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## RESEARCH ARTICLE

### ABUNDANCE OR DOMINANCE: WHICH IS MORE JUSTIFIED TO CALCULATE IMPORTANCE VALUE INDEX (IVI) OF PLANT SPECIES?

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#### ABSTRACT

Abundance and dominance are two aspects of the plant species diversity dynamics, often considered interchangeably together with frequency and density to estimate Importance Value Index (IVI). The importance of the use of abundance or dominance for IVI has been explored through an investigation of abundance-dominance directed species dynamics on Gandhamardan hill of western Odisha in the altitudinal range 340-960m. In total 232 plant species were documented. Large number of species have higher abundance guided IVI (A-IVI) compared to dominance guided IVI (D-IVI). Whole vegetation, Tree-1(>15cm GBH), Tree-2(<15cm GBH), Shrub, LTC (Lianas, Twinner, Climber), Herb/Grass and Seedling community, with 93.53%, 81.40%, 89.66%, 100%, 100%, 100% and 99.01% species showing contiguous distribution, respectively, justify this finding. The values of Shannon-Wiener and Simpson's diversity indices and Evenness index are higher in case of A-IVI compared to D-IVI. The R2 values for A-IVI based Whittaker plot of top twenty species in Tree-2, Shrub, LTC, Herb/Grass and Seedling communities are higher than that of D-IVI based plot except in Tree-1 and Whole vegetation. In these communities the evenness of top twenty species is more expressed by A-IVI than D-IVI. The mean R2 value for A-IVI and D-IVI based plots are 0.64 and 0.56, respectively, indicating that the species evenness is explainable at 64% level by A-IVI, in contrast to 56% level by D-IVI. There are number of species common to the Abundance and Dominance based groups of top twenty five species in each community and this commonness follows the order 'LTC>Shrub>Seedling>Tree-2>Tree-1>Herb/Grass>Whole vegetation'. For A-IVI and D-IVI based groups of top twenty species, the order is 'Shrub>LTC=Tree-2>Tree-1=Seedling>Herb/Grass>Whole vegetation'. In the two orders, 'whole vegetation' is placed at the end with 8% and 45% common species, suggesting that abundance and dominance have high discriminating ability when the whole vegetation is considered as a unit. In this community, nine species are observed to be common amongst top twenty species for A-IVI and D-IVI groups, out of which five are tree species; top twenty species in A-IVI and D-IVI based groups consists of six and sixteen tree species, respectively. Out of top twenty five plant species in whole plant community based on abundance, 19 are herbs/grasses (76%), while on dominance, 24 are trees (96%). Thus, abundance is a factor in vegetation survey, which reveals, promotes and prioritizes communities other than trees. Dominance is justified for tree community as the individuals of tree species are available in higher girths. Therefore, importance value index of species belonging to tree and other communities should be evaluated based on dominance and abundance separately.

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#### INTRODUCTION

The Indian bauxite industry's first encounter with protest movements occurred in the late 1980s when Bharat Aluminium Company (BALCO) searched for additional ore on Gandhamardan Hill in Western Odisha (Mishra, 1987). This hill is known for its biodiversity as well as important Hindu and tribal pilgrimage location. It remained silent observer to a significant established opposition movement when local and

national activists could not quite believe that "Gandhamardan will truly come of age with ancient holy temples of Nrusinghanath and Harishankar and modern industrial temples co-existing and enriching each other." Especially the local mobilisation forced the company to leave and the Hill remains without mining projects to date (Oskarsson, 2013). The relative proximity of the bauxite mining locations in the states of Odisha and Andhra Pradesh, and the dominance of tribal inhabitants have contributed to the formation of the life-giving hills discourse. At the same time the Indian government has closed ranks with forest and environment bureaucrats and experts dropping their earlier resistance to mining with the

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development of forest payment and plantation programs to compensate for lost forest lands from mining (Oskarsson, 2015). In addition, the proposed bauxite mining areas have often had great environmental values justifying conservation and effective ground level survey on vegetation, geology, hydrology and wildlife. Conservation efforts involve study and analysis of plant species dynamics which is one of the significant aspects of biodiversity conservation as well as management with monitoring of a landscape on long term basis. The understanding on ever changing species dynamics relative to abundance and dominance across land scapes is the fundamental requirement for species conservation and propagation. This investigation along an altitudinal gradient, across valleys and perennial stream paths enlightens and reflects the vegetation composition on Gandhamardan hills situated over border adjoining two western districts of Odisha such as Balangir and Baragarh. In India, the Gandhamardan hills is an eco-fragile and eco-sensitive zone hosting numbers of perennial streams and huge bauxite reserve. This hill range falls under tropical dry deciduous forest type (Champion and Seth, 1968). Gandhamardan hills carry not only the signature of mythological significance but also plant diversity, animal diversity, geology, minerals, hydrology, microclimate, topography, socioeconomics and livelihood support. BALCO constructed a road during 1980s for the purpose of mining bauxite from the hills. The road is situated on the North-Western part of the hills extending from foot hill at Nrusinghanath temple to plateau top of the lateritised cap. This is the only accessible road to move into the hill ecosystem by vehicles. Hence plant species diversity and dynamics study is important to keep vigil on the impact of anthropogenic as well as tourism impact on the hill ecosystem.

The most common expression of an ecosystem is the number of species and the proportion in which each species is geospatially distributed in the community. This distribution can be viewed from two angles of abundance and dominance together. In short, a community will have a high alpha diversity, when there is a high number of species and their abundances are much similar. The more similarity in abundances of species implies more evenness and uniformity in horizontal spreading over of individuals of the species. The high alpha diversity points towards a sustainable ecosystem with potential to absorb the anthropogenic disturbance and recover from the unpredictable natural events. Therefore, the plant species dynamics study along the altitudinal limit of the hills is the need of the hour because of prevailing anthropogenic demand for extraction of natural resource like food, fuel, housing materials, herbal medicine and other commercial commodity. The credit for the first attempt in botanical exploration of Gandhamardan hills bestows on Mooney (1950). He carried out a single exploration trip to Gandhamardan hills during the month of September, 1949 and documented seventeen new plant records for the state. After this, many workers like Raju (1960), Panigrahi *et al.* (1964), Misra (1990, 1994, 1996), Saxena and Brahmam (1995), Misra and Das (1998a,b,c), Mishra *et al.* (2001), Mishra and Das (2003), Reddy and Pattanaik (2009), Bhadra *et al.* (2009), Bhadra *et al.* (2009), Sahu *et al.* (2010), Bhadra and Dhal (2010), Bhadra *et al.* (2010), Sahu *et al.* (2010), Bhadra *et al.* (2014), Bhadra *et al.* (2016) have carried out extensive vegetation survey on the Gandhamardan hills from time to time. However, the present study is distinguished from the

previous investigations in exploring plant species level dynamics relative to abundance and dominance on the Gandhamardan hill.

## MATERIALS AND METHODS

### Study area

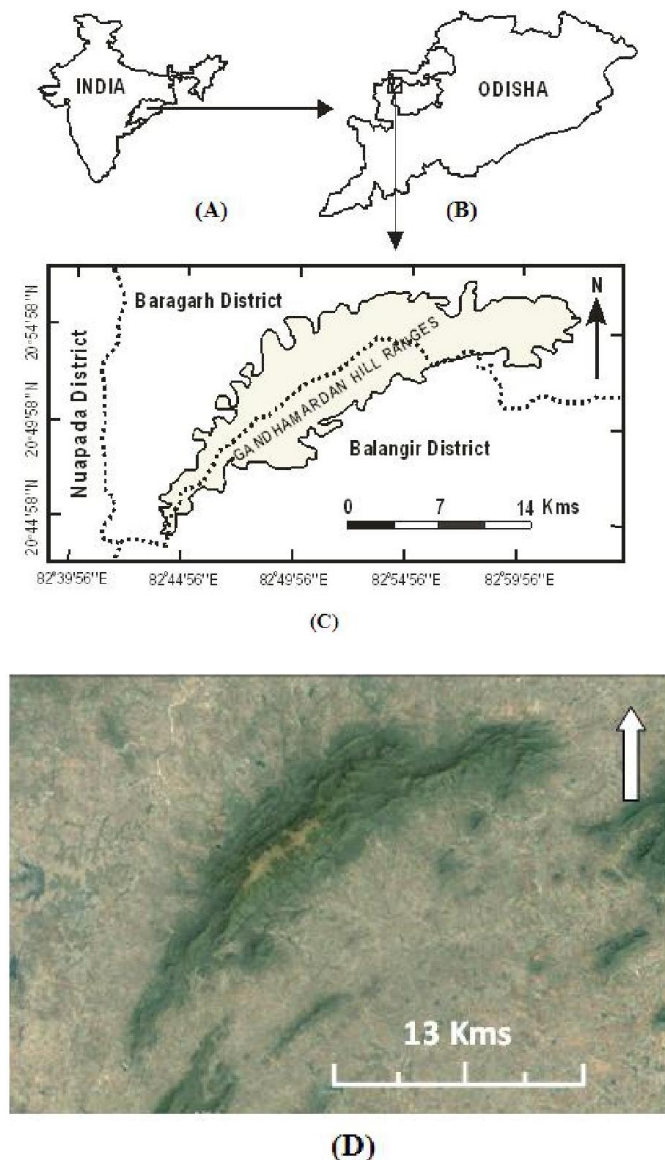
Gandhamardan Hill ranges lies between 20° 42' to 21° 00' N latitudes and 82° 41' to 83° 05' E longitudes in the North-West of Bolangir and South-West of Baragarh district, Odisha, India (Fig.1). The hill ranges define an undulating mountain system in the elevation range of 300m to 1220m a.s.l. It extends over several km in north-east and south-west direction and receives annual rainfall ranging from 750 mm to 1600 mm having average rainfall of 1297 mm.

### Field sampling

The field survey was conducted during months of January to December, 2014. The minimum size and number of quadrates were determined by species area curve method (Mishra, 1968). A total number of 42 sample quadrates of 20m×20m for tree community having >15cm GBH (Tree-1), 15m×15m for tree community having <15cm GBH (Tree-2), 10m×10m for shrubs, 10m×10m for liana, twinner and climber (LTC), 5m×5m for herbs as well as seedlings were laid down along BALCO road from the foot hill near Nrusinghanath temple to the plateau top. The sampled quadrates were laid in such a manner that the plant species recorded from the quadrate must reflect different vegetation types, landform, elevation, phytosociety, abundance, dominance and density. Information on GPS locations and elevation with error value, slope, aspect, canopy density, presence of wildlives, forest fire and weed invasion were noted down for reference and analysis.

### Data analysis

Species were identified following the standard procedure given in the regional flora by Saxena and Brahmam (1996) as well as in national flora by Hooker (1872-97) with reference to Herbarium of CSIR-Institute of Minerals and Materials Technology (CSIR-IMMT), Bhubaneswar. The voucher specimens are kept in the P.G. Department of Environmental Sciences, Sambalpur University, Odisha. The data recorded were quantitatively analysed for whole plant community having number of taxa in species, genus and family to assess the pattern of alpha diversity. This exercise was also carried out for trees, shrubs, lianas, herbs and seedlings separately. The data recorded were quantitatively analysed for frequency, density, abundance, dominance and the relative values of these parameters were calculated and summed up for Importance Value Index (IVI) (Curtis, 1959 and Mishra, 1968). A/F of each species was determined to get distribution pattern of various species following the scheme given by Curtis and Cotton (1956) as regular (<0.025), random (0.025-0.050) and contiguous (>0.050). Dominance-Diversity curve has been drawn taking species on abscissa axis according to decreasing order of IVI values and IVI value on ordinate axis for the determination of species relationship. Shannon-Wiener and Simpson index of diversity were calculated following the formula mentioned below.



Source: [www.googleearth.com](http://www.googleearth.com), 2014) (D)

**Fig.1 Map showing the location of Orissa (A), location of Gandhamardan hill Range in Bolangir and Bargarh district (B, C) and satellite picture of the hill (D)**

Frequency (%) = (Number of quadrates of species occurrence / Total number of quadrates studied)  $\times$  100

Density = Total number of individuals of a species present in all quadrates / Total number of quadrates studied

Abundance = Total number of individuals of a species present in all quadrates/ Total number of quadrates of species occurrence

Dominance = Sum of basal area occupied by stems of all individuals of a species in all the studied quadrates where basal area of a stem is represented by  $\pi r^2$  and  $r$  = Radius of the stem

Relative frequency = (Frequency of a species / Sum of frequency of all species)  $\times$  100

Relative density = (Density of a species / Sum of density of all species)  $\times$  100

Relative abundance = (Abundance of a species / Sum of abundance of all species)  $\times$  100

Relative dominance = (Dominance of a species / Sum of dominance of all species)  $\times$  100

Importance Value Index (IVI) = Relative Frequency + Relative Density + Relative Abundance

Also, the index was calculated using dominance in place of abundance i.e.

Importance Value Index (IVI) = Relative Frequency + Relative Density + Relative Dominance

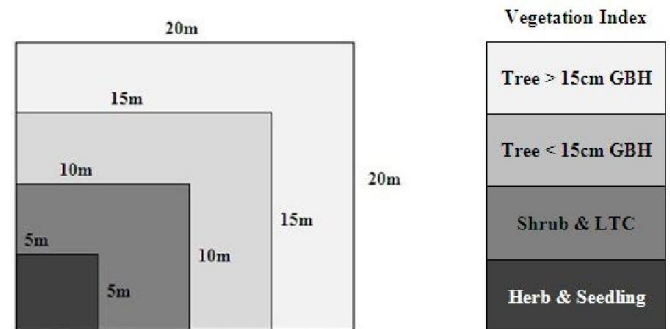
Shannon-Wiener index ( $H'$ ) =  $-\sum P_i \log P_i$ , where  $P_i = n_i / N$   
Simpson's index =  $1 - [\sum (n_i/N)^2]$

Where,  $n_i$  = Importance value of a species

$N$  = Sum of importance values of all the species

Evenness Index =  $E = H' / \log N'$

Where,  $N'$  = Number of plant species



**Fig. 2. A model set of quadrate with representative vegetation index area**

## RESULTS

The determination of minimum size and number of quadrates is the primary requirement for the effective study of a forest area to accommodate all plant species prevalent in the ecosystem. Based on field study, the findings at the two locations and ease of logical scientific survey in the field, the minimum size of quadrates fixed for vegetation survey along the BALCO road were 20m $\times$ 20m, 15m $\times$ 15m, 10m $\times$ 10m, 10m $\times$ 10m, 5m $\times$ 5m and 5m $\times$ 5m for Tree-1, Tree-2, Shrub, LTC, Herb and Seedling community, respectively. Then the fixed minimum size of quadrates were laid along the BALCO road starting from the foothill towards uphill to assess the minimum number of quadrates for effective vegetation survey covering maximum probable plant species. The minimum number of quadrates determined for Tree-1, Tree-2, Shrub, LTC, Herb and Seedling community are 14, 15, 11, 8, 13 and 14, respectively. Hence 42 sets of quadrates (Fig.3) covering along the altitudinal variations were laid down along the BALCO road transect from foot hill to top of plateau to enumerate the plant species occurrence, assess the  $\alpha$ -diversity of the region and quantitative characteristics of plant species. The plant species recorded in each plot were quantitatively analysed. Total 232 plant species were documented having 189 genera and 66 families.

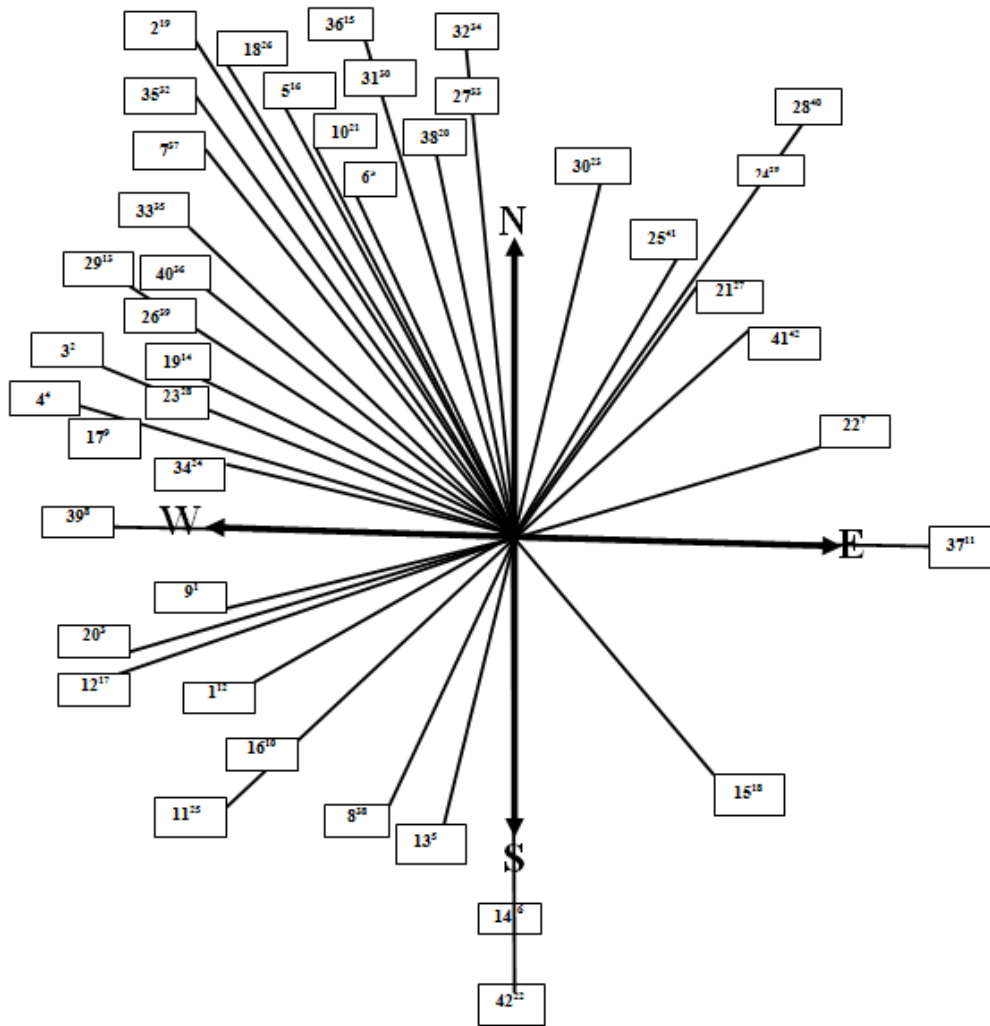


Fig. 3. Aspect of forty two sets of quadrates sampled on Gandhamardan hill along BALCO road. Number and the superscript shows the serial number and population rank of the quadrate respectively

The matured tree community (Tree-1) has 86 species, 71 genera and 35 families. The immature tree community (Tree-2) has 58 species, 51 genera and 30 families. The shrub community is having 34 species, 33 genera and 23 families. The LTC (Liana, Twinner and Climber) community is having 26 species, 21 genera and 12 families. The herb/grass community is having 82 species, 69 genera and 25 families. The seedling community is having 101 species, 90 genera and 44 families. Abundance and dominance are two quantitative characteristics from which any one is taken into account while calculating importance value index (IVI) of a plant species. However, here we have calculated IVI of each plant species taking both values to study dynamics with respect to the two parameters. This investigation was done in Tree Species > 15cm GBH (Tree-1), Tree Species < 15cm GBH (Tree-2), Shrub, LTC, Herb/Grass, Seedling and whole plant community separately to study plant species dynamics. In the whole plant community, abundance guided IVI ranges from 17.43 (*Thysanolaena maxima*) to 0.12 (*Alangium salvifolium*, *Alstonia scholaris*, *Antidesma acidum*, *Ardisia solanacea*, *Breynia retusa*, *Embelia tsjeriam-cottam*, *Ficus arnottiana*, *Ficus benghalensis*, *Ficus microcarpa*, *Ficus religiosa*, *Ficus virens*, *Glochidion zeylanicum*, *Leptadenia reticulata*, *Pterospermum acerifolium*, *Streblus asper* and *Trema orientalis*) and dominance guided IVI ranges from

13.53 (*Diospyros melanoxylon*) to 0.07 (*Alangium salvifolium*, *Breynia retusa*, *Embelia tsjeriam-cottam* and *Leptadenia reticulata*). Tree-1 community is having highest abundance guided IVI of 18.51 (*Cleistanthus collinus*) and lowest of 0.86 (*Alstonia scholaris*, *Antidesma acidum*, *Ardisia solanacea*, *Ficus arnottiana*, *Ficus benghalensis*, *Ficus microcarpa*, *Ficus religiosa*, *Ficus virens*, *Glochidion zeylanicum*, *Mangifera indica*, *Phoenix sylvestris*, *Pterospermum acerifolium*, *Streblus asper* and *Trema orientalis*). This community is having highest Dominance guided IVI of 21.34 (*Cleistanthus collinus*) and lowest of 0.23 (*Antidesma acidum*, *Ardisia solanacea*, *Ficus virens*, *Glochidion zeylanicum*, *Phoenix sylvestris*, *Pterospermum acerifolium*). Tree-2 community is having highest abundance guided IVI of 30.00 (*Anogeissus latifolia*) and lowest of 1.54 (*Antidesma acuminatum*, *Bauhinia malabarica*, *Bombax ceiba*, *Canthium dicoccum*, *Cochlospermum religiosum*, *Euphorbia nivulia*, *Garuga pinnata*, *Kydia calycina*, *Protium serratum*, *Strychnos nuxvomica* and *Wrightia arborea*). This community is having highest Dominance guided IVI of 43.73 (*Anogeissus latifolia*) and lowest of 0.50 (*Protium serratum*). The shrub community is having highest Abundance guided IVI of 72.09 (*Thysanolaena maxima*) and lowest of 0.75 (*Breynia retusa* and *Ziziphus oenoplia*) while it is having highest Dominance guided IVI of 130.69 (*Dendrocalamus strictus*) and lowest of

0.55 (*Breynia retusa* and *Ziziphus oenoplia*). Lianas, Twinner and Climber (LTC) community is having highest abundance guided IVI of 36.32 (*Hemidesmus indicus*) and lowest of 3.87 (*Lygodium flexuosum*). LTC community is having highest dominance guided IVI of 101.63 (*Bauhinia vahlii*) and lowest of 1.72 (*Ampelocissus latifolia*). The Herb/Grass community is having highest abundance guided IVI of 19.76 (*Hemigraphis latebrosa*) and lowest of 0.61 (*Colocasia esculenta*) while the highest and lowest dominance guided IVI are 31.35 (*Hemigraphis latebrosa*) and 0.47 (*Evolvulus alsinoides*). Lastly, the seedling community is having highest and lowest values for Abundance directed IVI are 27.12 (*Acacia torta*) and 0.36 (*Atylosia scarabaeoides*, *Chlorophytum arundinaceum*, *Embelia tsjeriam-cottam*, *Eriolaena hookeriana*, *Gardenia gummifera*, *Leptadenia reticulata* and *Syzigium cumini*) while those for dominance directed IVI are 41.55 (*Diospyros melanoxylon*) and 0.25 (*Atylosia scarabaeoides*) respectively. There are some cases of species where the A-IVI and D-IVI are equal in values. In the whole plant community, *Erythrina variegata*, *Murraya paniculata* and *Pongamia pinnata* are having 0.18, 0.19 and 0.19 as both A-IVI and D-IVI values respectively. None of the species in Tree-1, Tree-2, Shrub, LTC and Herb/Grass community shows equal A-IVI and D-IVI values. Only three species of the seedling community i.e. *Embelia tsjeriam-cottam*, *Meyna spinosa* and *Phoenix sylvestris* show equal A-IVI and D-IVI values of 0.36, 1.76 and 0.51 respectively. On the other hand, 63, 39, 27, 20, 56, 68 and 172 species show higher A-IVI than D-IVI and 23, 19, 7, 6, 26, 30 and 57 species show lower A-IVI than D-IVI in the Tree-1, Tree-2, Shrub, LTC, Herb/Grass and seedling community respectively (Fig.4). Maximum 79.4% species of shrub community and minimum 67.2% species of Tree-2 community show higher A-IVI than D-IVI while maximum 32.8% species of Tree-2 and minimum 20.6% species of shrub community show lower A-IVI than D-IVI values. Only 3% species of seedling and 1.3% species of whole plant community show equal A-IVI and D-IVI.

Distribution pattern of all species across all communities was found out based on the ratio of abundance to frequency value of each individual species. To discover that not a single plant species in all the communities shows regular distribution pattern. 15, 16, 6 and 1 number of species show random distribution pattern in the whole plant, Tree-1, Tree-2 and seedling community respectively. 217, 70, 52, 34, 26, 82 and 100 numbers of species show contiguous distribution pattern in the whole plant, Tree-1, Tree-2, Shrub, LTC, Herb/Grass and Seedling community respectively. Also, no species in shrub, LTC and Herb/Grass community shows random distribution pattern (Table-9). The Shannon-Wiener index of diversity (H'), Simpson's index of diversity (D) and Evenness index (E) were derived based on the importance value index calculated taking both abundance and dominance values. It was observed that in all the cases, the indices guided by A-IVI are higher than those guided by D-IVI (Table-10). Shannon-Wiener index of diversity guided by A-IVI is highest in Total plant community i.e. 2.13 followed by Tree-1, Herb/Grass, Seedling, Tree-2, LTC and shrub in decreasing order where Tree-1 and Herb/Grass community are having equal H' values. This trend of Shannon-Wiener index deviates in case guided by D-IVI having Herb/Grass index higher than Tree-1. The trend is highest in Total plant community i.e. 2.03 followed by Herb/Grass, Tree-1, Seedling, Tree-2, LTC and Shrub in

decreasing order. The trend of Simpson's index guided by A-IVI and D-IVI are 'Total plant community > Tree-1=Herb/Grass > Tree-2 > Seedling > LTC > Shrub' and 'Total plant community > Tree-1=Herb/Grass > Tree-2 = Seedling > LTC > Shrub' respectively. The trend of evenness index guided by A-IVI and D-IVI are 'LTC > Tree-2 = Herb/Grass > Tree-2 > Total plant community > Seedling > Shrub' and 'Herb/Grass > Tree-2 > Total plant community = Tree-1 > Seedling > LTC > Shrub' respectively.

Dominance-Diversity curve was made taking species on X-axis and IVI value on Y-axis for each of vegetation communities (Fig.5). The top twenty plant species with A-IVI and D-IVI in each community have been depicted in the curve to find the species dynamics with respect to abundance and dominance. The coefficient of determination ( $R^2$ ) of each curve was found out. It was seen that  $R^2$  value for D-D curve guided by A-IVI in Tree-2, Shrub, LTC, Herb/Grass and Seedling communities are higher than  $R^2$  value for D-D curve guided by D-IVI except in Tree-1 and Whole plant community where reverse trend was observed. In the Tree-1 (Tree species > 15cm GBH) community, *Cleistanthus collinus* tops with A-IVI value of 18.51 followed by *A. latifolia*, *D. melanoxylon*, *P. marsupium*, *B. retusa*, *B. lanzan*, *C. swietiana*, *L. parviflora*, *S. chelonoides*, *L. coromandelica*, *N. arbor-tristis*, *Z. xylopyrus*, *T. alata*, *P. emblica*, *H. cordifolia*, *D. montana*, *M. parviflora*, *E. hookeriana*, *C. glauca* and *C. elliptica* in decreasing order (Fig.5-A1). At the same time, *C. collinus* also tops in Tree-1 community with D-IVI value of 21.34 followed by *A. latifolia*, *P. marsupium*, *D. melanoxylon*, *B. retusa*, *L. parviflora*, *T. alata*, *H. cordifolia*, *B. lanzan*, *C. swietiana*, *M. parviflora*, *S. chelonoides*, *L. coromandelica*, *D. aurea*, *T. bellirica*, *Z. xylopyrus*, *M. indica*, *P. emblica*, *E. hookeriana* and *S. oleosa* in decreasing order (Fig.5-A2). Sixteen species such as *M. parviflora*, *C. collinus*, *A. latifolia*, *D. melanoxylon*, *P. marsupium*, *B. retusa*, *B. lanzan*, *C. swietiana*, *L. parviflora*, *S. chelonoides*, *L. coromandelica*, *Z. xylopyrus*, *T. alata*, *P. emblica* and *H. cordifolia* are observed in common to the top ranking 20 species based on IVI guided by abundance and dominance.

Four species unique to top ranking twenty species projected by A-IVI are *N. arbor-tristis*, *D. montana*, *C. glauca* and *C. elliptica* while four species unique to top ranking twenty species projected by D-IVI are *D. aurea*, *T. bellirica*, *M. indica* and *S. oleosa*. The  $R^2$  value 0.782 guided by A-IVI is lower than the value 0.842 guided by D-IVI in the Tree-1 community. In the Tree-2 (Tree species < 15cm GBH) community, *A. latifolia*, *D. melanoxylon*, *C. swietiana*, *P. marsupium*, *C. elliptica*, *C. collinus* and *E. hookeriana* occupy the top seven positions in decreasing order of both A-IVI and D-IVI values (Fig.5-B1 & B2). From eighth position onwards, there is change in positions of different species depending up on index values. *H. cordifolia* and *G. orbiculata* are the two species with A-IVI which are absent in the top twenty tree species with D-IVI and *S. oleosa* and *C. graveolens* are the two species with D-IVI which are absent in the top twenty tree species with A-IVI in the Tree-2 community. All the eighteen tree species such as *A. latifolia*, *D. melanoxylon*, *C. swietiana*, *P. marsupium*, *C. elliptica*, *C. collinus*, *E. hookeriana*, *B. lanzan*, *P. emblica*, *C. glauca*, *H. pubescens*, *L. parviflora*, *M. parviflora*, *Z. xylopyrus*, *B. retusa*, *S. chelonoides*, *T. alata* and *L. coromandelica* are common to the top twenty tree species

with A-IVI and D-IVI in the Tree-2 community. The  $R^2$  values of D-D curve guided by A-IVI and D-IVI in this community are 0.523 and 0.504 respectively. The shrub community is having 34 species. In the top twenty species guided by A-IVI and D-IVI, nineteen species such as *T. maxima*, *D. strictus*, *H. isora*, *P. barlerioides*, *D. pulchellum*, *A. torta*, *C. buchananii*, *G. hirsuta*, *S. polyandrum*, *I. cassioides*, *B. cristata*, *C. paniculata*, *B. montanum*, *M. extensa*, *W. fruticososa*, *O. scandens*, *C. oppositifolia*, *L. asiatica* and *F. bracteata* are commonly found. *D. velutinum* and *C. serratum* are only found in top twenty species guided by A-IVI and D-IVI respectively. *T. maxima* tops with A-IVI of 72.09 and *D. strictus* tops with D-IVI of 130.69 while *T. maxima* occupies fourth position with D-IVI of 16.09 and *D. strictus* occupies second position with A-IVI of 54.98 (Fig.5-C1 & C2). The correlation coefficients of D-D curves guided by A-IVI and D-IVI for shrub community are 0.530 and 0.306 respectively. Out of total twenty six species of LTC community, eighteen are commonly observed in the top twenty species guided by A-IVI and D-IVI. Those species are *H. indicus*, *B. vahlii*, *G. sylvestre*, *C. pariera*, *V. madraspatana*, *V. hainiana*, *D. glabra*, *V. denticulata*, *A. scarabaeoides*, *G. tenuiflora*, *A. tomentosa*, *D. puber*, *C. grandis*, *B. parviflora*, *D. tomentosa*, *D. wallichii*, *W. volubilis* and *C. repens* (Fig.5-D1 & D2). Two species *I. eriocarpa* and *M. dioica* present in top twenty species guided by A-IVI are absent in top twenty species guided by D-IVI while *T. cordifolia* and *M. racemosa* present in top twenty species guided by D-IVI are absent in top twenty species guided by A-IVI. *H. indicus* holds top position with A-IVI value of 36.32 followed by *B. vahlii* with 30.68 while *B. vahlii* hold top position with D-IVI value of 101.63 followed by *H. indicus* with 30.96 in the LTC community. *C. repens* occupies the same twentieth position in both Dominance-Diversity curves guided by A-IVI and D-IVI.

The correlation coefficients of D-D curves guided by A-IVI and D-IVI for LTC community are 0.667 and 0.313 respectively. The Herb/Grass community is having 82 species out of which twelve species are commonly shared by top twenty species guided by both A-IVI and D-IVI. Those twelve species are *H. latebrosa*, *B. herbacea*, *F. argentea*, *A. paniculata*, *M. japonica*, *C. parviflorum*, *A. mutica*, *C. parasitica*, *A. racemosus*, *C. orchiooides*, *V. cinerea* and *H. salicifolia*. Eight species present in top twenty Herb/Grass species guided by A-IVI such as *A. philippense*, *A. lancifolius*, *A. incisum*, *C. farinosa*, *F. scandens*, *A. pumila*, *D. bupleuroides* and *T. quadrivalvis* are absent in top twenty Herb/Grass species guided by D-IVI. Likewise eight species present in top twenty Herb/Grass species guided by D-IVI such as *C. arundinaceum*, *A. indica*, *C. longiflora*, *C. trichocarpa*, *L. fasciculata*, *S. dulcis*, *C. verticillatus* and *G. abyssinica* are absent in top twenty Herb/Grass species guided by A-IVI. *H. latebrosa* and *B. herbacea* holds first and second place with A-IVI 19.76 and 14.04 but these two species interchange their ranks in the Dominance-Diversity curve guided by D-IVI with values 18.52 and 31.35 respectively (Fig. 5-E1 & E2). The correlation coefficient of Dominance-Diversity curves guided by abundance and dominance values of top twenty species having highest IVI are 0.714 and 0.501 respectively in the Herb/Grass community. The seedling community is enriched with 101 species. In the top twenty plant species of this community guided by both A-IVI and D-IVI, sixteen species such as *A. torta*, *D. melanoxyton*, *S.*

*robusta*, *C. parviflorum*, *C. orchiooides*, *C. swietiana*, *M. extensa*, *P. marsupium*, *C. paniculata*, *D. strictus*, *S. polyandrum*, *H. isora*, *A. latifolia*, *B. vahlii*, *P. barlerioides* and *C. fistula* are observed in common (Fig.5-F1 & F2). Four species found only in top twenty species group guided by A-IVI are *T. maxima*, *H. latebrosa*, *M. indica* and *H. indicus* while those four species found only in top twenty species group guided by D-IVI are *V. denticulata*, *S. chelonoides*, *C. collinus* and *W. volubilis*. In the seedling community, *A. torta* and *D. melanoxyton* occupies first and second positions with A-IVI value of 27.12 and 26.81 but these two species interchange their rank place in the Dominance-Diversity curve guided by D-IVI with values 36.60 and 41.55 respectively. The correlation coefficient of Dominance-Diversity curves guided by abundance and dominance values of top twenty seedling species having highest IVI are 0.684 and 0.569 respectively in the seedling community. The whole plant community consists of 232 plant species in total including Tree, Shrub, LTC, Herb and Grass species. In the top twenty plant species of whole plant community guided by both A-IVI and D-IVI, only nine species such as *D. melanoxyton*, *D. strictus*, *A. torta*, *H. latebrosa*, *A. latifolia*, *H. isora*, *C. swietiana*, *C. collinus* and *P. marsupium* are observed in common (Fig.5-G1 & G2). Out of these nine, five species are trees, three species are shrubs and one is Herb. In the total top twenty species guided by A-IVI, six are trees, six are shrubs and eight are Herb/Grass while there is no LTC species. Likewise, in the total top twenty species guided by D-IVI, majority sixteen species are trees, three species are shrubs and one species is only Herb/Grass while there is also no LTC species. Eleven species being present in the top twenty plant species group guided by A-IVI but absent in the top twenty plant species group guided by D-IVI are *T. maxima*, *C. parviflorum*, *F. argentea*, *A. philippense*, *A. lancifolius*, *B. herbacea*, *D. pulchellum*, *P. barlerioides*, *C. orchiooides*, *S. robusta* and *M. japonica*.

Reversely, eleven species which are present in the top twenty plant species group guided by D-IVI but absent in the top twenty plant species group guided by A-IVI are *B. retusa*, *H. cordifolia*, *T. alata*, *L. parviflora*, *T. bellirica*, *M. indica*, *D. aurea*, *S. oleosa*, *B. lanzan*, *M. parviflora* and *S. chelonoides*. These eleven species happens to be all tree species. *T. maxima* tops in the rank of IVI guided by abundance with value of 17.43 followed by *D. melanoxyton* with index value of 10.16. but *T. maxima* is all total absent in the rank of IVI of top twenty plant species guided by dominance while at the same time *D. melanoxyton* tops in the same list with 13.53 index value. *P. marsupium* which is ranked twentieth in the A-IVI with index value 3.48 is holding the second position with index value 10.80 in the rank list of species guided by D-IVI. The correlation coefficient of Dominance-Diversity curves guided by abundance and dominance values of top twenty plant species having highest IVI are 0.584 and 0.903 respectively in the whole vegetation. Community wise plant species dynamics was studied earmarking the top twenty five plant species based on their abundance and dominance values (Fig.6). *N. arbor-tristis* with abundance 9 occupies the first rank in the Tree-1 community followed by *C. collinus* and *G. orbiculata* with abundance 6 and 5 respectively. *C. tomentosa*, *A. latifolia* and *D. melanoxyton* with abundance 4 each; *A. marmelos*, *B. malabarica*, *D. montana*, *C. swietiana*, *B. lanzan*, *D. paniculata*, *B. retusa* and *P. marsupium* with

abundance 3 each and *S. chelonoides*, *W. tinctoria*, *C. glauca*, *B. serrata*, *E. nivulia*, *H. cordifolia*, *D. latifolia*, *P. emblica*, *L. coromandelica*, *A. acuminatum* and *C. dicoccum* with abundance 2 each come in series after *D. melanoxyton*. *P. marsupium* holds first rank with dominance of 3.74m<sup>2</sup> followed by *B. retusa* (3.14m<sup>2</sup>), *C. collinus* (3.11m<sup>2</sup>), *A. latifolia* (2.76m<sup>2</sup>), *H. cordifolia* (2.51m<sup>2</sup>), *T. bellirica* (2.48m<sup>2</sup>), *T. alata* (2.31m<sup>2</sup>), *M. indica* (2.26m<sup>2</sup>), *D. melanoxyton* (2.24m<sup>2</sup>), *D. aurea* (1.96m<sup>2</sup>), *L. parviflora* (1.87m<sup>2</sup>), *S. oleosa* (1.82m<sup>2</sup>), *M. parviflora* (1.41m<sup>2</sup>), *B. lanzan* (1.31m<sup>2</sup>), *C. swietiana* (1.21m<sup>2</sup>), *E. hookeriana* (0.86m<sup>2</sup>), *S. chelonoides* (0.80m<sup>2</sup>), *Z. xylopyrus* (0.79m<sup>2</sup>), *B. malabarica* (0.78m<sup>2</sup>), *B. ceiba* (0.74m<sup>2</sup>), *L. coromandelica* (0.64m<sup>2</sup>), *P. emblica* (0.54m<sup>2</sup>), *G. latifolia* (0.45m<sup>2</sup>), *S. cumini* (0.44m<sup>2</sup>) and *S. robusta* (0.44m<sup>2</sup>). Only twelve species common to 25 top ranking species guided by both abundance and dominance in Tree-1 community are *C. collinus*, *A. latifolia*, *D. melanoxyton*, *B. malabarica*, *C. swietiana*, *B. lanzan*, *B. retusa*, *P. marsupium*, *S. chelonoides*, *H. cordifolia*, *P. emblica* and *L. coromandelica*. Therefore, 13 species unique in top 25 tree species group controlled by abundance are *N. arbor-tristis*, *G. orbiculata*, *C. tomentosa*, *A. marmelos*, *D. montana*, *D. paniculata*, *W. tinctoria*, *C. glauca*, *B. serrata*, *E. nivulia*, *D. latifolia*, *A. acuminatum* and *C. dicoccum*. On the other hand, 13 species unique in top 25 tree species group controlled by Dominance are *T. bellirica*, *T. alata*, *M. indica*, *D. aurea*, *L. parviflora*, *S. oleosa*, *M. parviflora*, *E. hookeriana*, *Z. xylopyrus*, *B. ceiba*, *G. latifolia*, *S. cumini* and *S. robusta*. *N. arbor-tristis* which holds first rank in the top 25 tree species group based on abundance is completely absent in the top 25 tree species group based on dominance value in the Tree-1 community.

In the Tree-2 community, *G. orbiculata* and *A. latifolia* holds first and second positions with abundance 5 and 4 respectively in the top 25 tree species group having highest abundance (Fig.6-B1). *P. marsupium*, *C. glauca*, *D. melanoxyton*, *H. cordifolia*, *C. swietiana* and *E. hookeriana* with abundance 3 each and *H. pubescens*, *B. lanzan*, *C. graveolens*, *D. oojeinensis*, *D. montana*, *F. indica*, *H. nepalense*, *S. urens*, *T. chebula*, *C. collinus*, *A. marmelos*, *A. odoratissima*, *P. emblica*, *M. parviflora*, *S. cumini*, *B. retusa* and *C. tomentosa* with abundance 2 each come next in the series. *A. latifolia* with dominance 0.08111m<sup>2</sup> occupies first place followed in series by *D. melanoxyton*, *C. swietiana*, *P. marsupium*, *C. collinus*, *E. hookeriana*, *P. emblica*, *C. elliptica*, *B. lanzan*, *C. glauca*, *L. parviflora*, *Z. xylopyrus*, *B. retusa*, *C. graveolens*, *T. alata*, *M. parviflora*, *L. coromandelica*, *H. pubescens*, *D. montana*, *H. cordifolia*, *A. marmelos*, *F. indica*, *S. oleosa*, *S. chelonoides* and *M. spinosa* in the top 25 tree species group based on dominance values (Fig.6-B2). Seventeen species common to these both top 25 tree species based on abundance and dominance are *A. latifolia*, *P. marsupium*, *C. glauca*, *D. melanoxyton*, *H. cordifolia*, *C. swietiana*, *E. hookeriana*, *H. pubescens*, *B. lanzan*, *C. graveolens*, *D. montana*, *F. indica*, *C. collinus*, *A. marmelos*, *P. emblica*, *M. parviflora* and *B. retusa*. Eight species present only in top 25 species based on abundance but absent in top 25 species based on dominance are *G. orbiculata*, *D. oojeinensis*, *H. nepalense*, *S. urens*, *T. chebula*, *A. odoratissima*, *S. cumini* and *C. tomentosa* while reversely eight species present in top 25 species based on dominance but absent in top 25 species based on abundance are *C. elliptica*, *L. parviflora*, *Z. xylopyrus*, *T. alata*, *L.*

*coromandelica*, *S. oleosa*, *S. chelonoides* and *M. spinosa*. *G. orbiculata* holding first position in the top 25 tree species group based on abundance is completely absent in the top 25 tree species group based on dominance value in the Tree-2 community. In the shrub community, *T. maxima* having abundance 280 hold first rank followed by *D. pulchellum*, *D. strictus*, *B. montanum*, *D. velutinum*, *B. cristata*, *P. barlerioides*, *H. isora* and *C. oppositifolia* with abundance value of 65, 24, 14, 11, 10, 9, 7 and 6 respectively (Fig.6-C1). After this, *C. buehananii*, *W. fruticosa*, *M. malabathricum* and *S. polyandrum* with abundance 5 each; *I. cassioides* and *T. lampas* with abundance 4 each; *L. asiatica*, *A. venenata*, *C. serratum*, *D. viscosa*, *T. pilosa*, *G. hirsuta*, *A. torta*, *F. bracteata* and *P. crassicaulis* with abundance 3 each and *O. scandens* with abundance 2 come down in the series within the group. Here in the shrub community, the second highest gap of 278 is found in the abundance of first rank species and twenty fifth rank species. In the top ranking 25 shrub species based on dominance value, *D. strictus* holds first position with dominance of 0.73292m<sup>2</sup>. Then *W. fruticosa*, *H. isora*, *A. torta*, *P. barlerioides*, *M. extensa*, *C. buehananii*, *P. crassicaulis*, *O. scandens*, *C. serratum*, *J. arborescens*, *S. virosa*, *T. maxima*, *S. polyandrum*, *E. paniculata*, *C. oppositifolia*, *F. bracteata*, *L. asiatica*, *D. viscosa*, *G. hirsuta*, *M. malabathricum*, *S. suaveolens*, *B. montanum*, *I. cassioides* and *A. venenata* come down in the series (Fig.6-C2). Twenty species are occurring in common to the two groups of 25 top ranking shrub species based on abundance and dominance values. These are *T. maxima*, *D. strictus*, *B. montanum*, *P. barlerioides*, *H. isora*, *C. oppositifolia*, *C. buehananii*, *W. fruticosa*, *M. malabathricum*, *S. polyandrum*, *I. cassioides*, *L. asiatica*, *A. venenata*, *C. serratum*, *D. viscosa*, *G. hirsuta*, *A. torta*, *F. bracteata*, *P. crassicaulis* and *O. scandens*. Five species present only in 25 top ranking shrubs on the basis of abundance are *D. pulchellum*, *D. velutinum*, *B. cristata*, *T. lampas* and *T. pilosa*. On the other hand, five species present only in the 25 top ranking shrubs on the basis of dominance are *M. extensa*, *J. arborescens*, *S. virosa*, *E. paniculata* and *S. suaveolens*. *T. maxima* occupying first position in the 25 top ranking shrub species group holds 13<sup>th</sup> position in the 25 top ranking species based on dominance. Out of *D. pulchellum* and *D. strictus* occupying second and third position respectively in the top ranking 25 shrubs, the first one is completely absent and second one holds first position in the top ranking 25 shrub species based on dominance values. In the LTC community, out of 26 species, 25 species have been depicted with highest abundance and dominance values (Fig.6-D1 & D2). It is seen that all 25 species are same in both the groups with different ranks. These species are *G. sylvestre*, *I. eriocarpa*, *H. indicus*, *M. dioica*, *B. vahlii*, *D. glabra*, *B. parviflora*, *D. tomentosa*, *D. wallichii*, *V. denticulata*, *V. madraspatana*, *V. hainiana*, *A. tomentosa*, *C. repens*, *D. puber*, *C. grandis*, *A. scarabaeoides*, *G. tenuiflora*, *A. latifolia*, *C. auriculata*, *M. racemosa*, *S. zeylanica*, *W. volubilis*, *C. pariera* and *T. cordifolia*. *G. sylvestre* holds first rank with abundance of 14 followed by *I. eriocarpa* and *H. indicus* with 8 and 5 respectively. Then, *M. dioica* and *B. vahlii* with abundance 4 each; *D. glabra*, *B. parviflora*, *D. tomentosa*, *D. wallichii*, *D. denticulata*, *V. madraspatana*, *V. hainiana*, *A. tomentosa*, *C. repens* and *D. puber* with 3 each; *C. grandis*, *A. scarabaeoides*, *G. tenuiflora*, *A. latifolia*, *C. auriculata*, *M. racemosa*, *S. zeylanica*, *W. volubilis*, *C. pariera* and *T. cordifolia* with 2 each come down

Table 1. Phytosociological attributes and distribution pattern of whole plant community

Plant species	A-IVI	D-IVI	A/F	Distribution
<i>Acacia torta</i> (Roxb.) Craib	9.29	8.28	0.31	C
<i>Acrocephalus hispidus</i> (L.) Nicolson & Sadasiv.	0.42	0.27	0.42	C
<i>Adiantum incisum</i> Forssk.	2.38	0.98	4.15	C
<i>Adiantum philippense</i> L.	4.18	1.24	13.13	C
<i>Aegle marmelos</i> (L.) Corr.	1.36	1.22	0.68	C
<i>Alangium salvifolium</i> (L.f.) Wang.	0.12	0.07	0.42	C
<i>Albizia odoratissima</i> (L.f.) Benth.	1.35	2.03	0.04	Ra
<i>Alloteropsis cimicina</i> (L.) Stapf	1.14	0.40	3.26	C
<i>Alstonia scholaris</i> (L.) R.Br.	0.12	0.24	0.42	C
<i>Alstonia venenata</i> R.Br.	0.23	0.09	1.26	C
<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson	0.23	0.16	0.32	C
<i>Ampelocissus latifolia</i> (Roxb.) Planch.	0.85	0.58	0.49	C
<i>Ampelocissus tomentosa</i> (Roth) Planch.	0.47	0.35	0.26	C
<i>Andrographis paniculata</i> (Burm.f.) Wall.ex Nees	3.32	2.08	1.58	C
<i>Anisochilus carnosus</i> (L.f.) Wall.	0.39	0.27	0.37	C
<i>Anisomeles indica</i> (L.) Kuntz	1.06	0.88	0.18	C
<i>Anogeissus latifolia</i> (Roxb.ex DC.) wall.ex Guill. & Perr.	4.62	10.01	0.09	C
<i>Antidesma acidum</i> Retz.	0.12	0.08	0.42	C
<i>Antidesma acuminatum</i> Wall.ex Wight	0.23	0.10	1.26	C
<i>Apluda mutica</i> L.	2.70	1.31	3.10	C
<i>Ardisia solanacea</i> Roxb.	0.12	0.08	0.42	C
<i>Arthraxon lancifolius</i> (Trin.) Hochst.	3.86	1.15	12.08	C
<i>Arundinella pumila</i> (Hochst ex A.Rich.) Steud.	1.96	0.83	3.36	C
<i>Asparagus racemosus</i> Willd.	1.35	1.20	0.10	C
<i>Atylosia scarabaeoides</i> (L.) Benth.	0.59	0.49	0.14	C
<i>Azadirachta indica</i> A.Juss.	0.19	0.92	0.21	C
<i>Baliospermum montanum</i> (Willd.) Muell.-Arg.	1.01	0.49	1.54	C
<i>Barleria cristata</i> L.	1.19	0.81	0.56	C
<i>Bauhinia malabarica</i> Roxb.	0.73	2.09	0.37	C
<i>Bauhinia vahlii</i> Wight & Arn.	2.11	1.97	0.15	C
<i>Blepharis maderaspatensis</i> (L.) Roth	0.59	0.34	0.75	C
<i>Blumea lacera</i> (Burm.f.) DC.	0.53	0.37	0.34	C
<i>Blumea virens</i> Wall.ex DC.	0.59	0.34	0.75	C
<i>Bombax ceiba</i> L.	0.29	1.72	0.19	C
<i>Boswellia serrata</i> Roxb.ex Colebr.	0.37	0.64	0.33	C
<i>Bothriochloa bladhii</i> (Retz.) S.T.Blake	1.18	0.55	1.87	C
<i>Breynia retusa</i> (Dennst.) Alston	0.12	0.07	0.42	C
<i>Bridellia retusa</i> (L.) Spreng.	2.83	9.03	0.05	Ra
<i>Buchanania lanzan</i> Spreng.	2.38	4.87	0.08	C
<i>Butea parviflora</i> Roxb.	0.42	0.28	0.42	C
<i>Byttneria herbacea</i> Roxb.	3.82	3.18	0.34	C
<i>Callicarpa tomentosa</i> (L.) Murr.	0.57	0.88	0.39	C
<i>Canscora decussata</i> (Roxb.) Schult. & Schult.f.	1.46	0.77	1.52	C
<i>Canscora diffusa</i> (Vahl) R.Br.	1.67	0.73	2.80	C
<i>Canthium dicoccum</i> (Gaertn.) Teijsm. & Binnend.	0.23	0.12	1.26	C
<i>Capillipedium parviflorum</i> (R.Br.) Stapf	4.85	2.75	3.12	C
<i>Careya arborea</i> Roxb.	0.43	0.75	0.10	C
<i>Casearia elliptica</i> Willd.	2.13	2.53	0.03	Ra
<i>Casearia graveolens</i> Dalz.	1.15	1.41	0.06	C
<i>Cassia fistula</i> L.	1.67	1.97	0.04	Ra
<i>Cassine glauca</i> (Rottb.) Kuntze	1.42	2.00	0.15	C
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	0.96	1.63	0.10	C
<i>Cayratia auriculata</i> (Wall.) Gamble	0.39	0.27	0.37	C
<i>elastrus paniculata</i> Willd.	2.00	1.67	0.23	C
<i>Centotheca lappacea</i> (L.) Desv.	0.32	0.18	0.63	C
<i>Cheilanthes farinosa</i> (Forssk.) Kaulf.	2.31	0.96	4.01	C
<i>Cheilanthes tenuifolia</i> (Burm.f.) Sw.	1.18	0.55	1.87	C
<i>Chlorophytum arundinaceum</i> Baker	0.96	0.56	0.89	C
<i>Chloroxylon swietiana</i> DC.	4.09	6.22	0.12	C
<i>Christella parasitica</i> (L.) Lev.	2.14	1.07	2.39	C
<i>Chrysopogon verticillatus</i> (Roxb.) Trin.ex Steud.	1.60	0.70	2.66	C
<i>Cipadessa baccifera</i> (Roxb.) Miq.	0.49	0.47	0.07	C
<i>Cissampelos pariera</i> L.	1.24	1.14	0.06	C
<i>Cissus repens</i> Lam.	0.29	0.17	0.53	C
<i>Cleistanthus collinus</i> (Roxb.) Benth.ex Hook.f.	3.95	9.92	0.12	C
<i>Clerodendrum serratum</i> (L.) Moon	0.42	0.28	0.42	C
<i>Coccinia grandis</i> (L.) Voigt	0.44	0.34	0.24	C
<i>Cochlospermum religiosum</i> (L.) Alston	0.23	0.14	1.26	C
<i>Colebrookea oppositifolia</i> Sm.	1.22	0.89	0.42	C

.....Continue



<i>Colocasia esculenta</i> (L.) Schott	0.18	0.08	0.84	C
<i>Combretum roxburghii</i> Spreng.	0.63	0.47	0.29	C
<i>Commelina erecta</i> L.	0.78	0.31	2.10	C
<i>Costus speciosus</i> (Koenig) Sm.	0.42	0.33	0.21	C
<i>Crotalaria prostrata</i> Rottl.ex Willd.	0.61	0.34	0.79	C
<i>Cryptolepis buchananii</i> Roem. & Schult.	1.92	1.68	0.15	C
<i>Curculigo orchiioides</i> Gaertn.	3.56	2.45	1.09	C
<i>Curculigo trichocarpa</i> (Wight) Bennet & Raizada	1.17	0.42	3.36	C
<i>Curcuma zedoaria</i> (Christm.) Rosc.	0.40	0.12	2.52	C
<i>Curcumorpha longiflora</i> (Wall.) A.S.Rao & Verma	0.51	0.31	0.61	C
<i>Cyperus brevifolius</i> (Rottb.) Hassk.	1.35	0.73	1.39	C
<i>Cyperus difformis</i> L.	1.69	0.32	12.18	C
<i>Cyperus halpan</i> L.	1.35	0.27	9.66	C
<i>Cyperus nutans</i> Vahl	0.34	0.11	2.10	C
<i>Cyperus rotundus</i> L.	0.29	0.10	1.68	C
<i>Dalbergia latifolia</i> Roxb.	1.06	1.71	0.18	C
<i>Dalbergia paniculata</i> Roxb.	1.15	1.07	0.28	C
<i>Dendrocalamus strictus</i> (Roxb.) Nees	9.57	9.92	0.34	C
<i>Desmodium gangeticum</i> (L.) DC.	0.39	0.20	0.84	C
<i>Desmodium oojeinensis</i> (Roxb.) Ohashi	1.33	1.53	0.08	C
<i>Desmodium pulchellum</i> (L.) Benth.	3.71	0.64	27.30	C
<i>Desmodium velutinum</i> (Willd.) DC.	0.78	0.41	1.12	C
<i>Dicliptera bupleuroides</i> Nees	1.94	0.82	3.31	C
<i>Dillenia aurea</i> Sm.	1.39	5.30	0.04	Ra
<i>Dimeria ornithopoda</i> Trin.	0.51	0.14	3.36	C
<i>Dioscorea bulbifera</i> L.	0.23	0.16	0.32	C
<i>Dioscorea glabra</i> Roxb.	0.53	0.37	0.34	C
<i>Dioscorea puber</i> Bl.	0.54	0.43	0.20	C
<i>Dioscorea tomentosa</i> Koenig ex Spreng.	0.42	0.27	0.42	C
<i>Dioscorea wallichii</i> Hook.f.	0.32	0.18	0.63	C
<i>Diospyros melanoxylon</i> Roxb.	10.16	13.53	0.37	C
<i>Diospyros montana</i> Roxb.	1.74	1.83	0.08	C
<i>Dodonaea viscosa</i> (L.) Jacq.	0.23	0.16	0.32	C
<i>Elephantopus scaber</i> L.	0.29	0.10	1.68	C
<i>Embelia tsjeriam-cottam</i> (Roem. & Schult.) DC.	0.12	0.07	0.42	C
<i>Eriolaena hookeriana</i> Wight & Arn.	1.82	3.49	0.05	Ra
<i>Erycibe paniculata</i> Roxb.	0.23	0.16	0.32	C
<i>Erythrina variegata</i> L.	0.18	0.18	0.84	C
<i>Eulalia quadrinervis</i> (Hack.) Kuntze	1.40	0.63	2.29	C
<i>Euphorbia nivulia</i> Buch.-Ham.	0.42	0.51	0.21	C
<i>Evolvulus alsinoides</i> (L.) L.	0.23	0.09	1.26	C
<i>Evolvulus nummularius</i> (L.) L.	0.23	0.09	1.26	C
<i>Ficus arnottiana</i> (Miq.) Miq.	0.12	0.08	0.42	C
<i>Ficus benghalensis</i> L.	0.12	0.13	0.42	C
<i>Ficus microcarpa</i> L.f.	0.12	0.48	0.42	C
<i>Ficus religiosa</i> L.	0.12	0.08	0.42	C
<i>Ficus virens</i> Ait.	0.12	0.08	0.42	C
<i>Fimbristylis argentea</i> (Rottb.) Vahl	4.57	1.34	14.39	C
<i>Flacourtia indica</i> (Burm.f.) Merr.	0.75	0.68	0.16	C
<i>Flemingia bracteata</i> (Roxb.) Wight	0.47	0.35	0.26	C
<i>Floscopa scandens</i> Lour.	2.17	0.69	6.62	C
<i>Galactia tenuiflora</i> (Klein ex Willd.) Wight & Arn.	0.52	0.42	0.18	C
<i>Gardenia gummifera</i> L.f.	0.57	1.06	0.13	C
<i>Gardenia latifolia</i> Ait.	1.23	2.02	0.08	C
<i>Garuga pinnata</i> Roxb.	0.56	0.76	0.12	C
<i>Globba racemosa</i> Sm.	0.51	0.14	3.36	C
<i>Glochidion zeylanicum</i> (Gaertn.) Juss.	0.12	0.08	0.42	C
<i>Gloriosa superba</i> L.	0.60	0.46	0.25	C
<i>Gmelina arborea</i> Roxb.	0.43	1.09	0.10	C
<i>Grewia hirsuta</i> Vahl.	1.94	1.79	0.07	C
<i>Grewia orbiculata</i> Rottl.	0.62	0.20	4.20	C
<i>Grewia tiliifolia</i> Vahl	0.19	0.32	0.21	C
<i>Guizotia abyssinica</i> (L.f.) Cass.	1.60	1.41	0.12	C
<i>Gymnema sylvestre</i> (Retz.) R.Br.ex Schult.	0.85	0.19	5.88	C
<i>Haldinia cordifolia</i> (Roxb.) Ridsd.	2.02	6.96	0.07	C
<i>Hedyotis affinis</i> Roem. & Schult.	0.54	0.32	0.65	C
<i>Hedyotis verticillata</i> (L.) Lam.	0.71	0.29	1.89	C
<i>Helicteres isora</i> L.	4.58	4.26	0.11	C
<i>Hemidesmus indicus</i> (L.) R.Br.	2.19	1.87	0.19	C
<i>Hemigraphis latebrosa</i> (Heyne ex Roth) Nees	7.08	4.68	2.39	C
<i>Heteropogon contortus</i> (L.) P.Beauv.	1.52	0.67	2.52	C
<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall.ex G.Don.	1.63	1.68	0.07	C

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<i>Homalium nepalense</i> Benth.	0.42	0.24	0.95	C
<i>Hygrophila salicifolia</i> (Vahl) Nees	1.26	0.91	0.45	C
<i>Indigofera cassioides</i> Rottl.ex DC.	1.37	1.16	0.17	C
<i>Ipomea eriocarpa</i> R.Br.	0.51	0.14	3.36	C
<i>Ixora pavetta</i> Andr.	0.19	0.24	0.21	C
<i>Jasminum arborescens</i> Roxb.	0.23	0.16	0.32	C
<i>Justicia diffusa</i> Willd.	0.46	0.29	0.51	C
<i>Knoxia sumatrensis</i> (Retz.) DC.	0.93	0.62	0.55	C
<i>Kydia calycina</i> Roxb.	0.98	1.30	0.29	C
<i>Lagerstroemia parviflora</i> Roxb.	2.80	6.48	0.04	Ra
<i>Lansea coromandelica</i> (Houtt.) Merr.	2.14	3.35	0.04	Ra
<i>Laportea interrupta</i> (L.) Chew	0.57	0.39	0.39	C
<i>Leea asiatica</i> (L.) Ridsdale	0.69	0.50	0.34	C
<i>Lepidagathis fasciculata</i> (Retz.) Nees	0.91	0.61	0.54	C
<i>Leptadenia reticulata</i> (Retz.) Wight & Arn.	0.12	0.07	0.42	C
<i>Leucas mollissima</i> Wall.ex Benth.	0.42	0.21	0.95	C
<i>Lygodium flexuosum</i> (L.) Sw.	0.29	0.17	0.53	C
<i>Madhuca indica</i> Gmel.	1.33	5.67	0.21	C
<i>Mallotus philippensis</i> (Lam.) Muell.-Arg.	0.19	0.18	0.21	C
<i>Mangifera indica</i> L.	0.51	0.20	3.36	C
<i>Melastoma malabathricum</i> L.	0.34	0.11	2.10	C
<i>Meyna spinosa</i> Roxb.ex Link.	1.13	1.16	0.08	C
<i>Millettia extensa</i> (Benth.) Baker	3.01	2.49	0.32	C
<i>Millettia racemosa</i> (Roxb.) Benth.	0.26	0.18	0.42	C
<i>Mitracarpus villosus</i> (Sw.) DC.	1.78	0.58	5.36	C
<i>Mitragyna parviflora</i> (Roxb.) Korth.	2.09	4.86	0.04	Ra
<i>Momordica dioica</i> Roxb.ex Willd.	0.29	0.10	1.68	C
<i>Morinda pubescens</i> Sm.	0.61	0.56	0.09	C
<i>Murdannia japonica</i> (Thunb.) Faden	3.50	1.05	10.92	C
<i>Murraya paniculata</i> (L.) Jack	0.19	0.19	0.21	C
<i>Nyctanthes arbor-tristis</i> L.	0.91	0.87	1.35	C
<i>Olax scandens</i> Roxb.	0.60	0.46	0.25	C
<i>Oplismenus compositus</i> (L.) P.Beauv.	0.52	0.24	1.26	C
<i>Orthosiphon rubicundus</i> (D. Don) Benth.	1.06	0.68	0.67	C
<i>Panicum notatum</i> Retz.	0.45	0.22	1.05	C
<i>Pavetta crassicaulis</i> Bremek.	0.29	0.18	0.53	C
<i>Pavonia odorata</i> Willd.	0.49	0.23	1.16	C
<i>Pennisetum pedicellatum</i> Trin.	1.46	0.49	4.31	C
<i>Petalidium barlerioides</i> (Roth.) Nees	3.58	3.14	0.19	C
<i>Phoenix sylvestris</i> (L.) Roxb.	0.23	0.10	1.26	C
<i>Phyllanthus emblica</i> L.	2.26	3.25	0.06	C
<i>Pimpinella heyneana</i> (Wall.ex DC.) Kurz	0.34	0.11	2.10	C
<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	0.29	0.17	0.53	C
<i>Polygonum barbatum</i> L.	0.34	0.11	2.10	C
<i>Pongamia pinnata</i> (L.) Pierre	0.19	0.19	0.21	C
<i>Protium serratum</i> (Wall.ex Colebr.) Engl.	0.36	0.40	0.13	C
<i>Pterocarpus marsupium</i> Roxb.	3.48	10.80	0.07	C
<i>Pterospermum acerifolium</i> (L.) Willd.	0.12	0.08	0.42	C
<i>Rungia pectinata</i> (L.) Nees	0.68	0.16	4.62	C
<i>Schleichera oleosa</i> (Lour.) Oken	1.50	5.10	0.05	Ra
<i>Schrebera swietenoides</i> Roxb.	1.20	1.74	0.04	Ra
<i>Scoparia dulcis</i> L.	0.71	0.38	0.98	C
<i>Securinega virosa</i> (Roxb.ex Willd.) Baill.	0.34	0.25	0.28	C
<i>Selaginella repanda</i> (Desv.ex Poir.) Spring	1.35	0.82	0.94	C
<i>Semecarpus anacardium</i> L.f.	1.59	1.89	0.15	C
<i>Shorea robusta</i> Gaertn.f.	3.54	2.56	4.17	C
<i>Sida cordata</i> (Burm.f.) Borssum	0.42	0.27	0.42	C
<i>Sida rhombifolia</i> L.	0.69	0.44	0.55	C
<i>Smilax zeylanica</i> L.	0.29	0.17	0.53	C
<i>Sorghum nitidum</i> (Vahl) Pers.	1.07	0.22	7.56	C
<i>Spermadictyon suaveolens</i> Roxb.	0.18	0.08	0.84	C
<i>Sterculia urens</i> Roxb.	0.77	1.26	0.11	C
<i>Stereospermum chelonoides</i> (L.f.) DC.	2.58	4.06	0.05	Ra
<i>Streblus asper</i> Lour.	0.12	0.10	0.42	C
<i>Strychnos nux-vomica</i> L.	0.53	0.57	0.34	C
<i>Symphorema polyandrum</i> Wight	2.12	1.79	0.21	C
<i>Syzygium cumini</i> (L.) Skeels	0.49	1.30	0.15	C
<i>Terminalia alata</i> Heyne ex Roth	2.24	6.83	0.04	Ra
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	1.01	5.96	0.05	Ra
<i>Terminalia chebula</i> Retz.	1.02	1.71	0.06	C
<i>Themeda quadrivalvis</i> (L.) Kuntze	1.95	0.63	5.88	C
<i>Themeda triandra</i> Forssk.	0.76	0.40	1.07	C
<i>Thespesia lampas</i> (Cav.) Dalz. & Gibs.	0.32	0.18	0.63	C

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<i>Thysanolaena maxima</i> (Roxb.) Kuntze	17.43	2.82	130.20	C
<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thoms.	0.59	0.41	0.42	C
<i>Trema orientalis</i> (L.) Bl.	0.12	0.11	0.42	C
<i>Triumfetta pilosa</i> Roth.	0.42	0.27	0.42	C
<i>Triumfetta rhomboidea</i> Jacq.	0.51	0.37	0.32	C
<i>Urginea indica</i> (Roxb.) Kunth	0.59	0.34	0.75	C
<i>Ventilago denticulata</i> Willd.	1.37	1.12	0.22	C
<i>Ventilago madraspatana</i> Gaertn.	0.89	0.66	0.35	C
<i>Vernonia cinerea</i> (L.) Less.	1.92	1.29	0.81	C
<i>Vigna hainiana</i> Babu	0.56	0.44	0.22	C
<i>Wattakaka volubilis</i> (L.f.) Stapf	1.18	1.00	0.16	C
<i>Woodfordia fruticosa</i> (L.) Kurz	0.80	0.69	0.44	C
<i>Wrightia arborea</i> (Dennst.) Mabb.	0.49	0.59	0.15	C
<i>Wrightia tinctoria</i> (Roxb.) R.Br.	0.89	0.75	0.52	C
<i>Ziziphus mauritiana</i> Lam.	0.19	0.16	0.21	C
<i>Ziziphus oenoplia</i> (L.) Mill.	0.51	0.41	0.17	C
<i>Ziziphus rugosa</i> Lam.	0.41	0.42	0.08	C
<i>Ziziphus xylopyrus</i> (Retz.) Willd.	2.19	3.71	0.04	Ra

in the series. *B. vahlii* which occupies fifth rank in abundance ranking holds first rank in dominance ranking with occupied area of 0.06581m<sup>2</sup>. Following *B. vahlii* in the dominance ranking, *M. racemosa*, *B. parviflora*, *V. madraspatana*, *W. volubilis*, *T. cordifolia*, *V. denticulata*, *H. indicus*, *G. sylvestre*, *S. zeylanica*, *A. tomentosa*, *D. puber*, *C. auriculata*, *D. tomentosa*, *C. pariera*, *A. latifolia*, *V. hainiana*, *C. repens*, *D. glabra*, *I. eriocarpa*, *C. grandis*, *G. tenuiflora*, *A. scarabaeoides*, *M. dioica* and *D. wallichii* come down in the series. *D. wallichii* occupying 25<sup>th</sup> rank in the dominance ranking holds 9<sup>th</sup> position in abundance ranking and *T. cordifolia* occupying 25<sup>th</sup> rank in abundance ranking holds 6<sup>th</sup> position in dominance ranking. Collectively, there are 82 herb and grass species occurring along the investigated elevational limits of Gandhamardan hills. According to ranking of herb and grass species based on abundance, *F. argentea* occupies first position with abundance of 69 followed by *A. philippense*, *H. latebrosa*, *A. lancifolius*, *M. japonica*, *F. scandens*, *A. incisum*, *A. mutica*, *C. difformis*, *C. farinosa*, *T. quadrivalvis*, *A. paniculata*, *M. villosus*, *A. pumila*, *D. bupleuroides*, *C. halpan*, *C. parviflorum*, *C. parasitica*, *P. pedicellatum*, *C. diffusa*, *C. verticillatus*, *H. contortus*, *S. nitidum*, *E. quadrinervis* and *C. trichocarpa* with abundance of 63, 61, 58, 52, 32, 30, 30, 29, 29, 28, 26, 26, 24, 24, 23, 23, 23, 21, 20, 19, 18, 18, 16 and 16 respectively (Fig.6-E1). Like this on the basis of ranking by dominance, *H. latebrosa* occupies first position with 0.00539m<sup>2</sup> followed by *V. cinerea*, *B. herbacea*, *C. arundinaceum*, *C. longiflora*, *C. trichocarpa*, *S. dulcis*, *A. paniculata*, *L. fasciculata*, *C. verticillatus*, *M. japonica*, *A. indica*, *C. parviflorum*, *A. mutica*, *E. quadrinervis*, *C. orchioides*, *T. quadrivalvis*, *D. bupleuroides*, *H. contortus*, *B. bladhi*, *H. salicifolia*, *U. indica*, *A. paeoniifolius*, *C. zedoaria* and *G. superba* down in the series (Fig.6-E2). 14 species occurring only in top 25 ranked species based on abundance but not in top 25 ranked species based on dominance are *F. argentea*, *A. philippense*, *A. lancifolius*, *F. scandens*, *A. incisum*, *C. difformis*, *C. farinosa*, *M. villosus*, *A. pumila*, *C. halpan*, *C. parviflorum*, *C. parasitica*, *P. pedicellatum*, *C. diffusa* and *S. nitidum*. At the same time, 14 species occurring only in top 25 ranked species based on dominance but not in top 25 ranked species based on abundance are *V. cinerea*, *B. herbacea*, *C. arundinaceum*, *C. longiflora*, *S. dulcis*, *L. fasciculata*, *A. indica*, *C. orchioides*, *B. bladhi*, *H. salicifolia*, *U. indica*, *A. paeoniifolius*, *C. zedoaria* and *G. superba*. *F. argentea* occupying first position in the top ranking 25 species

based on abundance is completely absent in the top ranking 25 species based on dominance while *H. latebrosa* occupying first position in the top ranking 25 species based on dominance is occupying third position in the top ranking 25 species based on abundance. On the other hand, *C. trichocarpa* occupying twenty-fifth position in the top ranking 25 species based on abundance has placed itself in the sixth position in the top ranking 25 species based on dominance while *G. superba* occupying twenty-fifth position in the top ranking 25 species based on dominance is completely absent in the top ranking 25 species based on abundance. The seedling community is having 101 species. Based on abundance and dominance, top ranking 25 species have been depicted in the graph to study their dynamics (Fig.6- F1 & F2). Eighteen seedling species are observed in common to the both top ranking 25 species based on abundance and dominance. These are *S. robusta*, *C. parviflorum*, *C. orchioides*, *T. maxima*, *D. melanoxyton*, *A. torta*, *H. latebrosa*, *M. indica*, *M. extensa*, *S. anacardium*, *D. strictus*, *A. marmelos*, *V. madraspatana*, *Madhuca indica*, *P. barlerioides*, *C. oppositifolia*, *D. paniculata* and *C. collinus*. Seven seedling species found only in top 25 based on abundance are *C. paniculata*, *K. sumatrensis*, *H. cordifolia*, *Mangifera indica*, *H. indicus*, *F. indica* and *A. latifolia*. On the other side, only seven seedling species found in top 25 based on dominance are *P. marsupium*, *H. isora*, *G. latifolia*, *S. polyandrum*, *D. montana*, *S. chelonoides* and *W. volubilis*. *S. robusta* holding first position with abundance of 152 in the top 25 species based on abundance also occupies fourth position with dominance of 0.00323m<sup>2</sup>. *D. melanoxyton* with dominance of 0.00663m<sup>2</sup> occupying first position in the top ranking 25 seedling species based on dominance holds 5<sup>th</sup> position in top ranking 25 seedling species based on abundance. *C. collinus* occupying 25<sup>th</sup> position in seedling species ranking based on abundance is placed in 15<sup>th</sup> position with dominance of 0.00039m<sup>2</sup> in the seedling species ranking based on dominance while *W. volubilis* occupying 25<sup>th</sup> position in the top ranking 25 seedling species based on dominance is absent within the top 25 seedling species based on abundance. *D. strictus* and *A. torta* occupying 2<sup>nd</sup> and 3<sup>rd</sup> position in the top ranking 25 species based on dominance holds 12<sup>th</sup> and 6<sup>th</sup> position in the top ranking 25 species based on abundance. *C. parviflorum* and *C. orchioides* occupying 2<sup>nd</sup> and 3<sup>rd</sup> position in the top ranking 25 species based on abundance holds 16<sup>th</sup> and 6<sup>th</sup> position in the top ranking 25 species based on dominance.

Table 2. Phytosociological attributes and distribution pattern of Tree-1 (&gt;15cm GBH) community

Plant species	A-IVI	D-IVI	A/F	Distribution
<i>Aegle marmelos</i> (L.) Corr.	3.60	1.88	0.34	C
<i>Albizia odoratissima</i> (L.f.) Benth.	2.98	2.99	0.06	C
<i>Alstonia scholaris</i> (L.) R.Br.	0.86	0.40	0.42	C
<i>Anogeissum latifolia</i> (Roxb.ex DC.) Wall.ex Guill. & Perr.	13.79	17.29	0.05	Ra
<i>Antidesma acidum</i> Retz.	0.86	0.23	0.42	C
<i>Antidesma acuminatum</i> Wall.ex Wight	1.56	0.31	0.84	C
<i>Ardisia solanacea</i> Roxb.	0.86	0.23	0.42	C
<i>Azadirachta indica</i> A.Juss.	1.09	1.25	0.21	C
<i>Bauhinia malabarica</i> Roxb.	3.94	3.55	0.27	C
<i>Bombax ceiba</i> L.	1.32	2.23	0.14	C
<i>Boswellia serrata</i> Roxb.ex Colebr.	2.44	1.37	0.33	C
<i>Bridellia retusa</i> (L.) Spreng.	9.65	14.53	0.05	Ra
<i>Buchanania lanzan</i> Spreng.	9.32	10.17	0.06	C
<i>Callicarpa tomentosa</i> (L.) Murr.	3.40	1.37	0.84	C
<i>Canthium dicoccum</i> (Gaertn.) Teijsm. & Binnend.	1.56	0.33	0.84	C
<i>Careya arborea</i> Roxb.	1.60	1.15	0.19	C
<i>Casearia elliptica</i> Willd.	4.43	4.04	0.04	Ra
<i>Casearia graveolens</i> Dalz.	3.67	3.15	0.05	Ra
<i>Cassia fistula</i> L.	2.54	1.97	0.11	C
<i>Cassine glauca</i> (Rottb.) Kuntze	5.08	4.37	0.09	C
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	3.37	3.06	0.09	C
<i>Chloroxylon swietiana</i> DC.	9.06	9.65	0.07	C
<i>Cipadessa baccifera</i> (Roxb.) Miq.	2.01	1.41	0.07	C
<i>Cleistanthus collinus</i> (Roxb.) Benth.ex Hook.f.	18.51	21.34	0.09	C
<i>Cochlospermum religiosum</i> (L.) Alston	1.56	0.35	0.84	C
<i>Dalbergia latifolia</i> Roxb.	2.96	2.42	0.18	C
<i>Dalbergia paniculata</i> Roxb.	3.00	1.28	0.42	C
<i>Desmodium oojeinensis</i> (Roxb.) Ohashi	3.37	2.59	0.09	C
<i>Dillenia aurea</i> Sm.	4.19	7.52	0.04	Ra
<i>Diospyros melanoxylon</i> Roxb.	12.53	14.95	0.06	C
<i>Diospyros montana</i> Roxb.	6.11	4.39	0.12	C
<i>Eriolaena hookeriana</i> Wight & Arn.	5.30	6.11	0.04	Ra
<i>Erythrina variegata</i> L.	1.56	0.40	0.84	C
<i>Euphorbia nivulia</i> Buch.-Ham.	2.44	1.16	0.33	C
<i>Ficus arnottiana</i> (Miq.) Miq.	0.86	0.24	0.42	C
<i>Ficus benghalensis</i> L.	0.86	0.29	0.42	C
<i>Ficus microcarpa</i> L.f.	0.86	0.64	0.42	C
<i>Ficus religiosa</i> L.	0.86	0.24	0.42	C
<i>Ficus virens</i> Ait.	0.86	0.23	0.42	C
<i>Flacourtia indica</i> (Burm.f.) Merr.	1.78	1.04	0.13	C
<i>Gardenia gummifera</i> L.f.	2.17	1.87	0.12	C
<i>Gardenia latifolia</i> Ait.	3.06	3.30	0.05	Ra
<i>Garuga pinnata</i> Roxb.	1.97	1.51	0.10	C
<i>Glochidion zeylanicum</i> (Gaertn.) Juss.	0.86	0.23	0.42	C
<i>Gmelina arborea</i> Roxb.	1.97	1.96	0.10	C
<i>Grewia orbiculata</i> Rottl.	3.66	0.55	2.10	C
<i>Grewia tilifolia</i> Vahl	1.09	0.64	0.21	C
<i>Haldinia cordifolia</i> (Roxb.) Ridsd.	6.51	10.33	0.06	C
<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall.ex G.Don	2.54	1.76	0.11	C
<i>Homalium nepalense</i> Benth.	1.86	0.63	0.42	C
<i>Ixora pavetta</i> Andr.	1.09	0.56	0.21	C
<i>Kydia calycina</i> Roxb.	2.23	1.70	0.18	C
<i>Lagerstroemia parviflora</i> Roxb.	7.98	10.69	0.03	Ra
<i>Lannea coromandelica</i> (Houtt.) Merr.	7.78	7.80	0.04	Ra
<i>Madhuca indica</i> Gmel.	2.77	6.70	0.07	C
<i>Mallotus philippensis</i> (Lam.) Muell.-Arg.	1.09	0.49	0.21	C
<i>Mangifera indica</i> L.	0.86	0.29	0.42	C
<i>Meyna spinosa</i> Roxb.ex Link	1.88	0.96	0.23	C
<i>Mitragyna parviflora</i> (Roxb.) Korth.	6.04	8.01	0.03	Ra
<i>Morinda pubescens</i> Sm.	1.56	0.32	0.84	C
<i>Murraya paniculata</i> (L.) Jack	1.09	0.50	0.21	C
<i>Nyctanthes arbor-tristis</i> L.	7.78	2.76	1.21	C
<i>Phoenix sylvestris</i> (L.) Roxb.	0.86	0.23	0.42	C
<i>Phyllanthus emblica</i> L.	6.70	6.46	0.05	Ra
<i>Pongamia pinnata</i> (L.) Pierre	1.09	0.50	0.21	C
<i>Protium serratum</i> (Wall.ex Colebr.) Engl.	1.60	0.86	0.19	C
<i>Pterocarpus marsupium</i> Roxb.	10.22	16.32	0.04	Ra

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<i>Pterospermum acerifolium</i> (L.) Willd.	<b>0.86</b>	0.23	0.42	C
<i>Schleichera oleosa</i> (Lour.) Oken	2.92	<b>5.85</b>	0.07	C
<i>Schrebera swietenoides</i> Roxb.	<b>2.77</b>	2.59	0.07	C
<i>Semecarpus anacardium</i> L.f.	<b>3.80</b>	3.41	0.06	C
<i>Shorea robusta</i> Gaertn.f.	<b>1.88</b>	1.74	0.23	C
<i>Sterculia urens</i> Roxb.	<b>1.97</b>	1.82	0.10	C
<i>Stereospermum chelonoides</i> (L.f.) DC.	7.81	<b>7.95</b>	0.05	Ra
<i>Streblus asper</i> Lour.	<b>0.86</b>	0.25	0.42	C
<i>Strychnos nux-vomica</i> L.	<b>1.09</b>	0.66	0.21	C
<i>Syzygium cumini</i> (L.) Skeels	<b>1.47</b>	1.45	0.32	C
<i>Terminalia alata</i> Heyne ex Roth	6.86	<b>10.56</b>	0.04	Ra
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	2.98	<b>7.38</b>	0.06	C
<i>Terminalia chebula</i> Retz.	<b>3.67</b>	3.59	0.05	Ra
<i>Trema orientalis</i> (L.) Bl.	<b>0.86</b>	0.27	0.42	C
<i>Wrightia arborea</i> (Dennst.) Mabb.	<b>2.46</b>	1.40	0.21	C
<i>Wrightia tinctoria</i> (Roxb.) R.Br.	<b>3.16</b>	1.79	0.20	C
<i>Ziziphus mauritiana</i> Lam.	<b>1.09</b>	0.47	0.21	C
<i>Ziziphus rugosa</i> Lam.	<b>1.78</b>	1.20	0.08	C
<i>Ziziphus xylopyrus</i> (Retz.) Willd.	6.87	<b>7.29</b>	0.04	Ra

Table 3. Phytosociological attributes and distribution pattern of Tree-2 (&lt;15cm GBH) community

Plant species	A-IVI	D-IVI	A/F	Distribution
<i>Aegle marmelos</i> (L.) Corr.	4.30	3.92	0.18	C
<i>Alangium salvifolium</i> (L.f.) Wang.	1.54	0.53	0.42	C
<i>Albizia odoratissima</i> (L.f.) Benth.	4.30	3.13	0.18	C
<i>Anogeissus latifolia</i> (Roxb.ex DC.) Wall.ex Guill. & Perr.	30.00	43.73	0.06	C
<i>Antidesma acuminatum</i> Wall.ex Wight	1.54	0.79	0.42	C
<i>Bauhinia malabarica</i> Roxb.	1.54	0.78	0.42	C
<i>Bombax ceiba</i> L.	1.54	0.51	0.42	C
<i>Bridellia retusa</i> (L.) Spreng.	5.75	6.37	0.09	C
<i>Buchanania lanzan</i> Spreng.	8.67	9.94	0.08	C
<i>Callicarpa tomentosa</i> (L.) Murr.	2.72	2.16	0.32	C
<i>Canthium dicoccum</i> (Gaertn.) Teijsm. & Binnend.	1.54	0.53	0.42	C
<i>Casearia elliptica</i> Willd.	10.28	12.41	0.03	Ra
<i>Casearia graveolens</i> Dalz.	5.39	5.54	0.17	C
<i>Cassia fistula</i> L.	3.87	3.20	0.10	C
<i>Cassine glauca</i> (Rottb.) Kuntze	8.11	8.13	0.21	C
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	2.72	2.02	0.32	C
<i>Chloroxylon swieteniana</i> DC.	12.04	14.85	0.09	C
<i>Cleistanthus collinus</i> (Roxb.) Benth.ex Hook.f.	9.73	12.32	0.07	C
<i>Cochlospermum religiosum</i> (L.) Alston	1.54	0.58	0.42	C
<i>Dalbergia latifolia</i> Roxb.	3.49	3.09	0.08	C
<i>Dalbergia paniculata</i> Roxb.	3.04	2.24	0.19	C
<i>Desmodium oojenensis</i> (Roxb.) Ohashi	2.76	1.29	0.84	C
<i>Dillenia aurea</i> Sm.	3.87	3.55	0.10	C
<i>Diospyros melanoxylon</i> Roxb.	15.06	20.13	0.08	C
<i>Diospyros montana</i> Roxb.	5.39	4.81	0.17	C
<i>Eriolaena hookeriana</i> Wight & Arn.	8.86	10.43	0.14	C
<i>Euphorbia nivulia</i> Buch.-Ham.	1.54	0.70	0.42	C
<i>Flacourtia indica</i> (Burm.f.) Merr.	4.73	4.04	0.21	C
<i>Gardenia gummifera</i> L.f.	2.72	1.62	0.32	C
<i>Gardenia latifolia</i> Ait.	2.52	1.59	0.14	C
<i>Garuga pinnata</i> Roxb.	1.54	0.79	0.42	C
<i>Grewia orbiculata</i> Rottl.	6.42	1.88	2.10	C
<i>Haldinia cordifolia</i> (Roxb.) Ridsd.	6.90	5.48	0.24	C
<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall.ex G.Don	7.96	7.21	0.12	C
<i>Homalium nepalense</i> Benth.	2.76	1.26	0.84	C
<i>Kydia calycina</i> Roxb.	1.54	0.55	0.42	C
<i>Lagerstroemia parviflora</i> Roxb.	7.90	9.24	0.04	Ra
<i>Lannea coromandelica</i> (Houtt.) Merr.	5.56	5.89	0.07	C
<i>Madhuca indica</i> Gmel.	2.52	1.97	0.14	C
<i>Meyna spinosa</i> Roxb.ex Link.	5.56	5.33	0.07	C
<i>Mitragyna parviflora</i> (Roxb.) Korth.	7.16	7.32	0.08	C
<i>Phyllanthus emblica</i> L.	8.54	10.35	0.07	C
<i>Protium serratum</i> (Wall.ex Colebr.) Engl.	1.54	0.50	0.42	C
<i>Pterocarpus marsupium</i> Roxb.	11.15	12.95	0.15	C
<i>Schleichera oleosa</i> (Lour.) Oken	5.45	5.76	0.05	Ra
<i>Schrebera swietenoides</i> Roxb.	3.87	3.63	0.10	C
<i>Semecarpus anacardium</i> L.f.	2.72	1.39	0.32	C
<i>Shorea robusta</i> Gaertn.f.	<b>2.03</b>	1.10	0.21	C
<i>Sterculia urens</i> Roxb.	<b>3.42</b>	1.77	0.42	C

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<i>Stereospermum chelonoides</i> (L.f.) DC.	5.74	<b>5.86</b>	0.05	Ra
<i>Strychnos nux-vomica</i> L.	<b>1.54</b>	0.57	0.42	C
<i>Syzygium cumini</i> (L.) Skeels	<b>3.55</b>	2.66	0.23	C
<i>Terminalia alata</i> Heyne ex Roth	5.74	<b>6.54</b>	0.05	Ra
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	<b>3.44</b>	2.98	0.13	C
<i>Terminalia chebula</i> Retz.	<b>3.42</b>	1.90	0.42	C
<i>Wrightia arborea</i> (Dennst.) Mabb.	<b>1.54</b>	0.63	0.42	C
<i>Wrightia tinctoria</i> (Roxb.) R.Br.	<b>2.72</b>	1.69	0.32	C
<i>Ziziphus xylopyrus</i> (Retz.) Willd.	6.69	<b>7.85</b>	0.04	Ra

Table 4. Phytosociological attributes and distribution pattern of Shrub community

Plant species	A-IVI	D-IVI	A/F	Distribution
<i>Acacia torta</i> (Roxb.) Craib	10.32	<b>12.24</b>	0.08	C
<i>Alstonia venenata</i> R. Br.	<b>1.26</b>	0.72	1.26	C
<i>Baliospermum montanum</i> (Willd.) Muell.-Arg.	<b>5.34</b>	2.61	2.94	C
<i>Barleria cristata</i> L.	<b>6.29</b>	4.25	1.08	C
<i>Breynia retusa</i> (Dennst.) Alston	<b>0.75</b>	0.55	0.42	C
<i>Celastrus paniculata</i> Willd.	<b>5.50</b>	5.07	0.12	C
<i>Clerodendrum serratum</i> (L.) Moon.	<b>2.59</b>	2.32	0.42	C
<i>Colebrookea oppositifolia</i> Sm.	<b>3.56</b>	2.60	0.79	C
<i>Combretum roxburghii</i> Spreng.	<b>2.22</b>	1.84	0.28	C
<i>Cryptolepis buchananii</i> Roem. & Schult.	<b>9.78</b>	9.38	0.20	C
<i>Dendrocalamus strictus</i> (Roxb.) Nees	54.98	<b>130.69</b>	0.36	C
<i>Desmodium pulchellum</i> (L.) Benth.	<b>17.12</b>	4.07	27.30	C
<i>Desmodium velutinum</i> (Willd.) DC.	<b>4.41</b>	2.23	2.31	C
<i>Dodonaea viscosa</i> (L.) Jacq.	<b>1.26</b>	0.81	1.26	C
<i>Erycibe paniculata</i> Roxb.	<b>1.46</b>	1.37	0.32	C
<i>Flemingia bracteata</i> (Roxb.) Wight	<b>3.04</b>	2.71	0.26	C
<i>Grewia hirsuta</i> Vahl.	<b>9.06</b>	8.63	0.09	C
<i>Helicteres isora</i> L.	26.44	<b>28.31</b>	0.10	C
<i>Indigofera cassioides</i> Rottl.ex DC.	<b>6.77</b>	5.96	0.23	C
<i>Jasminum arborescens</i> Roxb.	1.46	<b>1.49</b>	0.32	C
<i>Leea asiatica</i> (L.) Ridsdale	<b>3.35</b>	2.85	0.34	C
<i>Melastoma malabathricum</i> L.	<b>1.78</b>	0.91	2.10	C
<i>Millettia extensa</i> (Benth.) Baker	4.65	<b>4.95</b>	0.12	C
<i>Olex scandens</i> Roxb.	<b>3.63</b>	3.54	0.20	C
<i>Pavetta crassicaulis</i> Bremek.	1.77	<b>1.86</b>	0.53	C
<i>Petalidium barlerioides</i> (Roth) Nees	<b>18.49</b>	17.44	0.22	C
<i>Securinega virosa</i> (Roxb.ex Willd.) Baill.	<b>2.22</b>	2.15	0.28	C
<i>Spermatoclyon suaveolens</i> Roxb.	<b>1.01</b>	0.71	0.84	C
<i>Symphorema polyandrum</i> Wight	<b>8.34</b>	7.73	0.19	C
<i>Thespesia lampas</i> (Cav.) Dalz. & Gibs.	<b>1.52</b>	0.73	1.68	C
<i>Thysanolaena maxima</i> (Roxb.) Kuntze	<b>72.09</b>	16.09	117.60	C
<i>Triumfeta pilosa</i> Roth.	<b>2.59</b>	2.02	0.42	C
<i>Woodfordia fruticosa</i> (L.) Kurz	4.19	<b>10.63</b>	0.55	C
<i>Ziziphus oenoplia</i> (L.) Mill.	<b>0.75</b>	0.55	0.42	C

Table 5. Phytosociological attributes and distribution pattern of LTC community

Plant species	A-IVI	D-IVI	A/F	Distribution
<i>Ampelocissus latifolia</i> (Roxb.) Planch.	<b>4.07</b>	1.72	0.84	C
<i>Ampelocissus tomentosa</i> (Roth) Planch.	<b>10.34</b>	7.46	0.26	C
<i>Atylosia scarabaeoides</i> (L.) Benth.	<b>11.32</b>	8.70	0.18	C
<i>Bauhinia vahlii</i> Wight & Arn.	30.68	<b>101.63</b>	0.13	C
<i>Butea parviflora</i> Roxb.	9.60	<b>10.23</b>	0.42	C
<i>Cayratia auriculata</i> (Wall.) Gamble	<b>5.73</b>	3.42	0.42	C
<i>Cissampelos pariera</i> L.	<b>18.63</b>	16.41	0.08	C
<i>Cissus repens</i> Lam.	<b>6.67</b>	3.72	0.53	C
<i>Coccinia grandis</i> (L.) Voigt	<b>9.71</b>	7.04	0.24	C
<i>Dioscorea glabra</i> Roxb.	<b>12.24</b>	8.39	0.34	C
<i>Dioscorea puber</i> Bl.	<b>10.34</b>	7.46	0.26	C
<i>Dioscorea tomentosa</i> Koenig ex Spreng.	<b>9.60</b>	6.07	0.42	C
<i>Dioscorea wallichii</i> Hook.f.	<b>7.60</b>	4.02	0.63	C
<i>Galactia tenuiflora</i> (Klein ex Willd.) Wight & Arn.	<b>11.32</b>	8.70	0.18	C
<i>Gymnema sylvestre</i> (Retz.) R.Br.ex Schult.	<b>22.46</b>	5.88	5.88	C
<i>Hemidesmus indicus</i> (L.) R.Br.	<b>36.32</b>	30.96	0.16	C
<i>Ipomea eriocarpa</i> R.Br.	<b>13.26</b>	3.71	3.36	C
<i>Lygodium flexuosum</i> (L.) Sw.	<b>3.87</b>	2.68	0.21	C
<i>Millettia racemosa</i> (Roxb.) Benth.	5.73	<b>11.72</b>	0.42	C
<i>Momordica dioica</i> Roxb.ex Willd.	<b>7.13</b>	2.35	1.68	C
<i>Smilax zeylanica</i> L.	<b>4.07</b>	1.81	0.84	C
<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thoms.	4.80	<b>5.87</b>	0.32	C
<i>Ventilago denticulata</i> Willd.	<b>11.61</b>	9.06	0.32	C
<i>Ventilago madraspatana</i> Gaertn.	13.04	<b>13.63</b>	0.24	C
<i>Vigna hainiana</i> Babu	<b>12.46</b>	9.40	0.22	C
<i>Wattakaka volubilis</i> (L.f.) Stapf	7.40	<b>7.96</b>	0.28	C

Table 6. Phytosociological attributes and distribution pattern of Herb/Grass community

Plant species	A-IVI	D-IVI	A/F	Distribution
<i>Acrocephalus hispidus</i> (L.) Nielson & Sadasiv.	1.63	1.43	0.42	C
<i>Adiantum incisum</i> Forsk.	6.22	3.97	4.15	C
<i>Adiantum philippense</i> L.	9.77	4.59	13.13	C
<i>Alloteropsis cimicina</i> (L.) Stapf	2.98	1.96	3.26	C
<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson	0.96	1.94	0.32	C
<i>Andrographis paniculata</i> (Burm.f.) Wall.ex Nees	10.05	10.44	1.58	C
<i>Anisochilus carnosus</i> (L.f.) Wall.	1.57	1.89	0.37	C
<i>Anisomeles indica</i> (L.) Kuntz	4.22	5.93	0.21	C
<i>Apluda mutica</i> L.	7.39	6.63	3.10	C
<i>Arthraxon lancifolius</i> (Trin.) Hochst.	9.05	4.14	12.08	C
<i>Arundinella pumila</i> (Hochst ex A.Rich.) Steud.	5.25	3.71	3.36	C
<i>Asparagus racemosus</i> Willd.	5.87	6.39	0.07	C
<i>Blepharis maderaspatensis</i> (L.) Roth	1.54	1.38	1.16	C
<i>Blumea lacera</i> (Burm.f.) DC.	2.14	2.04	0.34	C
<i>Blumea virens</i> Wall.ex DC.	2.03	1.73	0.75	C
<i>Bothriochloa bladhii</i> (Retz.) S.T.Blake	3.41	3.43	1.87	C
<i>Byttneria herbacea</i> Roxb.	14.04	18.52	0.34	C
<i>Canscora decussata</i> (Roxb.) Schult. & Schult.f.	4.39	3.84	1.52	C
<i>Canscora diffusa</i> (Vahl) R.Br.	4.56	3.31	2.80	C
<i>Capillipedium parviflorum</i> (R.Br.) Stapf	8.07	8.01	1.60	C
<i>Centotheca lappacea</i> (L.) Desv.	1.18	1.11	0.63	C
<i>Cheilanthes farinosa</i> (Forsk.) Kaulf.	6.05	3.78	4.01	C
<i>Cheilanthes tenuifolia</i> (Burm.f.) Sw.	3.41	2.36	1.87	C
<i>Chlorophytum arundinaceum</i> Baker	3.14	7.43	0.87	C
<i>Christella parasitica</i> (L.) Lev.	6.04	4.59	2.39	C
<i>Chrysopogon verticillatus</i> (Roxb.) Trin.ex Steud.	4.39	5.05	2.66	C
<i>Colocasia esculenta</i> (L.) Schott	0.61	0.92	0.84	C
<i>Commelina erecta</i> L.	2.19	1.88	2.10	C
<i>Costus speciosus</i> (Koenig) Sm.	1.89	2.41	0.21	C
<i>Crotalaria prostrata</i> Rottl.ex Willd.	2.09	1.70	0.79	C
<i>Curculigo orchiooides</i> Gaertn.	5.38	6.30	0.41	C
<i>Curculigo trichocarpa</i> (Wight) Bennet & Raizada	3.05	5.43	3.36	C
<i>Curcuma zedoaria</i> (Christm.) Rosc.	1.07	1.64	2.52	C
<i>Curcumorpha longiflora</i> (Wall.) A.S.Rao & Verma	1.86	5.73	0.61	C
<i>Cyperus brevifolius</i> (Rottb.) Hassk.	4.14	3.73	1.39	C
<i>Cyperus difformis</i> L.	3.75	1.59	12.18	C
<i>Cyperus halpan</i> L.	3.05	1.20	9.66	C
<i>Cyperus nutans</i> Vahl	0.95	0.91	2.10	C
<i>Cyperus rotundus</i> L.	0.84	0.55	1.68	C
<i>Desmodium gangeticum</i> (L.) DC.	1.32	1.40	0.84	C
<i>Dicliptera bupleuroides</i> Nees	5.19	4.39	3.31	C
<i>Dimeria ornithopoda</i> Trin.	1.30	0.61	3.36	C
<i>Elephantopus scaber</i> L.	0.84	0.73	1.68	C
<i>Eulalia quadrinervis</i> (Hack.) Kuntze	3.93	4.21	2.29	C
<i>Evolvulus alsinoides</i> (L.) L.	0.72	0.47	1.26	C
<i>Evolvulus nummularius</i> (L.) L.	0.72	0.49	1.26	C
<i>Fimbristylis argentea</i> (Rottb.) Vahl	10.64	4.96	14.39	C
<i>Floscopa scandens</i> Lour.	5.29	3.07	6.62	C
<i>Globba racemosa</i> Sm.	1.30	0.73	3.36	C
<i>Gloriosa superba</i> L.	2.54	3.10	0.25	C
<i>Guizotia abyssinica</i> (L.f.) Cass.	4.59	4.82	0.17	C
<i>Hedyotis affinis</i> Roem. & Schult.	1.92	1.56	0.65	C
<i>Hedyotis verticillata</i> (L.) Lam.	2.04	1.33	1.89	C
<i>Hemigraphis latebrosa</i> (Heyne ex Roth) Nees	19.76	31.35	3.63	C
<i>Heteropogon contortus</i> (L.) P.Beauv.	4.21	3.90	2.52	C
<i>Hygrophila salicifolia</i> (Vahl) Nees	4.71	5.24	0.45	C
<i>Justicia diffusa</i> Willd.	1.75	1.53	0.51	C
<i>Knoxia sumatrensis</i> (Retz.) DC.	1.46	1.38	0.28	C
<i>Laportea interrupta</i> (L.) Chew	2.24	2.11	0.39	C
<i>Lepidagathis fasciculata</i> (Retz.) Nees	3.32	5.42	0.54	C
<i>Leucas mollissima</i> Wall.ex Benth.	1.39	1.11	0.95	C
<i>Mitracarpus villosus</i> (Sw.) DC.	4.43	2.88	5.36	C
<i>Murdannia japonica</i> (Thunb.) Faden	8.25	5.72	10.92	C
<i>Oplismenus compositus</i> (L.) P.Beauv.	1.61	1.19	1.26	C
<i>Orthosiphon rubicundus</i> (D. Don) Benth.	3.68	3.77	0.67	C
<i>Panicum notatum</i> Retz.	1.47	1.15	1.05	C
<i>Pavonia odorata</i> Willd.	1.54	1.35	1.16	C
<i>Pennisetum pedicellatum</i> Trin.	3.70	2.70	4.31	C
<i>Pimpinella heyneana</i> (Wall.ex DC.) Kurz	0.95	0.81	2.10	C
<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	1.10	1.02	0.53	C

..... Continue

<i>Polygonum barbatum</i> L.	0.95	<b>1.03</b>	2.10	C
<i>Rungia pectinata</i> (L.) Nees	<b>1.65</b>	0.76	4.62	C
<i>Scoparia dulcis</i> L.	2.32	<b>5.19</b>	0.98	C
<i>Selaginella repanda</i> (Desv.ex Poir.) Spring	<b>4.41</b>	3.75	0.94	C
<i>Sida cordata</i> (Burm.f.) Borssum	<b>1.63</b>	1.48	0.42	C
<i>Sida rhombifolia</i> L.	<b>2.54</b>	2.28	0.55	C
<i>Sorghum nitidum</i> (Vahl) Pers.	<b>2.47</b>	1.51	7.56	C
<i>Themeda quadrivalvis</i> (L.) Kuntze	<b>4.79</b>	3.72	5.88	C
<i>Themeda triandra</i> Forssk.	<b>2.44</b>	2.32	1.07	C
<i>Triumfetta rhomboidea</i> Jacq.	<b>2.09</b>	1.95	0.32	C
<i>Urginea indica</i> (Roxb.) Kunth	1.61	<b>2.27</b>	1.26	C
<i>Vernonia cinerea</i> (L.) Less.	4.96	<b>15.63</b>	1.14	C

Table 7. Phytosociological attributes and distribution pattern of Seedling community

Plant species	A-IVI	D-IVI	A/F	Distribution
<i>Acacia torta</i> (Roxb.) Craib	27.12	<b>36.60</b>	0.41	C
<i>Aegle marmelos</i> (L.) Corr.	<b>3.07</b>	2.60	1.00	C
<i>Albizia odoratissima</i> (L.f.) Benth.	2.11	<b>2.24</b>	0.06	C
<i>Ampelocissus latifolia</i> (Roxb.) Planch.	<b>2.59</b>	2.41	0.49	C
<i>Ampelocissus tomentosa</i> (Roth) Planch.	<b>0.66</b>	0.33	1.26	C
<i>Anisomeles indica</i> (L.) Kuntz.	<b>0.51</b>	0.33	0.84	C
<i>Anogeissus latifolia</i> (Roxb.ex DC.) Wall.ex Guill. & Perr.	4.26	<b>4.43</b>	0.10	C
<i>Asparagus racemosus</i> Willd.	<b>1.40</b>	0.77	1.16	C
<i>Atylosia scarabaeides</i> (L.) Benth.	<b>0.36</b>	0.25	0.42	C
<i>Baliospermum montanum</i> (Willd.) Muell.-Arg.	<b>0.96</b>	0.57	2.10	C
<i>Barleria cristata</i> L.	<b>1.05</b>	0.82	0.74	C
<i>Bauhinia malabarica</i> Roxb.	<b>0.96</b>	0.43	2.10	C
<i>Bauhinia vahlii</i> Wight & Arn.	<b>3.93</b>	3.87	0.25	C
<i>Blepharis maderaspatensis</i> (L.) Roth	<b>0.96</b>	0.49	2.10	C
<i>Bridellia retusa</i> (L.) Spreng.	2.98	<b>3.11</b>	0.13	C
<i>Buchanania lanzan</i> Spreng.	<b>1.12</b>	1.10	0.33	C
<i>Callicarpa tomentosa</i> (L.) Murr.	<b>0.81</b>	0.46	1.68	C
<i>Capillidium parviflorum</i> (R. Br.) Stapf	<b>19.47</b>	4.85	54.60	C
<i>Careya arborea</i> Roxb.	<b>0.61</b>	0.55	0.21	C
<i>Casearia elliptica</i> Willd.	1.50	<b>1.55</b>	0.13	C
<i>Cassia fistula</i> L.	3.72	<b>3.76</b>	0.04	Ra
<i>Cassine glauca</i> (Rottb.) Kuntze	<b>0.96</b>	0.76	0.63	C
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	<b>0.96</b>	0.73	0.63	C
<i>Cayratia auriculata</i> (Wall.) Gamble	<b>0.81</b>	0.34	1.68	C
<i>Celastrus paniculata</i> Willd.	<b>4.85</b>	3.77	0.86	C
<i>Chlorophytum arundinaceum</i> Baker	<b>0.36</b>	0.26	0.42	C
<i>Chloroxylon swietiana</i> DC.	8.96	<b>11.14</b>	0.11	C
<i>Cissampelos pariera</i> L.	<b>1.33</b>	1.17	0.21	C
<i>Cleistanthus collinus</i> (Roxb.) Benth.ex Hook.f.	2.93	<b>3.30</b>	0.40	C
<i>Colebrookea oppositifolia</i> Sm.	2.74	<b>2.89</b>	0.54	C
<i>Combretum roxburghii</i> Spreng.	<b>1.40</b>	1.29	0.51	C
<i>Cryptolepis buchananii</i> Roem. & Schult.	2.41	<b>2.54</b>	0.17	C
<i>Curculigo orchoides</i> Gaertn.	<b>13.55</b>	8.52	15.65	C
<i>Dalbergia latifolia</i> Roxb.	<b>1.91</b>	1.67	0.47	C
<i>Dalbergia paniculata</i> Roxb.	<b>2.64</b>	2.62	0.50	C
<i>Dendrocalamus strictus</i> (Roxb.) Nees	4.58	<b>17.92</b>	0.58	C
<i>Desmodium oojeinensis</i> (Roxb.) Ohashi	<b>2.37</b>	2.33	0.16	C
<i>Desmodium velutinum</i> (Willd.) DC.	<b>0.51</b>	0.28	0.84	C
<i>Dillenia aurea</i> Sm.	<b>0.61</b>	0.55	0.21	C
<i>Dioscorea bulbifera</i> L.	<b>0.70</b>	0.53	0.32	C
<i>Dioscorea puber</i> Bl.	<b>0.51</b>	0.28	0.84	C
<i>Diospyros melanoxylon</i> Roxb.	26.81	<b>41.55</b>	0.48	C
<i>Diospyros montana</i> Roxb.	1.82	<b>2.30</b>	0.13	C
<i>Embelia tsjeriam-cottam</i> (Roem. & Schult.) DC.	<b>0.36</b>	<b>0.36</b>	0.42	C
<i>Eriolaena hookeriana</i> Wight & Arn.	<b>0.36</b>	0.27	0.42	C
<i>Flacourtia indica</i> (Burm.f.) Merr.	<b>1.10</b>	0.81	2.52	C
<i>Gardenia gummifera</i> L.f.	<b>0.36</b>	0.27	0.42	C
<i>Gardenia latifolia</i> Ait.	1.96	<b>2.70</b>	0.29	C
<i>Garuga pinnata</i> Roxb.	<b>0.70</b>	0.61	0.32	C
<i>Grewia hirsuta</i> Vahl.	<b>2.85</b>	2.75	0.17	C
<i>Guizotia abyssinica</i> (L.f.) Cass.	<b>2.33</b>	1.94	0.40	C
<i>Haldinia cordifolia</i> (Roxb.) Ridsd.	<b>1.75</b>	1.44	1.58	C
<i>Helicteres isora</i> L.	4.44	<b>5.08</b>	0.18	C
<i>Hemidesmus indicus</i> (L.) R.Br.	<b>3.59</b>	3.11	0.39	C
<i>Hemigraphis latebrosa</i> (Heyne ex Roth) Nees	<b>3.69</b>	2.55	3.89	C
<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall.ex G.Don	2.54	<b>2.62</b>	0.12	C

..... Continue



<i>Homalium nepalense</i> Benth.	0.66	0.41	1.26	C
<i>Indigofera cassioides</i> Rottl.ex DC.	2.02	1.96	0.18	C
<i>Knoxia sumatrensis</i> (Retz.) DC.	2.48	1.86	1.26	C
<i>Kydia calycina</i> Roxb.	2.54	2.46	0.30	C
<i>Lagerstroemia parviflora</i> Roxb.	2.89	2.91	0.12	C
<i>Leea asiatica</i> (L.) Ridsdale	1.05	1.10	0.74	C
<i>Leptadenia reticulata</i> (Retz.) Wight & Arn.	0.36	0.26	0.42	C
<i>Lygodium flexuosum</i> (L.) sw.	0.66	0.31	1.26	C
<i>Madhuca indica</i> Gmel.	3.69	2.17	3.89	C
<i>Mangifera indica</i> L.	1.25	0.81	2.94	C
<i>Meyna spinosa</i> Roxb.ex Link.	1.76	1.76	0.22	C
<i>Millettia extensa</i> (Benth.) Baker	8.44	11.93	0.54	C
<i>Mitragyna parviflora</i> (Roxb.) Korth.	1.06	0.94	0.28	C
<i>Morinda pubescence</i> Sm.	1.68	1.75	0.09	C
<i>Nyctanthes arbor-tristis</i> L.	0.66	0.33	1.26	C
<i>Olax scandens</i> Roxb.	0.66	0.31	1.26	C
<i>Petalidium barlerioides</i> (Roth) Nees	3.72	3.88	0.42	C
<i>Phoenix sylvestris</i> (L.) Roxb.	0.51	0.51	0.84	C
<i>Phyllanthus emblica</i> L.	2.19	2.27	0.13	C
<i>Pterocarpus marsupium</i> Roxb.	5.18	6.00	0.10	C
<i>Schleichera oleosa</i> (Lour.) Oken	2.14	2.24	0.12	C
<i>Schrebera swietenoides</i> Roxb.	0.70	0.57	0.32	C
<i>Semecarpus anacardium</i> L.f.	3.44	3.27	1.91	C
<i>Shorea robusta</i> Gaertn.f.	22.72	13.24	63.84	C
<i>Smilax zeylanica</i> L.	0.70	0.57	0.32	C
<i>Sterculia urens</i> Roxb.	1.05	0.91	0.74	C
<i>Stereospermum chelonoides</i> (L.f.) DC.	3.10	3.40	0.15	C
<i>Strychnos nux-vomica</i> L.	1.31	0.95	1.05	C
<i>Symphorema polyandrum</i> Wight	4.48	4.81	0.19	C
<i>Syzygium cumini</i> (L.) Skeels	0.36	0.26	0.42	C
<i>Terminalia alata</i> Heyne ex Roth	1.70	1.90	0.20	C
<i>Terminalia chebula</i> Retz.	0.51	0.32	0.84	C
<i>Thespesia lampas</i> (Cav.) Dalz. & Gibs.	0.51	0.29	0.84	C
<i>Thysanolaena maxima</i> (Roxb.) Kuntze	4.66	2.29	12.60	C
<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thoms.	1.53	1.35	0.61	C
<i>Urginea indica</i> (Roxb.) Kunth	0.81	0.43	1.68	C
<i>Ventilago denticulata</i> Willd.	3.49	3.40	0.27	C
<i>Ventilago madraspatana</i> Gaertn.	1.84	2.45	1.68	C
<i>Vernonia cinerea</i> (L.) Less.	2.43	2.12	0.44	C
<i>Wattakaka volubilis</i> (L.f.) Stapf	3.15	3.27	0.22	C
<i>Woodfordia fruticosa</i> (L.) Kurz	0.96	0.39	2.10	C
<i>Wrightia arborea</i> (Dennst.) Mabb.	0.78	0.66	0.42	C
<i>Wrightia tinctoria</i> (Roxb.) R. Br.	1.79	1.71	0.42	C
<i>Ziziphus oenoplia</i> (L.) Mill.	1.39	1.33	0.24	C
<i>Ziziphus xylopyrus</i> (Retz.) Willd.	1.10	1.11	0.11	C

Table 8. Abundance-Dominance guided highest and lowest IVI

Vegetation Communities	No of Species	Abundance guided IVI (A-IVI)		Dominance guided IVI (D-IVI)	
		Highest Value	Lowest Value	Highest Value	Lowest Value
Total Plants	232	17.43	0.12	13.53	0.07
Tree-1	86	18.51	0.86	21.34	0.23
Tree-2	58	30.00	1.54	43.73	0.50
Shrub	34	72.09	0.75	130.69	0.55
LTC	26	36.32	3.87	101.63	1.72
Herb/Grass	82	19.76	0.61	31.35	0.47
Seedling	101	27.12	0.36	41.55	0.25

Table 9. Plant species distribution pattern

Vegetation community	Distribution pattern						Total Number of Species
	Regular		Random		Contiguous		
	Number	%	Number	%	Number	%	
Total Plants	Nil	-	15	6.47	217	93.53	232
Tree-1	Nil	-	16	18.60	70	81.40	86
Tree-2	Nil	-	06	10.34	52	89.66	58
Shrub	Nil	-	Nil	-	34	100.0	34
LTC	Nil	-	Nil	-	26	100.0	26
Herb/Grass	Nil	-	Nil	-	82	100.0	82
Seedling	Nil	-	01	0.99	100	99.01	101

Table 10. Abundance-Dominance guided values of indices

Vegetation communities	Abundance guided values			Dominance guided values		
	H'	D	E	H'	D	E
Total plants	2.13	0.99	0.90	2.03	0.98	0.86
Tree-1	1.79	0.98	0.92	1.66	0.97	0.86
Tree-2	1.65	0.97	0.93	1.53	0.95	0.87
Shrub	1.18	0.89	0.77	1.03	0.79	0.67
LTC	1.34	0.94	0.94	1.14	0.86	0.80
Herb/Grass	1.79	0.98	0.93	1.74	0.97	0.91
Seedling	1.72	0.96	0.86	1.64	0.95	0.82

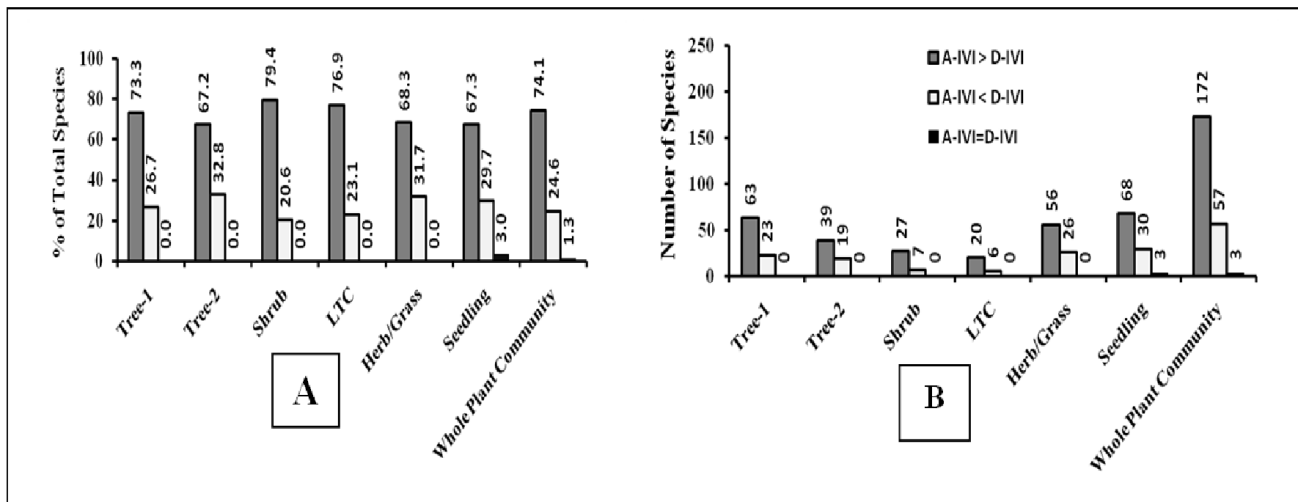


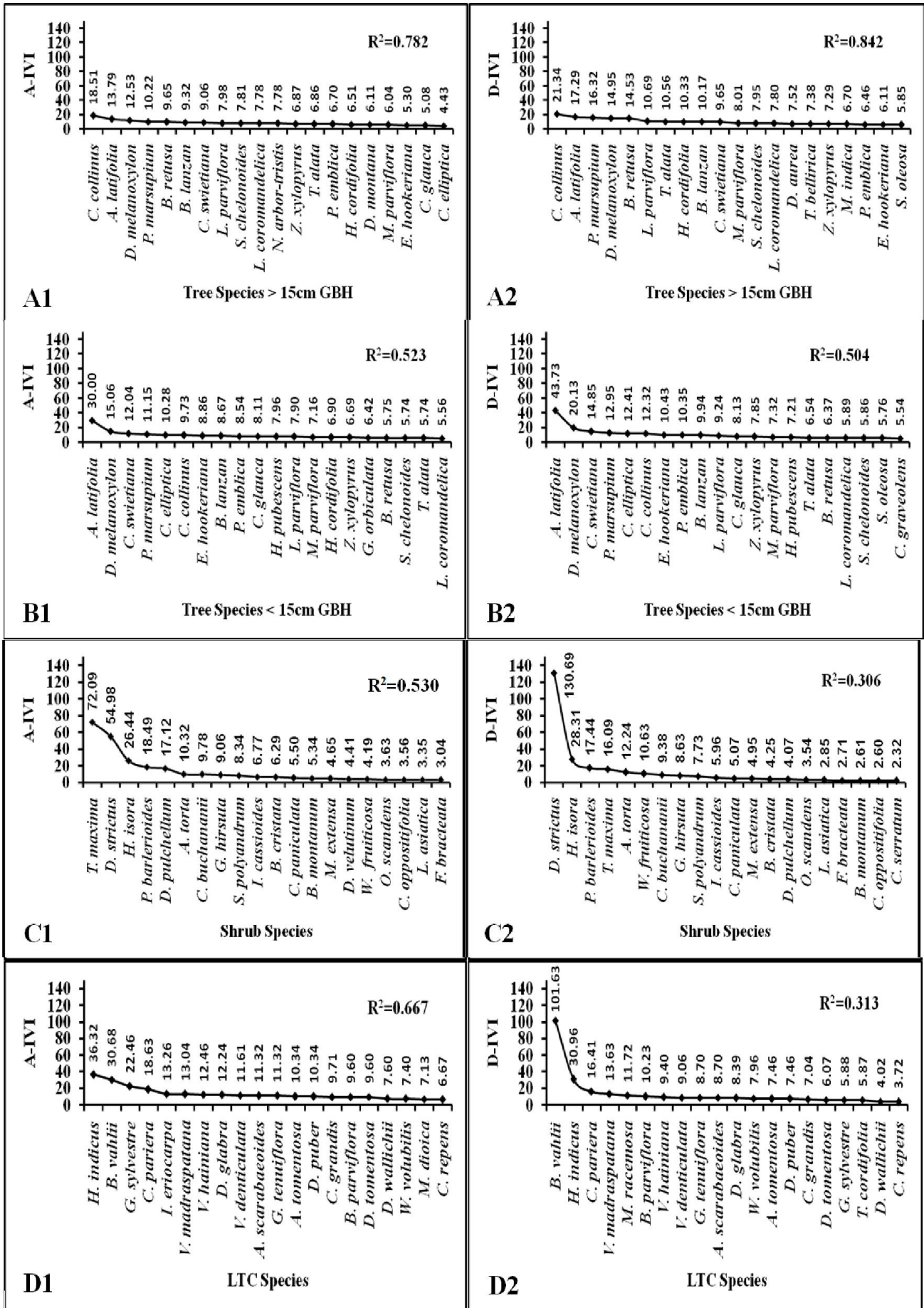
Fig. 4 Plant species representation by Abundance and Dominance guided IVI values (A-By number of Species and B- By percentage of total species)

The whole plant community was interpreted after the above community wise analysis and comparisons of vegetation taking into account their abundance and dominance. Top ranking 25 plant species based on abundance are *T. maxima*, *F. argentea*, *D. pulchellum*, *A. philippense*, *A. lancifolius*, *M. japonica*, *H. latebrosa*, *C. parviflorum*, *S. robusta*, *F. scandens*, *A. incisum*, *A. mutica*, *C. difformis*, *C. farinosa*, *T. quadrivalvis*, *A. paniculata*, *D. melanoxyton*, *M. villosus*, *D. strictus*, *A. pumila*, *D. bupleuroides*, *C. orchioides*, *C. halpan*, *C. parasitica* and *A. torta* with abundance of 310, 69, 65, 63, 58, 52, 51, 45, 40, 32, 30, 30, 29, 29, 28, 26, 26, 26, 24, 24, 23, 23, 23 and 23 respectively. Top ranking 25 plant species based on dominance are *P. marsupium*, *B. retusa*, *C. collinus*, *A. latifolia*, *H. cordifolia*, *T. bellirica*, *T. alata*, *D. melanoxyton*, *Madhuca indica*, *D. aurea*, *L. parviflora*, *S. oleosa*, *M. parviflora*, *B. lanzan*, *C. swietiana*, *E. hookeriana*, *S. chelonoides*, *Z. xylopyrus*, *B. malabarica*, *D. strictus*, *B. ceiba*, *L. coromandelica*, *P. emblica*, *G. latifolia* and *S. cumini* with dominance of 3.73m<sup>2</sup>, 3.15m<sup>2</sup>, 31.13m<sup>2</sup>, 2.84 m<sup>2</sup>, 2.52 m<sup>2</sup>, 2.48 m<sup>2</sup>, 2.32 m<sup>2</sup>, 2.28 m<sup>2</sup>, 2.27 m<sup>2</sup>, 1.97 m<sup>2</sup>, 1.89 m<sup>2</sup>, 1.83 m<sup>2</sup>, 1.42 m<sup>2</sup>, 1.32 m<sup>2</sup>, 1.23 m<sup>2</sup>, 0.88 m<sup>2</sup>, 0.81 m<sup>2</sup>, 0.80 m<sup>2</sup>, 0.78 m<sup>2</sup>, 0.74 m<sup>2</sup>, 0.74 m<sup>2</sup>, 0.65 m<sup>2</sup>, 0.56 m<sup>2</sup>, 0.45 m<sup>2</sup> and 0.44 m<sup>2</sup> respectively. Only two species which are common to both top ranking 25 plant species based on abundance and dominance are *D. melanoxyton* and *D. strictus*. Out of top ranking 25 plant species based on abundance, 2 are tree, 4 are shrub and 19 are herb/grass species where as out of top ranking 25 plant species based on dominance, only 1 is shrub and 24 are tree species. So, comparing whole plant community on the basis of their abundance and dominance, herbs/grasses (76%) are maximally represented in the top ranking 25 species guided by

abundance where as trees (96%) are maximally represented in the top ranking 25 species guided by dominance. Shrub and tree are represented by 16% and 8% following herbs/grasses in the top ranking 25 plant species projected on the basis of their abundance while shrub shows its only presence by 4% in the top ranking 25 plant species projected on the basis of their dominance following trees.

## DISCUSSION

A central goal in community ecology remains disentangling and understanding the mechanisms important to the maintenance of plant species diversity (Royo and Carson, 2005). One of the fundamental goals of ecology is to decipher the processes that determine species diversity and, in turn, to understand how diversity affects ecosystem processes (Chesson, 2000; Srivastava and Vellend, 2005). A frequent goal of ecosystem restoration is to re-create the patterns of plant species richness found in remnant landscapes. Restorations are chiefly monitored primarily for the number of native species that are present. Less attention has been given to measuring species level abundances and dominances in forest communities. Low levels of evenness, however, may indirectly reduce species richness by increasing the rate of local extinctions (Wilsey and Polley, 2004). In highly uneven assemblages, many species are rare, and rare species of plants are especially prone to local extinction (Duncan and Young, 2000). To increase or maintain richness over the long-term thus may require a better understanding of the processes that promote equitability in species abundances. Quadrature laying method is generally applied in forest surveys to take stock of the status of vegetation.



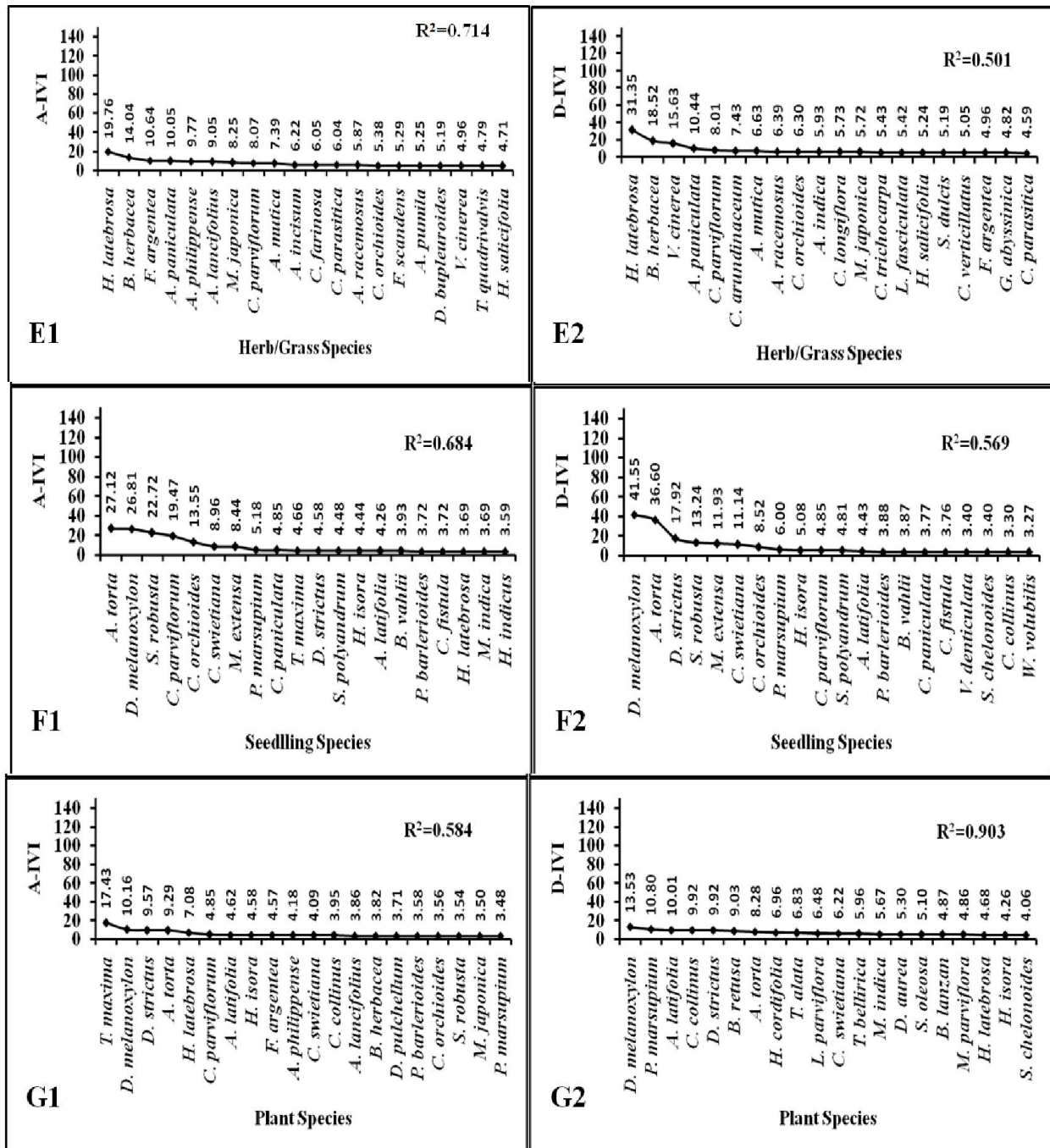
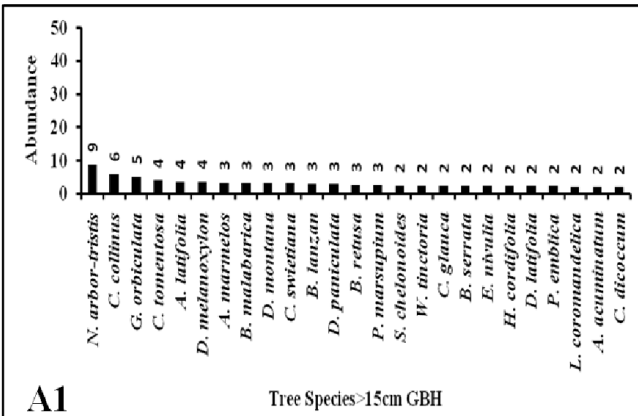


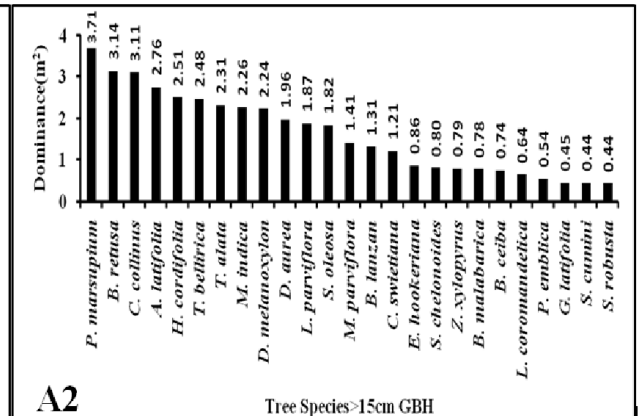
Fig. 5. Dominance-Diversity curve of top twenty plant species of plant communities i.e. Tree-1(A1,A2); Tree-2(B1,B2); Shrub(C1,C2); LTC(D1,D2); Herb/Grass(E1,E2); Seedling(F1,F2) and whole plant community(G1,G2)

Abundance and dominance are the two quantitative characters taken into account for calculation of importance value index of each species in the community. Abundance takes into account the average number of individuals of the species present per quadrat in which that species is observed. On the other hand, dominance is the total area of the stems of all individuals of the species found in all the studied quadrates. Hence; germination rate, mortality, age and geospatial variation in distribution of different species are the four distinguishing key factors which determine the dynamism of species with respect to abundance and dominance. The calculated importance value index with respect to abundance and dominance in case of all plant species across all plant communities shows the index to be higher value in most of the cases when the index derived using abundance value of the species (Fig.4).

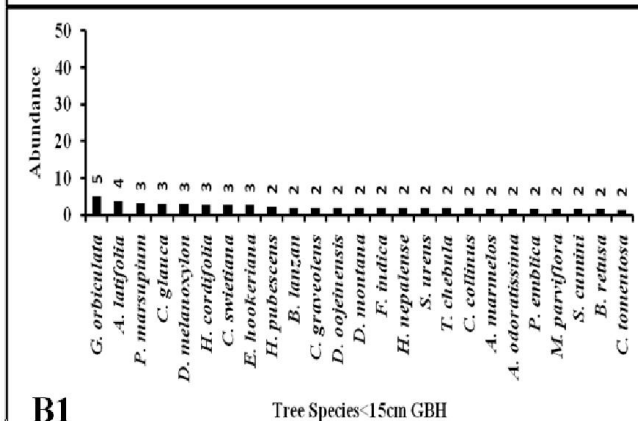
In all the communities, above 67% species represent higher abundance guided IVI than dominance guided IVI and below 33% species represent lower abundance guided IVI than dominance guided IVI. Only 3% and 1.3% species of seedling and whole plant community show equal abundance and dominance guided IVI values respectively. Three species such as *Erythrina variegata*, *Murraya paniculata* and *Pongamia pinnata* of the whole plant community and three species such as *Embelia tsjeriam-cottam*, *Meyna spinosa* and *Phoenix sylvestris* of the seedling community show equal IVI values guided by both abundance and dominance. All these six species belong to tree species. The contribution of more number of species to higher IVI guided by abundance may be correlated to the distribution pattern of plant species.



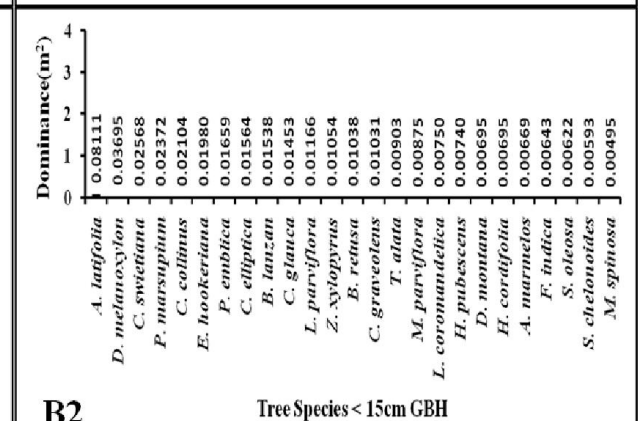
**A1** Tree Species >15cm GBH



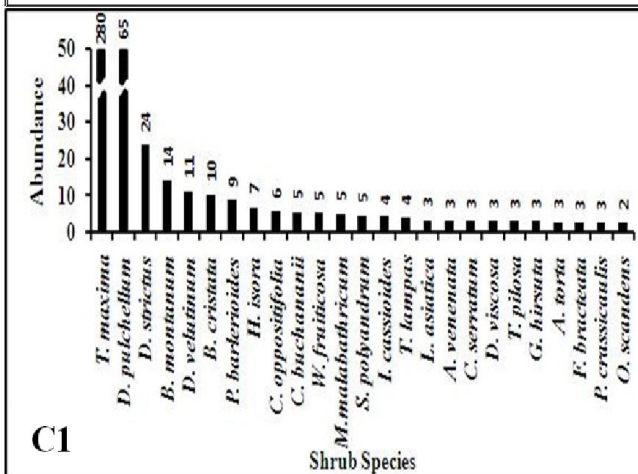
**A2** Tree Species >15cm GBH



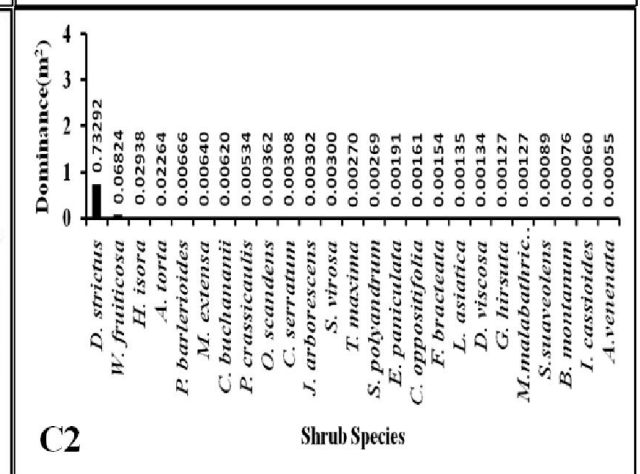
**B1** Tree Species <15cm GBH



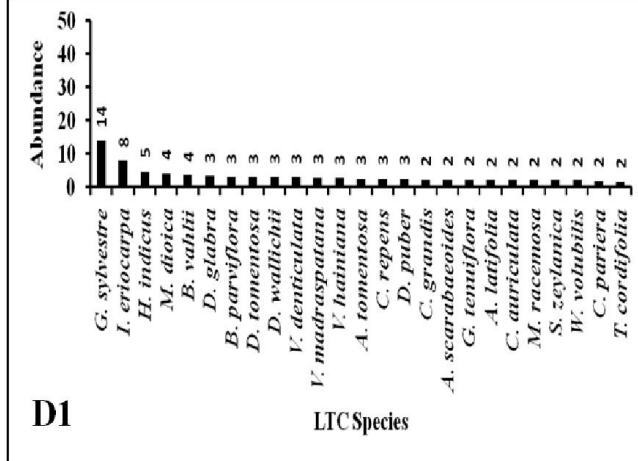
**B2** Tree Species <15cm GBH



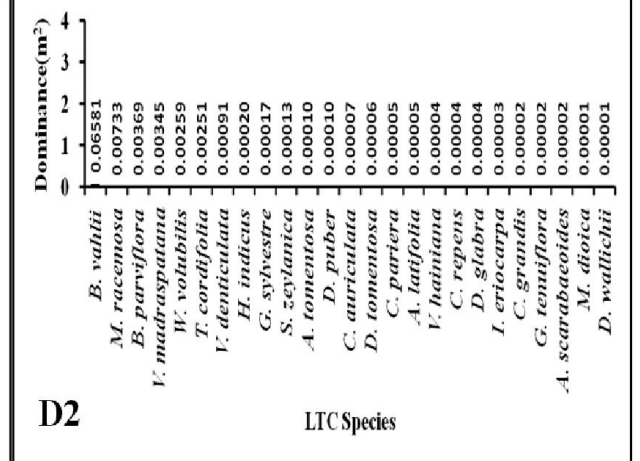
**C1** Shrub Species



**C2** Shrub Species



**D1** LTC Species



**D2** LTC Species

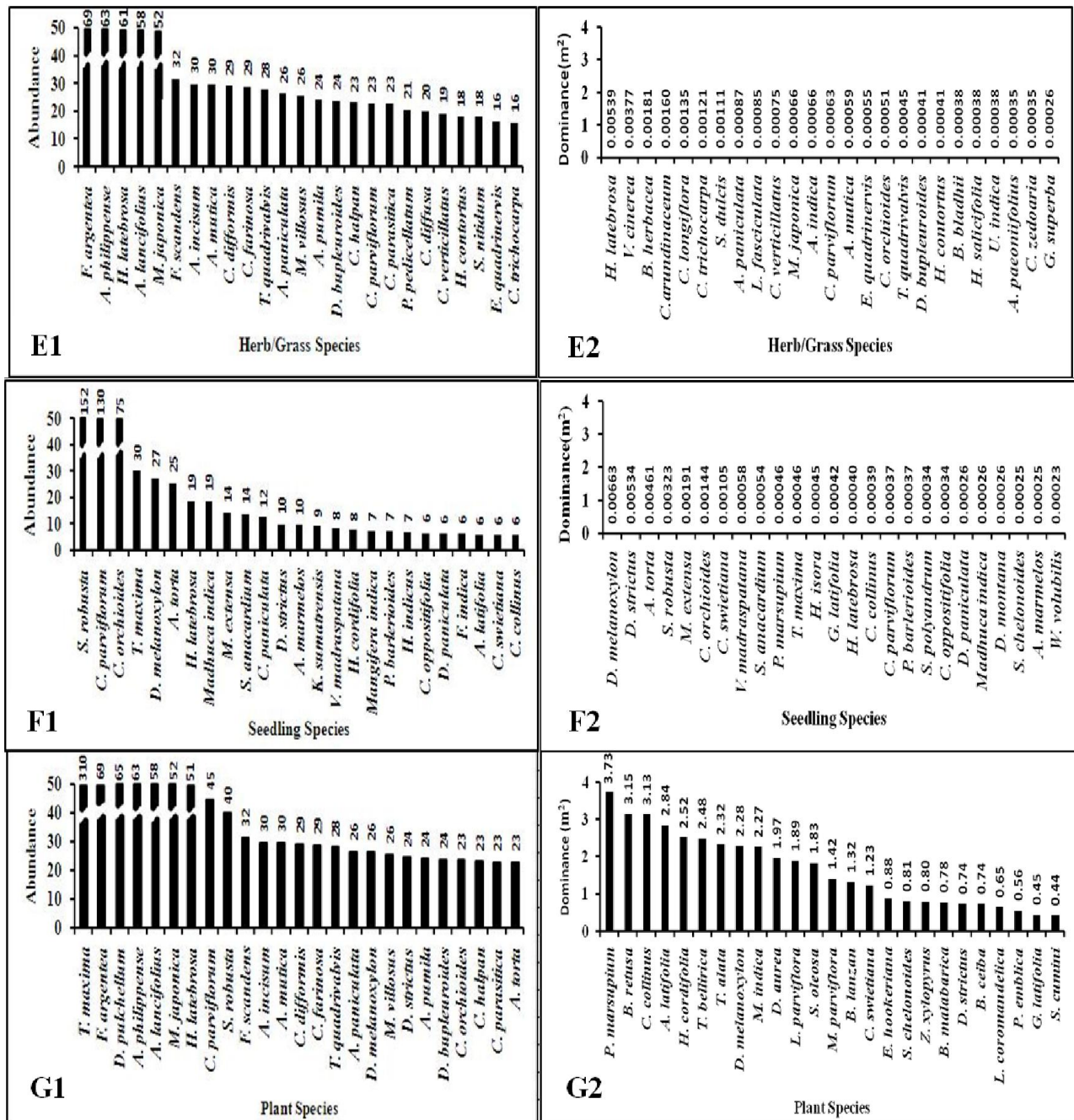
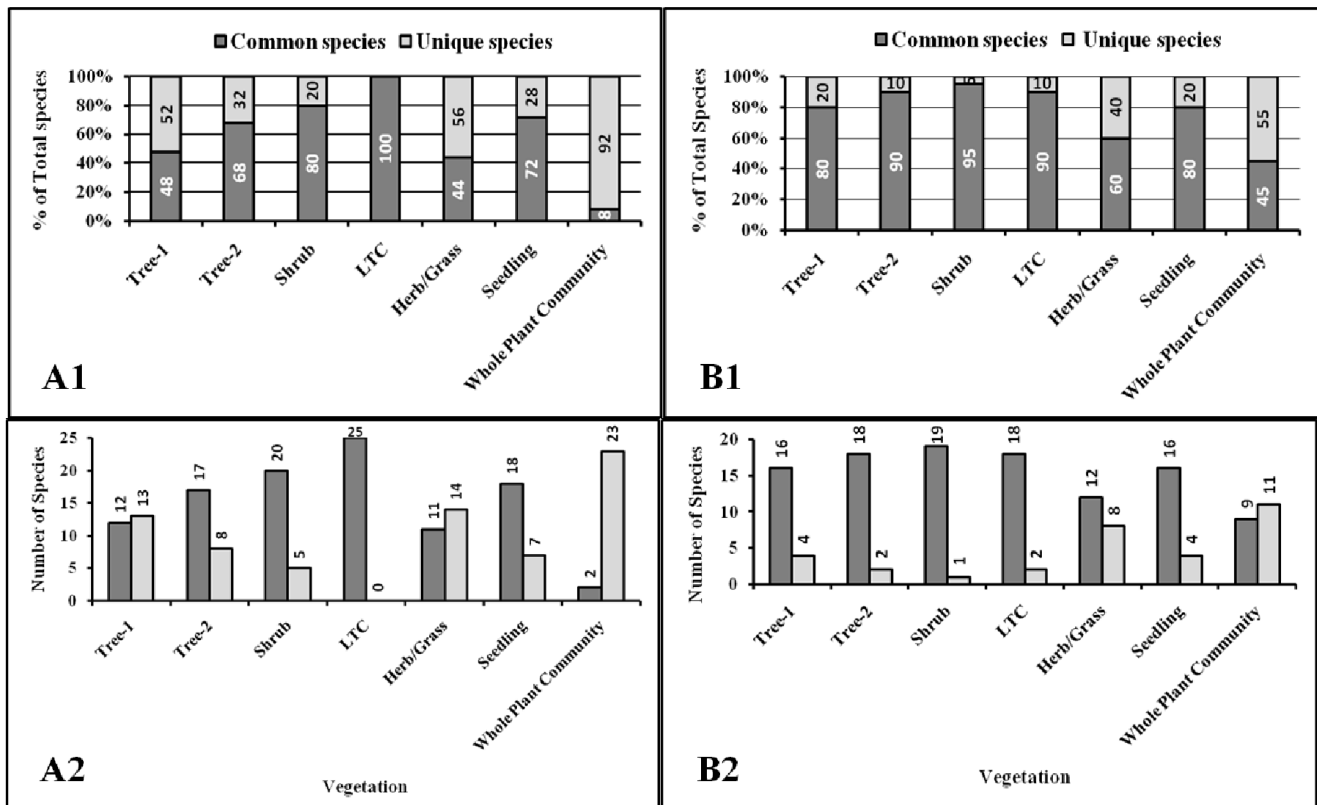


Fig. 6. Abundance and Dominance (m<sup>2</sup>) guided change in top twenty five plant species ranking across communities on Gandhamardan hills i.e. Tree-1(A1,A2); Tree-2(B1,B2); Shrub(C1,C2); LTC(D1,D2); Herb/Grass(E1,E2); Seedling(F1,F2) and whole plant community(G1,G2)

Higher abundance of a species is directly controlled by its contiguous type of distribution. This can be corroborated with the fact that 93.53%, 81.40%, 89.66%, 100%, 100%, 100% and 99.01% species of total plant community, Tree-1, Tree-2, Shrub, LTC, Herb/Grass and Seedling community shows contiguous distribution respectively (Table-9). In addition to this, 6.47%, 18.60%, 10.34% and 0.99% species of total plant community, Tree-1, Tree-2 and Seedling community show random distribution while none of the species of any plant community shows regular distribution. Supplementing to this finding, the values of Shannon-Wiener index of diversity, Simpson's index of diversity and Evenness index are observed to be always higher in all the plant communities when calculated taking IVI based on abundance rather than corresponding dominance (Table-10).

The shortcomings of diversity indices that cannot display the relative role different variables played in their calculation is fulfilled by dominance diversity curve or rank abundance curve or Whittaker plot which is a chart used by ecologists to display relative species abundance, a component of biodiversity (Whittaker, 1965 and Magurran, 2004). It can also be used to visualize species richness and species evenness. Species richness can be viewed as the number of different species on the chart i.e., how many species were ranked. Species evenness is derived from the slope of the line or coefficient of determination ( $R^2$ ) value that fits the graph. A steep gradient indicates low evenness as the high ranking species have much higher abundances or dominances than the low ranking species.



**Fig. 7** Number of common and unique species in the top ranking 25 species guided by Abundance and Dominance (A1- By percentage of total species and A2- By number of Species) and in the top ranking 20 species guided by A-IVI and D-IVI (B1- By percentage of total species and B2- By number of Species)

A shallow gradient indicates high evenness as the abundances or dominances of different species are nearly similar. The coefficient of determination ( $R^2$ ) value for Whittaker plot guided by A-IVI in Tree-2(Tree Species <15cm GBH), Shrub, LTC, Herb/Grass and Seedling communities are higher than  $R^2$  value for Whittaker plot guided by D-IVI except in Tree-1(Tree species >15cm GBH) and Whole plant community where reverse trend was observed. Hence, the evenness of top twenty species represented by A-IVI is more than the top twenty species represented by D-IVI in the Tree-2, Shrub, LTC, Herb/Grass and Seedling communities. Simultaneously, the evenness of top twenty species represented by A-IVI is less than the top twenty species represented by D-IVI in the Tree-1 and Whole plant community. The Whittaker plots guided by A-IVI shows correlation coefficient above 0.50 in all the seven studied communities where as plots guided by D-IVI shows correlation coefficient above 0.50 in five communities and below 0.32 in two communities. Among all plots guided by A-IVI, Tree-1 community leads with correlation coefficient of 0.782 followed by Herb/Grass (0.714), Seedling (0.684), LTC (0.667), whole plant community (0.584), Shrub (0.530) and Tree-2 (0.523) while the plots guided by D-IVI shows the whole plant community with highest coefficient value of 0.903 followed by Tree-1(0.842), Seedling(0.569), Tree-2(0.504), Herb/Grass(0.501), LTC(0.313) and shrub(0.306). The mean  $R^2$  value for the seven plots guided by A-IVI and D-IVI are 0.64 and 0.56 respectively. Therefore species evenness is more explainable when ranked according to abundance based IVI at 64% level than dominance based IVI which is at 56%. Top twenty five species ranked on the basis of abundance and dominance for each community comprises common as well as unique species (Fig.7-A1 and A2).

Also, Whittaker plots drawn for top twenty species on the basis of A-IVI and D-IVI for the same community comprises common as well as unique species (Fig.7-B1 and B2). This shows the species dynamics with respect to rank position, abundance and dominance. The decreasing order of number of common species in the top ranking twenty five species based on abundance and dominance for communities is LTC>Shrub>Seedling>Tree-2>Tree-1>Herb/Grass>Whole plant community while that order for Whittaker plots guided by A-IVI and D-IVI for communities is Shrub>LTC=Tree-2>Tree-1=Seedling>Herb/Grass>Whole plant community.

In the above two cases, whole plant community occupies the last position with 8% and 45% common species in the context of abundance versus dominance and A-IVI versus D-IVI respectively. Also, 8% is the least common species among all communities on the above two contexts. So, abundance and dominance are the two distinguishing characters which discriminate plant species largely when the whole plant community is considered as a unit rather than when it is divided into subunits. Likewise, whole plant community also shows highest discrimination when top twenty species are ranked on the guidelines of importance value index controlled by abundance and dominance. The total nine species being common to top twenty species guided by A-IVI and D-IVI consists of five tree species where as the top twenty species based on A-IVI consists of six tree species but that on D-IVI consists of sixteen tree species in the whole plant community(Fig.5-G1 & G2). *T. maxima*; a shrub tops in the species rank according to A-IVI with value of 17.43 followed by *D. melanoxylon* with index value of 10.16 but *T. maxima* is all total absent in the rank list according to D-IVI of top

twenty plant species where *D. melanoxyton* tops in the same list with 13.53 index value. At the same time, out of top ranking twenty five plant species based on abundance, 2 are tree, 4 are shrub, 19 are herb/grass species where as that based on dominance, 24 are tree and only 1 is shrub species (Fig.6-G1 & G2). So, comparing whole plant community on the basis of their abundance and dominance, herbs/grasses (76%) are maximally represented when guided by abundance where as trees (96%) are maximally represented when guided by dominance. Hence, abundance is a factor in community analysis which reveals, promotes and prioritizes communities other than trees but dominance is a factor which exposes especially tree community as the individuals of tree species are available in higher girth classes.

### Conclusion

The present study reveals abundance and dominance to be the key factor for community analysis. Calculation of importance value index is done taking relative frequency, relative density and relative abundance. Also, relative dominance is taken in the place of relative abundance while calculating the index. Taking this dual approach of calculation as the path and finding best one as the objective of present research paper, it was solved that a forest community consists of profiles of vegetation beginning from ground level to meters of height. Out of these profiles, tree community is enriched with individuals of species which range from having 1cm to more than 169cm girth or circumference of the stems. However, the individuals of other communities like shrub, LTC (Lianas, Twinner and Climber) and Herb/Grass hardly reach such high girth class. Therefore, during calculation of importance value index based on abundance, the later said three communities or their species take lead because of their 100% contiguous distribution. No species of these communities are regularly or randomly distributed. Simultaneously, when the index is calculated based on dominance, the tree community or its species take lead as they exist in very high girth classes as well as showing contiguous distribution to be less than cent percent. The whole plant community as a unit and seedling community also shows less than cent percent contiguous distribution. Hence, the more the community or its species contiguously distributed the more will be its abundance so as suitable to evaluate its importance value guided by abundance. On the other hand, the community or its species which does not show more contiguous type distribution and exist with individuals having far higher girths than individuals of other communities, is appropriate to be evaluated through importance value index based on dominance. Therefore, importance value index of species belonging to tree and other communities should be evaluated based on dominance and abundance respectively.

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