CHAPTER IV - OBSERVATIONS

Introduction

Biological diversity exists at many different levels, from the genetic diversity within local populations of a species, or between geographically distinct populations of the same species, all the way up to communities or ecosystems. One of the important aspects of ecology is the study of the distribution of plants and animals in habitats (spatial distribution) and change in population over a period of time (temporal distribution). Thus the most specific questions on ecology normally rest on the type of species, the number of species, the distribution of species and the environmental factors (physical and chemical characters) that determine the distribution (Spellerberg 1992).

The aim of this chapter is to study some of the basic elements of floristic biodiversity relevant to ecological elevation and assessment of nature. The most commonly used criteria for evaluation (in order to conserve) have been diversity, rarity and area (Margules and Usher 1981, Smith and Theberg 1986). Therefore, the same parameter has been made the basis of the present morphological and ecological studies. In addition vegetation composition in relation to the temporal distribution has been studied. The criteria of naturalness and of representativeness have also been considered as they have been extensively used in assessing areas for nature reserves.

4.1 FLORISTIC DIVERSITY OF DANGS

In the present work a total of 1276 taxa (1266 species and 10 varieties) belonging to 710 genera and 154 families of angiosperm have been collected from Dangs (Appendix 1, Table 4.1). Of these dicots represented by 895 species belonging to 522 genera and 116 families while monocots represented by 371 species belonging to 188 genera and 38 families. Of the 1266 species 362 are cultivated species (Appendix I).

The ratio of monocotyledons to dicotyledons is 1: 3 of families, 1:2.7 for genera and 1: 2.4 of species. The ratio of Family to Genera and Species is 1: 4.6: 8.2.

Out of the 1276 known species 914 species are wild in nature while 362 species are cultivated or introduced. The ratio of the wild plants - Monocots to Dicots

- is recorded as 1: 2.2, while the ratio of the cultivated and introduced plants - Monocots to Dicots - is 1: 3.1.

Table 4.1 Flowering Plants in Dangs

Group	Families	Genus	Species	Varities	Cultivated	Wild
Dicot	116	523	895	9	273	631
Monocot	38	183	371	1	89	283
Total	**154**	**706**	**1266**	**10**	**362**	**914**

The Monocotyledons apart from Poaceae and Cyperaceae, have been poorly represented, where as Fabaceae and Asteraceae are the largest families among the Dicotyledons. 75 families are represented by a single genus while 55 families represented by a single species.

Out of the total 1276 species of flowering plants of Dangs, 136 species (10.65 %) are climbers, 74 species (5.79 %) are shrubs, 237 species (18.57 %) are trees and 829 species (64.96 %) are herbs. (Appendix 1). This study shows that herbaceous plants (ephemeral plants) are dominating the forest and their surroundings. This is probably owing to the tropical dry conditions and erratic rainfall.

In comparison to the rest of the country, the ratio of genera to species in the present studies of flora of the Dangs is 1: 1.79. This is quite low in contrast to the corresponding ratio of India (1:7), but it is more or less in conformity with the ratio of Saurashtra (1: 2.05) (Santapau 1968, Bole and Pathak 1988); Gujarat (1: 2.1 Shah 1978); the Gangetic plain region (1: 2.2 Hooker 1907); and that of Delhi state (1: 1.63), as reported by Maheshwari (1963).

A ratio of Genera to Species to variety is given for all families occurring in the Dangs (Table 4.2). Among Dicots Fabaceae was the largest group with 65 Genera, 164 species and 3 varities while the monocot was lead by Poaceae with 66 Genera and 153 species. The other prominent families among dicots were Asteraceae (54:71), Acanthaceae (24: 46), Rubiaceae (20:30), Euphorbiaceae (19:47), Scrophulariacae (18:29). Further in the group of monocots there were Araceae (17:23) and Arecaceae (14:16), however this ratio is owing to number of cultivated species of this family grown in Dangs (Appendix I).

Table 4.2 Families of Angiosperm occur in Dangs with ratio of Genera: Species: varieties

Sr.No	Family	Genera : Species : Variety
1)	Acanthaceae	24:46
2)	Agavaceae	4:9
3)	Aizoaceae	1:1
4)	Alangiaceae	1:1
5)	Alliaceae	1:2
6)	Amaranthaceae	10:22:1
7)	Amryllidaceae	6:9
8)	Anacardiaceae	6:6
9)	Annonaceae	4:6:1
10)	Anthericaceae	1:4
11)	Apiaceae	9:12
12)	Apocynaceae	14:19
13)	Aponogetonaceae	1:1
14)	Araceae	17:23
15)	Arecaceae	14:16
16)	Aristolochiaceae	1:1
17)	Asclepiadaceae	9:12
18)	Asparagaceae	1:3
19)	Asphodelaceae	1:1
20)	Asteraceae	54:71
21)	Averrhoaceae	1:1
22)	Balanitaceae	1:1
23)	Balsaminaceae	1:2
24)	Basellaceae	1:1
25)	Begoniaceae	1:2
26)	Bignoniaceae	16:17
27)	Bixaceae	1:1
28)	Bombacaceae	3:3
29)	Boraginaceae	6:10
30)	Bromeliaceae	1:1
31)	Buddlejaceae	1:1
32)	Burseraceae	3:3
33)	Butomaceae	1:1
34)	Cactaceae	2:2
35)	Campanulaceae	1:1
36)	Cannaceae	1:2
37)	Capparidaceae	5:7
38)	Caricaceae	1:1
39)	Caryophyllaceae	2:2
78)	Lecythidaceae	3:3
79)	Leeaceae	1:2
80)	Lemnaceae	2:3
81)	Lentibulariaceae	1:3
82)	Linaceae	1:2
83)	Lobeliaceae	1:2
84)	Loganiaceae	1:1
85)	Loranthaceae	2:3
86)	Lythraceae	5:10
87)	Magnoliaceae	1:1
88)	Malpighiaceae	2:2
89)	Malvaceae	11:28
90)	Martyniaceae	1:1
91)	Meliaceae	3:4
92)	Menispermaceae	3:4
93)	Molluginaceae	2:2
94)	Moraceae	4:18:1
95)	Moringaceae	1:2
96)	Muntingiaceae	1:1
97)	Musaceae	2:2
98)	Myrsinaceae	1:1
99)	Myrtaceae	5:6
100)	Najadaceae	1:1
101)	Nelumbonaceae	1:1
102)	Nolinaceae	1:1
103)	Nyctaginaceae	2:6
104)	Nymphaeaceae	1:2
105)	Oleaceae	3:7
106)	Onagraceae	1:3
107)	Orchidaceae	12:26:1
108)	Orobanchaceae	1:1
109)	Oxalidaceae	2:3
110)	Pandanaceae	1:1
111)	Papvaraceae	1:1
112)	Passifloraceae	1:2
113)	Pedaliaceae	2:2
114)	Periplocaceae	2:2
115)	Phytolaccaceae	1:1
116)	Piperaceae	2:3
117)	Plumbaginaceae	1:1

40)	Casuarinaceae	1:1
41)	Celastraceae	3:3
42)	Chenopodiaceae	3:3
43)	Clusiaceae	1:1
44)	Cochlospermacea e	1:1
45)	Colchicaceae	2:2
46)	Combretaceae	3:8
47)	Commelianaceae	7:17
48)	Convolvulaceae	7:28:1
49)	Costaceae	1:1
50)	Crassulaceae	4:5
51)	Cruciferae	4:8:2
52)	Cucurbitaceae	11:18
53)	Cuscutaceae	1:2
54)	Cyperaceae	15:48
55)	Dilleniaceae	1:2
56)	Dioscoreaceae	1:7
57)	Dipterocarpaceae	1:1
58)	Dracaenaceae	3:7
59)	Ebenaceae	1:1
60)	Ehretiaceae	2:5
61)	Elaeocarpaceae	1:1
62)	Elatinaceae	1:1
63)	Eriocaulaceae	1:4
64)	Euphorbiaceae	19:47
65)	Fabaceae	65:164: 3
66)	Flacourtiaceae	2:4
67)	Gentianaceae	5:7
68)	Gesneriaceae	1:1
69)	Goodeniaceae	1:1
70)	Heliconiaceae	1:1
71)	Hyacynthiaceae	2:2
72)	Hydrocharitaceae	5:5
73)	Hydrophyllaceae	1:1
74)	Hypoxidaceae	2:2
75)	Iridaceae	2:2
76)	Lamiaceae	13:22
77)	Lauraceae	1:1
118)	Poaceae	66:153
119)	Polygalaceae	1:2
120)	Polygonaceae	4:6
121)	Pontederiaceae	2:2
122)	Portulacaceae	2:4
123)	Potamagetonaceae	1:1
124)	Primulaceae	2:2
125)	Proteaceae	1:1
126)	Punicaceae	1:1
127)	Ranunculaceae	1:2
128)	Rhamnaceae	2:8
129)	Rosaceae	1:1
130)	Rubiaceae	20:30
131)	Rutaceae	5:8
132)	Santalaceae	1:1
133)	Sapindaceae	5:6
134)	Sapotaceae	3:4
135)	Scrophulariaceae	18:29
136)	Simaroubaceae	1:1
137)	Smilacaceae	1:1
138)	Solanaceae	10:20
139)	Spigeliaceae	1:1
140)	Sterculiaceae	6:9
141)	Sterlitziaceae	2:2
142)	Taccaceae	1:1
143)	Tamaricaceae	1:1
144)	Theophrastaceae	1:1
145)	Tiliaceae	4:11
146)	Turneraceae	1:1
147)	Typhaceae	1:1
148)	Ulmaceae	2:2
149)	Urticaceae	7:7
150)	Verbenaceae	11:17
151)	Violaceae	1:1
152)	Vitaceae	4:5
153)	Zingiberaceae	4:7
154)	Zygophyllaceae	1:1

4.2 COMPARATIVE ACCOUNT OF THE DOMINANT FAMILIES OF THE REGION

A comparative account of the dominant ten families of The Flora of the Presidency of Bombay (Cooke, 1903-08), Flora of Maharashtra state (Singh &

Kartikeyan, 2000), Flora of Gujarat state (Shah, 1978) and Dharmapur Taluka (Reddy, 1987) with respect to Dangs showed that Fabaceae family headed the floral list in the flora of the country (Table 4.3). However in the present investigations Fabaceae has been observed as the dominant family, which in turn is followed by Poaceae and Asteraceae (probably on account of the intensive overgrazing in the area). The third dominant family Asteraceae shows conformity with Dharampur Taluka (Reddy 1987). This is an important diversion from the usual dominant list of families with the rest of the country. As regards the genera, the dominant generic group is that of Poaceae followed by Fabaceae and Asteraceae. In addition to this no other significant change has been observed in the case of the dominant genus *Cyperus.*

Table 4.3 Comparative analysis of ten dominant families in descending order of their occurrence in the Dangs in context of the country and the state

Sr. No.	Flora of Precidency of Bombay (Cooke 1901-08)	Flora of Maharashtra state (Singh & Kartikeyan, 2000)	Flora of Gujarat state (Shah 1978)	Dhrampur Taluka (Reddy 1987)	Dangs (Present Studies 2010-2013)
1	Fabaceae	Poaceae	Poaceae	Fabaceae	Fabaceae
2	Poaceae	Fabaceae	Fabaceae	Poaceae	Poaceae
3	Acanthaceae	Cyperaceae	Cyperaceae	Asteraceae	Asteraceae
4	Asteraceae	Acanthaceae	Asteraceae	Euphorbiaceae	Cyperaceae
5	Euphorbiaceae	Asteraceae	Acanthaceae	Acanthaceae	Euphorbiaceae
6	Rubiaceae	Orchidaceae	Euphorbiaceae	Convolvulaceae	Acanthaceae
7	Orchidaceae	Euphorbiaceae	Malvaceae	Cyperaceae	Rubiaceae
8	Lamiaceae	Rubiaceae	Convolvulaceae	Malvaceae	Scrophulariaceae
9	Scrophulariaceae	Scrophulariaceae	Lamiaceae	Rubiaceae	Malvaceae
10	Asclepiadaceae	Malvaceae	Scrophulariaceae	Cucurbitaceae	Convolvulaceae

4.3 SPECIES REPORTED IN EARLIER STUDIES AND IN PRESENT STUDY

With reference to earlier studies there is an addition of 363 species of which maximum addition of 40 species is from Fabaceae family while 13 species from Poaceae and Euphorbiaceae, 10 species from Orchidaceae and 9 species from Rubiaceae, 6 species from Asteraceae and Acanthaceae are reported as addition. Most of these species are indigenous to the region.

However, in an earlier survey at the Dangs, Suryanarayana (1968) has enlisted as many as 655 plant species (507 dicots and 148 monocots) with the ratio of dicots to moncots being 1: 3.4. Later, Shah and Suryanarayana (1969) added further 223 species (155 dicots and 68 monocots). During present study out of 878 species recorded from Dangs, 51 could not be relocated. Inspite of these factors there is an over all increase in the species diversity owing to an addition of 363 species (of which 277 species are of dicots and 86 species of monocots) to the list documented by Suryanaryana (1968,1969) and Desai (2013) (Table 4.4).

Table 4.4 Comparative account of species reported during earlier studies and present study.

Family	Suryanarayana (1968)	Suryanarayana and Shah (1969)	Total reports in 1968-1969	Present work (2009 -13)	Addition To Dangs
Fabaceae	91	33	124	164	40
Poaceae	65	43	108	153	45*
Asteraceae	46	19	65	71	06
Acanthaceae	28	12	40	46	06
Cyperaceae	28	16	44	48	04
Euphorbiaceae	27	07	34	47	13
Scrophulariaceae	21	10	31	29	02
Malvaceae	19	06	25	28	03
Lamiaceae	16	06	22	22	00
Convolvulaceae	14	09	23	28	05
Rubiaceae	14	07	21	30	09
Orchidaceae	12	04	16	26	10

*** Of these 32 species were reported by Desai (2013) thus there is an addition of 13 species.**

4.4 ADDITION TO THE FLORA OF GUJARAT

Seven wild plant species not reported earlier from Gujarat are recorded from the first time from the Dangs are as follows:

1.	*Adelocaryum coelestinum* (Lindl.) Brand Syn. *Paracaryum coelestinum* (Lindl.) C.B.Clarke	Boraginaceae
2.	*Dendrolobium umbellatum* (L.) Benth. Syn. *Desmodium umbellatum* (L.) DC.	Fabaceae
3.	*Erythrina stricta* Roxb.	Fabaceae
4.	*Geissaspis tenella* Benth.	Fabaceae
5.	*Geodorum densiflorum* (Lam.) Schltr.	Orchidaceae
6.	*Lamprachaenium microcephalum* Benth.	Asteraceae
7.	*Limnophila racemosa* Benth.	Scrophulariacee

Morphological characters of the plant species collected for the first time from the region are as follows:

***Adelocaryum coelestinum* (Lindl.) Brand**, Repert. Spec. Nov. Regni Veg. 13: 549. (1915). – *Cynoglossum coelestinum* Lindl. Edwards' Bot. Reg. 25: t. 36 (1839). – *Paracaryum coelestinum* (Lindl.) Benth. & Hook.f. Gen. Pl. 2: 850 (1876) in adnot.; C.B.Clarke in Hook.f., Fl. Brit. India 4: 160 (1883). – *Paracaryopsis coelestina* (Lindl.) R.R.Mill, Edinburgh J. Bot. 48: 57 (1991)

Biennial herb (as underground stem grows in full plant next year). Stems (30–) 90– 150 cm, stout, erect, reddish, lower part appressed-pubescent when young, later glabrate, upper part sparsely retrorse adpressed pubescent. Radical leaves with long petiole upto 15 cm or more longer; lamina broadly ovate, to at least 13–15 x 10.5–15 cm, acute at apex, base distinctly cordate; total number of principal veins (including midvein) 17–23, veins arcuately ascending, their hairs retrorse, dense with some hairs deflexed-patent; upper surface dark green with rather sparse 6 antrorse setules arising from calcifying tuberculate bases, lower surface paler, setulose only on veins, the hairs dense and mostly retrorse. Cauline leaves ovate, 4–10.5 x 2–4 cm (possibly larger), lower ones very shortly petiolate, upper ones sessile with cuneate base. Inflorescence a panicle of numerous furcate or simple terminal and subterminal scorpioid cymes, the primary dichotomies occasionally simple but usually with at

least secondary and frequently tertiary bifurcations; primary branches of inflorescence 12–20 cm in fruit including cyme; cymes of primary branches up to 30- flowered, secondary and tertiary branches shorter and fewer-flowered. Pedicels 0.5– 2 mm in flower, up to c.4 mm in fruit but often hidden by the group of nutlets which thus appears subsessile, somewhat curved downwards in fruit. Flowers all ebracteate. Calyx lobed almost to base; lobes ovate or ovate-elliptic, 2–3 x 1–1.5 mm in flower, 4–5 x 1.8–2.5 mm in fruit, densely hairy at base and with a thin line of hairs along midvein and around margin, otherwise glabrous. Corolla normally pale blue (white with blue centre during the dry season), shortly campanulate, 4–5 mm long, at least 6–8 mm in diameter (according to Riedl, 1992 up to 10–12 mm in diameter), the corolla lobes c.3 mm, the midvein normally not noticeably darker than the rest of the lobe (but contrasting at one locality; see note). Faucal scales semilunar, c.0.5–0.6 x 0.9–1 mm, emarginate. Gynobase in fruit 4–5 mm, narrowly pyramidal, the very short style comprising the uppermost c.0.5 mm and hardly projecting beyond the nutlets; stigma capitate. Nutlets 4 (all maturing), light ivory-grey when mature, triangular-napiform (the three distinct edges almost equilateral), 4–6 x 3.5–4.5 mm; wing c.2 mm high, its inner margin incurving slightly over the disc and coarsely dentate with c.5–6 glochidiate teeth on each of the three edges, the teeth 0.6–1 mm, narrowed from a slightly expanded base into a glochidiate tip; disc with scattered, short, erect glochids mainly in its central part, the midline 6 faintly raised; ventral surface glochidiate all over except on the attachment scar.

Distribution and ecology: India (Gujarat, Maharashtra, Karnataka). Wet forest on the Western Ghats, up to at least 1370 m.
Flowering: August to April.

Specimen examined: Gujarat, The Dang district, Ahwa tehsil, Saputara. DST 36 & DST 37 (BARO, Herbarium of Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara) **(Plate 28).**

Dendrolobium umbellatum (L.) Bentham in Miquel, Pl. Jungh. 218. 1852.

Hedysarum umbellatum L., Sp. Pl. 2: 747. 1753; *Desmodium umbellatum* (L.) Candolle.

Dwarf shrubs to shrubs or small trees, to 3 m tall. Young shoots terete, densely appressed sericeous. Leaves 3-foliolate; petiole 2-5 cm; terminal leaflet blade elliptic or ovate to orbicular or broadly ovate, 5-14(-17) × 3-7(-8.5) cm, lateral leaflets slightly smaller, abaxially appressed long hairy, adaxially glabrescent, lateral veins 7-12 on each side of midvein, reaching margin. Umbels often 10-20-flowered. Pedicel 3-7 mm at anthesis, 5-12 mm in fruit. Calyx 4-5 mm, upper lobe 2-toothed at apex. Corolla white; standard broadly obovate or elliptic, 1-1.3 cm × 6-10 mm, clawed; wings narrowly elliptic, 1.1-1.2 cm × 1-2 mm, clawed; keel broader than wings, 1.1-1.2 cm × 3-5 mm, clawed. Stamens ca. 1 cm. Pistil to 1.5 cm; ovary sericeous; style ca. 1.2 cm, glabrous. Legume narrowly oblong, 2-3.5 × 0.4-0.6 cm, (3-) 8-jointed; articles broadly elliptic or oblong. Seed elliptic or broadly elliptic, ca. 4 × 3 mm. Fl. Aug-Oct, fr. Nov-Mar.

Distribution and ecology: Cambodia, China, India, Indonesia, S Japan (Ryukyu Islands), Malaysia, Myanmar, Sri Lanka, Thailand, Vietnam; Africa, Australia, Pacific islands.

Flowering: August to October. **Fruiting:** November to March.

Specimen examined: Gujarat, The Dang district, Ahwa tehsil, Ambapada. DST 1653 & DST 1654 (BARO, Herbarium of Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara) **(Plate 10).**

Erythrina stricta Roxb. Fl. Ind., ed. 1832, 3: 251. 1832.

Trees, 7–12 m tall. Trunk straight. Branches with short whitish prickles. Leaves pinnately 3-foliolate; stipules deciduous; petiole 12–15 cm, rarely with prickles; terminal leaflet broadly triangular, almost rhomboid, or broadly reniform-oblate, 7–19 × 7–24.5 cm, both surfaces glabrous, lateral veins 5– 8 pairs, base nearly cordate, truncate, or broadly cuneate, margin entire, apex acute or caudate with mucro 10–15 mm. Raceme ca. 15 cm, flowers in clusters of 3 or 4. Calyx spathelike, undivided or apex slightly 2-lobed. Corolla red; standard elliptic- lanceolate or ovate-triangular, erect, 3–4.5 cm, subsessile; wings subobovate, 6–8 mm, shorter than calyx; keels much longer than wings. Ovary hairy, stipitate; style narrow, glabrous. Legume 7–12 × 0.7–1.5 cm, glabrous. Seeds 1–3 or more, light or dark brown, reniform.

Distribution and ecology: Bhutan, Cambodia, China, India, Laos, Myanmar, Nepal, Thailand, Vietnam.
Flowering: March to July. Fruiting: April to September.

Specimen examined: Gujarat, The Dang district, Ahwa tehsil, Saputara. DST 1727 & DST 1801 (BARO, Herbarium of Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara) **(Plate 10).**

Geissaspis tenella Benth., Fl. 32: 559. 1849; Baker in Hook.f. Fl. Brit. India 2;141. 1876; Cooke, Fl. Pres. Bombay 1; 354. 1958 (Repr.) Sanjappa, Legumes of India 181. 1991; Kothari in Singh *et al.* Fl. Maharashtra St. Dicot. 1: 692. 2000.

Herbs, annual, 15–60 cm tall. Stems becoming somewhat woody at base, procumbent, many branched at base, with aboveground adventitious roots; branchlets sparse, slender. Stipules lanceolate, 3–4 mm, membranous, apically striate, margin long ciliate. Leaves 4-foliolate; petiole 3–4 mm; rachis swollen to shortly winged; leaflets subsessile; leaflet blades obcordate to obovate, 4–7 × 3–4 mm, secondary veins 3–5 on each side of midvein, base cuneate and oblique, apex acute to slightly emarginated and mucronate. Racemes axillary, congested, 1.5–1.6 cm; peduncle ca. 1.2 cm; bracts 6–12, almost orbicular to obliquely reniform, 0.7–1 × ca. 1.5 cm, with yellow setaceous cilia. Calyx 1.2–1.5 mm. Corolla yellow or purple; standard ca. 5 mm wide, creamy outside, with 2 purple-red spots inside near base; wings obovate, small; keels purplish black, small. Ovary linear; style filiform; stigma terminal. Legume oblong, ca. 4 mm, with conspicuous margin, with 1 or 2 articles, apex shortly beaked. Seeds chestnut-brown, reniform, ca. 2 mm in diam. Fl. and fr. May–Jan.

Distribution and ecology: India.
Flowering: July to March. Fruiting: July to March.

Specimen examined: Gujarat, The Dang district, Ahwa tehsil, Saputara. DST 1737 & DST 1838 (BARO, Herbarium of Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara) **(Plate 11).**

Geodorum densiflorum (Lam.) Schltr. in Feddes Repert. 4: 259. 1929; Santapau and Kapadia, Orch. Bombay 203, t. 50. 1966; B. D. Sharma *et al.*, Fl. Karnataka Anal. 270. 1984; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 140. 1989. *Limodorum densiflorum* Lam., Encycl. 3: 516. 1791-92. *Geodorum dilatatum sensu* Hook. *f.*, Fl. Brit. India 6: 17. 1890, *non* R. Br. 1813; T. Cooke, Fl. Pres. Bombay 3: 198. 1958 (Repr.). '*Haryakand*'.

Terrestrial, perennial herbs. Pseudobulbs tuberous, ovoid-conical, greenish brown, *ca* 5 x 3 cm. Leaves 1 or 2, forming a pseudostem *ca* 1.5 cm tall and *ca* 1.3 cm thick, the leaves *ca* 30 x 8 cm, sheathing at base, many nerved, obovate-oblong or elliptic-lanceolate, subplicate, acute, entire, upper one tapering into long narrow petiole. Flowers *ca* 1.5 cm long, numerous in a compact subcorymbose raceme, facing downwards, pinkish-white or white, bracteate, shortly pedicellate. Sepals *ca* 1.2 x 0.4 cm, pure white or white flushed with very pale mauve. Petals similar to sepals but slightly broader. Lip obscurely 3-lobed, white, flushed with pale pink or mauve. Capsules ellipsoid, conspicuously 6- ribbed.

Distribution and ecology: Bhutan, Cambodia, China, India, Laos, Myanmar, Nepal, Thailand, Vietnam.
Flowering: June to October. Fruiting: July to November.

Specimen examined: Gujarat, The Dang district, Ahwa tehsil, Ambapada. DST 1789 & DST 1790 (BARO, Herbarium of Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara) **(Plate 11).**

Lamprachaenium microcephalum Benth.in Benth & Hook. f. Gen. Pl. 2: 226. 1873; Hook. f. Fl. Brit. India. 3: 229. 1881: Cooke, Fl. Pres. Bombay 2: 64. 1858. (Repr.); Uniyal in Hajra et. al. Fl. India 13:337. 1995.

An erect herb 30-60 cm. high; stem simple or branched, glabrous, hairy or glandular, often tinged with purple. Leaves 5-8 x 2.5-4 cm., elliptic, acuminate, sparsely clothed with short bristly hairs above, densely covered with white woolly tomentum beneath, distantly bristle-serrate, tapering at the base ; petioles 9-19 mm long. Heads small, 5-9 mm. in diam., numerous, on slender hairy peduncles. Involucre -bracts elliptic-lanceolate, cuspidate, white-tomentose on the back; the exterior

foliaccous at the tip, erect or recurved, acute, with densely ciliate margin; the interior a little longer, scarious, villous. Pappus reddish, equalling the corolla-tube, rigid. Achenes 2-3 mm long, obovoid, turgid, slightly compressed, smooth, shining.

Distribution and ecology: Bhutan, Cambodia, China, India, Laos, Myanmar, Nepal, Thailand, Vietnam.
Flowering: June to October. Fruiting: July to November.

Specimen examined: Gujarat, The Dang district, Ahwa tehsil, Saputara. DST 1759 & DST 1760 (BARO, Herbarium of Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara) **(Plate 28).**

Limnophila racemosa, Benth. Scroph. Ind. (1835) p. 26.

Stem 30-60 cm. long or in deep water longer, stout, erect, mostly submerged, glabrous or hairy. Upper leaves sessile, 3-5 x 0.6-1.3 cm., opposite or 3-nately whorled, semi-amplexicaul and somewhat rounded at the base, oblong-lanceolate, serrate-dentate, glabrous, strougly 3-5-nerved ; lower leaves submerged, capillaceo-multifid, often deflexed and root-like. Flowers large, usually in long erect leafy racemes 5-10 cm. long; bracteoles 2 mm. long, linear-subulate; pedicels 5-12 mm. long, filiform. Calyx 5 mm. long, thinly membranous, glabrous, not striate in fruit, divided about half -way down; segments deltoid-ovate, acute, sometimes colored. Corolla 12 mm. or more long, pale-violet; lobes of the upper lip short, rounded, those of the lower lip ovate, acute. Capsules subglobose, 5 mm. long, enclosed in the membranous calyx. Seeds scarcely 1 mm. long, truncate at both ends.

Distribution and ecology: India. Found submerged in shallow water of rivers. In later season sometime get exposed and found as wetland plant.
Flowering: October to May. Fruiting: October to May.

Specimen examined: Gujarat, The Dang district, Ahwa tehsil, Ambapada. DST 1771 & DST 1772 (BARO, Herbarium of Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara) **(Plate 11).**

4.5 ADDITION TO THE FLORA OF DANGS

Addition of 363 plant species not reported earlier from Dangs after the last extensive studies done by Suryanarayana (1968), Shah and Suryanarayna (1969), Shah (1978) and Desai (2013) has been made. The new addition includes indigenous species, cultivated, cultivated and escapes species as an addition to the flora of Dangs (Appendix I) **(Plate 8, 9)**.

4.6 PLANT SPECIES REPORTED EARLIER FROM DANGS BUT COULD NOT BE RELOCATED IN THE PRESENT STUDIES

51 Plant species reported earlier from Dangs by Suryanarayana (1968), Shah and Suryanarayna (1969) and Shah (1978) could not be relocated in the present studies. Out of 51 plant species 23 are dicots and 28 are monocots. The details of these plant species are as follows:

Dicots

1) *Antidesma ghaesaembilla* Gaertn. (EUPHORBIACEAE): Collected by Dastur (1922) from Dangs; later reported from Valsad, growing in hedges (Shah, 1978).
2) *Barleria gibsoni* Dalz. (ACANTHACEAE): Dangs (Saputara); rare.
3) *Barleria lawii.* T. Anders
   Syn *Barleria longifolia* Grah (ACANTHACEAE): Has been reported from Saputara (Shah and Suryanarayana, 1969) where they found it common and abundant but not observed in present study may be due to ecotourism development of Saputara which resulted in habitat destruction of the species.
4) *Breynia retusa* (Dennst.) Alston.
   Syn. *Breynia patens* (Roxb.) Rolfe, *Melanthesa retusa* (Dennst.) Kostel., *Phyllanthus retusus* Dennst.(EUPHORBIACEAE): A shrub with wide distribution in Gujarat but not relocated.
5) *Casearia nigrescens* Tul.
   Syn.*Casearia elliptica* Tul. (FLACOURTIACEAE): A small tree, earlier reported from Dangs, Valsad and Dediapara forests as occasional (Joshi 1983). However, the species was not located from the known site or even from the sites visited.
6) *Clematis heynei* M.A.Rau & al.

Syn. *Clematis triloba* Heyne ex Roth. (RANUNCULACEAE): The climber has been reported from Dangs (Unai) by Santapau (1953). However, Unai region now comes under Navsari district.

7) *Convolvulus arvensis* L. (CONVOLVULACEAE): Reported throughout in plains as common but not relocated may be due to hilly region.
8) *Corchorus trilocularis* L. (TILIACEAE): Reported throughout as uncommon but not relocated may be due to over grazing.
9) *Derris scandens* (Roxb.) Benth. (FABACEAE (PAPILIONACEAE): A large, woody climber earlier observed in Vansda and Vad Khamba, near habitations on hedges, not noted from the forests (Joshi 1983). However, Vansada region now comes under Navsari district.
10) *Diospyros montana* Roxb. (EBENACEAE): A tall armed tree, earlier reported from Saputara as very rare could not be relocated may be due to ecotourism development of Saputara which resulted in habitat destruction of the species.
11) *Dodonaea viscosa* (L.) Jacq. (SAPINDACEAE): Reported from Forest office as hedge plant at Ahwa (Shah and Suryanarayana, 1969) and could not be relocated due to removal of hedge.
12) *Ficus rumphii* Bl. (MORACEAE): A tree was listed by Patel, R.I. from South Gujarat forests.
13) *Grewia columnaris* Sm. (TILIACEAE): The tree earlier reported from Valsad. However, the species was not located from the known site or even from the sites visited. As such the plant species is rare and has been reported to occur in Dangs.
14) *Hiptage benghalensis* (L.) Kurz Syn.*Banisteria bengalensis* L. *H. madablota* Gaertn. (MALPIGHIACEAE): Reported earlier from Malegaon-Saputara forests but not observed in present study may be due to ecotourism development of Saputara which resulted in habitat destruction of the species.
15) *Flacourtia montana* Grah. (FLACOURTIACEAE): The thorny tree has been reported from Pavagadh. However, the species was not located from the known site or even from the sites visited. As such the plant species is rare and has been reported to occur in Dangs.
16) *Grewia columnaris* Sm. (TILIACEAE): The tree earlier reported from Valsad. However, the species was not located from the known site or even from the

sites visited. As such the plant species is rare and has been reported to occur in Dangs.

17) *Luffa echinata* Roxb. (CUCURBITACEAE): A glabrous climber observed on hedges, not frequent. As such the plant species is rare and has been reported to occur in Dangs.

18) *Merremia aegyptia* (L.) Urban. Syn. *Ipomoea pentaphylla* Jacq., *I. aegyptia* L., *M. pentaphylla* Hall. (CONVOLVUCEAE): Plant has been repoted as a rare climber on hedges and in Forest undergrowth. The plant could not be located in wild.

19) *Salix tetrasperma* Roxb. (SALICACEAE): Reported from stony river beds at Mahal.

20) *Sesbania sesban* (L.) Merr.

Sesbania sesban var. *picta* Sant. Syn. *S. aegyptiaca* Poir. (FABACEAE): Reported throughout as uncommon but not relocated may be due to over grazing.

21) *Sida retusa* L. (MALVACEAE): Reported throughout as uncommon but not relocated may be due to over grazing.

22) *Triumfetta petandra* A.Rich. Syn.*T. neglecta* W. & A. (TILIACEAE): Reported throughout as uncommon but not relocated may be due to over grazing.

23) *Trichodesma amplexicaule* Roth.

Syn. *Trichodesma indicum* (L.) R. Br. var *amplexicuale* Cooke. (BORAGINACEAE): A much-branched, very hispid herb. Infrequently distributed throughout in fallow fields, and among grasses but not relocated may be due to over grazing.

MONOCOTS:

1) *Amorphophallus commututus* (Schott.) Engler. Syn. *Conophallus commutatus* Schott.; *Amorphophallus sylvaticus* Dalz. & Gibs. (ARACEAE): A herb reported throughout in deciduous forests in shade but not relocated.
2) *Aristida cyanantha* Nees ex Steud (POACEAE): Earlier reported as very rare.
3) *Arthraxon prionodes* (Steud.) Dandy. Syn. *Andropogon prionodes* Steud. (POACEAE): Throughout, among other grasses.
4) *Arundinella metzii* Hochst. Ex Miq. Syn. *Agrostis pygmaea* Hk. f. (POACEAE): Throughout in moist places, except Kutch and Saurashtra; frequent.
5) *Arundo donax* L. (POACEAE): Patel (1965) reports it to be common in South Gujarat, Central Gujarat and North Gujarat in wet areas. But it has been seen by Shah only under cultivation. Blatter and McCann (1935) have also so reported.
6) *Bothriochloa intermedia* (R.Br.) ACamus. Syn.*Andropogon intermedius* R. Br., *Amphilophis glabra* Blatt. & McC. (POACEAE): Perennial, from North to South Gujarat, common (Patel 1965).
7) *Brachiaria setigera* (Retz.) Hubb. Syn. *Panicum setigerum* Retz.; *Urochloa setigera* (Retz) Stapf. (POACEAE): Slender herb, throughout.
8) *Capillipedium assimile* (Steud.) A. Camus Syn *Andropogon assimilis* Steud. (POACEAE): Herb, reported from South Gujarat growing in shady ground (Patel 1965).
9) *Capillipedium filliculme* (Hk.f.) Stapf. Syn. *Andropogon filiculmis* Hk.f. (POACEAE): Throughout, except Saurashtra and Kutch, in plains and hills.
10) *Capillipedium parviflorum* (R. Br.) Stapf. Syn *Holcus parviflrous* R. Br. (POACEAE): Dangs.
11) *Chrysopogon fulvus* (Spreng.) Choiv. Syn.*Pollinia fulva* Spreng., *Andropogon monticola* Schult. Ex Roem. (POACEAE): Throughout, everywhere; common.

12) *Chrysopogon polyphyllus* (Hack. Ex. Hk. f.) Blatter. & McCann. Syn. *Andropogon polyphyllus*
Hack. ex Hk. f. (POACEAE): Throughout, in shaded spots.

13) *Commelina hasskarlii* Clarke. (Commelinaceae): Throught in moist ground; occasional.

14) *Cyperus compactus* Retz. Syn. *Cyperus dilutus* Vahl.; *Mariscus microcephalus* Presl.; *Mariscus compactus* Retz. (CYPERACEAE): South Gujarat (Dangs and Songadh); very rare.

15) *Fimbristylis tetragona* R. Br. Syn. *Fimbristylis cylindrocarpa* Kunth. (CYPERACEAE): Earlier reported from Kutch and South Gujarat (Valsad, Surat and Dangs).

16) *Fimbristylis woodrowii* C.B.Clarke (CYPERACEAE): Earlier reported from Central Gujarat (Baroda, Tuwa) and South Gujarat (Dangs).

17) *Heteropogon ritchiei* (Hk. f.) Blatter & McCann Syn. Andropogon ritchiei *Hk. f.* (POACEAE): North to South Gujarat, in dry or slightly moist places. Also reported from Dangs (Saxton 1921).

18) *Ischaemum goebelii* Hack. Syn. *Ischaemum aristatum* Hack. Subsp. *imberbe* Hack. Var. *imbricatum* Hack. (POACEAE): Dangs (Waghai).

19) *Ischaemum timorense* Kunth. (POACEAE): Dangs (Waghai).

20) *Kyllingiella microcephala* (Steud.) R.W.Haines & Lye Syn. *Scirpus kyllingioides* Boeck. (CYPERACEAE): Rhizomatous herb, earlier reported from Chotaudepur forest division, Panchmahal and Dangs.

21) *Oryza minuta* J. A. PresL. ex C. B. Presl. Syn. *Oryza latifolia* Hk. f. (POACEAE): Dangs (Waghai- Pimpri road and along Nasik road).

22) *Pseeudosorghum fasciculare* (Roxb.) A. Camus Syn. *Andropogon fascicularis* Roxb.; *Andropogon nitidus* Hk. f. (POACEAE): Dangs and Waghai.

23) *Pseudanthistiria hispida* Hk. f. (POACEAE): Gujarat, in forests, under shade (Patel 1965); at Dangs, abundant, gregarious in open grasslands.

24) *Schoenoplectiella roylei* (Nees) Lye Syn. *Scirpus roylei* (Nees) R. Parker; *Scirpus quinquefarius* Hau. (CYPERACEAE): An annual, throughout, common.

25) *Sorghum controversum* (Steud.) Snowden Syn. *Andropogon laxum* Roxb.; *Andropogon controversus* Steud. (POACEAE): Dangs - Ahwa; a very rare species.

26) *Sorghum purpureo - sericeum* (Hochst. ex A. Rich.) Aschers. Syn. *Andropogon purpureo-sericeus* Hochst. ex A. Rich.; *Sorghum deccanense* Sensu Patel (POACEAE): South Gujarat on black soil. Blatter and McCann (1935) cite loc. Garhvi- Dangs.

27) *Tripogon lisboae* Stapf (POACEAE): Reported by Santapau, H. (1955).

28) *Zeuxine strateumatica* (L.) Schlech. Syn. *Z. sulcata* Lindl. (ORCHIDACEAE): A herb throughout, among grasses (except Kutch).

4.7 ENDEMIC ANGIOSPERMS GENERA OF INDIA OCCURRING IN DANGS

A recent list of endemic genera of angiosperm in India has been prepared by Irwin and Narsimhan (2011) of which *Glyphochloa* Clayton (Poaceae), *Haplanthodes* Kuntze (Acanthaceae) **(Plate 29),** *Lamprachaenium* Benth. (Asteraceae) **(Plate 28),** *Paracaryopsis* (Riedl) R.R. Mill (Boraginaceae) **(Plate 28)** and *Trilobachne* Schenck ex Henrard (Poaceae) are endemic genera recorded from Dangs.

4.8 SPECIES WITH RESTRICTED DISTRIBUTION

In addition to the endemic species there are 33 plant species which are having restricted distribution to Saputara- Malegaon region probably due to high moisture content and high altitude. Most of these plant species have been collected from the steep slopes of Saputara at higher altitude. List of these plants is provided in Table no. 4.5

Table 4.5 Species with Restricted distribution

Sr. No.	FAMILY	SPECIES NAME
1	ACANTHACEAE	*Asystasia dalzelliana* Sant.
2	ACANTHACEAE	*Justicia betonica* L.
3	ACANTHACEAE	*Neuracanthus trinervius* Wt.
4	ACANTHACEAE	*Thunbergia fragrans* Roxb.
5	ARACEAE	*Remusatia vivipara* (Roxb.) Schott
6	ASCLEPIADACEAE	*Tylophora dalzellii* Hook.f.
7	ASCLEPIADACEAE	*Tylophora fasciculata* Ham.

Sr. No.	FAMILY	SPECIES NAME
8	ASTERACEAE	*Vernonia divergens* (DC.) Edgew.
9	BEGONIACEAE	*Begonia crenata* Dryand.
10	BORAGINACEAE	*Adelocaryum coelestinum* (Lindl.) Brand
11	BORAGINACEAE	*Cynoglossum meeboldii* Brand.
12	BORAGINACEAE	*Trichodesma inaequale* Edgew.
13	COMBRETACEAE	*Terminalia chebula* Retz.
14	CONVOLVULACEAE	*Ipomoea illustris* (CL.) Prain.
15	EUPHORBIACEAE	*Bridelia squamosa* (Lam.) Gehrm.
16	EUPHORBIACEAE	*Euphorbia pycnostegia* Boiss.
17	FABACEAE (FABOIDEAE)	*Dolichos trilobus* L.
18	FABACEAE (FABOIDEAE)	*Vigna khandalensis* (Santapau) Sundararagh. & Wadhw.
19	GENTIANACEAE	*Swertia minor* (Griseb.) Cooke.
20	HYPOXIDACEAE	*Hypoxis aurea* Lour.
21	ORCHIDACEAE	*Dendrobium barbatulum* Lindl.
22	ORCHIDACEAE	*Dendrobium microbulbon* A. Rich.
23	ORCHIDACEAE	*Dendrobium ovatum* (Willd.) Kranz
24	ORCHIDACEAE	*Dendrobium peguanum* Lindl.
25	RHAMNACEAE	*Zizyphus glaberrima* Santapau.
26	RUBIACEAE	*Pavetta crassicaulis* Bremk.
27	RUBIACEAE	*Wendlandia heynei* (R & S) Sant. & Merch.
28	SCROPHULARIACEAE	*Buchnera hispida* Buch Ham..
29	SCROPHULARIACEAE	*Centranthera indica* (L.) Gamble.
30	SCROPHULARIACEAE	*Sopubia trifida* Buch.-Ham. ex D. Don.
31	SCROPHULARIACEAE	*Striga asiatica* (L.) Kuntze.
32	SOLANACEAE	*Nicandra physalodes* (L.) Gaertn.
33	URTICACEAE	*Boehmeria scabrella* (Roxb.) Gaud.

4.9 EXOTIC PLANT SPECIES OF DANGS

During the past few decades a large number of plants have been introduced in India. Many of such plants got acclimatized and spreading successfully in different parts of the area (Dabgar, 2012). In India, comprehensive studies on invasive species and plant invasions are still missing. In view of this, the present study attempted to focus on the invasive alien species in the flora of Dangs.

Of the 1276 plant species collected from Dangs, 197 plant species are of exotic origin (Appendix II). The ratio of exotic monocots to dicots was 1:5.56. The large dicot families in the exotic flora were that of Asteraceae, Caesalpiniaceae, Convolvulaceae, Euphorbiaceae and Fabaceae, whereas the only major monocot family was Poaceae.

Table 4.6 Exotic plant species of the Dangs.

Category	Exotic species	
Dicotyledons	167	84.78%
Monocotyledons	30	15.22%
Total	**197**	**100%**

Table 4.7 Distribution of the exotic species of the Dangs among families and genera, genus/family (g/f) and species/family (s/f) ratios.

Angiosperms	Family	Genera	Species	g/f	s/f
Dicotyledons	53	134	167	2.53	3.15
Monocotyledons	12	27	30	2.25	2.5

Table 4.8 The largest families with more than 3 exotic species of angiosperms in the alien flora of the Dangs (present values refer to column totals).

Monocotyledons			**Dicotyledons**		
Family	**Exotic sp.**		**Family**	**Exotic sp.**	
POACEAE	14	46.67%	MALVACEAE	5	2.99%
			TILIACEAE	5	2.99%
			FABACEAE	8	4.79%
			CAESALPINIACEAE	10	5.99%
			MIMOSACEAE	6	3.59%
			ASTERACEAE	25	14.97%

			APOCYNACEAE	5	2.99%
			CONVOLVULACEAE	10	5.99%
			SOLANACEAE	8	4.79%
			BIGNONACEAE	5	2.99%
			AMARANTHACEAE	8	4.79%
			EUPHORBIACEAE	9	5.39%
Others	16	53.33%	Others	63	37.72%

4.10 PROVISIONING SERVICES OF ECOSYSTEM

WILD PLANTS USED AS FOOD PLANTS BY PEOPLE OF DANGS.

The tribal people of Dangs use various plants parts as a food. Of these the underground tubers/rhizome are the best source of food. As many as 11 tubers/ rhizome are used as a source of food. Many of the tender fuits and mature fruits (10) are also used as a source of food. Six members of Dioscoraceae are major source of food as tubers while three members of Anacardiaceae used as a source of fruit/food (Table 4.9). These are even sold in the market. Total 33 plants are used as food plants.

Table 4.9 Wild plant used as food by people of Dangs.

Sr. No.	FAMILY	SPECIES	Part used
1	DILLENIACEAE	*Dillenia pentagyna* Roxb.	Calyx
2	PORTULACACEAE	*Portulaca oleracea* L.	Whole plant
3	BOMBACACEAE	*Bombax ceiba* L.	Tender fruits
4	RUTACEAE	*Aegle marmelos* Corr.	Tender Fruits
5	BURSERACEAE	*Garuga pinnata* Roxb.	Tender fruits
6	SAPINDACEAE	*Schleichera oleosa* (Lour.) Merr.	Seeds
7	ANACARDIACEAE	*Buchanania cochinchinensis* (Lour.) M.R.Almeida	Fruit
8	ANACARDIACEAE	*Mangifera indica* L.	Fruit
9	ANACARDIACEAE	*Spondias pinnata* (L.) f.	Fruit
10	FABACEAE	*Abrus precatorious* L.	Leaves
11	CAESALPINIACEAE	*Bauhinia purpurea* L.	Tender leaves
12	COMBRETACEAE	*Terminalia bellirica* (Gaertn.) Roxb.	Seeds
13	RUBIACEAE	*Hymenodictyon orixense* (Roxb.) Mabb.	Roots
14	RUBIACEAE	*Morinda citrifolia* L.	Fruits
15	RUBIACEAE	*Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre	Fruits
16	SAPOTACEAE	*Madhuca longifolia* (J.König ex L.) J.F.Macbr	Flowers and Seeds
17	APOCYNACEAE	*Carissa congesta* Wight.	Fruits
18	EUPHORBIACEAE	*Emblica officinalis* Gaertn.	Fruits
19	ORCHIDACEAE	*Nervilia discolor* (Bl.) Schltr.	Tubers
20	MUSACEAE	*Ensete superbum* (Roxb.) Cheesman	Stalk of young inflorescence, and Pseudo stem

Sr. No.	FAMILY	SPECIES	Part used
21	DIOSCOREACEAE	*Dioscorea belophylla* (Prain) Voigt ex Haines	Tubers
22	DIOSCOREACEAE	*Dioscorea bulbifera* L.	Tubers
23	DIOSCOREACEAE	*Dioscorea hispida* Dennst.	Tubers
24	DIOSCOREACEAE	*Dioscorea oppositifolia* L.	Tubers
25	DIOSCOREACEAE	*Dioscorea pentaphylla* L.	Tubers
26	DIOSCOREACEAE	*Dioscorea wallichii* Hk. f.	Tubers
27	ANTHERICACEAE	*Chlorophytum borivilianum* Sant. & Fernand.	Leaves
28	ANTHERICACEAE	*Chlorophytum tuberosum* (Roxb.) Baker.	Leaves
29	ANTHERICACEAE	*Chlorophytum malabaricum* Baker.	Leaves
30	ARACEAE	*Amorphophallus bulbifer* (Roxb.) Blume	Tuber
31	ARACEAE	*Colocasia esculenta* (L.) Schott.	Leaf and Rhizome
32	POACEAE	*Dendrocalamus strictus* (Roxb.) Nees	Young shoots

CULTIVATED PLANTS

CEREALS

7 Cereals are generally cultivated in Dangs. *Pennisetum glaucum, Sorghum bicolor, Zea mays, Oryza sativa, Triticum aestivum, Eleusine coracana, Panicum miliaceum.*

PULSES

10 Pulses are generally grown in Dangs. *Cajanus cajan, Cicer arietinum, Vigna unguiculata subsp. cylindrica, Vigna radiata, Pisum sativum, Cyamopsis tetragonoloba, Phaseolus vulgaris.*

OIL YIELDING

7 Oil yielding plants are generally cultivated in Dangs.- *Arachis hypogaea, Glycine max, Guizotia abyssinica, Sesamum indicum, Helianthus annuus, Brassica juncea.*

FRUITS

10 Fruits plants are generally cultivated in Dangs.- *Mangifera indica, Papaya Carica papaya, Musa paradisiaca, Annona reticulata, Annona squamosa, Punica granatum, Manilkara zapota, Psidium guajava, Zizyphus mauritiana, Anacardium occidentale*

SPICES

9 Spices are generally grown in Dangs. - *Capsicum annum, Zingiber officinale, Foeniculum vulgare, Murraya koenigii, Curcuma longa, Coriandrum sativum L., Allium cepa, Curcuma amada*

VEGETABLES

21 Vegetables are generally grown in Dangs.- *Solanum melongena, Solanum tuberosum, Lycopersicon lycopersicum, Ipomoea batatas, Coccinia grandis, Cucumis sativus, Cucurbita maxima , Luffa cylindrica, Momordica charantia, Momordica dioica, Daucus carota, Capsicum annum, Brassica oleracea var. botyrytis, Brassica oleracea var. capitata, Amorphophallus campanulatus, Raphanus caudatus, Raphanus sativus, Cucumis sativus. Spinacia oleracea, Amaranthus tricolor, Chenopodium album,*

SUGAR SOURCE

1 sugar plant *Saccharum officinarum* is largely cultivated in the Dangs.

FIBRE PLANT

1 fiber plant *Crotalaria juncea* is widely grown for fiber in Dangs.

MASTICATORY

1 Masticatory plant *Nicotiana tabacumn* is cultivated in Dangs.

4.11 THREATS TO THE BIODIVERSITY

Loss of biodiversity has both direct and indirect causes. Land slide, Water erosion, Wind erosion, Tree falling, Fire, Lightning, Heavy rain fall and Water loss are the Natural threats. Heavy rain fall is the major threat which subsequently leads to other threats like land slide, water erosion, and tree falling and water loss.

A major natural threat to biodiversity of Dangs is owing to heavy rainfall. Heavy rainfall leads to soil erosion which leads to exposing roots of many plant species leads to death of them. Heavy rain also soften the soil which result in the falling of trees having high mass. High rainfall in hilly region often results in landslide which some time create much havoc in the area. Seeds and fruit of many plants run off with water during heavy rainfall resulting in loss of regenerating material.

Among the anthropological activity fuel wood collection is the major threat to biodiversity of Dangs. Most of people depends on fuel wood as the district has 94 % are tribal population. People depends on fuel wood from the forest area as the Dang has 77.69 % forest cover (FSI, 2011). Fuel wood collection result in degradation of forest and natural habitat. Direct cutting results in the falling of trees and loss of the shed barrier for the upcoming seedlings.

Ecosystem change (ecosystem loss and ecosystem alteration) is also considered as major threats to biodiversity. Threats from human activities result in the reduction, conversion, fragmentation, alteration, modification of habitat and/or ecosystems which may lead to a loss ecosystem integrity or function Shifting cultivation is practiced by many farmers in Dangs, where local people are allowed to use the forest land surrounding the village according to tribal act, 2006. These resulted in loss of the 3% forest area from 2009 to 2011 aasessment (FSI, 2011).

Pollution is minor threat to biodiversity of Dangs as there is no industrial area in the district and also there is no industrial area in vicinity of the district. The major air pollution in the area is due to fuel wood burning. Especially during monsoon season and winter season due to low temperature people burn more fuel wood, mostly throughout the night period to warm themselves and the living area.

Water pollution is done by people only through washing their clothes and animals in the river and streams which results in direct threats to aquatic biodiversity.

Grazing

There were times when the cows and buffaloes were kept to produce only he animals to be used as draught animals. Milk was never considered the economic product. In remote villages, one had to strive hard to get some milk for a morning tea. This was the condition in the hilly terrains of the forested area. Plains had herds, these produced milk and milk products and the history of "Shwet Kranti" is well known to all concerned.The results of "Shwet Kranti" did infiltrate in the outskirts: doodh mandlis" are established and cattle started giving economic returns to the tribals. With this social change the cattle population started increasing in the Dangs too. More milk means more food to milk giving cows and buffaloes. Stall-feeding is rarity or practical only during rainy days. Gauchers (the pasture lands) are identified and allotted to each village or to the group of villages in many regions of Dangs. The present status of such gauchers is not known. The matter needs further study. Even if gauchers are there the cattle will not necessarily confine to the boundaries of gauchers. They stray elsewhere and generally enters into forest areas causing damage to the biodiversity of the same. The damage is caused by real grazing, stampeding young saplings or by peeling off the bark of young trees.

Over-exploitation of plants

The forest has been exploited especially for timber for household purposes. Thus illicit cutting is practiced mainly for two purposes.

Building and repairs of their own house.

Selling the wood/fuelwood in nearby townships.

Non timber forest products are continuously gathered from the forest. Different organs are used for medicine, fuel, fodder, forage, fruits, vegetables, gums etc. This basically includes roots, tubers, bulbs, (under ground organs), bark and wood, stems, leaves, fruits, seeds and flowers. The collection methods are by and large destructive. In case of small herbs normally whole herbs are collected, dried and used as medicines. In case of climbers, shrubs and trees, one of the organs is used. Roots, tubers, bulbs and seeds are vital organs. Therefore, as and when vital organs are used, the further reproduction survival by progeny is discontinued. Gradually the

species disappears. In case of gums and exudates the bark is ruthlessly chopped off. In such cases either the tree dies of ringing or by a secondary infection. Sterculia urens, Terminalia crenulata, Pterocarpus marsupium, Bombax ceiba, Garuga pinnata meet with such a fate.

One more point that needs attention is the collection of material in a large quantity than the actual need of a tribal.e.g. wood for agricultural implement, house repairs or material for thatching the house or the medicine to treat their ills. Since the user collects himself, just guided by the human nature, and also the fact that one does not have to pay for it, one collects generously, more than the actual need. Leftover is a waste. It has to be efficiently managed in a way that there is equilibrium in the input and output usage of the resources.

4.12 VEGETATION OF DANGS

Vegetation

Forests are major stores of species, habitat, and genetic diversity (Noble and Dirzo, 1997). Activities on forest lands will have a significant impact on local, regional, and global diversity and the health and function of natural ecosystems (Kimmins, 1997).

Forest Types

According to Revised forest types of India (Champion and Seth, 1968) forests of Dangs district falls under Southern Tropical Moist Deciduous forest type. No area is completely deciduous in any one season, since different species shed their leaves at different times. However in hot season the forests are rather more open and eye-soaring because many trees are without leaves. Comparatively the forests along river banks are more dense and green.

Most of the reserved forest areas belong to the moist teak forests. These are high forests with tall trees growing 20-30 m in height and are confined to riverine areas. *Tectona* is the dominant species followed by *Terminallia* throughout and majority of the canopy is occupied by these two components. The rest of the canopy is covered by a number of miscellaneous associate, but the associate components are highly varied from place to place depending upon the topography and biotic interference. Lower storey includes a number of shrubs and small to medium sized

trees, including a few semi- evergreen species. Bamboos are seen at many places. Twiners and climbers are common and abundant. Grasses and other ground floral elements are poor and restricted to open areas.

Moist mixed deciduous forests are found at many places on the middle slopes and flat areas of tops of hills. *Tectona* is present, but low proportionate. The proportion of evergreen and semi- evergreen species is relatively larger than in case of teak forests. The soil is rich in humus and support the richness of ground flora.

However, for the better understanding of the vegetation pattern, here it is described under the following heads: (A) Forest vegetation, (B) Ruderal vegetation, (C) Riperian vegetation, (D) Aquatic vegetation, (E) Vegetation of cultivated fields, and (F) Epiphytes and parasitic vegetation.

(A) Forest vegetation

Though the forests are of deciduous type, no area is completely deciduous in any one season, since different species shed their leaves at different times due to presence of semi-evergreen and evergreen species along river banks and water streams. But in between February and May, the forest are rather However in hot season the forests are rather more open and eye-soaring as majority of tree species are in deciduous condition. This effect is also enhanced by looping. The forest composition does not show zonation. However, for the sake of convenience it can be arbitrarily divided as follows:

a. Top layer of trees (10 m or more tall)
b. Middle layer of trees and shrubs (2-10 m tall)
c. Ground layer of species (Less than 2 m tall)
d. Climbers and twiners

a. Top layer of trees (10 m or more tall)

Acacia chundra, Albizia odoratissima, Bombax cieba, Bridelia retusa, Dalbergia latifolia, Dendrocalamus strictus, Garuga pinnata, Holoptelia integrifolia, Kydia calycina, Lagerstroemia microcarpa, Lannea coromandelica, Madhuca indica, Melia dubia, Mitragyna parvifolia, Tectona grandis, Terminallia crenulata etc. are common.

Acacia ferruginea, Albizia lebbek, Bauhinia faveolata, Cordia dichotoma, Desmodium oojeinensis, Diospyros melanoxylon, Erythrina sp., Haldinia cordifolia, Mangifera indica, Pterocarpus marsupium, Tamarindus indica, Terminallia bellerica, Sterculia urens etc. are occasional.

Careya arborea, Ficus virens, Hymenodictyon orixense, Spondias pinnata, Sterculia guttata, Stereospermum colais, Terminallia chebula etc. are rare

b. Middle layer of trees and shrubs (2-10 m tall)

Bauhinia racemosa, Carissa carndas, Carvia callosa, Dillenia pentagyna, Ficus exasperate, Flacourtia indica, Grewia abutilifolia, Helicteris isora, Holarhhena pubescens, Oroxylum indicum, Pongamia pinnata, Securinega virosa, Syzygium cumini, Thespesia lampas, Trema orientalis, Wrightia tinctoria etc. are common.

Casearia graveolens, Embelia sp., Ficus racemosa, Gmelina arborea, Meyna laxiflora, Morinda tomentosa, Pavetta crassicaulis, Phyllanthus emblica, Trewia nudiflora, Zizyphus xylopyrus are occasional.

Colebrookea oppositifolia, Dolichandrone falcate, Ensete superbum, Eriolaena candollei, moringa concanensis, Radermachera xylocarpa are rare species.

c. Ground layer of species (Less than 2 m tall)

In the forest undergrowth, particularly in monsoon, a number of annual or perennial species will be seen, which begin to disappear during hot season.

The following are the common species found throughout the undergrowth of forest:

Abelmoschus manihot, Aerva sanguinolenta, Alysicarpus spp., *Barleria prattensis, Bllumea spp., Cassia absus, C. tora, Corchorus spp., Crotalaria* spp., *Curcuma inodora, Desmodium* spp., *Eranthemum roseum, Haplanthus verticillatus, Indigofera spp., Ischaemum* spp., *Leea edgeworthii, Neuracathus sphaerostachys, Oldenlandia corymbosa, Peristrophe paniculata, Rungia pectinata, Sida* spp., *Solanum incanum, Trachyspermum strictocarpum, Trichodesma* spp., *Urena lobata* ssp. *sinuata* etc.

Achyranthes aspera, baliospermum montanum, Blepharis asperrima, Celosia argentia, Cynoglossum zeylanicum, Euphorbia spp., *Hemigraphis latebrosa, Lindernia crustacean, Peucedanum grande* etc. are occasionally found.

Acanthospermum hispidum, Ageratum conyzoides, Anisomeles indica, Boehmeria scabrella, Colocasia esculenta, Commelina spp., *Curculigo orchioides,*

Glinus lotoides, Lavandula bipinnata, Leea macrophylla, Mollugo pentaphylla, Ocimum cannum, Pogostemon purpurascens, Pouzolzia zeylanica, Scilla hyacinthia, Torenia indica etc. are rare.

d. Climbers and twiners

Abrus precatorius, Acacia pennata, Ampelocissus latifolia, Aspidopteris cordata, Butea parviflora, Cardiospermum helicacabum, Cayratia trifolia, Celastrus paniculatus, Cissus repana, Clematis hedysarifolia, Combretum ovalifolium, Dioscorea spp., Ventilago denticulata, Zizyphus rugosa etc. are some other common species in the area in addition to several members of the families Asclepiadaceae, Convolvulaceae, Cucurbitaceae, Fabaceae and Menispermaceae,

(B) Ruderal vegetation

The following are tree species noted along road sides, paths and in waste places in plains. They are either planted by forest department, local, self-sown or growing wild:

Acacia auriculiformis, A. nilotica ssp. *indica, Annona squamosal, Azardirachta indica, Bauhinia variegata, Butea monosperma, Cordia gharaf, Dalbergia sisso, Delonix regia, Ficus* spp., *Manilkara hexandra, Pithecellobium dulce, Pongammia pinnata, Syzygium cumini, Tamarindus indica, Thespesia populnea* etc.

Besides, the following are the shrubs mostly form hedged and support a good number of climbers and twiners as well as herbs. They are also used by local as fences around cultivated fields. They are grown in grasslands and open areas of forests.

Alangium salvifolium, Cadaba fruticosa, Thevetia peruviana, Clerodendrum inerme, Euphorbia ligularia, Ipomoea fistulosa, Jatropha curcas, Lawsonia inermis, Maytenus emarginatus, Streblus aper, Vitex negundo, etc.

Abutilon indicum, Aeschynomene indica, Alysicarpus spp., Amaranthus spinosus, Anisomeles heyneana, Argemone mexicana, Blumea spp., Boerhavia diffusa, Calotropis gigantea, Calotropis procera, Cassia pumila, C. tora, Cleome viscosa, Girardinea diversifolia, Hyptis suaveolens, , Martynia annua, Pogostemon parviflorus, Tephrosia purpurea, Triumfetta rhomboidea, Xanthium strumarium, etc. are common road-side weeds growing in hedges and open places.

(C) Riperian vegetation

The riverbeds at many places are rocky, some places stony or pebbly and at other places alluvial. In stony and water-logged beds and along water streams *Crinum viviparum, Cryptocoryne retrospiralis, Cyperus sp., Homonia riparia, Polygonum glabrum, Rotala serpyllifolia, Rotula aquatica, Syzygium heyneanum, Tamarix ericoides, etc. are commonly found in patches. Hydrilla verticillata, Najas indica, Ottelia alismoides, Vallisneria spiralis* are also noted at some places.

The vegetation of moist alluvial soil is typicalof the one found in moist grounds and cultivated fields. Some interesting plants of such a habitat are *Ageratum conyzoides, Ammania baccifera, Bacopa monnieri, Bergia ammanioides, Caesulia axillaris, Cassia tora, Eclipta alba, Heliotropium ovalifolium, Lindernia* spp. and several member of Cyperaceae.

Dendrocalamus strictus, Combretum ovalifolium, Ixora arborea, Leucas biflora, Mallotus phillipinensis, Saccharum spontaneum, Trema orientalis, Ventilago denticulata, Vitex negundo etc. are commonly found on rock cuttings nearby riverbanks.

(D) Aquatic vegetation

In the present area, permanent ponds are almost 4. In hilly areas, there are practically no ponds, but a few ditches filled with water which support a few number of hydrophytes seen in monsoon. The aquatic vegetation of the present area can be grouped as follows:

Submerged:

Blyxa echinosperma, Hydrilla verticillata, Najas indica, Ottelia alismoides, Utricularia spp. etc.

Floating:

Nymphaea spp., *Nymphoides* spp. *Ipomoea aquatica, Lemna* spp.,

Wetland:

Alternanthera sessilis, Ammania baccifera, Caesulia axillaris, Eclipta alba, Elatostema cuneatum, Enicostemma axillare, Habenaria grandifloriformis, Hygrophilla serphyllum, Lindernia spp., *Lobelia alsinoides, Ludwigia perennis,*

Oldenlandia corymbosa, Phyla nodiflora, Pimpinella spp., *Pouzolzia zeylanica* etc. are common.

Physalis minima, Polygala sp., Portulaca oleracea, Ramphicarpa longiflora, Rorripa indica, Smithia salsuginea, Sopubia delphinifolia, Stemodia viscosa, Striga spp., *Trachyspermum* spp., *Trichodesma* spp., *Vicoa indica, Zornia gibbosa* etc. are occasional to rare.

(E) Vegetation of cultivated fields

Elusine corocana, Guizotia abyssinica, Oryza sativa etc. are extensively cultivated throughout the present area. The following are the common weeds associated in the cultivated fields:

Aerva lanata, Aeschynomene indica, Ageratum conyzoides, Alternanthera sessilis, Alysicarpus spp., *Amaranthus* spp., *Apluda mutica, Argemon mexicana, Biophytum sensitivum, Blumea* spp., *Bhachiaria ramosa, Caesulia axillaris, Cassia absus, Chrozophora rottleri, Commelina spp., Corchorus* spp., *Crotalaria* spp., *Cynodon dactylon, Cyperus* spp., *Dactyloctenium aegypticum, Desmodium spp., Desmostachya bipinnata, Dicanthium annulatum, Digera muricata, Digitaria spp., Dinerba retroflexa, Echinochloa colonum, Eclipta alba, Elusine indica, Elytrophorus spicatus, Eragrostis* spp., *Eriocaulon* spp., *Euphorbia* spp., *Hydrolea zeylanica, Indigofera* spp., *Isachne globosa, Ischaemum indicum, Justicia* spp., *Launnea procumbens, Leucas aspera, Lindernia spp., Linum mysorense, Lobelia alsinoides, Melilotus alba, Melochia corchorifolia, Mollugo pentaphylla, Ocimum canum, Phyllanthus* spp.

(F) Epiphytes and parasitic vegetation

Epiphytes:

Aerides crispum, A. maculosum, Dendrobium spp., Ficus spp., Rhynchostylis retusa, Remusatia vivipara, Vanda tesselata, V. Testacea are the epiphytes found in the present area generally on *Acacia chundra, Bombax cieba, Bridelia retusa, Mangifera indica, Tectona grandis, Terminallia crenulata and Heterophragma quadrilocularis.*

Parasites:

Buchnera hispida, Centrathera indica, Ramphicarpa longiflora, Sopubia delphinifolia, S. trifida, Striga spp. are the common root parasite on grasses.

Cuscuta chinensis, C. reflexa, Dedrophthoe falcata var. falcata, Dedrophthoe falcata var. pubescens and Viscum articulatum are the common stem parasites growng generally on Acacia chundra, Bombax ceiba, Bridelia retusa, Holarhhena pubescens, Mangifera indica, Tectona grandis, Terminallia crenulata, Wrightia tinctoria etc.

4.13 GENERAL PATTERN OF VEGETATION DANGS

Of the many sites visited the vegetation composition of Ahwa, Mahal, Saputara and Subir zones are as follows:

AHWA

A. Top layer

(a) Common

Acacia ferruginea, Adina cordifolia, Bambusa arundinacea, Butea monosperma and Tectona grandis forms a dominant forest community. Besides them *Albizia lebbeck, Albizia procera, Albizia odoratissima, Ficus asperima, Kydia calycina, Melanolepis mollucana, Desmodium oojeinensis, Terminallia crenulata* are also are common.

(b) Ocasional

Erythrina suberosa, Lagerstroemia parviflora, Mitragyna parviflora, Sterculia urens, Terminallia bellerica,

(c) Rare

Cordia macleodii, Dillenia pentagyna, Miliusa tomentosa, Piliostigma foveolata, Schrebera switenoides.

B. Middle layer

(a) Common

Bambusa arundinacea, Bauhinia racemosa, Carissa congesta, Casearia graveolens, Dendrocalamus strictus, Falcourtia indica, Helicteris isora, Holarrhena pubescens, Meyna laxiflora, Wrightia tinctoria, Xeromphis spinosa

(b) Occasional

Dalbergia paniculata, Dalbergia volubilis, Plumbago zeylanica, Trema orientalis, Wrightia tomentosa

(c) Rare

Buchanania lanzan, Dolichandrone falcata var. Lawii, Gmelina arborea, Zizyphus mauritiana

Mahal

A. Top layer

(a) Common

Acacia ferruginea, Adina cordifolia, Bambusa arundinacea, Butea monosperma and Tectona grandis forms a dominant forest community. Besides them *Albizia lebbeck, Albizia procera, Albizia odoratissima, Ficus asperima, Kydia calycina, Desmodium oojeinensis, Terminallia crenulata* are also are common.

(b) Occasional

Bridelia retusa, , Careya arborea, Emblica officinalis, Lagerstroemia lanceolata, Lagerstroemia parviflora, Madhuca indica, Terminallia bellerica

(c) Rare

Dalbergia lanceolaria, Dillenia pentagyna, Soymida febrifuga

B. Middle Layer

(a) Common

Diospyros melanoxylon, Holarrhena pubescens, Meyna laxiflora, Syzygium cumini, Xeromphis spinosa, Zizyphus mauritiana

(b) Occasional

Aegle marmelos, Ailanthus excelsa, Casearia elliptica, Elaeodendron roxbughii, Oroxylum indicum, Woodfordia fruticosa, Wrightia tomentosa, Trema orientalis

(c) Rare

Alangium salvifolium, Casearia esculenta, Ficus heterophylla

Malegaon- Saputara

A. Top layer

(a) *Anogeisus latifolia, Butea monosperma, Terminallia crenulata* and *Tectona grandis* forms the dominant component of the forests here. The other common species in the top layer are *Acacia chundra, Adina cordifolia, Diospyros melanoxylon, Emblica officinalis, Heterophragma quadriloculare, Lagerstroemia lanceolata, Lagerstroemia parviflora, Mitragyna parviflora, Schleichera oleosa*

(b) Occasional

Albizia odoratissima, Bombax ceiba, Ficus asperrima, Gmelina arborea, Grewia tiliaefolia, Miliusa tomentosa, Bauhinia foveolata, Bauhinia malabarica, Terminalia bellerica, Terminalia chebula

(c) Rare

Sapindus laurifolius, Schrebera switenoides

B. Middle layer

(a) Common

Bauhinia racemosa, Carissa congesta, Carvia callosa, Cassia fistula, Colebrookea oppositifolia, Flacourtia indica, Pavetta crassucaulis, Securinega virosa, Solanum indicum, Spermadicton suaveolens, Vernonia divergens, Zizyphus xylopyra

(b) Occasional

Capparis sepiaria, Cordia dichotoma, Meyna laxiflora, Pogostemon parviflorus, Woodfordia fruticosa, Xeromphis spinosa

(c) Rare

Eriolaena stocksii, Sapium insinge

Subir

A. Top layer

(a) *Butea monosperma, Desmodium oojeinsis, Tectona grandis* and *Terminalia crenulata* form the dominant component of forest. The other co-dominant species are *Acacia chundra, Albizia lebbeck, Albizia procera, Anogeisus latifolia, Garuga pinnata* and *Lannea coromadelica.*

(b) Occasional

Adina cordifolia, Albizia odoratissima, Bauhinia foveolata, Dalbergia latifolia, Holoptelia integrifolia, Madhuca indica, Mitragyna parviflora, Abuhinia malabarica

(c) Rare

Bombax ceiba, Dillenia pentagyna, Pterocarpus marsupium

B. Middle layer

(a) Common

Bauhinia racemosa, Ficus racemosa, Ficus tseila, Flacortia indica, Helicteris isora, Holarrhena pubescens, Xeromphis spinosa, Zizyphus xylopyra

(b) Occasional

Casearia graveolens, Grewia tiliaefolia, Mallotus phillipensis

(c) Rare

Aegle marmelos, Crataeva nurvula, Ehretia laevis, Ficus hispida, Vitex negundo

Climbers

A number of climbers and twiners belonging to the families Asclepiadaceae, Celastraceae, Combretaceae, Convolvulaceae, Cucurbitaceae, Dioscoreaceae, Malpighiaceae, Menispermaceae, Fabaceae, Ranunculaceae, Vitaceae etc. are found going over trees and shrubs or in absence of support trailing. Some of the more conspicuous ones, by their foliage or bright flowers are:

Abrus precatorius, Acacia pennata, Ampelocissus latifolia, Argyria sericea, Argyreia setosa, Aspidopteris cordata, Butea parviflora, Canavalia gladiata, Capparis zeylanica, Cayratia carnosa, Celastrus paniculata, Clematis hedysarifolia, Combretum ovalifolium, Cryptolepis buchanani, Cylista scariosa, Embelia tsejariam-cottam, Hemidesmus indicus, Luffa acutangula, Marsdenia tenacissima, Merremia aegyptiaca, Merremia vitifolia, Milletia racemosa, Mucuna prurita, Mukia maderaspatana, Oxystelma secamone, Pueraria tuberosa, Rhynchosia bracteata, Trichosanthes bracteata, Ventilago denticulata, Zizyphus rugosa.

Climbers which seem to have a restricted distribution are reported from **Malegaon-Saputara region** which are *Capparis sepiaria, Clematis gauriana, Ipomoea illustris, Rhynchospora rothii, Tinospora sinensis, Thunbergia fragrans, Tylophora dalzellii.*

C. Ground layer

The ground is covered with grasses and many herbaceous species, none of which, however, is common in the dry season. The common plants are *Achyranthes aspera var. porphyristachya, Aerva sanguinolenta, Anisomeles heyniana, Baliospermum montanum, Barleria prattensis, Blumea spp., Haplanthus tentaculatus, Haplanthus verticillatus, Canscora diffusa, Desmodium gangeticum, Dicliptera verticillata, Hemigraphis latebrosa.*

I. Vegetation on rocky ground

During monsoon rocks are covered with herbaceous plants. The common plants are: *Alysicarpus buplerifolius, Neanotis foetida, Neanotis rheedei, Borreria stricta, Bulbostylis barbatus, Cyanotis fasciculata, Cyperus squarrosus, Mollugo pentaphylla, Murdania nudiflora, Murdania semiteris.*

ii. Grasslands on hills:

After a first few showers a number of grasses sprout up; among those short grasses, other typical monsoon plants are; *Neanotis foetida, Chlorophytum malabaricum, Exacum pumilum, Fimbristylis lawiana, Iphigenia indica, Scilla hyacinthina, Scirpus kyllingioides, Senecio graham.*

By about the middle of monsoon grasses grow quite tall and become dominant in the area. They are *Apluda mutica, Coix lachryma-jobi, Cymbopogon martini, Sorghum halepense, Themeda quadrivalvis, Thysolaena maxima etc. Setaria glauca* by now is conspicuous by its reddish brown spikelets.

iii. Cultivated fields

Eleusine corocana, Panicum miliare, Sorghum vulgare are extensively cultivated in the district. *Arachis hypogea, Cajanus cajan* are also commonly cultivated. After the harvest by about the first weak of November a number of fields are left unattended. Many plants typical of the cold season appear as weeds in those fields. They are common and abundant, scattered or some time in pure stands: *Amaranthus hybridus, Amaranthus spinosus, Argemone mexicana, Blumea eriantha,*

Blumea oxydonta, Cleome viscose, Glinus lotoides, Leucas aspera, Ludwigia perennis, Sphaeranthus indicus

The other common plants are *Amaranthus viridis, Ammania baccifera, Ammania multiflora, Canscora diffusa, Centaurium roxbughii, Corchorus aestuans, Desmodium triflorum, Elytrophorus spicatus, Eriocaulon quinquangulare, Hoppea dichotoma, Hydrolea zeylanica, Lobelia alsinoides, Oldenlandia corymbosa, Phyllanthus asperulatus, Cyperaceae , Zornia gibbosa*

Most of these plants disappear by the beginning of the hot season. However a few hardy plants survive even when the soil is completely dry during hot season and disappear only after the first showers of monsoon of the next year. They are *Argemone mexicana, Blumea oxyodonta, Heliotropium supinum, Leucas aspera, Sphaeranthus indicus.*

iv. Vegetation of temporary ditches and ponds

Only at Ahwa and Saputara there is a perennial pond which serves as a source of drinking water for the local people.

In stagnant water of ditches and rivers along road *Aponogeton natans, Ottelia alismoides* are observed. In the moist ground along the margins of ditches a number of plants have been observed, some of them often found gregariously growing. Few of them are *Alternanthera sessilis, Cyperus, Cyperus pangorei, Commelina spp., Cyanotis cristata, Hygrophilla auriculata, Hydrolea zeylanica, Limnophilla indica.*

As the ditches begin to dry about the beginning of November the plants characteristic of the cold season appear. Some of them are:
Argemone Mexicana, Chrozophora rottleri, Eclipta alba, Glinus lotoides, Gnaphalium indicum, Heliotropium supinum, Hydrolea zeylanica, Solanum surattense, which are common and abundant, often forming large patches.

V. River side vegetation

A. (a) Forests

Along river banks the forest are quite dense, the dominant components being *Bambusa arundinacea* and *Dendrocalamus strictus* which form their own community.

The other common trees are *Careya arborea, Casearia spp., Dalbergia paniculata, Garuga pinnata, Ficus asperrima, Ficus racemosa, Heterophragma quinquangularis, Kydia calycina, Mallotus phillipensis, Oroxylum indicum, Pongamia pinnata, Schleichera oleosa, Securinega virosa, Sterculia urens, Syzygium cumini* and *Trema orientalis.*

Occasionally *Butea monosperma, Lagerstroemia sp., Tectona grandis, Terminalia bellerica and Terminalia crenulata* also occur.

(b) River beds

The vegetation of the river beds can broadly be divided, (for the sake of convenience) into two types:

Vegetation of stony or rocky ground

In such places *Ficus heterophylla, Homonia riparia, Kirganelia reticulata, Rotula aquatica, Syzygium cumini, Tamarix ericoides* are common and abundant, often gregarious , forming either mixed or pure, large patches. At some places they are so dense that they often are impenetrable.

In water logged stony around *Cryptocoryne retrospiralis* forms pure, dense patches mostly by themselves. Sometimes patches of Crinum vivipara are mixed among there. Rocks are covered by masses of *Rotala serpylifolia*, which are conspicuous by their over all reddish colour.

Vegetation in Alluvial soil

In such a ground a number plants have been observed. The following are some of the common plants, scattered or in patches: *Ageratum conyzoides, Ammania baccifera, Ammania multiflora, Chrozophora prstrata, Cleome chelidonii,* Members of Cyperaceae, *Eclipta alba, Euphorbia bombaiensis, Glinus lotoides, Gnaphalium indicum, Gnaphalium luteo-album, Heliotropium ovalifolium, Heliotropium supinum, Hydrolea zeylanica, Hygrophila serpyllum, Rorippa indica, Salvia plebeia, Verbascum chinense, Sphaeranthus indicus*

Some of the occasional plants are : *Hoppea dichotoma, Indigofera spicata, Lobelia alsinoides, Phyla nodiflora, Polycarpon prostratum, Polygonum plebeium, Portulaca oleracea, Stemodia viscosa, Sutera dissecta*

Near water courses *Polygonum barbatum var. gracile*, and *Polygonum glabrum* are often found in dense, pure stands or mixed with *Argemone mexicana, Salvia plebeia* and Cyperaceae spp. etc. at some places dense patches of Saccharum spontaneum are found.

Seasonal changes in the vegetation

With the first few showers of rain in early June, several bulbous plants of the families Amaryllidaceae, Araceae, Hypoxidaceae, Liliaceae, Orchidaceae and Zingiberaceae come in flower. Of these commoner ones are *Amorphophallus commutatus, Chlorophytum tuberosum, Curculigo orchioides, Curcuma inodora, Habenaria grandifloriformis, Nervillia aragona, Ophioglossum sp., Pancratium triflorum, Scilla hyacinthia.*

By early July a variety of grasses sprout up and cover the whole surface with a vivid green. Among these grasses, *Ageratum conyzoides, Amorphophallus commutatus, Arisaema neglectum, Arisaema tortuosum, Bidens biternata, Celosia argentea, Commelina suffruticosa, Commelina benghalensis, Curculigo orchioides, Curcuma inodora, Euphorbia parviflora, Habenaria gibsonii var. foliosa, Phyllanthus asperulatus, Phyllanthus simplex, Trichodesma sedgwickianum* etc. are found.

By the middle of August, grasses grow quite tall and many plants growing among them. During this period some other plants also become more conspicuous, besides some of the above species. They are: *Abelmoschus manihot, Acalypha indica, Azanza lampas, Blainvillea acmella, Corchorus olitorius, Crotalaria mysorensis, Centratherum phyllolaenum, Hibiscus furcatus, Indigofera glandulosa, Impatiens balsamina var. coccinea, Leea indica, Leea macrophylla, Neuracanthus sphaerostachys, Pimpinella heyneana, Plectaranthus mollis, Sauromatum guttatum, Sida glitinosa, Triumphetta pentandra, Tacca leontopetaloides.*

During this time *Acanthospermum hispidum, Cassia tora, Celosia argentea, Impatiens balsamina var. coccinea, Triumfetta rhomboidea, Xanthium strumarium* also become dominant, at several places forming dense pure stands, hiding the undergrowth vegetation.

Either by the end of monsoon or beginning of cold season, most of the plants mentioned above disappear or other plants characteristic of dry season appear.