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Applying quantitative analysis for road side population of Lower Risk (category of IUCN red list version 2.3 and version 3.1) tree species

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ABSTRACT

This paper provides more important quantification analysis such as abundance, relative density, frequency, relative frequency, important value and average species density of Lower Risk tree species with taxonomic information of LR tree species and IUCN red list categories version 2.3 and version 3.1. 20 quadrates, each 10×10 m^2 size, were placed randomly at each of the both sites on Highway for floristic study of LR tree species and quantitative analysis such as Abundance A (%), Relative Density RD (%), Frequency F (%), Relative Frequency RF (%), Important Value IV (%) and Density D (plants/m^2). The samples (Part of tree species) collected from the both sites were dried and poisoned with saturated mercuric chloride ($Hgcl_2$) solutions with ethyl alcohol (C_2H_6O) (115 g mercuric chloride dissolved in 4.5 liter ethyl alcohol, called Kew Mixture) and After the specimens were poisoned, they were dried and affixed (along with a label) on mounting sheets [28 cm X 42 cm (±1 cm) dimension] by using fevicol glue. A total identified 6 LR tree species *Pongamia pinnata* (L.) Pierre (1 ± 1.07), *Acacia auriculiformis* Benth (0.4 ± 0.59), *Alstonia scholaris* (L.) R.Br. (1.6 ± 1.31), *Delonix regia* (Hook.) Raf. (1 ± 0.97), *Shorea robusta* Gaertner f. (0.2 ± 0.52) and *Thuja occidentalis* L. (0.05 ± 0.22). The research work was totally based on identification of LR tree species, IUCN category red list status, taxonomic information and quantitative analysis of LR tree species along the highway.

Key words: IUCN, identification, road, quantitative analysis, tree species

INTRODUCTION

The Dhanbad district lies in the mid eastern part of Jharkhand state. Jharkhand state has rich in plant diversity. The National Highway-2, NH-2, (Delhi-Kolkata Highway) is very rich in plant diversity along to the Road (Rahul & Jain, 2016). It is connected through NH-2 and NH-32 from state capital and different district headquarters of the state. The Dhanbad town is spread over an area of 23.39 sq. kms. Dhanbad is the only district in the Jharkhand state where participation in the non-agricultural sector is more than that in the agricultural sector. It is obviously due to availability of the coal resources has prompted extensive mining activity. The reflexes of the mining activity on the environment are of great concern. Present study will mainly focus on NH-2 highway in Dhanbad, which enters from Barakar River in Dhanbad district and moves towards Gaya via Barwaadda, Raj Nagar and Isri (Rahul & Jain, 2014).

Monitoring and evaluation is an increasingly integral component of biodiversity conservation practice and policy. It enables the setting of management and policy objectives, adaptation of interventions, measurement of effectiveness and demonstration of results to donors, supporters and other stakeholders (Yoccoz *et al.,* 2001; Stem *et al.,* 2005; Sutherland *et al.,* 2010; Jones *et al.*, 2013).

Floristic surveys are helpful in proper identification of plant-wealth for their utilization on a scientific and systematic basis (Rahul *et al.,* 2015). The identification of local plants along with the description of an area is very important because it can show specific species of the local area and their occurrence, growing season, species hardness, distinct species, finding new species and the effect of climatic conditions like drought and overgrazing on vegetation (Ali, 2008).

Biodiversity plays an important role in decision making and is recognised as a key element of sustainable forest management world-wide (FAO 2006; Baycheva *et al.,* 2013). Well-targeted forest biodiversity conservation policies will become even more strategic in the future (Barbati *et al.,* 2014). Therefore, knowledge on whether or not, and to what extent the management strategies influence future species biodiversity is of high importance.

National RLIs have also been developed based on repeated application of the Red List categories and criteria at a national scale in order to assess national extinction risk, including for Australia (Szabo *et al.,* 2012), Sweden (Gärdenfors, 2010), Finland (Juslen *et al.,* 2013) and Paraguay (López, 2011). Global RLIs have been disaggregated to show trends in different biogeographic realms (Butchart *et al.,* 2004, 2005), for different taxonomic groups BirdLife International

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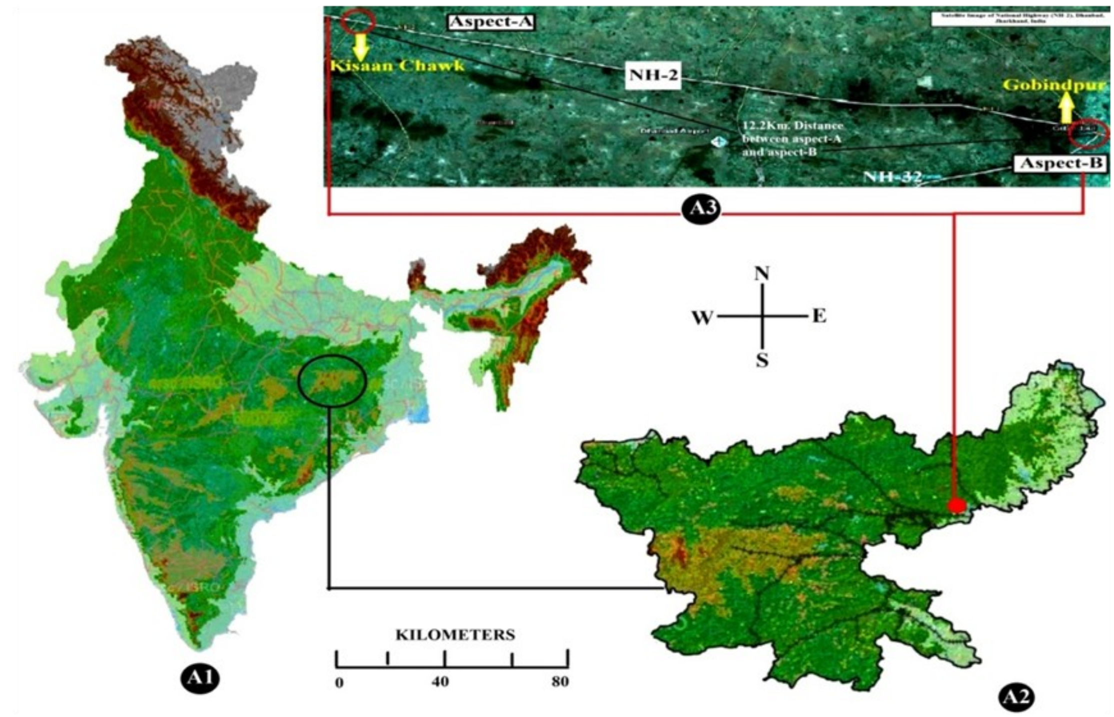

Figure 1. location of the aspect A (Kisaan Chawk) and aspect B (Gobindpur) study regions (A1) map of India showing the location of Jharkhand state (A2) map of Jharkhand state red dotted point showing the location of Dhanbad district (A3) satellite image showing the location of study area (NH-2, Dhanbad).

2013a, in relation to different international agreements (e.g. Ramsar Convention on Wetlands, the Agreement on the Conservation of Albatrosses and Petrels: BirdLife International 2013a; UN Millennium Development Goals: UN 2013), to show the contribution of different threats (Butchart 2008; Mcgeoch *et al.,* 2010; Almond *et al.,* 2013), to assess the effectiveness of protected areas (Butchart *et al.,* 2012), and to quantify the impact of conservation action (Hoffmann *et al.,* 2010).

Version 2.3: IUCN (1994) IUCN Council adopted this version, which incorporated changes as a result of comments from IUCN members, in December 1994. The initial version of this document was published without the necessary bibliographic details, such as a date of publication and ISBN number, but these were included in the subsequent reprints in 1998 and 1999. This version was used for the 1996 IUCN Red List of Threatened Animals (Baillie & Groombridge, 1996), The World List of Threatened Trees (Oldfield *et al.,* 1998) and the 2000 IUCN Red List of Threatened Species (Hilton-Taylor 2000). Version 3.1: IUCN (2001) The IUCN Council adopted this latest version, which incorporated changes as a result of comments from the IUCN and SSC memberships and from a final meeting of the Criteria Review Working Group, in February 2000.

The aim of this study was to provide identification of LR tree species along the highway. The present work reports the 6 LR tree species, quantitative analysis and taxonomic description with herbarium record. The recorded 6 LR tree species which will serve as baseline information to taxonomists, phytosociologist, range managers and policy makers for future research in the area under study.

MATERIALS AND METHODS

Study area

The research was conducted in the November to April between 2013 to 2014 in an area situated between the geographical coordinates the latitude of 23°51′-04.87′N 86°25′-48.98′E and longitude of 23°50′-09.20′N 86°30′-47.51′E occupied by two aspects (aspect-A and aspect-B) along the national highway (NH-2, Delhi-Kolkata National Highway). The range of the research area is 12.2 km. The natural vegetation is dominated by tree with spotted shrubs and herbs (Fig. 1).

Sampling site selection

The sampling of sites was done by determination the floristic study and quantification study of the LR tree species. Using visual dominance, the LR tree species were recorded and compared with both sites (aspect A and aspect B) from each aspect, ten quadrates were selected randomly from which twenty 10×10 m^2 quadrates for the quantification analysis, population and collection of plant specimens for herbarium preparation.

Data collection

The study area was stratified first according to habitat, identification of LR tree species and secondary according to total population of LR tree species along the highway. Data were collected at different altitudinal levels across the aspect A and aspect B of the study area. At each level, we randomly sampled all major vegetation communities on fallows, using 10 quadrates each quadrat size 10×10 m^2. Shrubs, herbs, climbers and grasses were not sampled Accept Trees in the fallows because the study was completely based on identification of LR tree

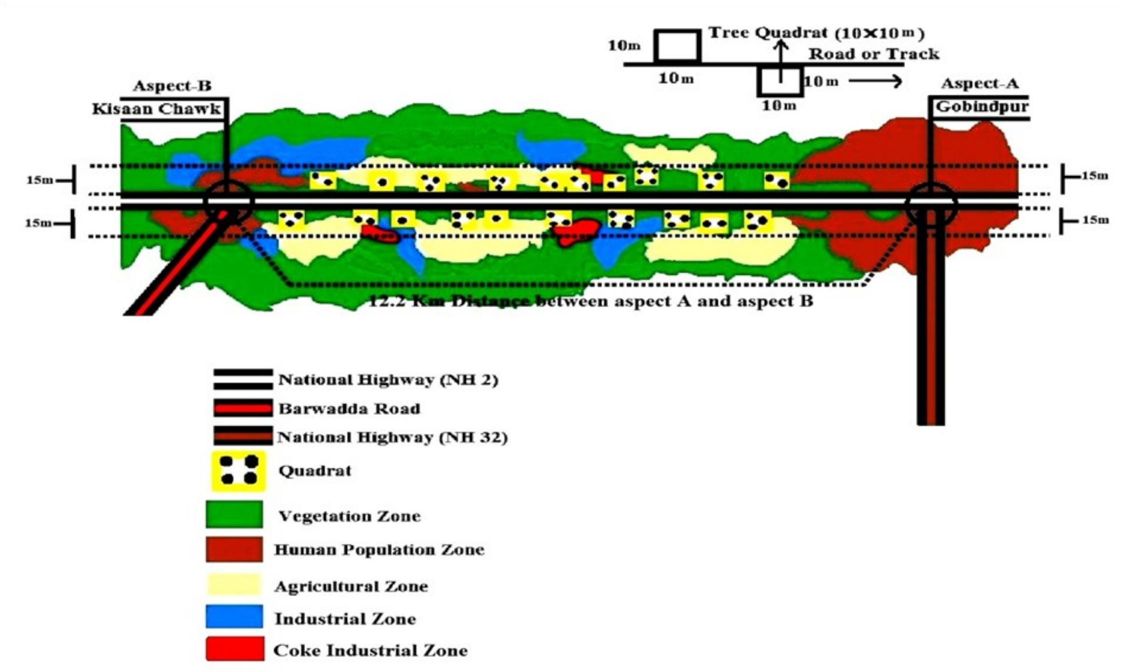

Figure 2. Diagrammatic sketch of study area

species. In the sacred groves, data were collected randomly from 2 aspects, each of which comprised a (10×10 m^2 quadrat) for trees only with a diameter at breast height (DBH) >10 cm (Fig. 2).

Floristic investigation of LR tree species

The whole study area was thoroughly surveyed during April, 2013 to February, 2014 for the collection and identification of plant specimens (LR Species). The collected specimens were processed for pressing, drying and mounting on herbarium sheets (Rahul & Jain 2015) All specimens were identified with the help of Flora of India, Flora of British India, Flora of The Upper Gangetic Plain (Duthie JF 1905; Hooker JD 1872; Roxburgh W 1832) and identification and taxonomic information about on the conformation of LR tree species with the help of International Union for Conservation of Nature and Natural Resources (IUCN red list) http://www.iucnredlist.org.

Quantification analysis of population

Quantification analysis such as Abundance (A %), Density (D plants/m^2), Relative Density (RD %), Frequency (F %), Relative Frequency (RF %) and Importance Value (IV %) for individual species was calculated according to the formula of (COTTAM & CURTIS 1956) calculated of LR tree species, as follows:

Abundance

$$A = \left[\frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats in which the species occurred}}\right]$$

Relative Density

$$RD = \left[\frac{\text{Number of individuals of a species}}{\text{Number of individuals of the sample}}\right]100$$

Frequency

$$F = \left[\frac{\text{Number of quadrates in which a species occurs}}{\text{Total number of quadrates examined}}\right]100$$

Relative Frequency

$$RF = \left[\frac{\text{Frequency value of single species}}{\text{Total frequency}}\right]100$$

Importance Value

$$IV = \left[\frac{\text{RD (Relative density)\%+RF (Relative frequency)\%}}{2}\right]$$

Density

$$D = \left[\frac{\text{Frequency value of single species}}{\text{Total frequency}}\right]$$

Shannon's index

Several indices of species diversity are used in the large amount of literature on biological diversity and ecological monitoring. A commonly used index is that referred to as 'Shannon's Index' or '*H*'. This Index is based on communication theory and stems from a common question in communication: how to predict the next letter in a message or communication? The uncertainty is measured by the Shannon Function '*H*'. This is the measure corresponding to the entropy concept defined by:

$$H' = -\sum_{i=1}^{s} (pi \ \mathrm{In}\ (pi))$$

where S is number of species, pi relative frequency of tree species ($pi = n_i / N$), n_i is the number of individuals per species i, N is the total number of individuals in the sample.

However, diversity indices do not allow for more detail interpretation of diversity changes. Therefore, tree species were further classified into successional groups according to their representation in the parent stand, their ecological demands and successional status in natural forest dynamics; late successional species (parent species), intermediate species and pioneer species (Martineau & Saugier 2007; Legner *et al.,* 2013).

Sørenson's index

Sørenson's index scores by dividing the observed similarity of two plots by the maximum possible similarity of those two plots, given their difference in diversity. Sørenson's index is calculated as:

$$\left[\frac{2(\text{no.spp.shared by the two plots})}{(\text{no.spp.in plot A} + \text{no.spp.in plot B})} \right]$$

Simpson index

The Simpson index (C) was calculated by following formula

$$C = \sum \left(\frac{n_i}{N}\right)^2$$

Where, n_i is the ith species where as N is the total number of species

Data calculations and statistics

The data shown in Table 8 and in Total population statistics (Means, SD, VSD, PSD, VPSD) of the Lower Risk (LR) tree species both sites (aspect A and aspect B) calculation with the help of easy calculation (https://www.easycalculation.com/statistics/standard-deviation.php) to assess the total population of LR tree species both sides of highway and compare to aspect A between aspect B. The data were subjected to one-way analysis of variance (ANOVA). One-way ANOVA test ($p < 0.05$) was applied to test the significance of differences among data groups aspect A plots and aspect B plots.

RESULTS AND DISCUSSION

A total of six LR identified tree species was recorded along the highway and the IUCN red list category with ecology & habit of *Pongamia pinnata* (L.) Pierre, *Acacia auriculiformis* Benth, *Alstonia scholaris* (L.) R.Br., *Delonix regia* (Hook.) Raf., *Shorea robusta* Gaertner f. and *Thuja occidentalis* L. **(**Table 1**)** belonging four families and six genera were recorded in which family *Fabaceae* was represented by three tree species followed by *Apocynaceae, Cupressaceae* and *Dipterocarpaceae,* only single species. *Fabaceae* family was dominant family. The Fabaceae is the third largest family of Angiosperms. This family shows an incredibly biological diversity, with approximately 720 genera and more than 18,000 species worldwide (Mabberley, 1997; Wojciechowski, 2003).

Table 1. List of lower risk (LR) tree species along with Coding, Botanical name, Common name, families, Ecology & habit, IUCN red list categories (ver 3.1 and ver 2.3).

Code Name	Species	Common Name	Family	Ecology & Habit	IUCN Categories (Red List)
DHN P10	*Pongamia pinnata* (L.) Pierre	Pongam tree	Fabaceae	*P. pinnata* is found in coastal areas, often along beaches or rivers and in thickets close to sea level. Terrestrial; Freshwater & Tree	Least Concern ver 3.1
DHN P20	*Acacia auriculiformis* Benth.	Ear-pod	Fabaceae	*A. auriculiformis* is a fast growing tree, particularly drought resistant, but also tolerates seasonally waterlogged soils and it is able to grow in poor soils & Terrestrial	Least Concern ver 3.1
DHN P30	*Alstonia scholaris* (L.) R.Br.	Devil tree	Apocynaceae	Moist deciduous forests and sacred groves, also in the plains & Terrestrial	Least Concern ver 2.3
DHN P40	*Delonix regia* (Hook.) Raf.	Gold Mohar	Fabaceae	*D. regia* is a deciduous tree up to 30 m tall. It is found within the dry forest especially on limestone & Terrestrial	Least Concern ver 3.1
DHN P50	*Shorea robusta* Gaertner f.	Sal tree	Dipterocarpaceae	Sal is a moderate to slow growing tree, which can grow upto 30-35 m tall. In wetter areas, it is evergreen; in drier areas, it is dry season deciduous shedding most of the leaves in February to April & Terrestrial.	Least Concern ver 2.3
DHN P60	*Thuja occidentalis* L.	White cedar	Cupressaceae	The climate is cool to cold temperate and relatively moist, with a short growing season especially in the north of its range. It grows equally well in swamps and on dry ground, but avoids extremes of both habitats; it is often growing abundantly on soils over limestone in upland areas and on alluvial soils with a high organic and mineral content in lowlands (rich fens supporting forest).	Least Concern ver 3.1

Table 2. Abundance (%) of lower risk (LR) tree species in aspect A and aspect B.

Code Name	Species	Species Authority	Abundance (%) of lower risk (LR) tree species		Means
			Aspect (A)	Aspect (B)	
DHNP10	*Pongamia pinnata*	(L.) Pierre	2.16	1.40	1.78
DHNP20	*Acacia auriculiformis*	Benth.	1.00	1.00	1.00
DHNP30	*Alstonia scholaris*	(L.) R.Br.	2.14	2.12	2.13
DHNP40	*Delonix regia*	(Hook.) Raf.	1.80	1.57	1.68
DHNP50	*Shorea robusta*	Gaertner f.	1.33	0.00	0.66
DHNP60	*Thuja occidentalis*	L.	1.00	0.00	0.50

Table 3. Relative Density (%) of lower risk (LR) tree species in aspect A and aspect B.

Code Name	Species	Species Authority	Relative Density(%) of lower risk (LR) tree species		Means
			Aspect (A)	Aspect (B)	
DHNP10	*Pongamia pinnata*	(L.) Pierre	29.54	17.50	23.52
DHNP20	*Acacia auriculiformis*	Benth.	04.54	12.50	08.52
DHNP30	*Alstonia scholaris*	(L.) R.Br.	34.09	42.50	38.29
DHNP40	*Delonix regia*	(Hook.) Raf.	20.45	27.50	23.97
DHNP50	*Shorea robusta*	Gaertner f.	09.09	00.00	04.54
DHNP60	*Thuja occidentalis*	L.	02.27	00.00	01.13

Quantification analysis of LR tree species

Abundance (A %)

It is the study of the number of individuals of different species in the community per unit area. By quadrats method, samplings are made at random at several places and the number of individuals of each species was summed up for all the quadrats divided by the total number of quadrats in which the species occurred. The data shows that among the study area (national highway 2 (NH-2), Dhanbad) both aspects (aspect A Gobindpur and aspect B Kisaan Chawk), the highest abundance 2.16 was recorded of DHNP10 (*Pongamia pinnata*) in aspect A and in aspect B highest abundance 2.12 was recorded of DHNP30 (*Alstonia scholaris*). The data show that the lowest abundance 1.00 was observed in aspect A of DHNP20 (*Acacia auriculiformis*) and DHNP60 (*Thuja occidentalis*) and in aspect B DHNP50 (*Shorea robusta*) and DHNP60 (*Thuja occidentalis*) were totally absent (Table 2).

Relative Density (RD %)

Relative density (RD) is the study of numerical strength of a species in relation to the total number of individuals of all the species. Highest relative density 34.09 was recorded for DHNP30 (*Alstonia scholaris*) in aspect A while lowest relative density was recorded for DHNP60 (*Thuja occidentalis*) 02.27 in aspect A. However, at aspect B, the maximum relative density of DHNP30 (*Alstonia scholaris*) 42.50 was recorded, and minimum relative density was recorded DHNP10 (*Pongamia pinnata*) 17.50 compared to other LR tree species along the highway. The data reveal the dominance LR species was *Alstonia scholaris*, because highest relative density was recorded both aspects (aspect A and aspect B) (Table 3).

Frequency (F %)

This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence. It was studied by sampling the study area at several places at random and recorded the name of the species that occurred in each sampling units. All 6 LR tree species is present in the aspect A but DHNP50 and DHNP60 were completely absent in the aspect B. The data show that the highest frequency 70% of DHNP30 (*Alstonia scholaris*) was observed in aspect A while the minimum frequency of 10% of DHNP60 (*Thuja occidentalis*) was observed at aspect A. similarly in aspect B, the highest frequency was recorded 80% of DHNP30 (*Alstonia scholaris*) and lowest frequency were recorded 50% of DHNP10, (*Pongamia pinnata*) and DHNP20 (*Acacia auriculiformis*), DHNP50 and DHNP60 were absent in aspect B (Table 4).

Relative Frequency (RF %)

The degree of dispersion of individual species in an area in relation to the number of all the species occurred. The maximum relative frequency 25% of DHNP10 (*Pongamia pinnata*) was recorded in aspect A; However, minimum relative frequency (4.16%) of DHNP60 (*Thuja occidentalis*) was recorded at an aspect A. the maximum relative frequency 32% of DHNP30 (*Alstonia scholaris*) at aspect B and minimum relative frequency 20% of DHNP10 (*Pongamia pinnata*) and DHNP20 (*Acacia auriculiformis*) at aspect B (Table 5).

Importance Value (IV %)

This index is used to determine the overall importance of each species in the community structure. In calculating this index, the percentage values of the relative frequency and relative density are summed up together and this

Table 4. Frequency (%) of lower risk (LR) tree species in aspect A and aspect B.

Code Name	Species	Species Authority	Frequency (%) of lower risk (LR) tree species		Means
			Aspect (A)	Aspect (B)	
DHNP10	*Pongamia pinnata*	(L.) Pierre	60	50	55
DHNP20	*Acacia auriculiformis*	Benth.	20	50	35
DHNP30	*Alstonia scholaris*	(L.) R.Br.	70	80	75
DHNP40	*Delonix regia*	(Hook.) Raf.	50	70	60
DHNP50	*Shorea robusta*	Gaertner f.	30	00	15
DHNP60	*Thuja occidentalis*	L.	10	00	5

Table 5. Relative frequency (%) of lower risk (LR) tree species in aspect A and aspect B.

Code Name	Species	Species Authority	Relative Frequency (%) of lower risk (LR) tree species		Means
			Aspect (A)	Aspect (B)	
DHNP10	*Pongamia pinnata*	(L.) Pierre	25.00	20	22.50
DHNP20	*Acacia auriculiformis*	Benth.	08.33	20	14.16
DHNP30	*Alstonia scholaris*	(L.) R.Br.	29.16	32	30.58
DHNP40	*Delonix regia*	(Hook.) Raf.	20.83	28	24.41
DHNP50	*Shorea robusta*	Gaertner f.	12.50	00	06.25
DHNP60	*Thuja occidentalis*	L.	04.16	00	02.08

Table 6. Importance Value (%) of lower risk (LR) tree species in aspect A and aspect B.

Code Name	Species	Species Authority	Importance Value (%) of lower risk (LR) tree species		Means
			Aspect (A)	Aspect (B)	
DHNP10	*Pongamia pinnata*	(L.) Pierre	27.27	18.75	23.01
DHNP20	*Acacia auriculiformis*	Benth.	06.42	16.25	11.33
DHNP30	*Alstonia scholaris*	(L.) R.Br.	31.62	37.25	34.43
DHNP40	*Delonix regia*	(Hook.) Raf.	20.64	27.75	24.19
DHNP50	*Shorea robusta*	Gaertner f.	10.79	00.00	03.59
DHNP60	*Thuja occidentalis*	L.	03.21	0.00	01.60

Table 7. Density (plants/m^2) of lower risk (LR) tree species in aspect A and aspect B.

Code Name	Species	Species Authority	Density (plant/m^2) of lower risk (LR) tree species		Means
			Aspect (A)	Aspect (B)	
DHNP10	*Pongamia pinnata*	(L.) Pierre	1.30	0.70	1.00
DHNP20	*Acacia auriculiformis*	Benth.	0.20	0.50	0.35
DHNP30	*Alstonia scholaris*	(L.) R.Br.	1.50	1.70	1.60
DHNP40	*Delonix regia*	(Hook.) Raf.	0.90	1.10	1.00
DHNP50	*Shorea robusta*	Gaertner f.	0.40	0.00	0.20
DHNP60	*Thuja occidentalis*	L.	0.10	0.00	0.05

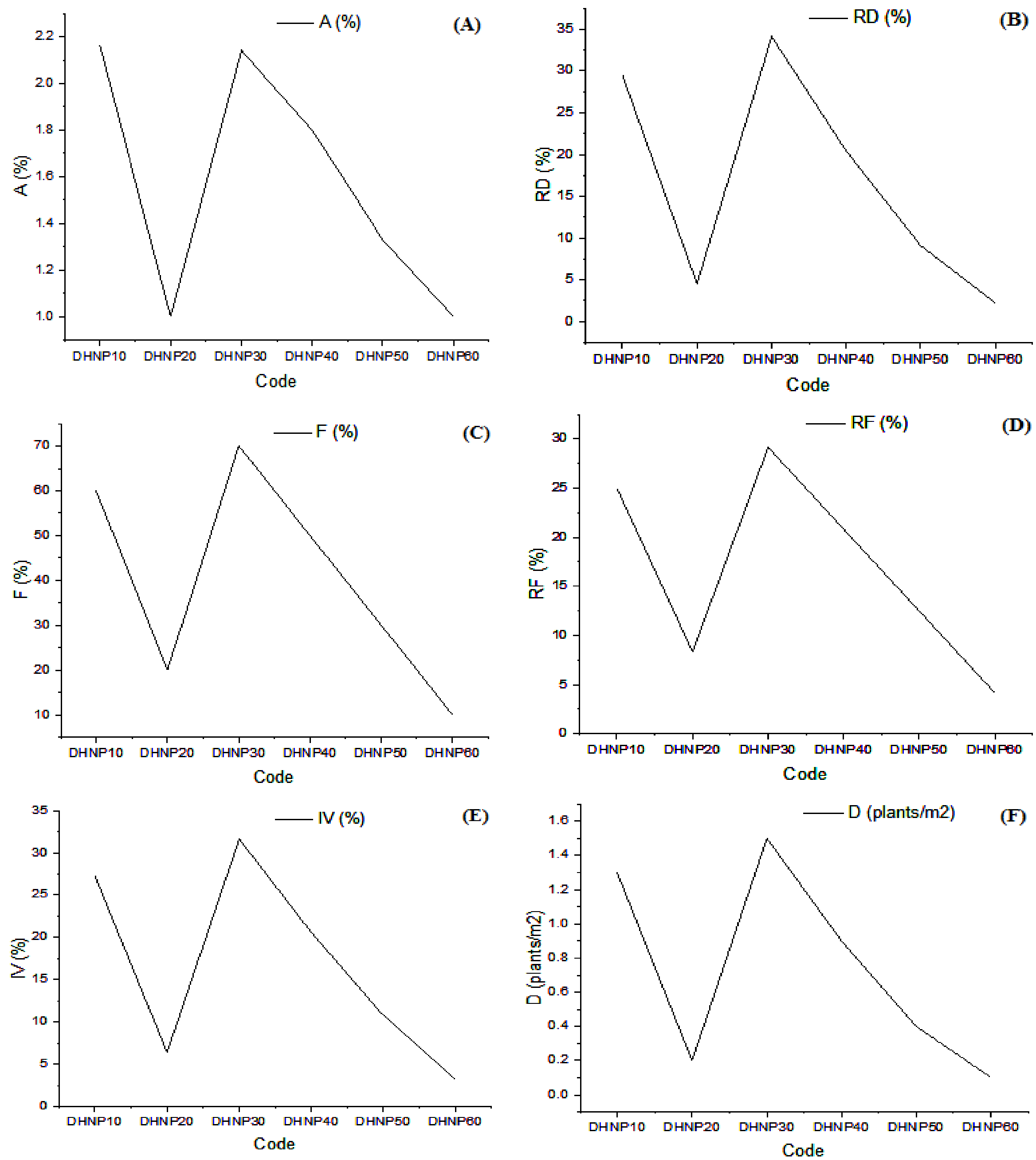

Figure 3. Quantification analysis of an aspect-A LR tree species (A) A- abundance (%), (B) RD- relative density (%), (C) F- frequency (%), (D) RF- relative frequency (%), (E) IV- importance value (%), (F) D- Density (plants/m^2).

value is designated as the Importance Value (IV) of the species. The Importance value is a good indicator for conservation of the Lower risk tree species really this is a very important analysis. Among the locations surveyed the highest importance value of 31.62% for DHNP30 (*Alstonia scholaris*) was recorded at aspect A and lowest importance value was recorded 3.21% of DHNP60 (*Thuja occidentalis*). At aspect B, highest importance value was recorded 37.25% of DHNP30 (*Alstonia scholaris*) and lowest importance value were recorded 18.75% of DHNP10 (*Pongamia pinnata*). *Pongamia pinnata* possessed the highest importance value at both aspects (aspect A and aspect B) examined thereby indicating them as significant among the LR tree species of the study area (Table 6).

Density (D plants/m^2)

Density (D) is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats studied. Density is calculated by the equation. The survey data shows that among the aspects, the highest density 1.50 plants/m^2 were recorded of DHNP10 (*Pongamia pinnata*) at aspect A and lowest density was 0.10 plants/m^2 of DHNP60 (*Thuja occidentalis*). The highest density was recorded 1.70 plants/m^2 of DHNP30 (*Alstonia scholaris*) at aspect B and lowest was recorded 0.50 plants/m^2 of DHNP20 (*Acacia auriculiformis*) (Table 7).

Figure b and c showed the quantification of LR tree species along the highway where sampling was carried out. The results of quantification analysis (Abundance, Relative Density, Frequency, Relative Frequency, Importance Value and Density) are present.

The mean value of abundance (%) in aspect A and aspect B was high (2.13) of DHNP30; mean of relative density (%) was higher (38.29) of DHNP30; mean of frequency (%) was higher (75) of DHNP30, and lower (5) was DHNP60. Mean of relative frequency (%) was higher (30.58) of DHNP30, and lower (2.08) was DHNP60. The mean of importance value (%) was higher (34.43) and lower (1.60) was DHNP60, and the mean value of density (plants/m^2) was higher (1.60) and lower (0.05) was DHNP60 (Fig. 3). So finally I was observed in the field site at the time of investigation DHNP30 (*Alstonia scholaris*) was dominance species because rich in population according to the quantification analysis, and DHNP60 (*Thuja occidentalis*) was observed poor population according to the values of quantification analysis may be the reason was *Thuja occidentalis* is the native species to the eastern Canada, and belong to the gymnosperm plant group.

The comparison of mean, A, RD, F, RF, IV and D value of DHNP30 was higher and total population of DHNP30 was also highest in the study area. Maximum population of LR tree species observed value of DHNP30 was higher than DHNP10, DHNP20, DHNP40, DHNP50 and DHNP60 as compared with both sites along the highway (Fig. 4).

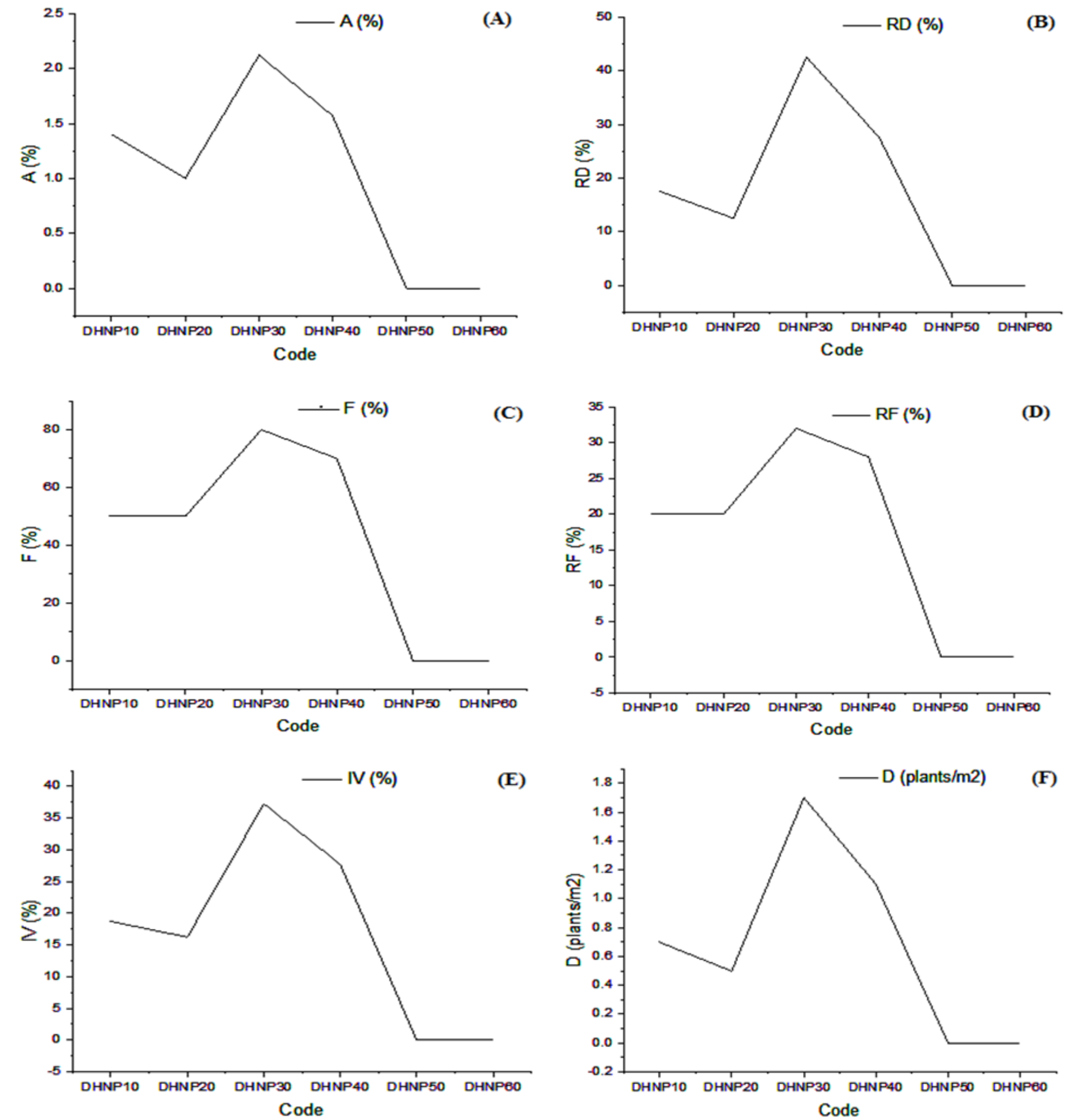

Figure 4. Quantification analysis of an aspect-B LR tree species (A) A- abundance (%), (B) RD- relative density (%), (C) F- frequency (%), (D) RF- relative frequency (%), (E) IV- importance value (%), (F) D- Density (plants/m^2).

Ecological habitat and taxonomy of lower risk tree species

A herbarium is a research and education center much like a library or a museum, but where plants collected from wild or cultivated populations are curated and stored in a stable environment. After plants are collected, pressed, and dried, they are mounted on acid-free, museum-quality paper with a label that documents when and where the specimen was collected, who collected it, in what type of habitat it occurred, and any brief observations that the collector may have made about the species that co-occurred with the specimen. The specimen (sheet) is then assigned an accession number and stored with other specimens in a systematic manner in cabinets. Photographs of preserved (herbarium) lower risk (LR) tree species samples mounted on the herbarium sheet [28 cm X 42 cm (±1 cm) dimension] and affixed with a label providing descriptive data. *Pongamia pinnata, Acacia auriculiformis, Alstonia scholaris, Delonix regia, Shorea robusta* and *Thuja occidentalis*.

As it may require a substantial increase in population or geographic range size, or a major reduction in the rate of decline, for a globally threatened species to move into a lower Red List category of extinction risk, the red list index is best suited to tracking changes in the status of species over at least moderate time periods (4–5 years or more). While deteriorations in status, and hence uplistings on the Red List can happen very rapidly (e.g. Indian white-backed Gyps bengalensis and long-billed Gyps indicus vultures, (Prakash *et al.,* 2003; spoon-billed sandpiper Eurynorhynchus pygmeus, Zockler *et al.,* 2010; & Saiga Antelope, Milner-Gulland *et al.,* 2001), for the eight study species that improved in status it took on average 16.3 years from the start of the intervention to the year of the first down listing, with a range of 11–25 years.

Change in the abundance of individual species was analyzed using only transects on which a species occurred in at least one of the sampling occasions. Only results for absolute abundance are presented because those for proportional abundance were similar. For most species this was conducted only at a reserve level owing to small sample sizes, but a few of the common species were also analyzed according to habitat (O'Connor & Page 2014) The density of the tallest trees has in general decreased and the density of trees of medium height (2–5 m) remained sTable The changes in density of the three smallest height classes (0–2 m) indicate that regeneration had in general been successful, with the density of the smallest individuals (0–1 m) being maintained and that of 1–2 m tall individuals increasing.

Population of LR tree species

Total eighty four populations of LR trees occurred in total twenty randomly selected plots both sites of highway. The total population was recorded 84 LR trees. We established 12.2 km are covered by plotting along the highway. Total 84 LR trees belonging to four families (Fabaceae, Apocynaceae, Dipterocarpaceae and Cupressaceae), 6 genera *Pongamia, Acacia, Alstonia, Delonix, Shorea* and *Thuja* were recorded in randomly selected 20 quadrates both sites of national highway, Dhanbad district, Jharkhand state, India studied area. Tree species richness changes along elevation gradients in response to underlying environmental conditions. Our hypothesis was that richness is associated with climatic variables and decreases with elevation. Trees were identified and measured in 0.1 ha at 15 sites located from 140 to 4000 m a.s.l. Generalized linear models were used to fit richness, diversity, basal area and density as a function of elevation; the best model was selected using Akaike's Information Criterion (Toledo-Garibaldi & Williams-Linera, 2014).

Ecological Study and Quantification Analysis for Population of LR tree species

Ecological studies on identification and quantification of LR tree species have been reported from different parts of India but in Jharkhand state only a few studies on LR tree species. The flora of endangered plant's species of Jharkhand is not complete prepared. This is incomplete many types of species present in this region many regions of Jharkhand are not studied by scientist or taxonomist.

It recorded all LR tree species encountered in the both aspects (aspect A- Kisaan Chawk and aspect B-Gobindpur) of Dhanbad district. Total number of LR trees recorded in the individual both sites ranged 12.2 km from 10-20 quadrates with a total of eight four trees in both aspects. Out of the five LR tree, species belongs to angiosperms; only one tree species (DHNP60-*Thuja occidentalis)* belonged to gymnosperm. The results of this field study showed that continues application of quantification analysis of LR tree species identification. The population of LR tree species showed the aspect A (Gobindpur) rich in population compare to aspect B (Kisaan Chawk). All plotted plots in aspect-A showed high population but plotted plots in aspect B showed low population.

Quantification analysis was used to evaluate checked the population between an aspect A and aspect B, because an aspect was the more natural and non-disturbed site compares to an aspect B. the involvement of human activity was not more, and mostly area was covered by the natural diversity of plants except 0-5m distance from the highway, because this area is under in National highway authority of India (NHAI).

Diversity

Shannon's diversity index (H') was highest in aspect A (2.159) followed by aspect B (1.852). Simpson's dominance index was highest (0.7611) in aspect A followed by aspect B (0.7154). The Simpson index was highest (0.2846) in aspect B followed by aspect A (0.2389). Same both aspect and absolute β beta value (S_0-c)-(S_1-c) was 5 in aspect A and in aspect B absolute β beta value (S_0-c)-(S_1-c) was 3. Species present in <5% of plots were eliminated from the analysis. Indicator species analysis among aspect A, species rich compared to an aspect B. However, the investigated aspect B is species poor, H' was evidently less compared to other aspects.

An important suite of policy-relevant indicators (Walpole *et al.,* 2009) was developed to measure biodiversity status, threats and responses at the global-level in response to the Convention of Biological Diversity's target to reduce the rate of biodiversity loss by 2010 (and these

Table 8. Total population statistics (Means, SD, VSD, PSD, VPSD) of the Lower Risk (LR) tree species both sites (aspect A and aspect B) along the highway, Dhanbad, India.

Code Name	Species	Population of lower risk (LR) tree species									
		Aspect A					Aspect B				
		Mean	*SD*	*VSD*	*PSD*	*VPSD*	Mean	*SD*	*VSD*	*PSD*	*VPSD*
DHNP 10	*Pongamia pinnata* (L.) Pierre	1.30	1.30	1.56	1.18	1.41	0.70	0.82	0.67	0.78	0.61
DHNP 20	*Acacia auriculiformis* Benth.	0.20	0.42	0.17	0.40	0.16	0.60	0.69	0.48	0.66	0.44
DHNP 30	*Alstonia scholaris* (L.) R.Br.	1.50	1.35	1.83	1.28	1.65	1.70	1.33	1.78	1.26	1.61
DHNP 40	*Delonix regia* (Hook.) Raf.	0.90	0.99	0.98	0.94	0.89	1.10	0.99	0.98	0.94	0.89
DHNP 50	*Shorea robusta* Gaertner f.	0.40	0.69	0.48	0.66	0.44	0.00	0.00	0.00	0.00	0.00
DHNP 60	*Thuja occidentalis* L.	0.10	0.31	0.10	0.30	0.09	0.00	0.00	0.00	0.00	0.00

Standard Deviation (SD), Variance Standard Deviation (VSD), Population Standard Deviation (PSD), Variance Population Standard Deviation (VPSD)

Table 9. Results of one way ANOVA showing significance (*P* value) between both sites (aspect A and aspect B) is treatment (total population in plots) at the P < 0.05 level the population means are significantly different.

Site	*F* value	mean ± SD									
		Plot-1	Plot-2	Plot-3	Plot-4	Plot-5	Plot-6	Plot-7	Plot-8	Plot-9	Plot-10
Aspect-A	0.729	0.6±1.03	0.1±0.40	1.1±1.60	0.8±0.98	0.5±0.83	0.8±1.33	0.3±0.51	1.3±1.21	1±1.26	0.5±0.83
Aspect-B	0.672	1±1.26	0.3±0.51	0.1±0.40	0.6±0.81	0.6±1.63	0.5±0.54	1.1±1.17	0.6±0.81	0.5±0.83	1.1±1.33

indicators were used to demonstrate that it was not met: Butchart *et al.,* 2010).

The number of species common to both aspects but in aspect B two LR tree species DHNP50-*Shorea robusta* and DHNP60-*Thuja occidentalis* was absent. However, no species was found to be common in both aspects but aspect A was rich in population of LR tree species compared to an aspect B.

We recorded 6 LR tree species (total population 84 trees) quantification study from two aspects along the highway. We show that taxonomic description with herbarium record and population of LR tree species along the highway. The results suggest that DHNP30 (*Alstonia scholaris*) has become a high population of LR tree species along highway in the area of investigation. DHNP30 (*Alstonia scholaris*) was found in both aspects showing 1.28 (PSD) population standard deviation in aspect A and 1.26 (PSD) population standard deviation showing in aspect B and DHNP60 (*Thuja occidentalis*) showing low population 0.30 (PSD) population standard deviation in aspect A but DHNP60 (*Thuja occidentalis*) and DHNP50 (*Shorea robusta*) were absent in the aspect B showing 0 (PSD) population standard deviation (Table 8).

Statically, test performed the results of ten selected plots this test was very important for the compare both aspects about population of LR tree species present in plots done with the help of one-way ANOVA. The highest number of trees was present in plot 3. The mean ± SD value of plot 3 was (1.1±1.60), and the value of plot 8 was (1.3±1.21) at aspect A. actually we have conformed the highest population of trees between each aspect after using the one way ANOVA. Similarly, the highest number of trees was present in aspect B (plot 1, 7 and 10) and the mean ± SD values are 1±1.26, 1.1±1.17 and 1.1±1.33 mostly similar values. The F value was high < 0.729 of aspect A compare to aspect B (Table 9).

The aspect A and aspect B recorded in the fallow LR tree species and the sacred groves were compared. A significantly (P < 0.05) higher value of DHNP30 Pierre was observed 1.5 ± 1.35 in the aspect A, and in aspect B 1.7 ± 1.33 while there was no significant difference in the index. DHNP10 was observed 1.3 ± 1.25 and in aspect, B was 0.7 ± 0.82, DHNP40 was 0.9 ± 0.99 in aspect A and 1.1 ± 0.99 in aspect B, DHNP50 0.4 ± 0.69 in aspect A and DHNP50 was absent in aspect B, DHNP20 was 0.2 ± 0.42 in aspect A and 0.6 ± 0.69 in aspect B, DHNP60 was lower value observed 0.1 ± 0.31 in aspect A and DHNP60 also was absent in aspect B (Table 10).

The recorded total population of LR tree species was highest in the series DHNP30<DHNP10< DHNP40<DHNP20<DHNP50<DHNP60 according to quantification analysis and floristic study. At the time, the investigation was launched; the highest number of tree was found in plot number 8 (total eight tree sample was found), and second highest number of tree was found in plot number 3 (total seven tree sample was found) in aspect B but in aspect B the highest number of tree was in, plot number 10 and second highest number of tree was found in plot number 1 and plot number 7 (total six tree sample found in each plot) (Fig. 5). Knowledge of population ecology of rare and endangered plants provides important baseline information for monitoring and conservation. As basic units, plant populations constitute communities in the wild.

Table 10. mean ± SD value of LR species.

Code	Species	mean ± SD	
		Aspect A	**Aspect B**
DHNP10	*Pongamia pinnata* (L.) Pierre	1.3±1.25	0.7±0.82
DHNP20	*Acacia auriculiformis* Benth.	0.2±0.42	0.6±0.69
DHNP30	*Alstonia scholaris* (L.) R.Br.	1.5±1.35	1.7±1.33
DHNP40	*Delonix regia* (Hook.) Raf.	0.9±0.99	1.1±0.99
DHNP50	*Shorea robusta* Gaertner f.	0.4±0.69	0
DHNP60	*Thuja occidentalis* L.	0.1±0.31	0

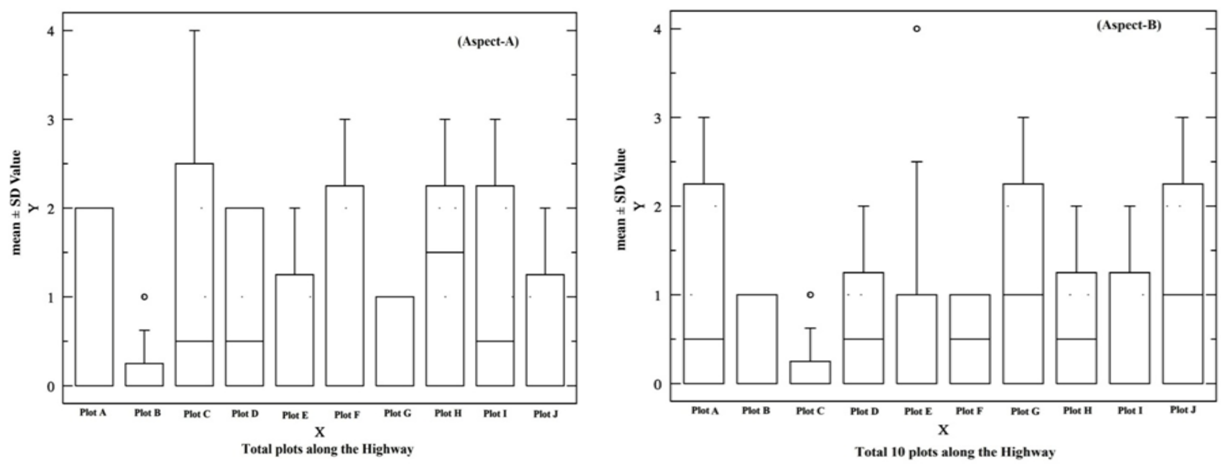

Figure 5. The results of an ANOVA statistical test performed the mean ± SD value of total 10 plots (A) aspect A and (B) aspect B *X* axis indicates the randomly selected plots, and *Y* axis indicates the mean ± SD values of tree's population present in plots. ANOVA was used to test the impact of treatments on diversity change, separately for each index and stand characteristic. At the ($P < 0.005$) level, the population means are significantly different. The means of all levels are equal, but the means of one or more levels are different.

A population is not only the fundamental unit of a species for existence, adaptation and evolution, but also the link between individuals, communities and ecosystems. First, analysis of plant population structure in different habitats can reflect the current state, and help to reveal the future population dynamics. Life tables, survival function curves and time-series analyses are the most important tools for studying population structure and dynamics. Applying these tools allows documentation of the changes in plant population's size classes, survival rates, mortality and survival trends. Second, population distribution patterns can reflect spatial changes in populations, suggesting the trend of population dynamics and community succession. Point pattern analysis, which can reveal the spatial pattern at different scales rather than only one, has recently been widely applied to study plant spatial patterns, especially for dominant trees in forests (Wiegand & Moloney 2004; Olagoke *et al.,* 2013). It can quantitatively describe the population's spatial structure and show how the structure developed, including the position and function of the species in a plant community (Kostrakiewicz 2008; LI *et al.,* 2009).

CONCLUSION

Our field investigation showed that most information about population, identification and quantification analysis (abundance, relative density, frequency, relative frequency, importance value and density) of Lower risk (LR) tree species were within the national highway in Dhanbad district, India (investigation area). The LR tree species generally occurs at <5-15 m along the highway. The quantification analysis is an important analysis for known about population of LR tree species. According to International Union for Conservation of Nature (IUCN) lower risk species one which has been categorized as evaluated but not qualified for any other category. The investigation highlights the value of LR tree species population conserving the natural fragments for maintaining the plant diversity. This is an important consideration in a region where high-value plant diversity rich. Our study shows that the ecological information on LR tree species and quantification analysis for population. These findings can help for identification of LR species or other IUCN red list categories of plant species.

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