Print ISSN: 0976-2876 Online ISSN: 2250-0138

Available online at: http://www.ijsr.in

INDIAN JOURNAL OF SCIENTIFIC RESEARCH

DOI:10.32606/IJSR.V11.I2.00006

Received: 10-05-2020 Accepted: 15-10-2020 Publication: 31-01-2021

Indian J.Sci.Res. 11 (2): 33-38, 2021 Original Research Article

EVALUATION OF DIVERSITY OF ANGIOSPERMIC TREES OF NAWADA DISTRICT BIHAR

S. M. ATEEQUE AHMAD[a1] AND NANDJEE KUMAR[b]

[ab]Department of Botany, Magadh University, Bodhgaya, Bihar, India

ABSTRACT

The present paper deals with measurement of diversity of tree species in a wide range of fourteen blocks of Nawada district of Bihar for which field survey was conducted choosing random sites in different seasons during 2015-17; however specific sites were selected for laying 25 quadrates (10mx10m) in each block. The tree species were counted and noted carefully. The collected samples were identified through updated literature and confirmed at Botanical Survey of India (BSI), Kolkata. The diversity parameters such as density, species diversity, diversity index, plant height, basal cover were calculated as described by Phillip (1959), Shannon & Weiner (1963), Mugurran (1988) and Addo- Fordjour *et al.*(2009). The results revealed that a total of 83 species of trees belonging to 71 genera and 32 angiospermic families were recorded of which dicot trees occupied 98.79 % and monoct 01.20 % only. The dominant families with eight tree species were noted as Caesalpinaceae, Moraceae, Euphorbiaceae followed by Rubiaceae, Fabaceae with six tree species and Mimosaceae, Anacariaceae with five tree species respectively. The results on diversity indices and basal cover of tree species confirmed that the two blocks Kawakol and Rajauli with maximum value of density, species diversity, diversity index and basal cover are tree dominating areas representing two major forest ranges of Nawada district.

KEYWORDS: Diversity Indices, Species Diversity, Diversity Index, Density, Basal Cover

Nawada is one of the administrative districts of Bihar located at $24^{0}88$'N latitude and $85^{0}53$'E longitude with an area of 2494 sq km, average rainfall 1142.3 mm and elevation of 80m from the sea level and divided into 14 blocks i.e. Hisua (Ha), Warsaliganj (Wg), Nawada (Nda), Kawakol (Kal), Akbarpur (Ap), Narhat (Nht), Nardiganj (Ndg), Meskaur (Mkr), Sirdala (Sda), Rajauli (Rjl), Pakaribarawan (Pb), Kashichak(Kac), Govindpur (Gp) and Roh (Rh).

Mugurran (1988) stated that species richness measures the ecosystem attributes because it characterizes the biodiversity of an area. Richness of species is controlled by a variety of biotic and abiotic factors (Cornell and Lawton, 1992; Pollock *et al.*, 1998). The pattern of species richness of ecosystem function is of great significance in terms of climate change concerns (Chapin and Korner, 1995; Reyholds and Tenhunen, 1996 and Oechel*et al.*1997).

Rai and Das (2008) studied the trees of foot hill region of Darjeeling. Chanda and Palit (2009) studied plant diversity in Rangiroom forest beat and Senchal west zone forest range, Darjeeling. Das, Pal and Palit (2012) studied the plant diversity of Rambi forest beat and Senchal east zone forest range, Darjeeling and measured species diversity by applying shannon's index. Sharma, Maury and Singh (2001) recorded the floristic composition and basal cover of vegetation along the revinelands of Kunwari catchment area of Morena (M P).

The tree covered land is the biological resources being managed in a natural integration. The distribution and magnitude of the biological diversity that exists today is a product of over 3.5 billion years of evolution involving speciation, migration, extension and extinction, however human influences with increased population, urbanization, industrialization and alteration of the natural habitats have been one of the major factors of destruction of forest wealth. As such the management and protection of trees of natural habitats will be a significant respect to ecological relationship (Chowdhery and Hajra, 2000).

Therefore, the present study comprises the measurement of diversity of trees in the wide range of 14 blocks of Nawada district of Bihar.

MATERIALS AND METHODS

The field survey was conducted in all the 14 blocks of the district choosing random sites in different seasons during 2015-17; however specific sites were selected for laying twenty five quadrates (10mx10m) in each block. The tree species with ≥ 2m height and ≥

[1]Corresponding author

10cm dbh were counted and enumerated carefully in table-1. The collected samples were identified through updated literature and confirmed at botanical survey of India (bsi), Kolkata. The dried specimens were mounted on herbarium sheets (28x42cm).

Diversity indices such as density, shannon & winner index, simpson's index were calculated as described by Philliph (1959), Shannon & Weiner (1963) and Mugurran (1988). The height of plants was determined by clinometer while basal cover was determined by multiplying density of species and basal area of species at breast height of trees as described by Addo-fordjour*et al.*(2009). The data were analysed statistically.

RESULTS

The survey in respect to floristic components of trees in the 14 blocks of Nawada district revealed that a total of 83 species of trees belonging to 71 genera and 32 families were recorded of which dicot tree species occupied 98.79 % and monocot tree species 01.20 % (table -1, 2).

The dominant families with maximum eight species of trees were noted as Caesalpinaceae, Moraceae and Euphorbiaceae followed by Rubiaceae, Fabaceae with six tree species , Mimosaceae, Anacardiaceae with five tree species, Apocynaceae, Combretaceae with four tree species and Myrtaceae with three tree species (table-3).

The results on diversity indices indicated that the maximum density of trees was recorded in Kawakol and Rajauli blocks with 390 and 385 individuals/ hectare respectively. The highest value of species diversity (Shannon- Winner index) was noted in Kawakol (3.7) and Rajauli (3.6) blocks respectively. Similarly diversity index (Simpson's index) with higher values were noted in tree species of Kawakol (2.70) and Rajauli (2.60) blocks (table-4).

Table 1: Enumeration of angiospermic trees distributed in 14 blocks of Nawada district

Sl. No.	Species name	Common name	Family	Ethno-botanical Uses
1.	*Acacia Arabica* (Lam) Willd	Babul	Mimosaceae	Gum yielding.
2.	*Acacia catechu* (L.f.) Willd	Khair	Mimosaceae	Ingredient of beetle.
3.	*Adina cordifolia*(Roxb)Hook f. ex Br	Karam	Naucleaceae	Timber yielding, suitable for railway wagon.
4.	*Aeglemarmelos*L.	Bel	Rutaceae	Fruits medicinal.
5.	*Aidiagenipiflora*D C	-	Rubiaceae	Timber yielding.
6.	*Ailanthus excels* Roxb	Maharukha	Simarubaceae	Bark medicinal.
7.	*Albizialebbeck*(L) Benth	Siris	Mimosaceae	Shade plants.
8.	*Albiziaprocera*(Roxb)Benth	Safedsiris	Mimosaceae	Timber yielding.
9.	*Anogeissuslatifolia*(DC) Wall ex Bedd	Dhawrna	Combretaceae	Wood for railway sleeper, gum used in explosive industries.
10.	*Astoniaboonei*(DC) Wald	-	Apocynaceae	Timber yielding.
11.	*Amphimonaspterocarpoies*Tarm	-	Fabaceae	Timber yielding.
12.	*AntiaristoxicariaRumph ex Pers*	Chandel	Moraceae	Bark yields poisonous latex.
13.	*Atrocarpusheterophyllus*Lamk	Kathal	Moraceae	Fruit edible.
15.	*Azadirachtaindica* A Juss	Neem	Meliaceae	Medicinal.
15.	*Bauhinia purpurea*L	LalKachnar	Caesalpinaceae	Bark fibre yielding.
16.	*Bauhinia variegata*L	Kachnar	Caesalpinaceae	Bark used in tanning.
17.	*Bauhinia retusa*Buch-Ham	Kandla	Caesalpinaceae	Gum yielding.
18.	*Bombexceiba*P Beauv	Simul	Bombacaceae	Wood for ply wood and packing box, silky floss for pillow.
19.	*Borassusflabelliferi*L	Tar	Arecaceae	Peduncle yields sap (neera).
20.	*Brideliaatroviridis*Mill Arg	-	Euphorbiaceae	Bark fibre yielding.
21.	*Brideliagrandis*Pierre ex Hutch	-	Euphorbiaceae	Medicinal.
22.	*BrideliaretusaSpreng*	Khaja	Euphorbiaceae	Bark oil used in rheumatism.
23.	*Broussonetiapapyrifera*Vent	Paper mulberry	Moraceae	Bark fibre yielding.

24.	*Buchnanialanzan*Spreng	Chiraunji	Anacardiaceae	Fruit yielding.
25.	*Buteamonosperma*(Lamk)Taubert	Palas	Fabaceae	Host for lac insects, medicinal.
26.	*Cassia siamea*Lamk	Kassod	Caesalpinaceae	Avenue tree.
27.	Cassia fistula L	Amaltas	Caesapinaceae	Ornamental, avenue tree.
28.	*Careyaarborea*Roxb	Kumbhi	Barringtoniaceae	Leaves used for bidi industry.
29.	*Ceibapentandra*(L) Gaertn	Safedsimal	Bombacaceae	Floss of inner fruit wall for mattress and pillow.
30.	*Cleistanthuscollinus*(Roxb) Benth	Garari	Euphorbiaceae	Wood pulp for paper industry.
31.	*Cochlospermusrelogiosum*(L)Alston	Pilikapas	Cochlospermaceae	Gum yielding, seed fibre used for mattress.
32.	*Cordiamillenii*Baker	Lisoora	Ehretiaceae	Medicinal, fruit edible.
33.	*Dalbergiasissoo*Roxb	Shisham	Fabaceae	Timber yielding.
34.	*Delonixregia*(Baj) Raf	Gulmohar	Caesalinaceae	Avenue tree, ornamental.
35.	*Diospyrosmelanoxylon*Roxb	Tendu	Ebenaceae	Fruit edible, leaves used for bidi.
36.	*Emblicaofficinalis*Gaertn	Amla	Euphorbiaceae	Laxative, rich in vitamin-c and antioxidant content.
37.	*Elaeodendronglaucum*Pers	Bakra	Celastaceae	Medicinal, used in headache.
38.	*Erythrinavariegata*L	Farhad	Fabaceae	Leaves used as fodder, hedge.
39.	*Ficusbenghalensis L.*	Bargad	Moraceae	Evergreen shade tree.
40.	*Ficusglomerata*Roxb	Gular	Moraceae	Shade tree, fruits edible.
41.	*Ficusreligiosa*L	Peepal	Moraceae	Avenue tree, worshiped by Hindus and Buddhists.
42.	*Ficusrumphii*Blume	Pakar	Moraceae	Fruits edible, used as pickles.
43.	*Garugapinnata*Roxb	Ghoghar	Burseraceae	Fruits edible, wood for furniture.
44.	*Grewiaasiatica*L	Phalsa	Tiliaceae	Wood used for golf shaft.
45.	*Gmelinaarborea*L	Gambhar	Verbenaceae	Wood used for furniture.
46.	*Holorrhinaantidysenterica*(L)Wall ex DC	Kurchi	Apocynaceae	Medicinal, leaves used to cure dysentery and diarrhoea.
47.	*Hymenodyctyonescelsum*(Roxb) Wall	Baulan	Rubiaceae	Wood used for match box, packing box, pencil, cricket bats.
48.	*Ixoraarborea*(Roxb) ex Sm	Jilapi	Rubiaceae	Branches spread like torch light
49.	*Lagerstromiaparviflora*Roxb	Dhaura	Lythraceae	Wood used for bridges and beams.
50.	*Lanneacoromandelica*Houtt	Jhingam	Anacardiaceae	Wood pulp used for paper industries.
51.	*Macarangadenticulata*Muell-Arg	-	Euphorbiaceae	Wood used for cabinet work.
52.	*Madhucaindica* J F Gmel	Mahua	Sapotaceae	Fruits used in alcohol preparation, bark used in curing bleeding gum.
53.	*Mangiferaindica*L	Aam	Anacardiaceae	Fruits edible, green fruits used for pickles, leaves in Hindu worship.
54.	*Mallotusphilippensis (Lamk) Muell-Arg*	Kamela	Euphorbiaceae	Source of kamela dye to stain silk and wool, used in skin diseases.
55.	*Morindatinctoria*Roxb	Aal	Rubiaceae	Roots yield red dye used to stain woollen and linen fibres.
56.	*Moringaoleifera*Lamk	Sahjan	Moringaceae	Seeds oil cures gout / rheumatism, wood used in paper industry.
57.	*Morusindica*L.	Shahtut	Moraceae	Fruits edible, source of vitamin-c.
58.	*Mitragynaparvifolia*(Roxb) Korth	Kadam	Rubiaceae	Bark fibre yielding, wood used for furniture.
59.	*Oroxylumindicum(L) Vent*	Arlu	Bignoniaceae	Root bark used in diarrhoea/ dysentery, rheumatism and leaves

				for curing spleen and ulcer.
60.	*Pithecellopiumbigeminnum*Mart	Kachlora	Mimosaceae	Seeds very effective in diabetes, leaf extract for hair growth.
61.	*Plumeria alba* L	White phrangipani	Apocynaceae	Latex useful in ulcer and herpes.
62.	*Pongamiapinnata*(L) vent	Karanj	Fabaceae	Seed oil used in the treatment of skin diseases, fruits edible.
63.	*Putranjivaroxburghii* Wall	Putranjiva	Euphorbiaceae	Nuts used for rosaries, shade plant.
64.	*Psidiumguajava*L	Amrud	Myrtaceae	Fruit edible, laxative, rich in vit-c.
65.	*Randiadumetorum*Lamk	Mainphal	Rubiaceae	Fruits edible.
66.	*Saracaasoca*Roxb de Wildo	Ashok	Caesalpiniaceae	Bark used in the preparation of ayurvedicdrug Asokarist.
67.	*Sapindusemerginatus*Vahl	Ritha	Sapindaceae	Detergent for woollen clothes, fruits for the treatment of lumbago.
68.	*Schleicheraoleosa*(Lour) Oken	Kushum	Sapindaceae	Seed oil used as lubricant and perfumery, timber for beams.
69.	*Semecarpusanacardium*L. f.	Bhilawa	Anacardiaceae	Yields Bhilawan Shell Liquid used in varnishes, enamel paints and anti-termite insecticides.
70.	*Sesbaniagrandiflora*(L) Poir	Agastoya	Fabaceae	Flowers edible as vegetable.
71.	*Shorearobusta*Gaertn f.	Sal	Dipterocarpaceae	Timber yielding, used for furniture and ply wood industry.
72.	*Spondiaspinnata (L.f.) Kurz.*	Amara	Anacardiacea	Fruits edible, used to prepare pickles, chutney, jam.
73.	SterculiaurensRoxb	Gulu	Sterculiaceae	Stem gum yielding used in textile, paper and cosmetics industries.
74.	*Syzygiumcumini*(L) Skeels	Jamun	Myrtaceae	Seeds useful in diabetes. bark in diarrhoea/dysentery, fruits edible.
75.	*Syzygiumfruticosum*(Roxb) DC	JungliJamun	Myrtaceae	Fruits edible with high vitamin-c content.
76.	*Tamarindusindica* L	Imali	Caesalpinaceae	Fruits edible, rich in tartaric acid.
77.	*Tectonagrandis* L f.	Sagwan	Verbenaceae	Timber yielding, used for furniture and in construction of ships.
78.	Terninaliaarjuna (Roxb) W &Arn	Kahua	Combretaceae	Medicinal, bark used to relieve hypertension.
79.	*Terminaliabellirica* (Gaertn) Roxb	Bahera	Combretaceae	Karnel oil used in soap industry, fruit pulp used in dropsy,leprosy.
80.	*Terminaliachebula*Retz	Harir	Combretaceae	Medicinal, fruit churna used as laxative, timber yielding.
81.	*Wrightiatomentosa*(Roxb) Roem&Shutt	Dudhi	Apocynaceae	Bark used in snake bite & scorpion bite, wood used for making comb and turnery.
82.	*Ziziphusmauritiana*Lamk.	Ber	Rhamnaceae	Rich source of vitamin-c, useful to cure pyorrhoea and gum bleeding.
83	*Ziziphusnummularia*Burm f.	Wild ber	Rhamnaceae	Fruits edible, rich source of vit-c.

Table 2: A synoptic account of total tree species, genera and families of Nawada district

Taxa	Total	Dicotyledons	%	Monocotyledons	%
Species	83	82	98.79	01	01.20
Genera	71	70	98.59	01	01.40
Families	32	31	96.67	01	3.12

Table 3: Dominant families and their tree species of Nawada district

Sl	Families	Number	Dominant species
1	Caesalpinaceae	08	*Bauhinia purpurea, B. variegata, B.retusa, Cassia siamea, C . fistula, Delonix regia, Tamarindusindica*
2	Moraceae	08	*Antiaristoxicaria, Atrocarpusheterophyllus, Broussonetiapapyrifera,Ficus benghalensis, F. glomerata, F .religiosa, F. rumphii, Morusindica*
3	Euphorbiaceae	08	*Brideliaatroviridis, B. grandis, B. retusa, Cleistanthuscollinus, Embilica officinalis, Macaranga denticulate, Mallotusphilippensis, putranjivaroxburghii*
4	Rubiaceae	06	*Aidiagenipiflora, Hymenodyctyonescelsum, Ixoraarborea, Morindatictoria, Mitragynaparvifolia, Randiadumetorum*
5	Fabaceae	06	*Amphimonaspterocarpoies, Buteamonosperma, Dalbergiasissoo, Erythrina variegata, Pongamiapinnata, Sesbaniagrandiflora*
6	Mimosaceae	05	*Acacia arabica, A. catechu,Abizialebbeck, A.procera, Pithecellopium Bigeminnum*
7	Anacardiaceae	05	*Buchnanialanzan, Lanneacoromandelica, Mangiferaindica, Semecarpus anacadium, Spondiaspinnata*
8	Apocynaceae	04	*Astoniaboonei, Holorrhinaantidysenterica, Plumeria alba, Wrightiatomentosa*
9	Combretaceae	04	*Anogeissuslatifolia, Terminaliaarjuna, T. bellirica, T. Chebula*
10	Myrtaceae	03	*Psidiumguajava, Syzigiumcumini, S. fruticosum*

Table 4: Density, species diversity, diversity index, mean plant height and basal cover of trees of 14 blocks of Nawada

Sl	Block Name	Density (Individuals/ha)	Species diversity (H')	Diversity index (D)	Plant height (m) M ± SE	basal cover (m2/ha) M ± SE
1.	Akbarpur (Ap)	95	2.6	1.34	26.60±3.20	0.294±0.092
2.	Govindpur (Gp)	187	3.1	1.80	29.10±2.16	06.66±0.012
3.	Hisua (Ha)	180	3.3	1.35	27.25±2.16	06.66±0.012
4.	Kashichak (Kac)	215	3.4	2.36	26.35±2.50	09.67±0.123
5.	Kawakol (Kal)	390	3.7	2.70	35.50±2.26	27.30±0.011
6.	Meskaur (Mkr)	185	3.5	1.85	27.35±1.85	04.77±0.030
7.	Nawada (Nda)	85	2.5	1.30	26.35±2.50	02.63±0.008
8.	Nardiganj (Ndg)	135	2.8	1.34	32.15±1.78	06.07±0.012
9.	Narhat (Nht)	107	2.9	1.45	30.26±2.15	01.60±0.003
10.	Pakribarawan (Pb)	25	3.5	2.40	32.50±2.50	00.27±0.001
11.	Roh (Rh)	132	2.8	1.36	27.50±1.75	04.09±0.031
12.	Rajauli (Rjl)	385	3.6	2.60	34.40±2.60	23.87±0.015
13.	Sirdala (Sda)	150	3.4	1.36	28.30±1.58	03.75±0.014
14.	Warisaliganj (Wg)	107	2.9	1.36	29.80±3.40	00.85±0.003

DISCUSSION

The present work is the outcome of two years (2015-17) of careful study of plants of 14 blocks of Nawada district. The study sites were randomly selected and 25 quadrates were laid down in each block for counting the number of tree species for diversity studies. The ground cover flora reflected the dominance of dicotyledonous plants over the monocotyledons. The families like Caesalpinaceae, Moraceae and

Euphorbiaceae with maximum number of species denoted the dominant forest vegetation of Nawada.

The data on density of tree species revealed that two blocks Kawakol (390) and Rajauli(385) had maximum density followed by Kashichak (215) and Govindpur (187) and minimum individuals /hectare was noted in Pakribarawan (25) followed by Nawada (85) and Akabarpur (95).

The diversity indices are used as a measurement of ecosystem health of the study sites. The data on Shannon-Wiener index (species diversity) and Simpson's index (diversity index) demonstrated that higher values of species diversity (H'= 3.7 & 3.6) and diversity index (D = 2.70 & 2.60) of Kawakol and Rajauli blocks indicate species richness is almost similar in both the blocks. The higher species diversity governs the stability of a community while higher value of diversity index represents good diversification of different species and lesser value a homogenous community.

The mean height and mean basal cover of trees are important parameters to assess the status of a forest. The basal cover is the ground area occupied by tree crown in vertical projection of the stem that measures the dominance of species. The basal cover is of great ecological importance as it protects the soil from erosive forces of water and rain drops.

The maximum mean height of trees (35.50m and 34.40m) and mean basal cover (27.30± 0.011m^2/ha and 23.87± 0.015 m2/ha) of two blocks Kawakol and Rajauli indicated that these two blocks are tree dominating areas representing two major forest ranges of Nawada district.

REFERENCES

Addo-Fordjour P., Anning A.K., Larbi J.A. and Akyeampong S., 2009. Liana species richness, abundance and relationship with trees in the Bobiri forest reserve, Ghana: Impact of management system. Forest Ecol Management, **257**: 1822-1828.

Chandra S. and Palit D., 2009. Ecological study on plant diversity and pedological characteristics in Rangiroom forest beat, Senchal West Zone Forest Range, Darjeeling. Pleione, **3(1)**: 50-58.

Chapin F.S. and Corner C., 1995. Pattern, causes, changes and consequences of biodiversity in arctic and alpine ecosystems. In: Chapin F.S. and Korner C. (eds), Arctic and Alpine Biodiversity. Springer, Berlin, pp. 313-320.

Chowdhery H.J. and Hajra P.K., 2000. Protected area network in-situ conservation strategies. In: Singh N.P., Singh D.K., Hajra P.K. and Sharma B.D. (eds), Flora of India, Introductory volume, Part II , BSI, Calcutta, pp. 388-431.

Cornell H.V. and Lawton J.H., 1992. Species interactions, local and regional processes and limits to the richness of ecological communities: A theoretical perspective. J. Anim Ecol. **61**: 01-12.

Das S., Pal S. and Palit D., 2012. Studies of plant diversity and pedological characteristics of Rambi forest beat, Senchal east zone forest range, Darjeeling. In: Maiti G. and Mukharjee S.K. (eds). Multidisciplinary Approaches in Angiosperm systematics, Volume II, pp. 532-540.

Magurran A.E., 1988. Ecological diversity and its measurement, Princeton University Press, Princeton.

Oechel W.C., Callaghan T., Gilmanovet T., Holten J.I., Maxwell B., Molau U. and Sveinbjmsson B., 1997. Global change and arctic terrestrial ecosystems. Springer, Berlin.

Philiph E.A., 1959. Methods of vegetation study. Henri Holt & company, New-York.

Pollock M.M., Naiman R.J. and Hanley T.A., 1998. Plant species richness in riparian wetland - a test of biodiversity theory. *Ecology*. **79**: 94-105.

Rai U. and Das A.P., 2008. Diversity of trees in the Darjeeling foothill region of eastern himalya. J. Plant Sci., **2**: 39-57.

Reynolds H.L. and Tenhumen J.D., 1996. Landscape function and disturbance in arctic tundra, Springer, Berlin.

Shannon C.E. and Weiner W., 1963. The mathematical theory of communication. University of Juionis Press, Urbana.

Sharma D.P., Maury A.N. and Singh H.K., 2001. Plant communities along the revineland of Kunwari catchment area at Morena (M P). Ph D Thesis of Dr B R Ambedkar University, Agra.