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Floristic evaluation and Phyto-sociological observation of Core Zone of Bhubaneswar Smart City, Odisha, India

Évaluation floristique et observation phyto-sociologique de la zone centrale de la Smart City de Bhubaneswar, Odisha, Inde

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Résumé: Les attributs phytosociologiques ont été réalisés dans la zone centrale de la ville de Bhubaneswar, Odisha. Une tentative a été faite pour découvrir les caractéristiques de l'analyse qualitative de la ville urbaine. L'analyse de la végétation a été effectuée par la méthode Quadrat, largement acceptée pour de telles études. Un total de 130 espèces végétales pour 65 familles a été enregistré comprenant 32 espèces d'arbres, 36 espèces d'arbustes et 15 espèces d'herbes, 20 espèces de plantes grimpantes, 16 espèces d'hydrophytes, 01 épiphyte et 10 ptreidophytes. Cette étude fournit des informations de base pour toutes les études futures, car aucune évaluation écologique précédente n'a été réalisée dans la zone centrale d'une ville urbaine. En termes d'IVI, Mangifera indica (61,6), Neolamarckia cadamba (Roxb.) Bosser (39,0), Butea monosperma (Lam.) Taub. (23.6), Ficus benghalensis L. var. bengalensis (19,5) parmi les espèces d'arbres était dominante, suivie par Ageratum conyzoides L.(40,0) dans les arbustes et Cynodon dactylon L.Sp.Pi (65,7) dans les herbes. La présente étude montre que la plupart des espèces présentaient un type de distribution groupée. La ville a été soumise à diverses pressions anthropiques résultant de l'épuisement de la végétation. L'étude a révélé une intervention de gestion à long terme pour établir la valeur écologique et esthétique globale des espèces végétales et, par conséquent, leur valeur pour d'autres formes de vie.

Mots clés : *diversité des formes de vie, diversité floristique, indice de valeur importante, modèle de distribution, application stricte*

Abstract: Phyto-sociological attributes was carried out in the Core zone of Bhubaneswar city, Odisha. An attempt was made to find out the characteristics of Qualitative analysis of urban city. Analysis of vegetation was done by Quadrat method, widely accepted for such studies. A total of 130 plant species for 65 families were recorded comprising of 32 species of trees, 36 species of shrubs and 15 species of herbs, 20 species of climbers, 16 species of hydrophytes, 01 epiphyte and 10 ptreidophytes. This study gives baseline information for all future studies as no previous ecological assessment was done in the core zone of an urban city. In terms of IVI, *Mangifera indica* (61.6), *Neolamarckia cadamba* (Roxb.) Bosser (39.0), *Butea monosperma* (Lam.) Taub. (23.6), *Ficus benghalensis* L. var. *bengalensis* (19.5) among tree species was found as dominant followed by *Ageratum conyzoides* L.(40.0) in shrubs and *Cynodon dactylon* L.Sp.Pi (65.7) in herbs. The present study shows most of the species showed clumped type of distribution. The city has been under various anthropogenic pressures resulting depletion of vegetation. The study revealed a long term management intervention to setup overall ecological and aesthetic value of the plant species and consequently their value for other life forms.

Key Words: *Life form diversity, Floristic diversity, Important value Index, distribution pattern, Strict enforcement*

INTRODUCTION

Vegetation ecology is the study of structure vegetation and vegetation systematic. This includes the investigation of species composition and the sociological interaction of species in communities. (MULLER DOMBOIS & ELLENBERG, 1974). It lays emphasis on study of composition, development, geographic distribution and environmental relationship of plant communities. According to DANSEREAU (1960), floristic composition is one of the major anatomical characters of the plant community. Further, number of species of a community reflects the gene pool and adoption potential of the community. Quantitative floristic inventories provide necessary context for planning and interpreting long terms ecological research. (PHILLIPS *et al*., 2003).

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The study of vegetation quantitatively is called phyto-sociology and its aims is to describe the vegetation explain or predict its pattern and classify it in a meaningful way. Phyto-sociological study is a prerequisite for understanding the structure and function of any forest tract. It is useful to collect the data to describe the population dynamics of each species studied and how they relate to the other species in the same communities. (WARGER AND MORREL, 1976). Sustainable planning of ecologically important regions could not be taken up due to lack of sufficient data on structure and functioning of ecosystem. Bhubaneswar city is one of such area containing diverse floral composition. Floristic assent and phyto-sociological observation are useful for comparing one community with the other in term of season and year under environmental stress. (SINGH AND WEIGAND,1994). Different phyto-sociological studies were conducted in different part of Odisha by SAHU et al., 2007; EKKA AND BEHERA, 2011; BEHURA et al., 2016 and NAYAK et al. 2010 etc.

Therefore the present study was aimed at documentary the status of the present vegetation structure of the peripheral sites of Bhubaneswar city through a detailed phyto-sociological analysis with different analytical characters which will be helpful to plan for a better management intervention to enhance the quality of this site.

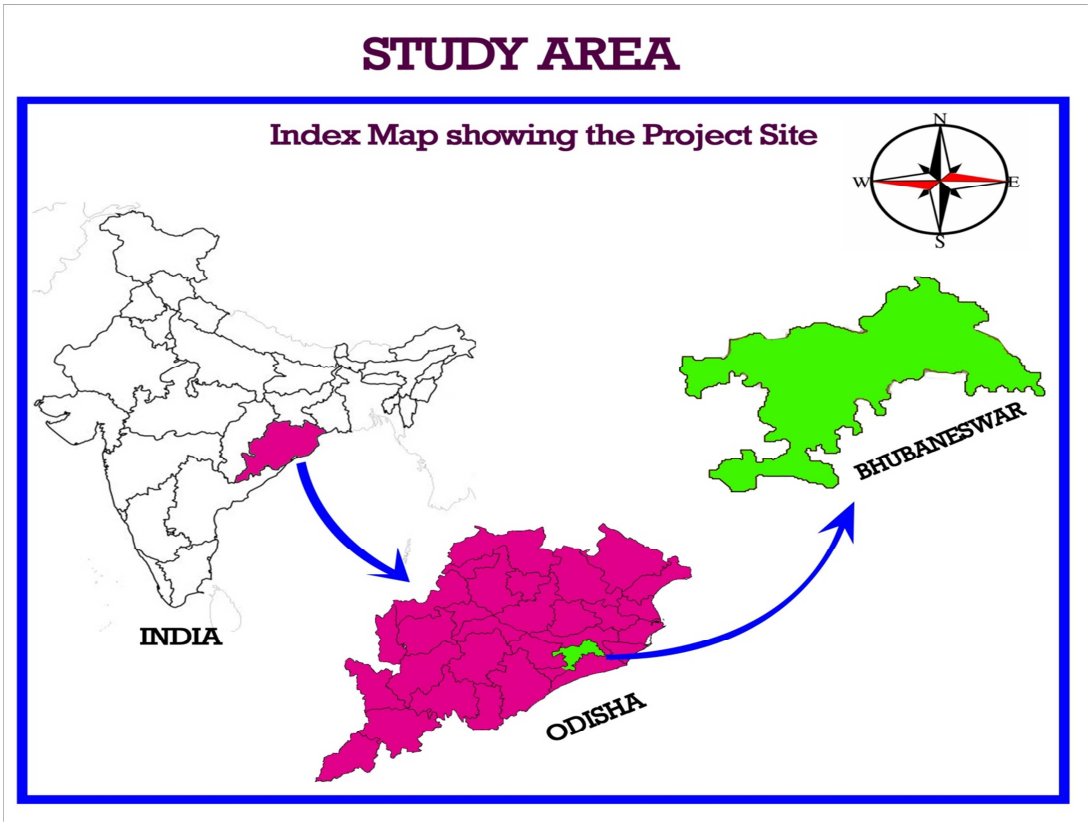

Fig.1 Study (Bhubaneswar City) area

MATERIALS AND METHODS

Smart city Bhubaneswar is located in the Khurda district of Odisha **,** India between 20° 12' N to 20° 25' N latitude and 85° 44' E to 85° 55' E longitude on the Western fringe of the coastal plain across the main axis of the Eastern Ghats. The present study is confined to the Bhubaneswar city coming under Bhubaneswar Municipality Corporation (BMC) having an area of 146 Sq.km. with 67 wards. However Bhubaneswar Development Plan (BDP) spreads over an area of 419 Sq. km that goes beyond the BMC jurisdiction.

The central part of the Bhubaneswar city was taken as Core Zone in the present study. It consists of 15 wards such as 28, 17, 15, 12, 37 36 etc. It includes cultivated lands, barren lands, marshy lands, and residential areas. Survey was carried in the core zone of the Bhubaneswar city (Fig.1).

The present study was based on primary data collected through the survey from holistic and eco-systematic perceptiveness. The plants collected repeated field trips were identified in the Botany section of Regional Institute of Education(NCERT), Bhubaneswar, Odisha, India and documented following the "The Botany of Bihar and Orissa" (HAINES, 1925) and "Flora of Orissa" (SAXENA AND BRAHMAN, 1996).

The sampling of vegetation was done for trees once for one year during Summer (March-May) and for herbaceous vegetation three times in a year i.e. Summer (March-May), Rainy (July-September) and Winter

(December-February). Similar observation continued for the second year also. The data were analyzed for all structural vegetation parameters for phyto-sociological analysis.

Plant community was quantitatively analyzed following Quadrate method. From each four sampling sites were randomly selected and from each site, 10 Quadrat were taken and the size of each Quadrat was decided looking into the nature of vegetation of the locality. The Quadrat size was taken 10mx10m for trees, 5m x5 m for shrubs and 1mx1m for herbs. All the plants were classified into 3 categories taking into their girth class i.e. circumference at breast height(cbh) (i) Herbs (0-10 cm cbh),(ii) Shrubs(10-30 cm cbh) and (iii) Trees(> 30 cm cbh) The size and number of Quadrats and collection of data based on standard method of MISHRA, 1968) AND KERSHAW, 1973).

Vegetation data were analyzed by their synthetic characters like Abundance (A), Frequency (F), Density (D), Relative Density (RD), Relative Frequency (RF), Relative Dominance (RDO), Basal Area (BA), Importance Value Index (IVI) following the standard formulae (KORMONDY, 1969). Abundance / Frequency (A/F) ratio was calculated to describe the distribution pattern of a species (CURTIS AND COTTON, 1956).

(i) Abundance: It represents the number of individuals of any species per unit area of occurrence. It was calculated as follows:

$$\text{Abundance} = \frac{\text{Total no. of individual of the species in all quadrats}}{\text{No. of quadrats in which species occurred}}$$

(ii) **Frequency**: Frequency is the number of sampling units in which a particular species occurs and this was calculated as follows:

$$\text{Frequency} = \frac{\text{No. of quadrats in which species occured}}{\text{Total no. of Sampling Unit Studied}}$$

(iii) **Density**: The number of individuals of the species in an unit area is its density. It was calculated as follows

$$\text{Density (\%)} = \frac{\text{No. of individuals of the species}}{\text{Total Area studied}}$$

iv) Dominance: Dominance is the stem area occupied by stem of a species in any given area. It is calculated by measuring the diameter of the individual stems and adding the stem areas of the species in a given area.
Basal area of the species = Sum of the basal areas of all individuals present.

v) Relative Density: This is calculated by the following formula

$$\text{Relative density} = \frac{\text{Density of the species}}{\text{Total density of all the species}} \times 100$$

vi) Relative Frequency: Relative frequency of the species is calculated by using the following formula:

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

vii) Relative Dominance: This is calculated by the following formula

$$\text{Relative dominance} = \frac{\text{Dominance (cover) of the species}}{\text{Total dominance of all species}}$$

viii) Importance Value Index (IVI): This is a value that reflects the relative importance of the individual species in the study area. It is calculated by adding relative density, relative dominance and relative frequency values for each species (CURTIS AND COTTON, 1956, PHILIP, 1959).
IVI = Relative Dominance + Relative Density + Relative Frequency.

ix) Abundance / Frequency ratio (A/F)

This is the ratio of the abundance and frequency of the given species (CURTIS AND COTTON, 1956). It is used to describe the distribution pattern of the species in the area. The distribution of plants is said to be regular, random and clumped or contagious when the value of A/F ratio is <0.025, 0.025-0.05 and >0.05 respectively.

RESULTS AND DISCUSSION

With exhaustive (Floristic) analysis, a total of 130 plant species belongs to 65 families were recorded from the peripheral sites of Bhubaneswar city. The collection embraced as many as 15 herbs and seedlings, 36 shrubs and saplings, 25 trees (Table 1 to Table 3), 20 climbers, 16 hydrophytes, 01 epiphytes, 10 pteridophytes. Their percent wise distribution is shown in the (Fig. 2). Among families, Fabaceae, Asteraceae and Euphorbiaceae were the dominant families in dicotyledons where as in monocotyledons, Poaceae and Cyperaceae were the dominant families.

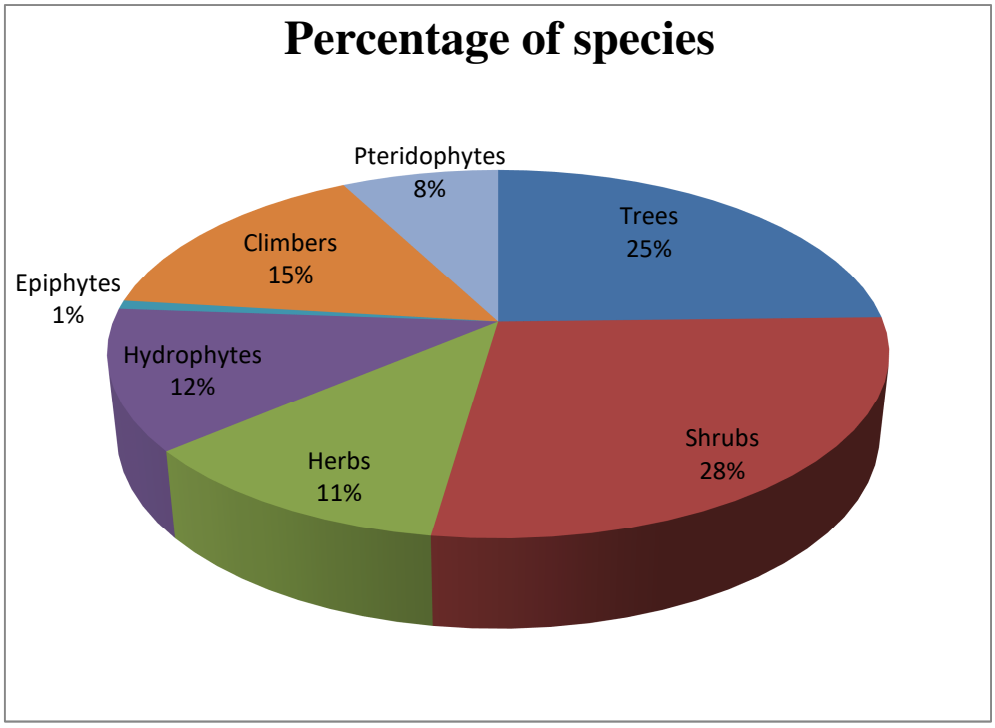

Fig.2 Different Life form diversity.

Dicotyledons consist of 81 species with 32 genera and monocot belongs to 42 species and 10 genera. (Fig 3). Out of 65 families, monocotyledons share 25 (38.47%) and Dicotylendons share 61.53 percentage. Monocotyledon represents 10 genera (23.81) and dicotyledons 32 genera (76.19). Dicotyledons share 65.85% and monocotyledons share 34.15% of the total number of species found in the study area. (Table 4)

Phyto-sociological structure of a species community, Importance Value Index (IVI) represents the measurement of ecological amplitude of species (LUDWIG AND REYNOLDS, 1988) to adopt over an array of habitats. It gives information by taking into consideration of relative density, relative frequency and relative basal area.

For holistic assessment, the vegetation of the site should be looked into upper story, middle- story and under story vegetation. The high IVI of the species indicates species dominance and ecological success, its better power of regeneration and ecological amplitude in the area. (BHANDARI et al., 1999). As frequency and density values are suitable for herbs, and shrubs (Airi et al. 2000) IVI is important information for tree species.

Table 1 Calculated Values of Relative Frequency, Relative Density, Relative Dominance and Importance value Index (I.V.I.) for plants (Trees) in the Core zone of Bhubaneswar City

Name of the plant species	Local name (Odia)	Density / ha	BA (m2/ha)	Frequency (%)	Relative Frequency (RF)	Relative Density (RD)	Relative Dominance (RDO)	Important Value Index (IVI)
Mangifera indica L.	Amba	105	0.348	50	9.677419	23.59551	28.33452	61.60744
Neolamarckia cadamba (Roxb.) Bosser.	Kadamba	75	0.261	40	9.677419	18.53933	10.81249	39.02923
Butea monosperma (Lam.) Taub.	Palasa	5	2.407	5	7.526882	10.67416	5.4445	23.64554
Ficus benghalensis L. var. bengalensis	Bara	20	1.932	5	3.225806	1.685393	14.64937	19.56057
Aegle marmelos (L.) Corr.	Bela	10	0.115	10	5.376344	4.494382	3.337221	13.20795
Ficus religiosa L.	Astha	40	0.188	20	3.225806	1.685393	8.095705	13.0069
Artocarpus heterophyllus Lam.	Panasa	20	0.072	15	4.301075	2.808989	3.84724	10.9573
Azadirachta indica A. Juss.	Nimba	20	0.304	5	4.301075	2.808989	3.449873	10.55994
Bauhinia variegate L.	kanchana	10	0.013	10	5.376344	2.27191	.425911	10.29664
Tamarindus indica L.	Tentuli	10	0.001	10	3.225806	2.27191	3.76766	9.240657
Acacia nilotica L.	Babul	10	0.017	5	3.225806	2.808989	2.725822	8.760617
Strychnos nux-vomica (L.)	Kochila	10	0.001	5	3.225806	2.808989	2.395745	8.43054
Annova squamosal L.	Atta	5	0.054	5	5.376344	2.277191	0.212956	7.836491
Plumeria rubra L.	Katha champa	5	0.020	5	4.301075	2.247191	0.689973	7.238239
Bombax ceiba L.	Simuli	6	0.023	10	3.225806	1.685393	2.17726	7.088459
Pongamia pinnata	Karanja	10	0.301	5	3.225806	1.685393	1.477145	6.388345
Terminalia bellirica (Gaertn.) Roxb.	Bahada	5	0.015	20	3.225806	2.247191	0.851822	6.32482
Syzygium cumini (L.) Skeels.	Jamukoli	7	0.108	5	3.225806	2.247191	0.545625	6.018622
Cassia fistula L.	Sunari	12	1.230	5	2.150538	1.685393	1.324753	5.160684
Pterocarpus marsupum Roxb.	Bija	14	0.220	5	2.150538	1.123596	1.379949	4.654082
Albizia lebbeck (L.) Benth.	Sisisa	5	0.304	20	2.150538	1.123596	1.2303384	4.504518
Tectona grandis	Saguan	5	0.275	15	2.150538	1.685393	0.638867	4.974798
Dillenia indica L.	Aau	16	0.119	5	2.150538	1.123596	0.958298	4.232431
Madhuca indica Gmel.	Mahula	11	0.412	5	2.150538	1.123596	0.613603	3.887736
Diospyros melanoxylon Roxb.	Kendu	9	0.045	10	2.150538	1.123596	0.613312	3.887445
Putranjiva roxburghii Wall.	Poichandia	10	0.123	5	2.150231	1.113210	0.603010	3.866451
Phoenix sylvestris (L.) Roxb.	Khajuri	12	0.210	5	2.150538	1.092300	0.593023	3.835861
Alstonia scholaris(L.) R.Br.	Chatian	6	1.20	10	2.150538	1.073426	0.584210	3.808174
Ziziphus mauritiana Lam.	Barakoli	7	0.321	15	2.150231	1.064523	0.563064	3.777818
Dillenia pentagyna Roxb.	Rai	5	0.056	5	2.150538	1.04572	0.528620	3.724874
Anogeissus acuminata (Roxb. ex DC.) Guillaum. & Perr	Phasi	4	0.231	5	2.150538	1.02397	0.495631	3.670139

Name of the plant species	Local name (Odia)	Density / ha	BA (m2/ha)	Frequency (%)	Relative Frequency (RF)	Relative Density (RD)	Relative Dominance (RDO)	Important Value Index (IVI)
Dalbergia lanceolaria l.f.	Takoli	5	0.425	5	2.150538	1.01543	0.463471	3.629439

(BA= Basal Area, RD= Relative Density, RF= Relative Frequency, RBA= Relative Basal Area, Relative Dominance= RDO, IVI= Important Value Index)

Table 2 : Species, Frequency, Density, Basal area, Abundance, Relative Frequency, Relative Density, Relative Abundance and Importance Value Index (IVI) of Shrubs of the Core zone of Bhubaneswar City

Botanical name	Local name(Odia)	Frequency	R F	Density	R D	Abundance	RA	IVI
Ageratum conyzoides L.	*Poka Sungha*	62.5	14.164	1290	20.925	5.160	4.994	40.083
Cassia alata L.	*chakunda*	55	12.465	1065	17.275	4.841	4.685	34.425
Acacia nilotica L.	*Babul*	15	3.399	430	6.975	7.167	6.937	17.311
Achyranthes aspera L.	*Apa maranga*	23.75	5.382	430	6.975	4.526	4.381	16.738
Mimosa himalayana Gamble,Kew	*kirki koli kanta*	12.5	2.833	355	5.758	7.100	6.872	15.463
Clerodendrum viscosum Vent.	*Gobra*	28.75	6.516	300	4.866	2.609	2.525	13.907
Albizia marginata(Lam)	*Beranga*	18.75	4.249	290	4.704	3.867	3.743	12.696
Jatropha gossypifolia L.	Nali-baigaba	10	2.266	235	3.812	5.875	5.686	11.764
Justicia adhatoda L.	Basanga / Basak	26.25	5.949	165	2.676	1.571	1.521	10.146
Lantana camera L.	Nagabairi / Jaikoli	18.75	4.249	185	3.001	2.467	2.387	9.638
Chromolaena odorata (L.) King. & Robins.	Pokasunga	7.5	1.700	150	2.433	5.000	4.839	8.972
Calotropis gigantean(L)R.Br.	Arakha	18.75	4.249	155	2.514	2.067	2.000	8.764
Calotropis procera(Ajit.)R.Br.	Dhala Arakha	7.5	1.700	145	2.352	4.833	4.678	8.730
Capparis zeylanica L.	Asadhua	10	2.266	150	2.433	3.750	3.630	8.329
Glycosmis pentaphylla(Retz.) DC	Chaula-dhua koli	18.75	4.249	110	1.784	1.467	1.420	7.453
Ipoema carnea Jacq.	Kalama	17.5	3.966	100	1.622	1.429	1.383	6.971
Croton roxburghii Balak.	Debachandan	12.5	2.833	115	1.865	2.300	2.226	6.924
Atalantia malabarica (Rafin.) Tanaka	Narguni	10	2.266	115	1.865	2.875	2.783	6.914
Breynia vitis-idaea (Burm.f.) Fischer	Jhanjika	13.75	3.116	65	1.054	1.182	1.144	5.314
Jasmium scandens Vahl.	Banamalli	2.5	0.567	35	0.568	3.500	3.388	4.522
Leonotis nepetiifolia(L.) R.Br.		5	1.133	40	0.649	2.000	1.936	3.718
Cissus quadranguda L.	Hadabhanga	1.25	0.283	15	0.243	3.000	2.904	3.430
Helicteres isora L.	Modimokika	1.25	0.283	15	0.243	3.000	2.904	3.430
Nerium oleander L.	Karabira	6.25	1.416	35	0.568	1.400	1.355	3.339
Ipomoea carnea Jacq. Spp. fistulosa(Mart. Ex Choisy) Austin	Amari	3.75	0.850	30	0.487	2.000	1.936	3.272
Ixora coccinea L.	Ixora	6.25	1.416	25	0.406	1.000	0.968	2.790
Mallotus repandus (Willd.) Muell.-Arg.	Dhankari/ Ghiirgudia	3.75	0.850	20	0.324	1.333	1.291	2.465
Melastoma malabathricum L.	Gangei / Karati	1.25	0.283	10	0.162	2.000	1.936	2.381
Mimosa himalayana Gamble.	Kirikichi	2.5	0.567	10	0.162	1.000	0.968	1.697
Nerium oleander L.	Karabira	2.5	0.567	10	0.162	1.000	0.968	1.697
Nyctanthes arbor-tristis L.	Gangasiuli	2.5	0.567	10	0.162	1.000	0.968	1.697
Rauwolfia tetraphylla L.	Patalagaruda	2.5	0.567	10	0.162	1.000	0.968	1.697
Ricinus communis L.	Jada / Gaba	1.25	0.283	5	0.081	1.000	0.968	1.332
Vitex negundo L.	Begunia	1.25	0.283	5	0.081	1.000	0.968	1.332
Phyllanthus recticulatus Poir.in	Macharanka	1.25	0.283	5	0.081	1.000	0.968	1.332
Ziziphus oenoplia (L.) Mill.	Kanteikoli	1.25	0.280	5	0.079	0.991	0.953	1.312

(RD= Relative Density, RF= Relative Frequency, RA= Relative Abundance, IVI-= Important Value Index)

Table 3 : Species, Frequency, Density, Basal area, Relative Frequency, Relative Density, Relative Abundance and Importance Value Index (IVI) of Herbs of the Core zone of Bhubaneswar City

Name of the plant species	Local name (Odia)	Frequency	RF	Density/m2	RD	Abundance	RA	IVI
Cynodon dactylon L.Sp.Pi	Duba Ghasa	23.75	13.768	2.175	30.000	9.158	21.936	65.704
Acanthospermum hispidum Dc.	Kantagokhru.	31.25	18.116	1.575	21.724	5.040	12.072	51.912
Mimosa pudica L.	Lajkuli lata	33.75	19.565	1.250	17.241	3.704	8.871	45.678
Sida cordiifolia L.Sp.Pl	Bajramuli	16.25	9.420	0.438	6.034	2.692	6.449	21.904
*Blumea lacera(*Burm.f)	Pokasungha	13.75	7.971	0.438	6.034	3.182	7.621	21.627
Cleome viscose L.	Bana sorisa	13.75	7.971	0.388	5.345	2.818	6.750	20.066
*Andrographis paniculata (*Burm.f)Wall.ex	Bhuin Nimba	15	8.696	0.363	5.000	2.417	5.789	19.484
Evolvulus alsinoides L.	Shankapuspi	8.75	5.072	0.225	3.103	2.571	6.159	14.335
Ageratum conyzoides L.Sp.Pi	Poksunga/Deksingi	3.75	2.174	0.100	1.379	2.667	6.387	9.941
Euphorbia hirta L.	Common spurge	5	2.899	0.113	1.552	2.250	5.389	9.840
Sida acuta Burm.f	Sunakhadika	5	2.899	0.113	1.552	2.250	5.389	9.840

The dominant tree species having maximum RF and RD were *Mangifera indica* L. followed by *Neolamarckia cadamba* (Roxb.) Bosser , *Butea monosperma* (Lam.) Taub, *Ficus benghalensis* L. var. *bengalensis* , *Aegle marmelos* (L.) Corr., *Ficus religiosa* L., *Artocarpus heterophyllus* Lam., *Azadirachta indica* A. Juss. etc. On the basis of IVI, *Mangifera indica* L was found as the dominant species having 61.66 followed by *Neolamarckia cadamba* (Roxb.) Bosser (39.02), and *Butea monosperma* (Lam.) Taub (23.64). *Ziziphus oenoplia* (L.) Mill.had IVI of 1.31 and was considered as the rare species of this region. All other tree species showed intermediate ranges. (Table 1). Low ecological status of the tree species (IVI) in the present study may attributed lack of dominance by any one of these species suggesting positive interaction among tree species. Besides several cutting stumps were observed indicating the impact of anthropogenic activities of that area.

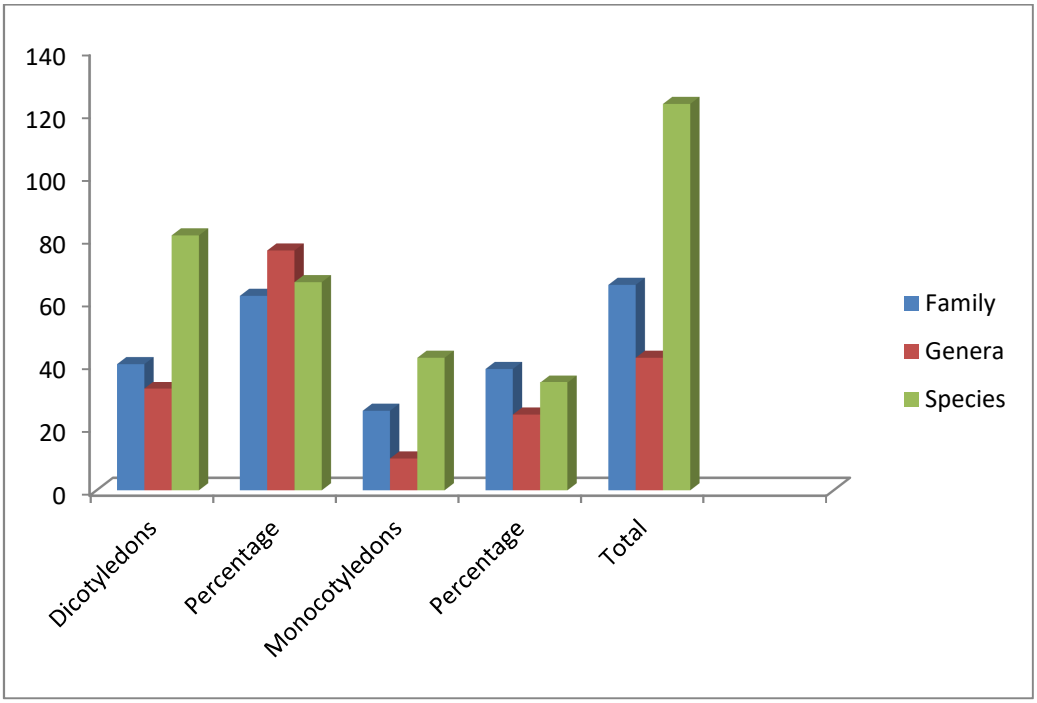

Fig.3 Species Diversity

Table 4 : Diversity of Family, Genera and Species

Dicotyledons			Monocotyledons		
Category	No.	Percentage	No.	Percentage	Total
Family	40	61.53	25	38.47	65
Genera	32	76.19	10	23.81	42
Species	81	65.85	42	34.15	123

Table 5 : Distribution pattern of vegetation layers in Core zones of Bhubaneswar City

Plant groups	No. of plant species in distribution category			
	Regular (< 0.025)	Random (0.025 – 0.05)	Contagious (>0.05)	Total number of species
Trees	02	06	24	32
Shrubs	01	08	27	36
Herbs	02	03	10	15
Climbers	00	04	16	20

Among the shrubs, which occupy middle storey vegetation *Ageratum conyzoides* L.shows highest IVI followed by *Cassia alata* L *Acacia nilotica L.*, *Achyranthes aspera L., Mimosa himalayana* Gamble, Kew etc.(Table 2) It consists of good number of climbers like *Clitoria ternatea* L., *Hemidesmus indicus* (L.) R. Br., *Abrus precatorius* L., *Asparagus racemosus* Willd., *Cuscuta chinensis* Lam.

Similarly in herb (understory vegetation), *Cynodon dactylon* L. Sp. Pi shows highest IVI followed by *Acanthospermum hispidum* Dc., *Mimosa pudica L., Sida cordiifolia* L.Sp.Pl etc.(Table 3)

Distribution of species is one of the important aspects of ecological studies. The ratio of abundance and frequency as a measure of contagiousness among plant population formulated by (WHITFORD, 1948) is widely accepted. In general, higher frequency and lower abundance indicates regular distribution patterns where as reverse condition is the contagious distribution. The distribution pattern of tree, shrubs, herbs and climbers shown is Table 5.

Out of 103 plants species, showed contagious distribution, 21 species had random distribution and 05 species had regular distribution. (ODUM, 1971) stated that, a clumped distribution of plant species under natural condition is normal. Random distribution occurs where severe competition coexists between individuals. The present study shows that most of the species showed clumped type of distribution. Regular distribution is completely lacking for climbers. These points strongly reflected that the Bhubaneswar city which is just adjacent to the Chandaka reserve forest has at least some areas suitable for vegetation. As a matter of fact it still enjoys a good species composition (unlike other cities) though not highly diversified like a forest. Secondly, the contagious nature of distribution shows a ray of natural impact over anthropogenic disturbance, though not in any case as it happens in a forest community.

Plant species like *Azadirachta indica* A. Juss., *Strychnos nux-vomica* (L.), *Asparagus racemosus*, *Acacia nilotica* L., *Mangifera indica* L., *Aegle marmelos* (L.) Corr., *Diospyros melanoxylon* Roxb. etc. have been used as medicine by the local people for years (Fig. 4). The uses of these plant species have been studied in India and abroad (BRAHMAN AND SAXENA, 1996; MOHANTY et al., 1996; MEHRA et al. 2014; BAJPAI et al., 2016; Rout et al. 2018). Unsustainable collection of above medicinal plants has placed them in threatened and vulnerable categories in Conservation Assessment and Management Plan (CAMP) of Odisha (PATTANAIK et al, 2009). Due to the depletion of important species, the traditional indigenous knowledge of the people is decreasing day by day. The impact of these problems on single species and ecosystems are likely to be complex. These plant species needs attention from conservation point of view.

The values of vegetation parameters obtained for most of the sites in the present study suggested interesting composition and structure of existing plants of the city. The obtained results, time and again, are not in tune with the popular opinion of complete devastation of plants due to habitation and city development. Neither has it supported complete destruction due to the catastrophy of super cyclone in 1999.

The Vegetation needs more attention for habitat conservation point of view. The Phyto-sociological analysis reveals good generation potential of the habitat and the tree species having low IVI deserves due attention to ensure strict enforcement of the rules and better monitoring for enhancement of ecosystem stability

of thin protected area. Lack of data base and structural and functional characters of the ecosystem at regular intervals will not help to develop a long terms strategy for sustainable development. Thus continuous collection of data as per long action plan on successional status of species level un-external and local pressure on the ecosystem, soil fertility management and linkage between social and ecological process is needed.

Fig. 4 : Some medicinal plant species in the Core zone of Bhubaneswar city **A,** Strychnos nux-vomica (L.): **B**, *Nyctanthes arbor-tristis* L; **C,** *Azadirachta indica* A. Juss.: **D,** *Diospyros melanoxylon* Roxb.: **E**, *Syzygium cumini* (L.) Skeels.: **F,** *Terminalia bellirica* (Gaertn.) Roxb.

CONCLUSION

Phyto-sociological attributes of the present study reveals that there is a gap between the values of different parameters (Frequency, Density, Abundance, IVI etc.). There are many trees having low value of IVI needs to be more attention. Further special care should to be taken for growth of immature tree species grow in that area. It gives an opportunity to investigate plant dynamics and changes in species relative abundances in the future. Educating the local people and effective implementation of the rules would be helpful in decreasing the depletion of natural resources.

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