breynia retusa*), Pyar and Raju.

Research Design

Descriptive research design accumulates the facts. The study was based on descriptive research design for accumulating facts about sandal wood. It was basically based on the direct observation, and exploring the distribution of the associated species. The

quantitative data were collected by conducting household survey, personal interview and key informant interview. The secondary data were collected by conducting extensive desk review of available literature such as the CF Operational Plan and Constitution, DFO (Pyuthan) publications, and peer reviewed scientific papers.

Sample Selection

Systematic sampling method was used for the sample collection. The sampling strata were formed based on the basis of location, area and plot to plot distance (Figure 2).

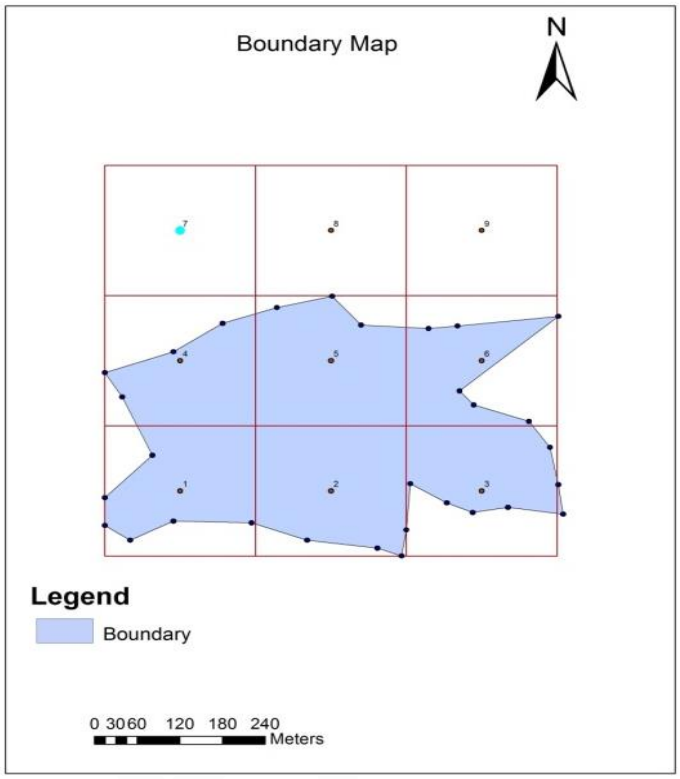

Figure 2 Sampling plot design

Sample Size

This forest is leaned towards conservation oriented management rather than commercial management. Therefore, the sampling intensity was at 0.1% for the data collection from the field. Square plots of 25 m^2 (5m x 5m) were established according to community forest inventory guideline (Figure 3).

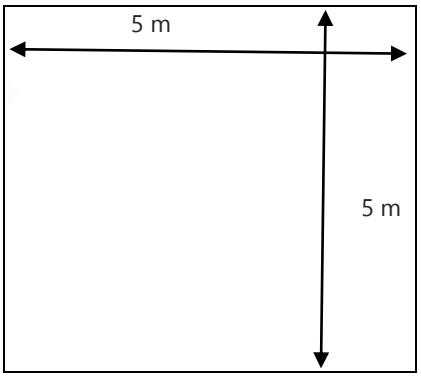

Figure 3 Shape and Size of Sample plot

Data collection

Relevant data/information was collected through primary and secondary sources. Data collection methods are presented below. All vegetation in the sample plots were measured and recorded during the field survey.

Secondary Data Collection

The main sources of secondary data were literature review and existing records. Relevant literatures were reviewed. Similarly, various records of Pyuthan District Forest Office (DFO), Federation of Community Forest of Nepal (FECOFUN), Non-Governmental Organization (NGO/INGO) and management plan of CF and LHF were other sources of secondary data.

Primary Data Collection

Primary data were collected by using different methods such as field observation. These methods elaborated below: Primary data collected using sampling techniques as follows.

Sampling Technique

A systematic sampling technique assigned to select sampling units. The study area divided into grids and allocates 4 sample plots of 5 m X 5 m. first sample plot was selected randomly. After selection of the first sample plot, other plots were selected systematically in equal distance. The sampling intensity was 0.1. Similarly, research activities were concentrated to achieve stated objectives and reliable information drawn according to established specific objectives.

Field Observation

Observation helped to internalize actual field situation and build perception regarding the research problems. Therefore, actual situation of Sandalwood observed, photographed and measured. The health condition and status of the Sandal tree, its availability and current uses have been observed and recorded.

Data Analysis

Data analysis includes both qualitative and quantitative data. Qualitative data were analyzed by classifying, grouping, tabulating and frequency analysis techniques. Parametric and nonparametric statistical tools were used to test the hypothesis for analysing the association of attributes. Confidence level of 95 percent was applied for test statistics. Quality of data were checked and verified before data entry in the computer. Descriptive statistics were calculated for all quantitative data and confidence intervals were constructed. Besides, tabulation, classification and sorting were common techniques for all data analysis. Based on the descriptive statistics obtained from quantitative data and frequency, ranking and grouping of qualitative data, inferences were drawn to the research questions. Microsoft Excel software were used for data analysis.

The collected data were analyzed in the following way

Density and Relative density:

$$D = \frac{N}{P_n \times A}$$

Where, D: density of species A
N: total number of individual of species A
P_n: total number of plots sampled
A: area of plot

Frequency and Relative frequency:

$$\text{Relative density of species A} = \frac{\text{Density of species "A"}}{\text{Total density}} \times 100\%$$

$$R_D = \frac{D}{T_D} \times 100\%$$

Where, R_D: relative density of species A
D: total number of individual of species A
T_D: Total density

$$\text{Frequency of species "A"} = \frac{\text{No. of plots in which species "A "occurs}}{\text{Total No. of plots sampled}} \times 100\%$$

$$F = \frac{N_P}{T_P} \times 100\%$$

Where, F: Frequency of species A
N_P: Number of plots in which species A occurs
T_P: Total number of plots sampled

$$\text{Relative Frequency of species A} = \frac{\text{Frequency value of species A}}{\text{Total frequency value of all species}} \times 100$$

$$R_F = \frac{F}{T_F} \times 100$$

Where, F: Frequency value of species A
R_F: Relative frequency of species A
T_F: Total frequency values of all species

Abundance of species "A"= {No. of species "A" in all quadrates} * size of quadrates
No. of quadrates in which species A occurred

[Source: Krebs, 1978]

Distribution of the Associated Species

The stock of Sandal wood is analyzed for natural forest to show its distribution and information about the plants. Associate species for natural forest were recorded during vegetation assessment.

Chi Square Test for Homogeneity

The Chi Square test was applied to test the homogeneity of the Regeneration of the species in study area. Decision was made at 5% level of significance.
Null hypothesis: H_0:the Regeneration are uniformly distributed within all species.
Alternative hypothesis: H_1: the Regeneration are not uniformly distributed within all species.

Calculated value of $\boldsymbol{\chi 2 = \Sigma(O - E)^2/E}$

where,
O refers to the observed frequency
E refers to the expected frequency

Decision,
Calculated value of $\chi 2$ is less than the tabulated value of$\chi 2$, the null hypothesis is accepted. Otherwise alternative hypothesis is accepted.

Correlation of Sandalwood with other associated species

Correlation is defined as the "relationship" or "association" between (among) the one dependent variable (or factor) and one (or more than one) independent variable (s) or factor (s).

In other words, correlation is the relationship between (or among) two or more variables. Thus correlation is a statistical tool, with the help of which, we can determine whether or not two or more variables are correlated and if they are correlated the degree and direction of correlation is determined.

The numerical measurement of relationship between the two variables is denoted by the symbol "r" whose values ranges from -1 to +1 .

That means:

If r = 0, there is no relationship between the variables

If r < 0, there is negative relationship between the variables

If r >0,there is positive relationship between the variables

If r = +1, the relationship is perfectly positive

If r = –1,the relationship is perfectly negative

Relative Importance Index

The respondents were asked to rank the importance of various problems and prospects based on their own jugdements and perceptions. Relative Importance Index (RII) will be calculated based on the ranks provided by the respondents. After the calculation of RII, the problems and prospects will be ranked in descending order.

3. RESULT AND DISCUSSION

Status of Sandalwood in study area

In study area (Sandalwod plot of KanyaKumari CF) Regeneration (Seedling and Sapling) of 10 species were recorded during the study. Out of them Baidaro and Sandal wood were dominated species. Khotesalla, Raju and Pyar were in less in number (Table 1). The study recorded 21 number of Regeneration of *Sandal wood* in KanyaKumari CF in Pyuthan. The largest number of the Regeneration was recorded for Baidaro (35) in all sample plots. The least number of the Regeneration was found for Khote Sallo (1 per 100 m^2).

Table 1 Regeneration of Sandal wood and other associated species in KanyaKumari Community Forests of Pyuthan Municipality

S.N.	Local name	Botanical name	Number of Regeneration /100 m^2	Area of Total Sample 25 m^2×4	Number of Regeneration /m^2	Number of Regeneration /ha	Number of Regeneration in total area (9.18 ha)
1	Sandal wood	*Santalum album*	21	100	0.21	2100	19278
2	Dhairo	*Woodfordia fruticosa*	7	100	0.07	700	6426
3	Tilko	*Wendlandia coriacea*	9	100	0.09	900	8262
4	Baidaro	*Lagerstroemia parviflora*	35	100	0.35	3500	32130
5	KhoteSallo	*Pinusroxburghii*	1	100	0.01	100	918
6	Siris	*Albizia*spp.	2	100	0.02	200	1836
7	Amaro	*Antidesma diandrum*	6	100	0.06	600	5508
8	Nundhiki	*Breyniaretusa*	12	100	0.12	1200	11016
9	Pyar		2	100	0.02	200	1836
10	Raju		2	100	0.02	200	1836
	Total		97	100	0.97	9700	89046

Density of species in the study area

Species density can be described by the number of plants within a given unit of area . Species density can impact the overall health of plants. Species that are too sparce (the density is to low) may be more susceptible to weeds, while species that are too dense

might force plants to compete over scarce nutrients and water and cause stunted growth. Population density of species is studied so that we may control the population within its suitable capacity. A total of 3500 regeneration of Baidaro were recorded per hectare whereas only 100 Regenerations of Khote Sallo were recorded per hectare. Altogether 2100 seedlings of *Sandalwood* were recorded per hectare in study area.

Relative Densities

The relative contribution of density dependent regulation and environmental stochasticity to the temporal dynamics of plant population is one of the issues of ecology. The relative density of Baidaro was highest (36.08%) among the species of study area. Whereas, relative density of Sallo was only 1.03 %. Relative density of Sandal wood was 21.67%

Frequency of sandalwood and associated species

Frequency is the number of times a plant species is present in a given number of quadrats of particular size or at a given number of sample points. Frequency is usually expressed as a percentage and a sometimes called a frequency index. The concept of frequency refers to the uniformity of a species in its distribution over an area. Frequency is most often used to compare plant communities and to detect changes in vegetation composition overtime; it is used to describe the distribution of a species in a community, often used in combination with density or cover estimates and used to measure trend or condition. Frequency of Sandal wood, Tilko, Baidaro and Nundhiki was 1. That of Dhairo and Amaro was 0.5. In contrast, frequency of Sallo, Siris, Pyar and Raju was 0.25 in study area.

Relative frequency

Relative frequency chart is a good way to visualize information. This is especially useful for information that is grouped into categories where we are looking for popularity or mode. It shows the popularty or mode of a certain type of data. When we look at a frequency, we are looking at the number of times an event occurs within a given scenario. Relative frequency of Sandal wood, Tilko, Baidaro and Nundhiki was 16.67%. That of Dhairo and Amaro was 8.33%. In contrast, relative frequency of Sallo, Siris, Pyar and Raju was 4.17% in KanyaKumari CF.

Abundance of the species

Abundance is an ecological concept referring to the relative representation of a species in a particular ecosystem. It is usually measured as the number of individuals found per sample. How species abundances are distributed within an ecosystem is referred to as relative species abundances. Abundance is contrasted with typically correlates to, incidence, which is the frequency with which the species occurs at all sample. When abundance is accompanied by low incidence, it is considered locally or sporadically abundant. The abundance of Baidaro was highest (35) among the all species of study area. The abundance of Sandal wood was 21 and that of Sallo was 4. The Sallo had lowest abundance.

Relative Abundance of the Species

It is a component of biodiversity and refers to how common or rare a species is relative to other species in a defined location or community. It is the percent composition of an organism of a particular kind relative to the total number of organism in the area. Relative species abundancetends to conform to specific patterns that are among the best-known and most-studied in macrology.

Importance value index (IVI)

Importance value is a measure of how dominant a species is in a given forest area. It is a standard tool used by foresters to inventory a forest. Foresters generally do not inventory a forest by counting all the trees, but by locating points in the forest and sampling a specified area around those points. Important value index is shown below (Table 2).

Table 22 Importance Value Index

Name of Species	R D	R F	R A	IVI
Shreekhanda	21.65	16.67	0.21	38.53
Dhairo	7.22	8.33	0.14	15.69
Tilko	9.28	16.67	0.09	26.04
Baidaro	36.08	16.67	0.35	53.10
KhoteSallo	1.03	4.17	0.04	5.24

Siris	2.06	4.17	0.08	6.31
Amaro	6.19	8.33	0.12	14.64
Nundhiki	12.37	16.67	0.12	29.16
Pyar	2.06	4.17	0.08	6.31
Raju	2.06	4.17	0.08	6.31

Distribution pattern of Sandalwood and other associated species

A chi square statistic is a measurement of how expectation compare to results. The data used in calculating a chi square statistic must be random, raw, mutually exclusive, drawn from independent variables and drawn from a large enough sample. The Chi Square test was applied to test the homogeneity of the regeneration of the species in study area. Decision was made at 5% level of significance (Table 3).

Null hypothesis: H_0:the Regeneration (seedling and sapling) are uniformly distributed within all 10 species.

Alternative hypothesis: H_1: the Regeneration(seedling and sapling) are not uniformly distributed within all 10species.

Calculated value of $\boldsymbol{\chi 2 = \Sigma(O - E)^2/E}$

Where,

O refers to the observed frequency

E refers to the expected frequency

Table 3 Chi Square Value of Species Distribution

S.N.	Species	O	E	O-E	$(O-E)^2$	$(O-E)^2/E$
1	Sandal wood	21	9.70	11.30	127.69	0.857
2	Dhairo	7	9.70	-2.70	7.29	0.049
3	Tilko	9	9.70	-0.70	0.49	0.003
4	Baidaro	35	9.70	25.30	640.09	4.296
5	Sallo	1	9.70	-8.70	75.69	0.508
6	Siris	2	9.70	-7.70	59.29	0.398
7	Amaro	6	9.70	-3.70	13.69	0.092
8	Nundhiki	12	9.70	2.30	5.29	0.036
9	Pyar	2	9.70	-7.70	59.29	0.398
10	Raju	2	9.70	-7.70	59.29	0.398
Total		**97**				**7.03**

Calculated value of $\chi 2(df=9) = 7.03$

Tabulated value of $\chi 2$ (df=9; 5% level of significance) = **16.92**

Decision,

Here, Calculated value of $\chi 2$ is less than the tabulated value of $\chi 2$ (7.03<16.92). So, the null hypothesis is accepted. i.e the difference between the observed frequencies and expected frequencies are insignificant, thus we can conclude that the uniform distribution holds good. There for we can say that the distribution patron among the species ofregeneration is uniform.

Correlation of Sandalwood with other associated species

Correlation is the relationship between (or among) two or more variables. Thus correlation is a statistical tool, with the help of which, we can determine whether or not two or more variables are correlated and if they are correlated the degree and direction of correlation is determined.

The numerical measurement of relationship between the two variables is denoted by the symbol "r" whose value ranges from -1 to +1.

That means:

If r = 0, there is no relationship between the variables

If r < 0, there is negative relationship between the variables
If r > 0, there is positive relationship between the variables
If r = +1, the relationship is perfectly positive
If r = –1, the relationship is perfectly negative

The table 4 shows the relationship between the sandalwood and others species. Sandalwood had perfectely positve correlation with Nundhiki in study area because the relation between sandalwood and Nundhiki is equal to +1. Like that the relation between sandalwood and Raju is equal to +1 so this species has positive corelation with Raju too. But the relationship between sandalwood and others species mention in this table is less than –1 therefore Tilko, Baidaro, Sallo, Siris, Amaro, and Pyar had negative correlation with this species.Therefore we cand say that thesr are not good associated species . Due to the perfectly positive value of sandalwood between Nundhiki and Raju, we can say that these species are good associated species of Sandalwood. We can conclude that, Sandal wood prefer the natural habitat of Nundhiki and Raju.

Table 4 Correlation of Sandalwood with other associated species

	Sandal wood	Dhairo	Tilko	Baidaro	Sallo	Siris	Amaro	Nundhiki	Pyar	Raju
Sandal wood	1									
Dhairo	-0.28	1.00								
Tilko	-0.32	0.99	1.00							
Baidaro	-0.98	0.15	0.20	1.00						
Sallo	-0.44	0.07	0.17	0.55	1.00					
Siris	-0.44	0.07	0.17	0.55	1.00	1.00				
Amaro	-0.76	-0.37	-0.30	0.86	0.58	0.58	1.00			
Nundhiki	1.00	-0.20	-0.25	-0.99	-0.47	-0.47	-0.82	1.00		
Pyar	-0.44	-0.49	-0.52	0.44	-0.33	-0.33	0.58	-0.47	1.00	
Raju	0.97	-0.49	-0.52	-0.91	-0.33	-0.33	-0.58	0.94	-0.33	1

4. CONCLUSION AND RECOMMENDATIONS

Sandalwood (*S. album*) is also known as Chandan in Nepal. It is considered as the exogenous species for Nepal. Sandalwood is a valuable tree associated with Hindu and Buddhist religions. It is considered as one of the most expensive wood in the world. The heartwood of the tree is valued for its aroma and is one of the finest natural materials for carving. *S. album* is included in the vulnerable category of the IUCN Red List.

There are 42 VDCs and one Municipality in Pyuthan. Among them natural forest of Sandal wood is found in kanyakumari c.f. within the municipality. Regeneration of all species are homogeneously distributed in study area. Important associated species of sandalwood are Nundhiki and Raju. Sandalwood, Tilko, Baidaro, Nundhiki were recorded in all sampling plots but other species were recorded in only some plots.

Problems for quality seedling, technical support for disease control and overall management of Sandal wood plantation and problem for marketing are top three problems of promotion of Sandalwood farming in study area. Despite various problems, there are still prospects of proper management and utilization in the future. For this, there needs to be due care on addressing the pressing issues identified in the study and promoting the innovative practices already applied in the field.

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