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Vegetational Study of The Temple City of Bhubaneswar (India) : Analysis of Floristic Diversity

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ABSTRACT

The present study was carried out in the fast expanding temple city of Bhubaneswar in order to understand its floristic diversity after about 70 years of its inception. From selected sites, both from Central and Transitional/Peripheral zones, a total 572 plant species were recorded that included 138 herbs, 36 shrubs, 100 trees, 35 climbers, 93 grasses, 16 hydrophytes, 2 epiphytes, 3 parasites, 2 bryophytes and 18 pteridophytes. From the study sites, 50 cultivars, 15 wild introduced and 12 weeds were recorded from the Central and Transition zones of the city besides 111 species of medicinal and 21 species poisonous/ toxic plants. Ten plants species were found to be endangered, threatened and vulnerable. Further, 60 plant species were identified as invasive alien species with *Ageratum conyzoides* L., *Hyptis suaveolens* (L.) Poit, *Sida acuta* L., *Alternanthera paronychioides* St., *Cleome viscosa* L. and *Parthenium hysterophorus* L. being abundant. From the analysis of Family Importance Value index, it was observed that Poaceae with 56 species was the most dominant family followed by Cyperaceae, Fabaceae Asteraceae, Euphorbiaceae, Rubiaceae, Mimosaceae, Convolvulaceae and Lamiaceae with high species richness. A total of five species such as *Cassis alata* L., *Clerondrum incisium* Klotzsch., *Aspargus setaceus* (Kunth) Jessop., *Allamanda nerifolia* Hook. and *Portulaca umbraticola* Kunth were recorded for the first time from the study areas of Bhubaneswar.

Keywords Diversity, Family, Central zone, Transition zone, Poaceae.

INTRODUCTION

Globalization and industrialization have brought rapid urbanization and fast growth of cities that are considered as the engines of economic growth (Kumar and Chithra 2012). Cities provide ample opportunities to their citizens for economic development, better living standards, jobs and educational opportunities leading to migration of people from villages to cities. This continuous and unabated migration over the years has made cities densely populated and unsustainable. It is observed (Hayat 2016) that about 54% population of the world is confined to about 4.0% of the terrestrial

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surface, while in India 16% of the total population of the world live on 2% of the total geographical area. With fast growth in urban population, global urban population is expected (Stanley 2008) to rise and reach at 70% by 2050 shrinking the available land area.

Bhubaneswar, the Capital of Odisha is rich with hundred of temples and is widely known as the "Temple City" of India. It is said that the city had about 7000 temples of which 500 do exist presently. The capital city came into existence in the year 1948 with total area of 510 ha (BDA 1989) that has increased tremendously in recent times because of rapid growth of infrastructure housing complexes, business houses, educational institutions, IT centers, soft ware parks.

At the time of construction of the new capital in 1948, Bhubaneswar and its adjoining areas had a thick vegetation cover, popularly called Rampur – Bharatpur Jungle - a part of Chandaka – Damapara forest complex. However with expansion of the capital city, the flora of Bhubaneswar has largely been replaced by thorny species, the trees being replaced by stunted growth of bushes.

Though some study has been carried out by Botanists relating to the Flora and Vegetation of Bhubaneswar city, there is no comprehensive study of the vegetation/floristic analysis that could throw some light on the future planning and development of Bhubaneswar smart city. Under this background, the present study was conceptualized. Objectives were quantitative analysis of vegetation patches and nature of plant species diversity and to study the vegetation in Bhubaneswar in terms of qualitative disappearance/ appearance of the species.

MATERIALS AND METHODS

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. It is situated on the South Eastern Railway line joining Howrah and Madras at about a distance of 435 km, South of Kolkata. The city stands at the Western side of the "Mahanadi Delta" on the bank of river Kuakhai, a distributory of Mahanadi river, 30 km South –West of Cuttack city. The river Daya that has branched off from Kathojodi, flows alone the South – Eastern part of the city. The present study is confined to the Bhubaneswar city that comes under Bhubaneswar Municipality Corporation (BMC) with an area of 148 sq km with 67 wards (BDA 2015). However Bhubaneswar Development Planned Area (BDPA) spreads over an area of 419 sq km that goes beyond the BMC jurisdiction (Fig.1).

The present study carried out on Bhubaneswar city is based on primary data collected through survey method. The floristic study was based on holistic and eco-systematic perceptiveness. Repeated field visits were organized to different words to collect information by the authors.

Details procedure from the collection of plants from the field such as their preservation, collection of data, identification were carried out following the method described by Radford et al. (1974), Jain and Rao (1977). The plants were identified in the botany department of Regional Institute of Education, Bhubaneswar and documented following, "The Botany of Bihar and Orissa" (Haines 1921—25) and the "Flora of Orissa" (Saxena and Brahman 1996). The names of the plants dealt here with have been updated in pursuance with ICBN (Tokyo Code) (Granter 1994).

For plant community analysis, the central part of the Bhubaneswar city was taken as the Central Zone (CZ) . It consisted of 4 wards, Ward Numbers (WN) being 28, 17, 37 and 36. The area beyond the Central Zone about 10 km radius surrounding the Central Zone was taken as Transition Zone (TZ). It consisted of four wards such as WN 23, 02, 32 and 67 (Fig. 2). Both Central and Transition Zones included cultivated lands, barren lands, marshy lands and small hills covered with plants and residential areas. Survey of vegetation was conducted in both Central and Transition Zones. To study the impact of city development during recent years on plant community, the plant species were collected in different seasons (summer, rainy and winter) from four different sites of both Central and Transition Zones.

Plant community (vegetation) was quantitatively

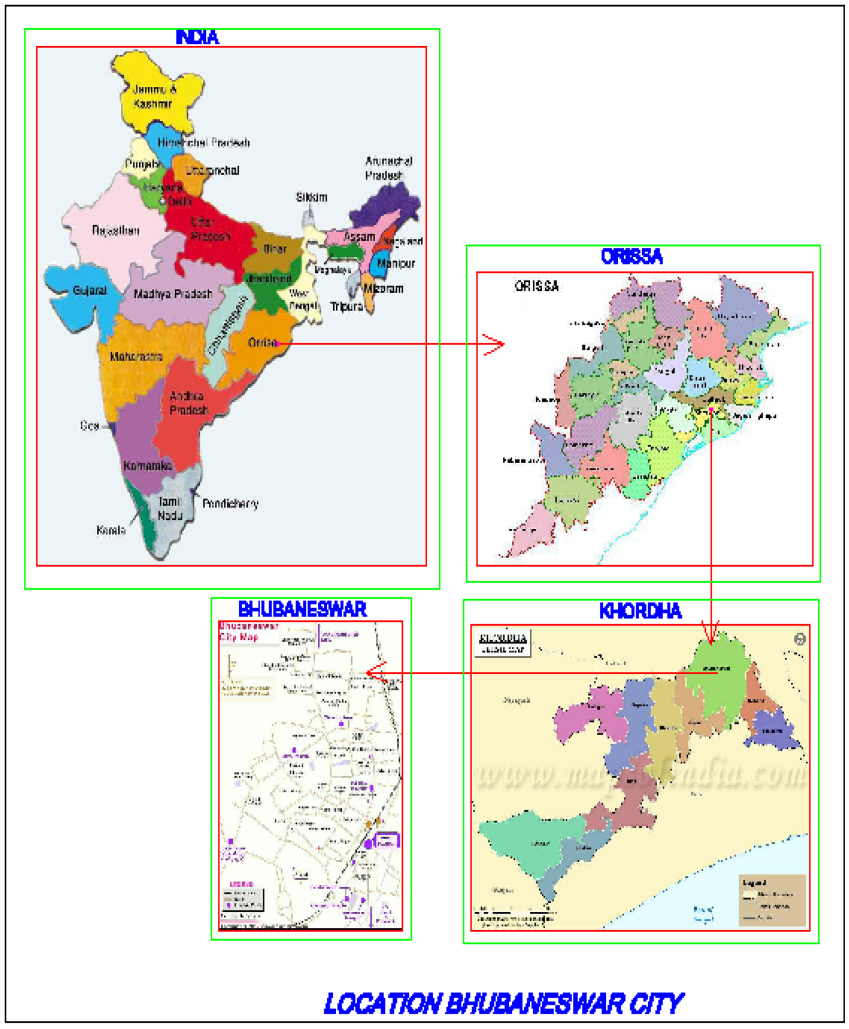

Fig. 1. Study area.

analyzed by commonly used quadrate method. From each zone (Central and Transition) and each site, the quadrates were taken and the size of the quadrate was decided talking into account the nature plant species. For example, trees were sampled in 10 m × 10 m quadrates, shrubs 5 m × 5 m quadrates and herbs / grasses from 1 m × 1 m quadrates.

Family Importance Value (FIV) that involves relative diversity and relative dominance of the family was calculated following Ganesh et al. (1996) for both Central as well as Transition Zones. To compare statistically, the number of plant species recorded at different sites, mean and Standard Deviation (SD) were calculated and t test was carried out following the software Excel (Version 7.0). The calculated t value was compared with the tabulated value to understand the level of significance.

RESULTS AND DISCUSSION

With exhaustive floristic analysis, a total of 572 plant species were recorded from both Central (CZ) and Transition Zones (TZ) (CZ =278 and TZ=294), of

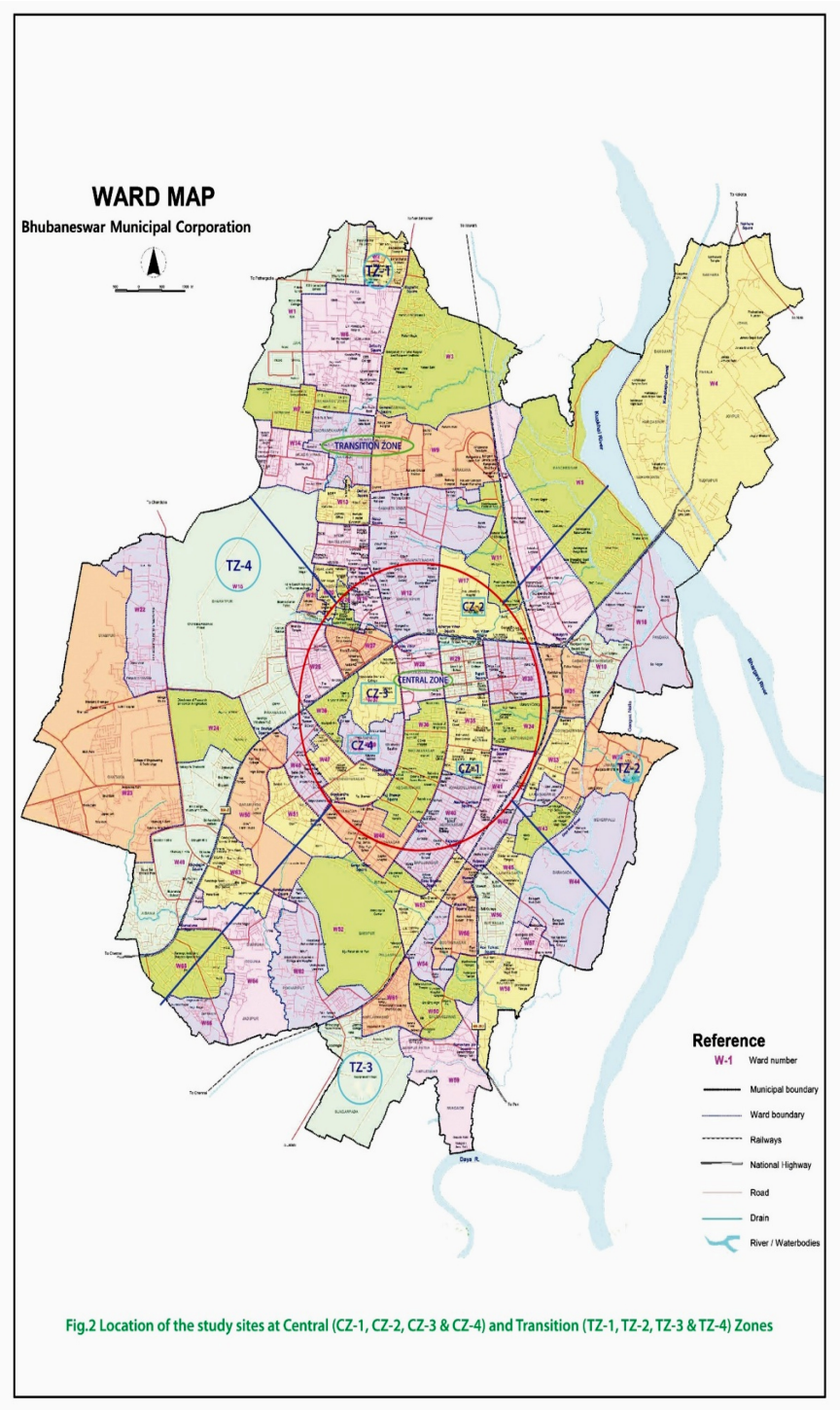

Fig. 2. Location of the study sites at Central (CZ-1, CZ-2, CZ-3 and CZ-4) and Transition (TZ-1, TZ-2, TZ-3 and TZ-4) Zones.

Table 1a. Total number of plant species (habit-wise) recorded in selected Central (CZ) and Transition Zones (TZ) of Bhubansewar city. * Sum to all these species in three season.

Plant groups (habit-wise)	Number of plant species: Central Zone (CZ) Summer (S)	Rainy (R)	Winter (W)	Total (S+R+W)	Com-mon*	Total (different species)	Transition Zone (TZ) Summer (S)	Rainy (R)	Winter (W)	Total (S+R+W)	Com-mon	Total species
Trees	100	100	100	300	100	100	48	48	48	144	-	48
Shrubs	25	25	25	75	25	25	23	23	23	69	-	23
Herbs	18	32	27	77	23	54	32	41	37	110	14	96
Hydrophytes	03	05	06	14	07	07	03	08	05	16	01	15
Epiphytes	01	-	-	01	-	01	01	-	-	01	-	01
Parasites	01	04	03	08	05	03	-	01	01	02	01	01
Climbers	07	20	18	45	22	23	04	09	07	20	04	16
Grass	10	28	16	54	06	48	25	37	32	94	08	86
Bryophytes	-	02	-	02	-	02	-	-	-	-	-	0
Pteridophytes	04	07	05	16	01	15	03	04	03	10	02	08
Total	169	223	200	592	314	278	139	171	156	466	172	294

Table 1b. Total number of plant species recorded in both Central and Transition Zones of Bhubaneswar with common and uncommon species.

Sl. No.	Plant groups (habit-wise)	Total species (CZ + TZ)	Species common to both zones (Common)	Total species
1	Trees	148	48	100
2	Shrubs	48	12	36
3	Herbs	150	12	138
4	Hydrophytes	22	06	16
5	Epiphytes	02	Nil	02
6	Parasites	04	01	03
7	Climbers	39	04	35
8	Grass	134	41	93
9	Bryophytes	02	Nil	02
10	Pteridophytes	23	05	18
		572	130	442

which 130 plants were common to both the Zones (Tables 1a and b). As such of 442 uncommon plant species were recorded belonging to 304 genera and 97 families. The collected plant species embraced as many as 138 herbs, 36 shrubs, 100 trees, 35 climbers, 93 grasses, 16 hydrophytes, 2 epiphytes, 3 parasite, 2 bryophytes and 18 pteridophytes. Their percent wise distribution has been depicted in Fig. 3 besides zone wise distribution being reflected in Figs. 4 and 5.

In the Central Zone, site-2 (CZ-2, WN17) had more number of plant species followed by site-1 (CZ-1, WN 28), site-3, (CZ-3, WN 37) and site-4 (CN-4, WN 36) (Table 2 and Fig.4). Mean population sizes

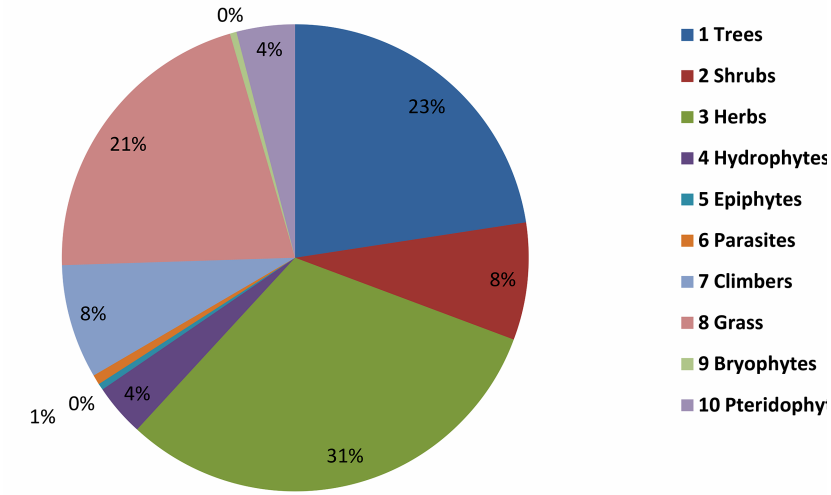

Fig. 3. Habit-wise plants recorded in (%) in both Central and Transition Zones of Bhubaneswar city.

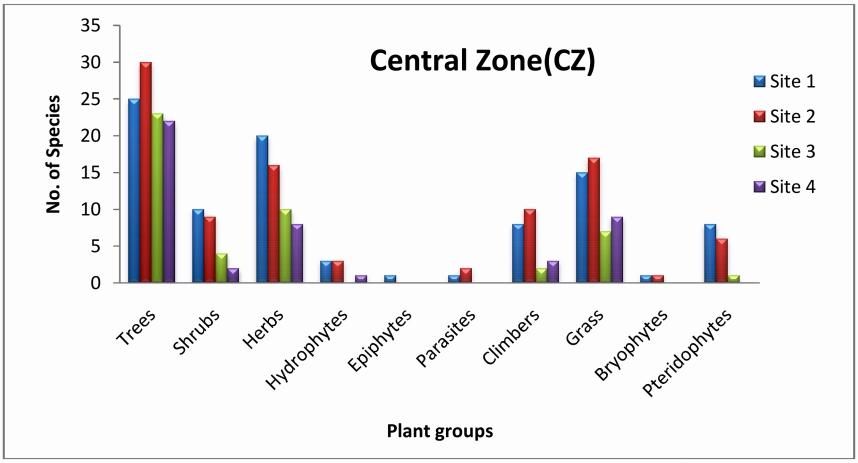

Fig. 4. Total number of plants recorded (habit-wise) in different sites of Central Zone (CZ) of Bhubaneswar city.

in different seasons and in different sites were calculated to find out statistically difference if any. It was noted that there was significant difference between the population size of site-1 and site-4 at 0.05 level and in other sites the difference were highly significant at 0.01 level of significance in summer season. In rainy season, the difference in population size was highly significant in all the sites except site-2 and site-3 which was significant at 0.05 levels. In winter season, leaving aside the mean population size of plant species in site–1 and site–2, there was significant difference in all the sites (Table 3).

More number of plant species were recorded in rainy season (230) in compassion to winter and summer seasons. Trees and shrubs were found in all the seasons but other plant groups like herbs, grasses and climbers were vary in their abundance. Similarly non-flowering plants like bryophytes and pteridophytes were as expected found very less in number.

So far as the distribution of plant species at different sites of the Central Zone is concerned, it was observed that the site–1 (CZ–1) and site–2 (CZ–2) had more number of species in comparison to other sites. It could be due to campus territory which is well protected and conserved without disturbance. The number of plants in site-3 (CZ–3) and site–4 (CZ–4) were found to be less probably due to development / expansion of the city in terms of construction of

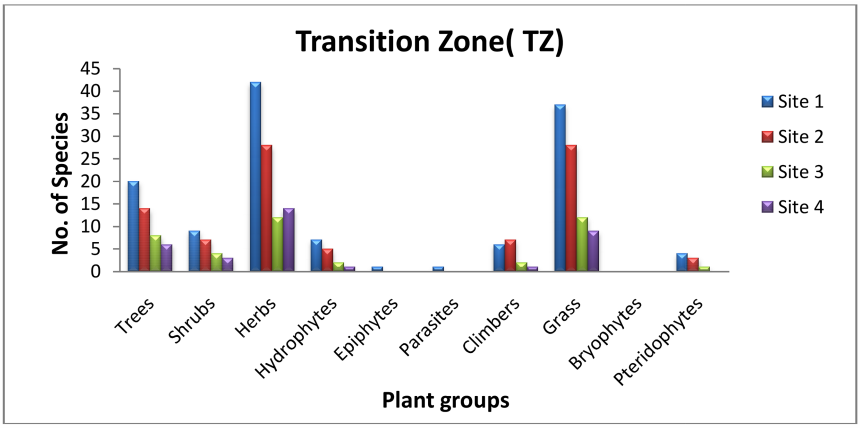

Fig. 5. Total number of plants recorded (habit-wise) in different sites of Transition Zone (TZ) in Bhubaneswar city.

Table 2. Total number of plants recorded (habit-wise) in different sites of Central Zone (CZ) of Bhubaneswar city.

Plant groups recorded (habit-wise)	Number of plant species			
	CZ-1	CZ-2	CZ-3	CZ-4
Trees	25	30	23	22
Shrubs	10	9	4	2
Herbs	20	16	10	8
Hydrophytes	3	3	–	1
Epiphytes	1	–	–	–
Parasites	1	2	–	–
Climbers	8	10	2	3
Grass	15	17	7	9
Bryophytes	1	1	–	–
Pteridophytes	8	6	1	–
Total	92	94	47	45

buildings and high rise apartments, roads, sub-roads, playgrounds.

In the Transition Zone, site-1 (TZ-1, WN23) had more number plant species followed by site-2 (TZ-2, WN02), site-3 (TZ-3, WN32) and site-4 (TZ-4, WN 67) (Table 4 and Fig. 5). Further a total of 466 plant species were recorded in three seasons, of which 172 plants were common (Table 1). As such 294 plant species were rcorded in four selected sites. The mean population sizes between site-1 with site-3 and site-2 with site-4 were significant at 0.05 levels and in other sites the differences were highly significant at 0.01 level in summer season. In rainy season, there was significant difference in the mean population size between site-1 and site-4 and between site-2 and site-3 at 0.05 level of significance whereas in other sites the difference were significant at 0.01 level. In winter season, the difference in the mean population size between site-1 and site-2 and site-3 were not significant whereas in other sites (site-1 and site-3, site-2 and site-4, site-4, site-3 and site-4) were highly significant (Table 5).

A total of 324 plant species were recorded in all the three seasons in the four sites of the Transition Zone. Among those 30 plant species were common leaving apart a total of 294 plant species were recorded. Here also in the rainy season more number of plant species was recorded than other two seasons could be because of availability of sufficient moisture and favorable weather conditions. Plant species recorded in two sites TZ-3 and TZ - 4 were less in number, probably due to anthropogenic interference such as construction activities undergoing round the year.

Among families, Fabaceae, Asteraceae and Euphorbiaceae were the dominant families in dicotyledons whereas in monocotyledons, Poaceae and Cyperaceae were dominant. Out of 97 families, the 10 most dominant families having plants in decreasing order were Poaceae (56), Cyperaceae (36), Fabaceae (17), Mimosaceae (12), Convolvulaceae (11) and Amaranthaceae (10).

Genera wise *Cyperus* followed by, *Ipomoea, Ficus* and *Phyllanthus* were the dominant genera in the present study both in Central as well as in Transition Zones.

Table 3. Mean number of plants recorded along with Standard Deviation (SD) and t –value in different sites in different seasons in the Central Zone of Bhubaneswar city. SD = Standard Deviation, * =Significant at 0.05 level, ** = Highly significant at 0.01, ns = Not significant.

Site (s)	Summer season		Rainy season		Winter season	
	Mean ± SD	t-value	Mean ± SD	t-value	Mean ± SD	t -value
S–1	52 ± 3.07	3.472**	69 ± 3.64	4.27**	66 ± 3.17	1.87^{ns}
S–2	59 ± 3.36		75 ± 4.06		70 ± 3.95	
S-1	52 ± 3.07	2.57**	69 ± 3.64	3.14**	66 ± 3.17	2.43**
S-3	32 ± 2.84		44 ± 3.19		35 ± 2.87	
S-1	52 ± 3.07	2.72*	69 ± 3.64	2.47**	66 ± 3.17	2.95**
S-4	26 ± 1.09		35 ± 2.87		29 ± 2.19	
S-2	59 ± 3.36	2.80*	75 ± 4.06	2.69*	70 ± 3.95	3.16**
S-3	32 ± 2.84		44 ± 2.43		35 ± 2.87	
S-2	59 ± 3.36	2.17**	75 ± 4.06	3.10**	70 ± 3.95	2.81**
S-4	26 ± 1.09		35 ± 2.87		29 ± 2.19	

Table 4. Total number of plants recorded (habit-wise) in different sites of Transition Zone (TZ) in Bhubaneswar city.

Plant groups recorded (habit-wise)	Number of plant species			
	TZ-1	TZ-2	TZ-3	TZ-4
Trees	20	14	8	6
Shrubs	9	7	4	3
Herbs	42	28	12	14
Hydrophytes	7	5	2	1
Epiphytes	1	-	-	-
Parasites	1	-	-	-
Climbers	6	7	2	1
Grass	37	28	12	9
Bryophytes	0	-	-	-
Pteridophytes	4	3	1	-
Total	127	92	41	34

Form the study area, 10 plant species were found to be endangered, threatened and vulnerable (Table 6). Sixty plant species were identified as invasive alien species with *Ageratum* conyzoides L., *Hyptis suaveolens* (L) Poit., *Sida acute* L., *Alternanthera paronychioides* St. , *Cleome viscosa* L. and *Parthenium hysterophorus* L. being abundant (Table7).

A total of 50 cultivable, 15 wild introduced and 42 weed plants were recorded in Central and Transition Zones (data not shown) . This could be because of many patches of cultivable lands and idle plots still seen in the city provide suitable lands for the plants to grow. Fabaceae followed by *Amaranthaceae* were the most dominant families among cultivated plant species recorded.

Out of 442 plant species recorded, 111 were found to be medicinally important as observed earlier by Kumar and Satapathy (2011). Euphorbiaceae followed by Lamiaceae were the most dominant families among the medicinally important plant species recorded. Most of the medicinal plants were recorded from site-2 in the Transition Zone possibly could be due to least amount of biotic interference. Further a total of 21 poisonous/toxic plant species were also identified in the present study as noted by Das et al. (2017). Besides toxicity as certain poisonous plants have medicinal importance and other economic values, those need to be conserved and used (Kumar and Chithra 2012) sustainably.

Structure, composition and function are the three important attributes of plant communities. These attributes change in response to climate, topography, soil and disturbances. All these factors along with succession are responsible for both local and landscape–level variations in plant communities (Timilsina et al. 2017).

Interestingly, a total of five plant species which were not reported by the previous workers like Haines (1921–25), Raizada (1949), Mooney (1950), Panigrahi et al. (1964) as well as by recent workers such as Saxena and Brahman (1994–96) from Bhubaneswar area were recorded from the Central and Transition Zones of Bhubaneswar city (Table 8). Such taxa

Table 5. Mean number of plants recorded along with Standard Deviation (SD) and t-value in different sites in different seasons in the Transition Zone of Bhubaneswar city. SD = Standard Deviation, *= Significant at 0.05 level, **= Highly significant at 0.01 level, ns = Not significant.

Site (s)	Summer season		Rainy season		Winter season	
	Mean ± SD	t-value	Mean ± SD	t-value	Mean ± SD	t-value
S-1	58 ± 3.24	3.14**	64 ± 3.13	4.86**	58 ± 3.24	1.69^{ns}
S-2	44 ± 2.43		51 ± 3.04		53 ± 3.10	
S-1	58 ± 3.24	2.62*	64 ± 3.13	3.67**	58 ± 3.24	3.12**
S-3	21 ± 1.03		31 ± 2.75		26 ± 1.09	
S-1	58 ± 3.24	4.37**	64 ± 3.13	2.14*	58 ± 3.24	3.52**
S-4	16 ± 0.92		25 ± 1.07		19 ± 1.07	
S-2	44 ± 2.43	4.62**	51 ± 3.04	2.71*	53 ± 3.10	1.82^{ns}
S-3	21 ± 1.03		31 ± 2.78		26 ± 1.09	
S-2	44 ± 2.43	2.69*	51 ± 3.04	4.56**	53 ± 3.10	2.32*
S-4	16 ± 0.92		25 ± 1.07		19 ± 1.07	

Table 6. List of Endangered, Threatened and Vulnerable species recorded in Central and Transition Zones of Bhubaneswar city.

Sl. No.	Botanical name	Family	Status
1.	*Atylosia cajanifolia* Haines	Fabaceae	Threatened
2.	*Bulbostylis subspinsens* C.B.Cl.	Cyperaceae	Threatended
3.	*Dracaena spicata* Roxb.	Agavaceae	Threatened
4.	*Gloriosa superba* L.	Liliaceae	Endangered
5.	*Paederia foetida* L.	Rubiaceae	Vulnerable
6.	*Piper longum* L.	Piperaceae	Endangered
7.	*Pterocarpus marsupium* Roxb. subsp. *Marsupium*	Fabaceae	Endangered
8.	*Rauwolfia serpentine* (L.) Benth. Ex.Kurz.	Apocynaceae	Endangered
9.	*Saraca asoca* (Roxb.) de Wilde	Caeslpiniaceae	Cricitcally Endangered
10.	*Strychnos potatorum* L.	Strychnaceae	Vulnerable

therefore seem to be new records for the Bhubaneswar city. These species were *Cassia alata* L., *Clerondrum incisium* Klotzsch., *Aspargus setaceus* (Kunth) Jessop, *Allamanda nerifolia* Hook and *Portalaca umbraticola* Kunth. These species were either were left unnoticed or might have migrated or transferred

Table 7. Selected list of alien species recorded in Central and Transition Zones of Bhubaneswar city.

Sl. No.	Name of the species	Family	Habit	Nativity
1.	*Abutilon indicum* (L.) Sweet	Malvaceae	Herb	Africa
2.	*Acanthospermum hispidium* DC.	Asteraceae	Herb	Brazil
3.	*Ageratum conyzoides* L.	Asteraceae	Herb	Tropical America
4.	*Alternanthera paronychioides* St.	Amaranthaceae	Herb	Tropical America
5.	*Antigonum leptopus* Hook & Arn.	Polygonaceae	Climber	Tropical America
6.	*Argemone maxicana* L.	Papaveraceae	Herb	Tropical Central & South America
7.	*Azolla pinnata* R. Br.	Azollaceae	Herb	Asia, Africa
8.	*Blumea lacera* (Burm.f.) DC.	Asteraceae	Herb	Tropical America
9.	*Borassus flabellifer* L.	Arecaceae	Tree	Tropical Africa
10.	*Calotropis gigantean* R. Br.	Asclepiadaceae	Shrub	Tropical Africa
11.	*Calotropis procera* (Ait.) R. Br.	Asclepiadaceae	Shrub	Tropical Africa
12.	*Cassia alata* L.	Caesalpiniaceae	Tree	West Indies
13.	*Cassia hirsute* L.	Caesalpiniaceae	Shrub	Tropical America
14.	*Cassia occidentalis* L.	Caesalpiniaceae	Herb	Tropical South America
15.	*Cassia tora* L.	Caesalpiniaceae	Herb	Tropical South America
16.	*Celosia argentea* L.	Amaranthaceae	Herb	Tropical Africa
17.	*Chloris barbata* Sw.	Poaceae	Herb	Tropical America
18.	*Cleome rutidosperma* DC	Capparaceae	Herb	Tropical America
19.	*Cleome viscosa* L.	Capparaceae	Herb	Tropical America
20	*Crotalaria pallida* Ait.	Fabaceae	Herb	Tropical America
21.	*Croton bonplandianus* Baill	Euphorbiaceae	Herb	Temperate South America
22.	*Cryptostegia grandiflora* R. Br.	Periplocaceae	Shrub	Madagascar
23.	*Cuscuta reflexa* Roxb.	Cuscutacea	Climber	Mediterranean
24.	*Cyperus difformis* L.	Cyperaceae	Herb	Tropical America
25.	*Datura metel* L.	Solanaceae	Herb	Tropical America
26.	*Eclipta prostrate* (L.) L. Mant.	Asteraceae	Herb	Tropical America
27.	*Eichhornia crassipes* (Mart.) Solms-Laub.	Pontederiaceae	Aquatic Herb	Tropical America
28.	*Evolvulus nummularius* (L.) L.	Verbenaceae	Herb	Tropical America
29.	*Gnaphalium polycaulon* Pers.	Asteraceae	Herb	Tropical America
30.	*Grangea maderaspatana* (L.) Poir.	Asteraceae	Herb	Tropical South America
31	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	Herb	Tropical America
32.	*Impatiens balsamina* L.	Balsaminaceae	Herb	Tropical America
33.	*Indigofera linaei* Ali	Fabaceae	Herb	Tropical Africa
34.	*Ipomea carnea* Jacq.	Convolvulaceae	Shrub	Tropical America

Table 8. New plants species recorded Bhubaneswar city.

Sl. No.	Scientific name	Family
1	*Cassia alata* L.	Fabaceae
2	*Clerondrum incisium* Klotzsch.	Lamiaceae
3	*Asparagus setaceus* (Kunth) Jessop	Asparagaceae
4	*Allamanda nerifolia* Hook.	Apocynaceae
5	*Portulaca umbraticola* Kunth	Portulacaceae

from other locations because of one or the other biotic factors.

Family Index Value (FIV) data showed that the most dominant family was Poaceae (57.73) followed by Cyperaceae (37.11), Fabaceae (26.80), Asteraceae (24.74), Euphorbiaceae (23.71), Rubiaceae (17.52), Mimosaceae (12.37), Convolvulaceae (11.34), Lamiaceae (11.34) and Amaranthaceae (10.30) (Figs. 6 and 7).

In terms of species richness, also family Poaceae (33 genera 56 species) had highest species richness followed by Cyperaceae (6 genera, 36 species), Asteraceae (20 genera, 21 species), Euphorbiaceae (15 genera, 21 species), Fabaceae (12 genera, 18 species), Rubiaceae(13genera, 14 species), Convolvulaceae (4 genera, 9 species) Lamiaceae (4 genera, 9 species), Anaranthaceae (5 genera, 9 species), Mimosaceae (9 genera, 4 species). The dominance of the families such as Poaceae and Cyperaceae could be because of availability of low lying and swampy areas plentily within the BMC area favoring the growth of members of the concerned families.

The vegetation of any place is the outcome interaction of many factors such as the elevation, soil, species composition and biotic interference (Bliss 1963). The number of species recorded in the present study was found to be 442 which is higher than the number of species reported by several workers for different human habitations (Chowdhury et al. 2000, 85 species), (Kadavul and Parthasarathy 1999, 89 species), (Uma Shankar 2001, 87 species). These points strongly suggest that the Bhubaneswar city which is just adjacent to the Chandaka reserve forest have at least some areas suitable for vegetation. As a matter of fact, it still enjoys a good species composition

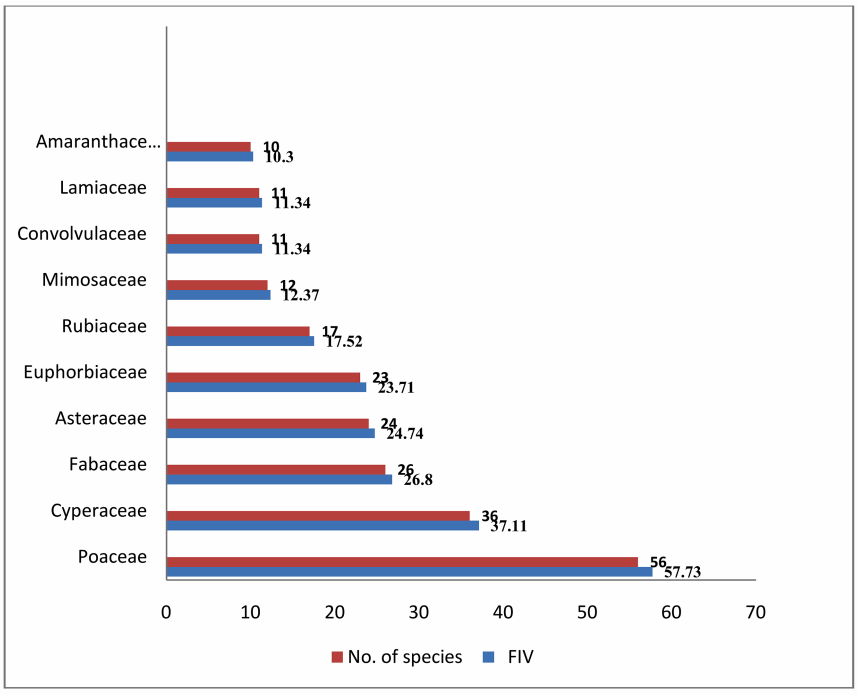

Fig. 6. Family-level dominance based on species richness and Family Importance Value (FIV).

Cassia alata L. *Clerodendrum incisium* Klotzsch.

Asparagus setaceus(Kunth)jessop *Portulaca umbraticola* Kunth

Allamanda nerifolia Hook.

Fig. 7. New species recorded from the Bhubaneswar city.

(unlike other cities) though not highly diversified like a forest. While looking for the development of the Bhubaneswar city, it is highly essential to put emphasis on the conservation of the existing floral diversity besides their sustainable use.

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