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A study on phytosociology, soil conservation and socio-economic aspects in red sand dunes near Bhimili of Visakhapatnam

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ABSTRACT

The total number of plant species observed was 105 belonging to 41 families. The highest number of plant species observed belongs to Fabacea family. According to the IVI values observed Tephrosea purpurea in herbs, Lantana camara in shrubs & climbers, and Anacardium occidentale in trees showing the maximum IVI value and these are considered as leading dominants and Acalypha alnifolia in herbs, Atylosia scaraeboides, Waltheria indica in shrubs and climbers and Sapindus emarginatus in tree species are considered as rare species to the study area, because these species having the least IVI values. The results in the major nutrients N, P, K levels are discouraging though the presences of these nutrients are comparatively very low in the corresponding coastal area. Aristida adscensionis and Cynodon doctylon are the effective, indigenous and suggested grasses to prevent the erosion in the study area.

Key Words: Soil nutrients, Quantitative analysis of vegetation, IVI, Conservation Value, Socio-economic profile.

INTRODUCTION

The study area Red Sand Dunes of Visakhapatnam is in between Nerellavalasa and Bhimunipatnam with latitudes 17°52'-53' N, longitudes 83°25'-27' E as shown in the map (Fig.1). The geographical extent of this area is about 600 hectares. The red sand dunes of 'Erra Matti Dibbalu' in general terms, near Bhimili with the occasional patches of vegetation is attracting tourists. It has a great unique ecological significance also. W. King reported the Red Sand Dunes near Bhimili and called them as 'badlands' [7]. Scientists believe that the red sand dunes had formed during the quarternary era, i.e. 1.8 million years ago, during which sea level oscillations, subsequent rapid climatic and geomorphological changes involving multiple cycles of depositions thereby formation of the dunes. Considerable range of metals contamination and Metal depletion in the soil of mean EF<1 was observed in the Red Sand Dunes for most elements is indispensable to the proper growth of the plants [13]. Nutrient loss through soil erosion leads to soil become unfertile. A rapid procedure in determination of available nitrogen in soils carried out by Subbiah et al., [19]. Sharma [17] conducted studies on nutrient status and energetics at Chakia forests.

The Importance Value Index (IVI) for each species was obtained by direct summation of relative frequency, relative density, and relative dominance [5, 12]. The species having the highest IVI recorded in the community area was grouped as dominants, co-dominants, associates and rare plant species. Raunkiaer suggested the life forms of plants and statistical plant geography being the collected papers of C. Raunkiaer [15]. Chughtai et al., conducted the phytosociological studies in grave-yard of peshawar district of Pakistan [4]. Bharadwaj made a study on the phytosociology of Pithoragarh grassland in the Himalaya [3]. The vegetation in Rajghat ravines was studied by Misra [11].

Methods for assessing the soil binding values of plants have been developed by Ambasht [1]. Ambasht [2] made a study on conservation of soil through plant cover of certain alluvial slopes in India. Kumar, R., et al., concluded the Soil, Water, Phosphorus and Nitrogen Conservation efficiency of five common riparian weeds in runoff experiment [8]. Srivastava et al., observed the role of herbs in reducing soil erosion [18]. Socio-economic policies reflected in land use are a major influence on how the land is farmed and therefore on erosion and pollution [6].

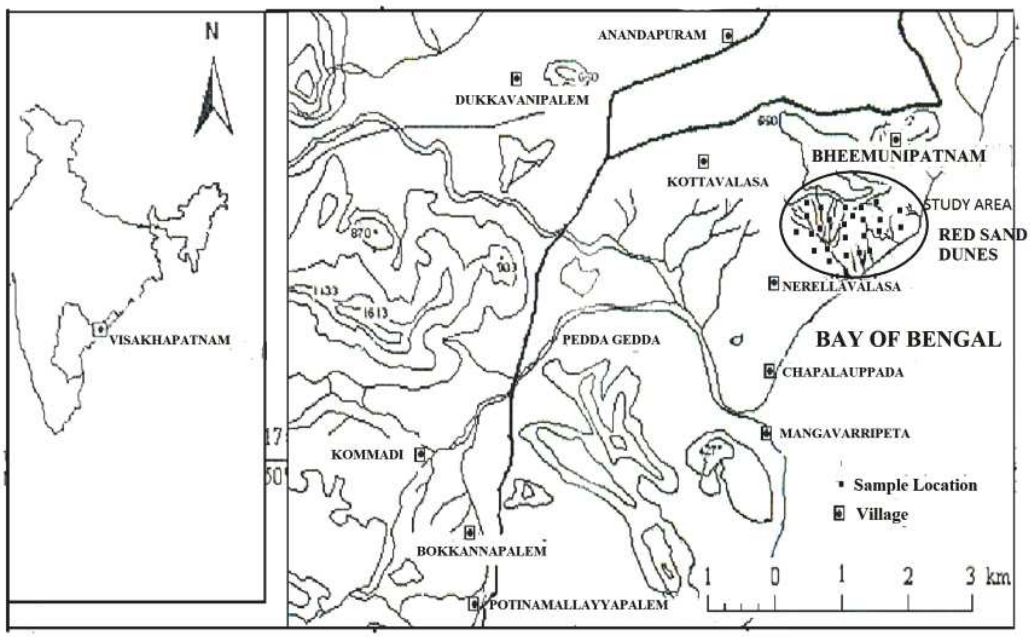


Fig.1. Map showing the Study Area.

MATERIALS AND METHODS

Soil Nutrients:

Soil samples (0 - 10 cm) were collected from the study site and brought to the soil laboratory at Krushi Vignana Kendra, Venkatapuram. They were air-dried, rolled and passed through a 2 mm sieve for analysis. Procedure for determining soil pH in a 1:1 (Soil:Water) suspension [10]. EC measurement and Potassium estimation is given in USDA Handbook [16].The total organic carbon (Walkley and Black method), total nitrogen (Micro Kjeldahl method) and total Phosphorus (Molybdenum-blue method), of each soil sample were estimated according to standard method [9].

Phytosociology:

Phytosociological studies were carried out during 2009 to 2011 which covered pre monsoon, monsoon and post monsoon periods and overall spectrum of vegetation of the study area. Tree species were enumerated for individual height and girth (≥15 cm) at breast height estimates. All the plots sampled were representative of most common types, sampling 10m x 10m for trees and 5x5 for shrubs, 1m x 1m for herbs square meter quadrats were laid.

Field data collected was analyzed and the main purpose of Phytosociological analysis in the study area. Vegetation data was quantitatively analyzed for Frequency, Density and Dominance using standard methodologies [5, 14]. Raunkiae'r suggested the five frequency classes index also applied. The following are the formulae to derive frequency, density and abundance [12].

$$\text{Frequency} = \frac{\text{Number of sampling units in which species occur}}{\text{Total Number of sampling units}} \times 100$$

$$\text{Density} = \frac{\text{Total Number of Individuals in all sampling units}}{\text{Total Number of sampling units studied}}$$

Basal area = πr^2 x Density

Usually after the quantitative estimations of values of density, frequency and dominance, the species are listed in order of decreasing importance. Not only IVI facilitates comparison between species of a community, but also the data collected on dispersion, number and cover can be profitably used in comparing the vegetation structure of two or more stands or of the same stand over a period of time. Vegetation structure with respect of varying environmental factors can also be studied through such studies in sets of varying environmental conditions.

The IVI was determined as the sum of the relative frequency, relative density and relative dominance. It thus incorporate three important parameters that measures of productivity and diversity of every species therefore.

IVI = Relative frequency + Relative density + Relative dominance

$$\text{Relative density} = \frac{\textit{Total number of individuals of a sps}}{\textit{Total number of individuals of all sps}} \text{ x } 100$$

$$\text{Relative Frequency} = \frac{\textit{Total occurrence of a sps}}{\textit{Total occurrence of all sps}} \text{ x } 100$$

$$\text{Relative Dominance} = \frac{\textit{Basal area of a sps}}{\textit{Basal area of all sps}} \text{ x } 100$$

Soil Erosion & Conservation

On twenty four dunes of red soil, contour terraces will be made with a spiral narrow channel. Grass plants grown on dunes which indigenous. 24 dunes were used to estimate the conservation value between the native plants covered and bared dunes. Two dunes were applied with the *Aristida adscensionis*, *Cynodon doctylon,* to compare the soil conservation value over erosion. Field experiments designed to determine the soil loss from relatively sample area or erosion plots often as part of an experiment and those designed to assess erosion over such as damage basis.

For the average of 8.5cm rain fall and contours with the slope of 30^o angle maintained to spiral drain channels ending to the collecting tanks made up by Zinc, because Zinc is rust free material. The soil conservation value was calculated as the percentage of soil retained. The soil conservation value by the species which without its cover would have been washed away when subjected to an equal erosion force. The following formula was used to calculate the conservation value [2].

CV=100-(SWP/SWO×100)

Where CV= Conservation Value, SWP and SWO are the quantity of soil washed from plant covered and bare plots respectively.

Socio-economic:

The primary data was collected through observation field guide/notes, schedule, interview and case study for collection of qualitative and quantitative data covering the factors like population, religion, and occupations. Unstructured schedule was constructed and used for collection of data.

RESULTS AND DISCUSSION

Soil Nutrients:

24 soil samples were analysed for the nutrient status and the data was tabulated (Table.1). The Organic Carbon (O.C) content ranges from 0.49 to 0.63 in the soil and the average value is 0.55 kg/ha (Table.1), which is medium in its presence. Organic Carbon content quantity indicates congenial growth for flora at the same time it demands the need of more plantation in the study area. More is the Organic Carbon content in the soil; more will be the buffering capacity of the soil. The Electrical Conductivity (E.C) in the study area ranges from 0.2 to 1, average result is 0.56 infers the good assimilation capacity of nutrients by soil. The average P^H result is 6.38 slightly acidic, and it is ranges from 6.1 to 6.9 (Table.1).

The average content of the major nutrients of soil Nitrogen (126), Phosphorus (16.24) and Potassium (10.68) are very low, medium and very low. The observed values for N is ranges from 121.2 to 134.2 kg/ha, P is ranges from

12.4 to 19.8 kg/ha and K is ranges from 8.4 to 13.4 kg/ha (Table.1). The results in the major nutrients are discouraging though the presences of these nutrients are comparatively very low in the corresponding Coastal area.

Table.1. Soil nutrients data (kg/ha):

Sample	pH	E.C	N	P	K	O.C
1	6.3	0.4	122.5	13.1	11.7	0.51
2	6.6	0.6	124.3	14.8	9.5	0.55
3	6.4	0.4	127.1	17.6	13.1	0.54
4	6.1	0.2	124.6	12.4	12.4	0.49
5	6.7	0.4	130.3	19.3	10.5	0.53
6	6.4	0.3	125.4	15.1	11.2	0.51
7	6.1	1	126.2	14.7	9.1	0.53
8	6.3	0.6	122.5	15.4	9.3	0.55
9	6.1	0.5	126.1	16.2	10.7	0.61
10	6.7	0.5	124.3	15.2	8.4	0.53
11	6.2	0.6	127.4	15.7	9.1	0.51
12	6.1	0.4	129.6	15.2	11.8	0.62
13	6.4	0.6	126.7	16.4	13.4	0.58
14	6.9	0.7	128.1	18.3	12.2	0.51
15	6.1	0.5	129.3	16.5	11.7	0.57
16	6.5	0.9	124.9	19.8	9.2	0.61
17	6.4	0.6	121.2	16.3	11.3	0.63
18	6.2	0.6	129.3	17.8	8.7	0.6
19	6.5	0.4	134.2	14.4	10.2	0.59
20	6.1	0.7	128.5	15.7	9.8	0.56
21	6.6	0.6	123.7	18.1	11.1	0.53
22	6.9	0.8	125.2	17.3	13.1	0.59
23	6.4	0.6	128.1	17.5	8.7	0.54
24	6.2	0.6	121.9	16.9	10.2	0.51
Minimum	6.1	0.2	121.2	12.4	8.4	0.49
Maximum	6.9	1	134.2	19.8	13.4	0.63
Mean	6.38	0.56	126.31	16.24	10.68	0.55
STDEV	0.25	0.18	3.07	1.80	1.52	0.04

Phytosociology:

Quantitative analysis was done for the study of vegetation in the study area covering the pre monsoon, monsoon, and post monsoon seasons of the years 2009 to 2011. Relative frequency, relative density, relative dominance and importance value index (IVI) values for herbs, shrubs & climbers, and tree plant species were computed. The results obtained indicating that the 105 plant species were recorded in the study area, out of them 64 herbs species, 29 shrubs & climbers, and 12 tree species were noted belonging to 41 families.

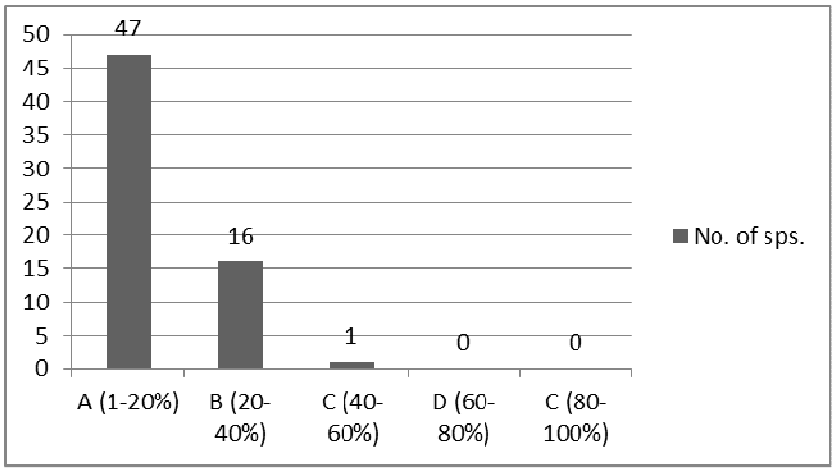
Table.2. Showing the families of the plant species recorded

S.No	Family	No. Herb Sps.	No. Shrubs & Climbers Sps.	No. Tree species.
1	Acanthaceae	5	-	-
2	Aizoaceae	1	-	-
3	Amaranthaceae	5	-	-
4	Anacardiaceae	-	-	1
5	Annonaceae	-	-	1
6	Apocyanaceae	1		
7	Asclepadaceae	-	4	-
8	Asteraceae	2	1	-
9	Caesalpiniaceae	-	1	-
10	Capparidaceae	1	-	-
11	Casuarinaceae	-	-	1
12	Commelinaceae	2	-	-
13	Convolvulaceae	1	4	-
14	Cuscutaceae	-	1	-
15	Cyperaceae	9	-	-
16	Ehretiaceae	-	1	-
17	Euphorbiaceae	9	2	-
18	Fabaceae	10	3	-
19	Lamiaceae	1	2	-
20	Malvaceae	4	-	-

21	Meliaceae	-	-	1
22	Menispermaceae	-	1	-
23	Mimosaceae	1	-	3
24	Myrtaceae	-	-	1
25	Nyctaginaceae	1	-	-
26	Oxalidaceae	1	-	-
27	Palme	-	-	2
28	Passifloraceae	-	1	-
29	Pedaliaceae	1	-	-
30	Plumbaginaceae		1	
31	Poaceae	2	-	-
32	Rhamnaceae	-	1	1
33	Rubiaceae	2	2	-
34	Sapindaceae	-	1	1
35	Solanaceae	1	-	-
36	Sterculiaceae	-	1	-
37	Tiliaceae	2	-	-
38	Verbenaceae	-	1	-
39	Violaceae	1	-	-
40	Vitaceae	-	1	-
41	Zygophyllaceae	1	-	-
	Total no. of plant species	64	29	12

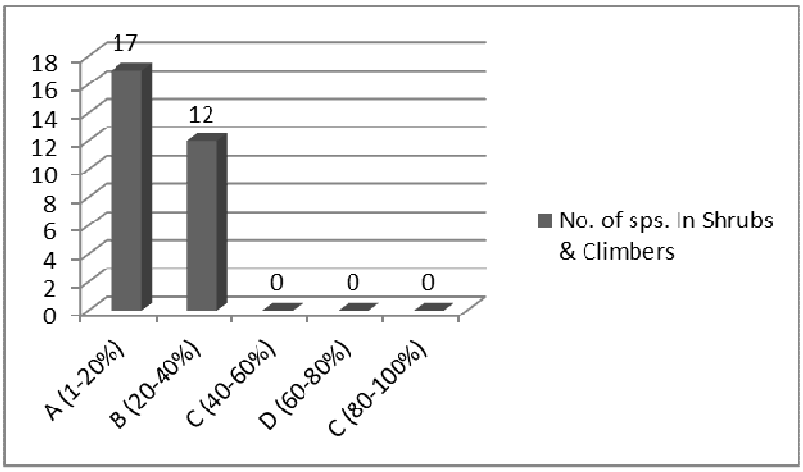
Herbs species encountered 23 families, shrubs species 18 families, tree species from 9 families. The largest family was *Fabaceae* in the herbs with 10 plant species, *Asclepadaceae* and *Convolvulaceae* in shrubs & climbers with 4 plant species and in trees *Mimosaceae* with 3 plant species. As a whole *Fabaceae* is the major plant community having the 10 herb species and 3 shrubs & climbers species in the study area (Table.2).

Fig.2. Raunkiaer's Frequency Class diagram of Herbs



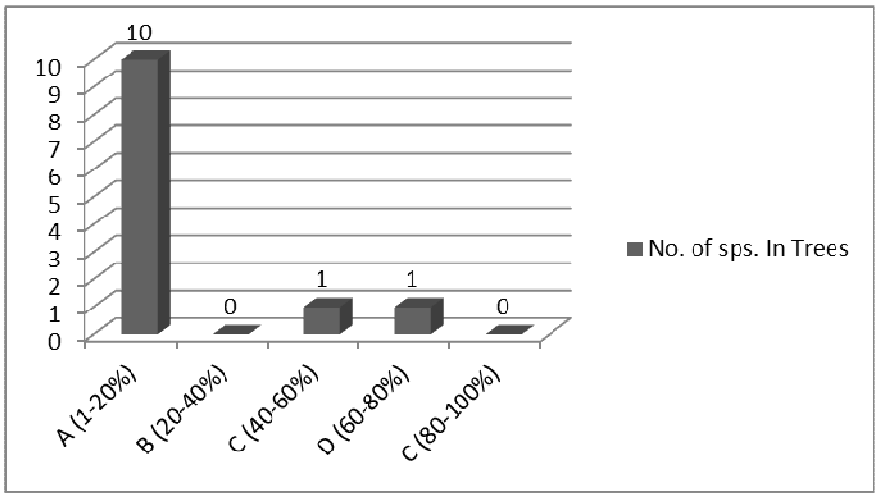
Frequency denotes the degree of dispersion of a species in the study area. As per the Raukiaer's group of frequency classes 47 in herbs, 17 in shrubs & climbers and 10 in tree plant species come under class 'A' (1-20%). while 16 in herbs, 12 in shrubs & climbers and none in tree plant species come under class 'B' (20-40%). Only 1 plant species in herbs i.e. *Tephrosea purpurea*, none in shrubs & climbers and 1 tree plant species i.e. *Casuarina equisetifolia* come under class 'C' (40-60%). The only one tree plant species i.e. *Anacardium occidentale* come under class 'D' (60-80%) (Fig.2,3&4).

Fig.3. Raunkiaer's Frequency Class index of Shrubs & Climbers



Relative frequency is the comparison of total occurrence of a species with that of the total occurrence of all species. The less occurred plants are more in number than the abundantly occurred plants, which is directly proportional to their biotic and genetic potential and environmental conditions.The results obtained revealing *Tephrosea purpurea* in herbs, *Eupatorium odoratum and Lantana camara* in shrubs & climbers, and *Anacardium occidentale* in trees encountered the maximum Relative Frequency values (Table.3,4&5).

Fig.4. Raunkiaer's Frequency Class diagram of Trees



Density is the numerical strength of a species per unit area. The comparison of total number of individuals of a species with total number of individuals of all species is Relative Density, based on the biotic, genetic potential and innate capacity and favourable climatic conditions the seed output and individual plants may be varying from species to species in that area. *Tephrosea purpurea* in herbs, *Eupatorium odoratum* in shrubs & climbers, and *Anacardium occidentale* in trees encountered the maximum Relative Density values (Table.3,4&5).

Basal area is an index of dominance. Comparison of basal area of a species with the total basal area of all species is Relative Dominance. Different plant species based on biotic, genetic potential and innate capacity and favourable environmental conditions the girth of the stems may be varying. With the comparison one can ascertain the Relative Dominance in terms of the girth area. *Triumfetta rhomboidea* in herbs, *Lantana camara* in shrubs & climbers, and *Anacardium occidentale* in trees encountered the maximum Relative Dominance values (Table.3,4&5).

Table.3. Importance Value Index (IVI) of Herbs

S.No	Plant name	R.Frequency	R.Density	R.Dominance	IVI
1	*Abutilon indicum*	1.234568	0.915331808	2.021868	4.17176734
2	*Acalypha alnifolia*	0.411523	0.228832952	0.251859	0.892214529
3	*Acalypha indica*	0.823045	0.686498856	0.596999	2.106543101
4	*Achyranthus aspera*	2.880658	3.432494279	5.044641	11.35779407
5	*Aerva lanata*	3.703704	3.203661327	2.310706	9.218070894
6	*Allmania nodiflora*	1.234568	1.830663616	1.399216	4.46444787
7	*Alysicarpus monilifer*	1.234568	1.601830664	1.155353	3.991751497
8	*Amaranthus viridis*	0.823045	0.686498856	0.932811	2.442355026
9	*Apluda mutica*	1.646091	2.517162471	1.017612	5.1808649
10	*Aristida adscensionis*	2.469136	3.432494279	4.121159	10.02278865
11	*Arundinella pumila*	1.234568	0.915331808	0.447749	2.597648942
12	*Asystasia gangetica*	1.646091	1.372997712	1.193998	4.213086201
13	*Blepharis molluginifolia*	2.057613	1.14416476	1.096986	4.298763549
14	*Boerhavia diffusa*	1.646091	1.601830664	1.023427	4.271348017
15	*Borreria hispida*	2.057613	2.517162471	1.719764	6.29453974
16	*Brachiaria semiverticellata*	1.646091	2.517162471	1.23131	5.394563397
17	*Carissa spinarum*	1.234568	0.915331808	0.699608	2.849507886
18	*Chloris barbata*	1.234568	1.830663616	0.787059	3.852290716
19	*Cleome viscosa*	1.234568	0.686498856	1.343248	3.264314456
20	*Commelina benghalensis*	1.234568	1.14416476	1.096986	3.475718282
21	*Corchorus acutangulus*	2.057613	1.601830664	1.295275	4.954718399
22	*Croton bonplandianum*	1.646091	2.288329519	1.010234	4.944654262
23	*Cynodon dactylon*	1.646091	2.745995423	0.932811	5.324896861
24	*Cynotis axillaris*	1.646091	2.517162471	1.719764	5.883017106
25	*Cyperus rotundus*	2.057613	3.890160183	2.016518	7.964291037
26	*Datura stramonium*	1.646091	0.915331808	8.087471	10.64889286
27	*Desmodium trifoliate*	1.646091	0.915331808	0.447749	3.009171576
28	*Dipteracanthus prostratus*	1.234568	0.686498856	0.457077	2.378144099
29	*Dactyloctenium aegyptium*	0.823045	0.686498856	0.335812	1.845356048
30	*Euphorbia hirta*	2.469136	1.372997712	1.865622	5.707755319
31	*Evolvulus nummularis*	2.057613	1.601830664	0.675622	4.335065443
32	*Fimbristylis congesta*	0.823045	0.457665904	0.223875	1.504585788
33	*Gomphrena decumbens*	1.646091	1.14416476	0.94587	3.73612555
34	*Heylandia latebrosa*	1.646091	1.372997712	1.135044	4.154132552
35	*Hybanthus enneaspermus*	1.234568	1.372997712	0.564351	3.171916209
36	*Indigofera enneaphylla*	2.057613	1.372997712	1.347912	4.778522634
37	*Indoneesiella echioides*	1.646091	0.915331808	0.846526	3.407948236
38	*Kyllinga monocephala*	1.646091	1.601830664	0.675622	3.923542809
39	*Leucas aspera*	1.234568	0.915331808	0.846526	2.996425603
40	*Micrococca mercurialis*	0.823045	1.14416476	0.805949	2.773158647
41	*Mimosa pudica*	0.823045	0.457665904	0.223875	1.504585788
42	*Mollugu nudicaulis*	1.234568	0.686498856	0.755577	2.676643588
43	*Oldenlandia corymbosa*	0.823045	2.288329519	0.808747	3.920121839
44	*Oxalis corniculata*	1.234568	0.915331808	0.699608	2.849507886
45	*Pavonia zeylanica*	2.057613	1.601830664	1.295275	4.954718399
46	*Pedalium murex*	1.234568	0.686498856	2.387996	4.309062667
47	*Phyllanthus amarus*	1.234568	1.830663616	1.133365	4.198596763
48	*Phyllanthus debilis*	1.234568	1.14416476	0.677221	3.055953376
49	*Phyllanthus maderaspatensis*	0.411523	0.686498856	0.457077	1.555098832
50	*Rothia indica*	2.057613	1.830663616	1.399216	5.287493138
51	*Ruellia tuberosa*	2.057613	1.14416476	1.813384	5.015162322
52	*Sebastiana chamaelea*	0.823045	1.14416476	0.559687	2.526896569
53	*Sida acuta*	1.646091	1.601830664	3.597985	6.845906107
54	*Sida cordifolia*	1.234568	1.14416476	2.238746	4.617478826
55	*Spinifex littoreus*	1.646091	1.372997712	1.683724	4.702811925
56	*Tephrosia maxima*	2.880658	2.288329519	1.234109	6.403096779
57	*Tephrosia purpurea*	4.526749	7.551487414	6.418587	18.4968234
58	*Tribulus terrestris*	1.234568	1.372997712	1.865622	4.473187417
59	*Tridax procumbens*	1.646091	1.14416476	1.432798	4.22305284
60	*Triumfetta rhomboidea*	1.234568	1.14416476	9.408331	11.78706342
61	*Vernonia cinerea*	2.057613	2.288329519	1.891741	6.237683198
62	*Vigna trilobata*	2.057613	1.601830664	1.599104	5.258548236
63	*Zornia diphylla*	0.823045	0.686498856	0.457077	1.966621465
64	*Zornia gibbosa*	0.411523	0.686498856	0.233203	1.331224215

The species having the highest IVI were considered as the leading dominants of the plant community in the study area. The results obtained revealing that, *Tephrosea purpurea* (18.496) in herbs, *Lantana camara* (34.494) in shrubs & climbers, and *Anacardium occidentale* (148.815) in trees encountered the maximum IVI value and these are considered as leading dominants in the study area (Table.3,4&5).

Table.4. Importance Value Index (IVI) of the Shrubs&Climbers

S.No	Plant name	R.Frequency	R.Density	R.Dominance	IVI
1	*Abrus precatorius*	3.100775194	2.030456853	5.224493745	10.35572579
2	*Anisomeles indica*	2.325581395	2.538071066	0.708651055	5.572303516
3	*Atylosia scarabaeoides*	1.550387597	1.015228426	0.144622664	2.710238688
4	*Calotropis gigantean*	4.651162791	3.045685279	11.08907669	18.78592476
5	*Canthium parviflorum*	4.651162791	4.060913706	3.986162183	12.69823868
6	*Cassia auriculata*	3.875968992	2.538071066	2.571069586	8.985109645
7	*Catunaregam spinosa*	1.550387597	1.015228426	0.578490657	3.14410668
8	*Cissus vitiginea*	3.100775194	2.030456853	0.339461531	5.470693578
9	*Cuscuta reflexa*	3.100775194	2.030456853	1.930310838	7.061542884
10	*Dodonaea viscosa*	3.875968992	4.060913706	2.125149705	10.0620324
11	*Ehretia microphylla*	3.100775194	2.030456853	1.255405071	6.386637118
12	*Eupatorium odoratum*	6.201550388	12.18274112	5.484948451	23.86923996
13	*Hyptis suaveolens*	3.875968992	3.553299492	0.371886851	7.801155336
14	*Ipomoea biloba*	2.325581395	3.045685279	0.708383235	6.07964991
15	*Ipomoea kentro*	2.325581395	2.538071066	0.708651055	5.572303516
16	*Ipomoea reptans*	2.325581395	2.538071066	1.749934237	6.613586699
17	*Jatropha gossypifolia*	5.426356589	5.583756345	14.93630738	25.94642031
18	*Lantana camara*	6.201550388	9.644670051	18.64871197	34.49493241
19	*Leptadenia reticulata*	3.100775194	2.030456853	3.055153782	8.186385829
20	*Merremia tridentate*	5.426356589	6.091370558	1.018384594	12.53611174
21	*Oxystelma esculentum*	3.100775194	2.538071066	1.645484535	7.284330795
22	*Passiflora foetida*	4.651162791	5.583756345	7.15882188	17.39374102
23	*Plumbago zeylanica*	1.550387597	1.52284264	0.966829292	4.040059529
24	*Teramnus labialis*	3.100775194	4.060913706	0.965155419	8.126844318
25	*Tinospora cordifolia*	4.651162791	4.060913706	3.301324767	12.01340126
26	*Tragia involucrate*	3.875968992	3.553299492	2.53548782	9.964756304
27	*Tylophora indica*	2.325581395	1.52284264	0.216933996	4.065358031
28	*Waltheria indica*	1.550387597	1.015228426	0.196847515	2.762463539
29	*Zizyphus oenoplia*	3.100775194	2.538071066	6.377859493	12.01670575

According to the results obtained *Triumfetta rhomboidea* (11.787) in herbs, *Jatropha gossypifolia* (25.946) in shrubs & climbers, and *Casuarina equisetifolia* (46.919) in trees considered as co-dominants in the study area. *Acalypha alnifolia, Zornia gibbosa* in herbs, *Atylosia scaraeboides, Waltheria indica* in shrubs and climbers and *Sapindus emarginatus* in tree species are considered as rare species to the study area having the low IVI values observed (Table.3,4&5).

Table.5. Importance Value Index (IVI) of the Tree species

S.No	Plant name	R.F	R.Density	R.Dominance	IVI
1	*Acacia auiriculiformis*	4.081632653	2.272727273	1.200091781	7.554452
2	*Anacardium occidentale*	36.73469388	48.86363636	63.21675159	148.8151
3	*Annona squamosa*	2.040816327	1.136363636	1.435416444	4.612596
4	*Azadirachta indica*	2.040816327	1.136363636	1.198598333	4.375778
5	*Borassus flabellifer*	6.12244898	4.545454545	16.22524087	26.89314
6	*Casuarina equisetifolia*	20.40816327	23.86363636	2.647994259	46.91979
7	*Dichrostachys cinerea*	4.081632653	2.272727273	0.742670131	7.09703
8	*Phoenix sylvestris*	6.12244898	3.409090909	7.721692761	17.25323
9	*Prosopis julifera*	6.12244898	4.545454545	0.537747793	11.20565
10	*Sapindus emarginatus*	2.040816327	1.136363636	2.21200917	5.389189
11	*Syzygium jambolanum*	2.040816327	1.136363636	1.693569521	4.870749
12	*Zizyphus jujuba*	8.163265306	5.681818182	1.168217343	15.0133

Soil Conservation:

The rapid runoff during the monsoonal period deepens the drainage channels with corresponding over steepening and collapse of its valley sides. Most of the channels are dry except rainy days. During the rainy season when the red

soil gets in touch with water, easily disintegrate and become a loose mass of sand and clay. But in the dry periods the surface is so hard. The disintegration property, heavy rains concentrated over short periods and the general slope towards the sea cumulatively acts in eroding and transporting enormous quantities of the red sediments to the sea (Fig.5). Occasionally the sediment load is so heavy and is deposited on the beach road causing a great problem for the vehicles pass through. In addition at some places the erosion is so high that some of the bridges on the beach road are on the threshold of collapse.

Soil containing Sand 20%, clay 43%, Silt 37% recorded in the study area supporting the erosion. During the monsoon period clay and silt being removed by the rain water. Bare dunes showed the loss of highest amount of soil through surface runoff because there was no vegetation cover to make slower the movement of water which rendered less time for infiltration there by higher amount as surface runoff. Vegetal covered dunes provided sufficient time to infiltrate and thus lowered loss of soil during rainfall and the conservation value obtained in comparison between bare and plant covered dunes is 37.159% (Table.6).

Table.6. Conservation Value

Dune no	SWP (Kg)	SWO (Kg)	CV for each dune (%)
1	3.18	4.967	35.97745
2	3.625	5.184	30.0733
3	3.742	5.368	30.29061
4	3.164	4.592	31.09756
5	3.581	4.973	27.99115
6	2.927	4.721	38.00042
7	3.214	4.836	33.54012
8	2.139	3.972	46.14804
9	2.583	4.268	39.47985
10	3.241	4.885	33.65404
11	1.952	3.769	48.20907
12	2.664	3.982	33.09895
13	2.385	3.956	39.71183
14	3.112	4.281	27.3067
15	3.046	4.538	32.87792
16	1.751	3.874	54.80124
17	2.625	4.132	36.47144
18	3.258	4.925	33.84772
19	3.147	4.783	34.20447
20	3.454	5.249	34.19699
21	2.938	4.55	35.42857
22	3.143	5.216	39.7431
23	1.915	4.207	54.48063
24	2.364	4.812	50.87282
Total	**69.15**	**110.04**	37.15921

Table.7. Conservation Value of Grass species applied.

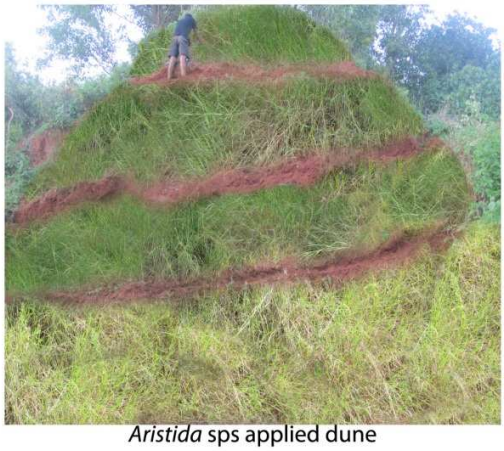
	SWP (Kg)	SWO (Kg)	C. V (%)
Aristida adscensionis	0.914	4.892	81.316
Cynodon doctylon	1.208	4.786	74.76

We have applied the grass species because grass species have dense vegetal cover and fine root system to bind the soil. *Aristida adscensionis* applied dune showed highest conservation value of 81.316% and *Cynodon doctylon* applied dune showed the conservation value of 74.76%. *Aristida adscensionis* has the dense vegetal cover than the *Cynodon doctylon*. Dense vegetal cover slowed the movement of falling water and pounding effect of the rain drops hitting the soil (Table.7) (Fig.5).

Fig.5.

Interacting with the local people in the field area

Bare dune (worker making spiral channels)



Aristida sps applied dune

Cynodon sps applied dune

Gully erosion

Ending up the soil in sea through streams

Socio-economic profile:
The people who are getting benefited by these Red Sand Dunes are residing in Nerellavalasa village. Nerellavalsa is small village which comes under Bhimili Mandal, Visakhapatnam district and it consists a number of 60 families, belong to scheduled caste. In 1970's 40 acres of land belonging to Red Sand Dunes was given to 20 families (each family 2 acres) lived in Nerellavalsa by the government of Andhra Pradesh at Yerra dibbalu(Red Beds). Now the families are increased from 20 to 60. Since then these socially and economically backward Scheduled Caste people occupied the lands in and around Red Sand Dunes to raise *Anacardium* and *Casuarina* plantation and getting a meager amount Rs. 15000/- to 20000/- per year. These people are totally depends on these lands for their sustainable livelihood. All head of the households are illiterates and a few middle aged and young people could able to complete their primary level of education.

The season for Cashew nut harvest is from September to December months. Remaining time these people sit ideally due to inability to skilled labour works that avail at nearer villages. Due to not having alternative livelihoods at their village few members of these families, especially young generation engaged themselves in daily wage labour works at nearer villages mostly at Visakhapatnam.

CONCLUSION

Anacardium occidentale and *Casuarina equisetifolia* are adding greenery to the study area. These two tree species are planted species in the Red Sand Dunes and rest of the plant species are naturally grown. The present investigation is contributed to provide some bench mark of the flora and nutrient status for future developmental aspects in Red Sand Dunes. The area is under severe erosion during monsoons and plant nutrients removed along the runoff and ending up into the sea resulting the land become unproductive. The results suggesting that, we need to protect such historical spot by maintaining the dune vegetation cover especially grass species Aristida adscensionis and Cynodon doctylon are the suggested grass species and showed the good conservation values. Grasses normally gives much better soil protection against erosion. Grass species have a much greater basal cover and have dense root systems to bind the soil. Erosion becomes negligible under continuous plant cover. We need to chalk out an integrated conservation programs to maintain the dune vegetation indigenous to the study area by involving the people who are getting benefited by the Red Sand Dunes. Moreover the study area is having tourism importance in Andhra Pradesh as it is integral part of natural beauty of Vishakapatnam. Conservation of this tourist spot will generate income to the government by implementing ecotourism practices too.

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