

Diversity of Angiospermic Plants in estuarine and Adjoining Riparian Areas of Sabarmati and Mahi Rivers, Gujarat, India

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ABSTRACT

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The present study was conducted with an aim of documenting the diversity of flowering plants in selected localities in the estuarine and adjoining riparian zones of Sabarmati and Mahi rivers of Gujarat, India. The Sabarmati and Mahi rivers are west-flowing perennial rivers having considerable ecological and religious importance. A total of 40 species of flowering plants belonging to 26 different families were recorded in the study area which were dominated by herbaceous plants. Among the 40 species recorded 2 species were trees, 8 species were shrubs, 28 species were herbs and 2 species were grasses. Moreover, as far as ecological groups are concerned, 6 species were halophytes, 13 species were hydrophytes, 17 species were mesophytes and 4 species were xerophytes. In the study area of Sabarmati river, 28 species were recorded that included 2 tree species, 6 shrub species, 18 herb species and 2 grass species. From the view point of ecological groups 5 species were halophytes, 3 species were hydrophytes, 16 species were mesophytes and 4 species were xerophytes. In the study area of Mahi river, 24 species were recorded that included 2 tree species, 6 shrub species, 14 herb species and 2 grass species. From the view point of ecological groups 5 species were halophytes, 12 species were hydrophytes, 5 species were mesophytes and 2 species were xerophytes.

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I. INTRODUCTION

An estuary is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it and with a free connection to the open

sea [1]. Estuaries form a transition zone between river environments and maritime environments. They are subject to both marine influences such as tides, waves, and the influx of saline water and to riverine influences such as flows of fresh water and sediment.

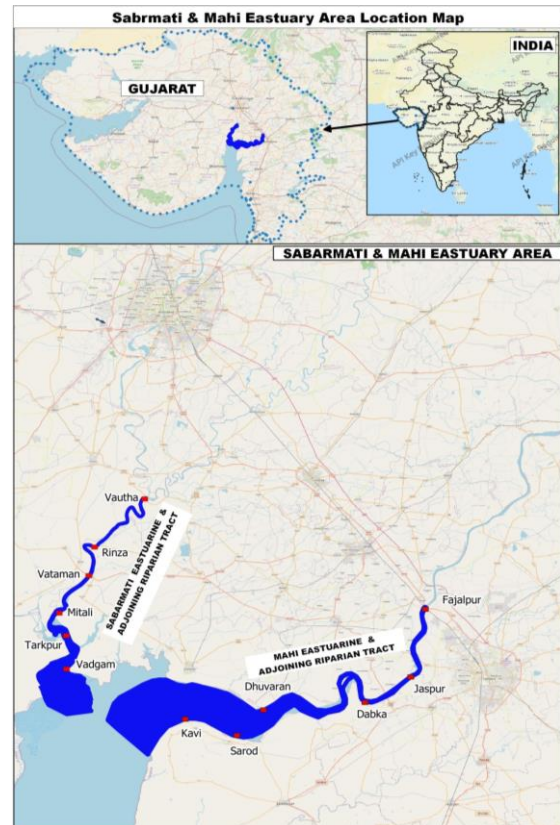
The mixing of sea water and fresh water provide high levels of nutrients both in the water column and in sediment, making estuaries among the most productive natural habitats in the world [2]. The plant communities of the larger riverine and estuarine ecosystems are often found to be the most productive. The riparian ecosystems of the rivers merging with estuaries support higher number of plant species which are arranged in more complex vegetation associations than the surrounding landscapes [3] [4]. The angiosperms or flowering plants are the largest highly diversified and most successful major group forming the dominant vegetation. According to GES, 2000 a total of 2106 angiosperm plant species in Gujarat state which belongs to 161 families representing 13% of the angiosperm species occurring in India. Hence, the current study was carried out with the aim to document the flowering plant diversity in selected villages located in the estuarine and riparian zone of Sabarmati and Mahi river.

II. MATERIAL AND METHODS

Study area

The present study assessed angiospermic diversity of estuarine and adjoining riparian tracts of Sabarmati and Mahi rivers. Sabarmati river rises in the southwest spurs of Aravalli hills in Rajasthan and it forms the estuarine zone with Gulf of Khambhat near Rinza village. For assessing estuarine and adjoining riparian angiospermic diversity. Sabarmati estuary and adjoining riparian tract, six sampling sites viz. Vadgam, Tarakpur, Mitali, Vataman, Rinza and Vautha were explored (**Fig. 1**).

Mahi river, rises in the western Vindhya Range, just south of Sardarpur, Madhya Pradesh and enters the Arabian sea after forming a wide estuary past Khambhat [5]. For assessing estuarine and adjoining riparian angiospermic diversity of Mahi estuary, six sampling sites viz, Kavi, Sarod, Dabka, Dhuvaran, Jaspur and Fajalpur were explored (**Fig. 1**).



In the present study, random stratified sampling approach was used for investigating angiospermic plant species at total 12 sites in estuarine and adjoining riparian tracts of Sabarmati and Mahi rivers. All the flowering plants growing naturally in study area were identified and recorded using available authentic flora [6] [7] [8] [9]. Other details such as botanical name, family and habit of each recorded plant species and its distribution over the various sites were also recorded (Table 1).

III. RESULTS AND DISCUSSION

A total of 40 species of angiosperms including 2 (5%) species of trees, 8 (20%) species of shrubs, 28 (70%) species of herbs and 2 (5%) species of grasses belonging to 26 different families were recorded in the study area (**Fig. 2a**) constituting estuarine and adjoining riparian tracts of Sabarmati and Mahi rivers considered together. **Fig. 2b** indicates such properties for each of these two rivers separately. The monocotyledons were represented by 11 species whereas the dicotyledons were represented by 29 species. In estuarine and adjoining riparian areas of

Sabarmati river 6 species of monocotyledons and 22 species of dicotyledons were recorded. On the other hand, Mahi estuarine and adjoining riparian areas were found to have 9 species of monocots and 15 species of dicot. The most dominant family was Fabaceae with 5 species followed by Solanaceae (4 species), Amaranthaceae and Hydrocharitaceae (3 species each), Asteraceae, Convolvulaceae and Poaceae (2 species each) (Fig. 3a) and rest all families having 1 species each. The number of species in Sabarmati study area was as follows: Fabaceae - 5 species, Solanaceae - 4 species, Amaranthaceae, Asteraceae and Poaceae - 2 species each. On the other hand, number of plant species in Mahi study area was as follows: Hydrocharitaceae - 3 species, Amaranthaceae, Convolvulaceae and Fabaceae - 2 species each, Asteraceae and Solanaceae - 1 species of each.

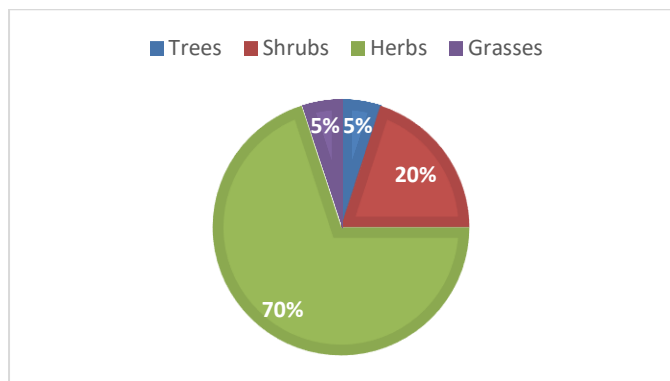


Figure 2a. Habit wise proportion plant species in estuarine and adjoining riparian tracts of Sabarmati and Mahi rivers considering collectively

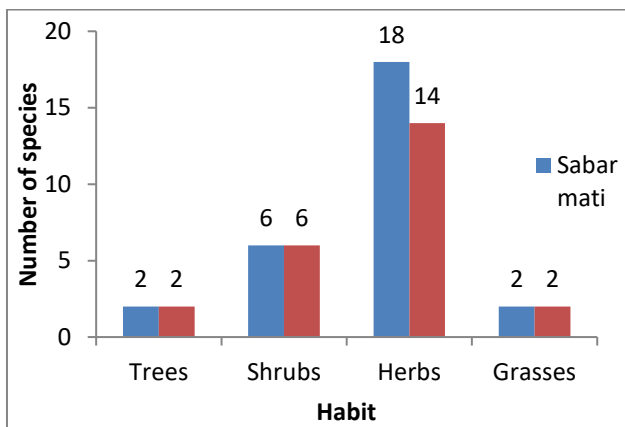


Figure 2b. Habit wise proportion plant species in estuarine and adjoining riparian area of each of Sabarmati and Mahi rivers

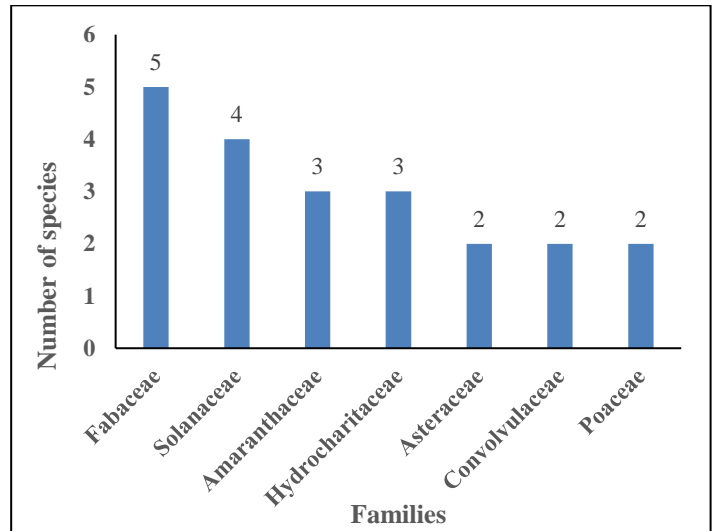


Figure 3a. Family wise number of species in the estuarine and adjoining riparian tracts of Sabarmati and Mahi rivers

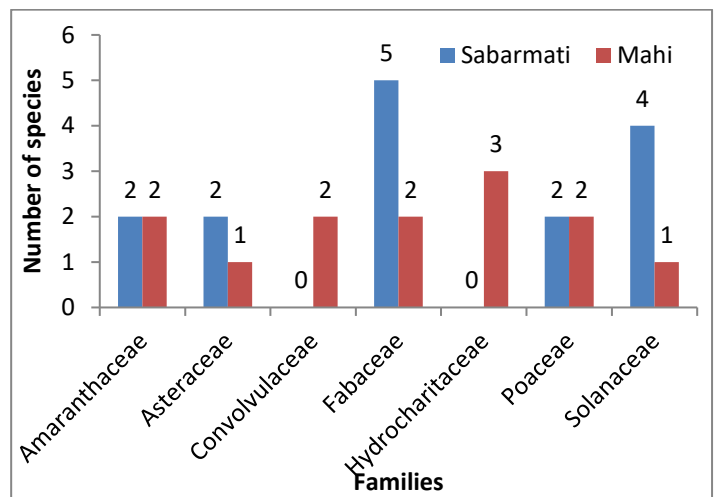


Figure 3b. Family wise number of species in the estuarine and adjoining riparian area of each of Sabarmati and Mahi rivers

Considering Sabarmati and Mahi rivers together (as the study area) it was found that out of total 40 species, 15% were halophytic species, 32% were hydrophytic species, 43% were mesophytic species and 10% were xerophytic species (Fig. 4a). In Sabarmati study area, out of 28 species, 21% were halophytic species, 50% were hydrophytic species, 21% were mesophytic species and 8% were xerophytic species (Fig. 4b). In Mahi study area, out of 24 species, 18% were halophytic species, 11% were hydrophytic species, 57% were mesophytic species and 14% were xerophytic species.

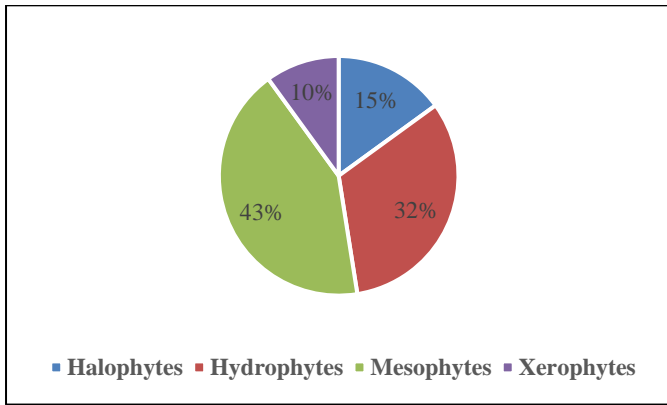


Figure 4a. Proportion of species belonging to various ecological groups in the study area

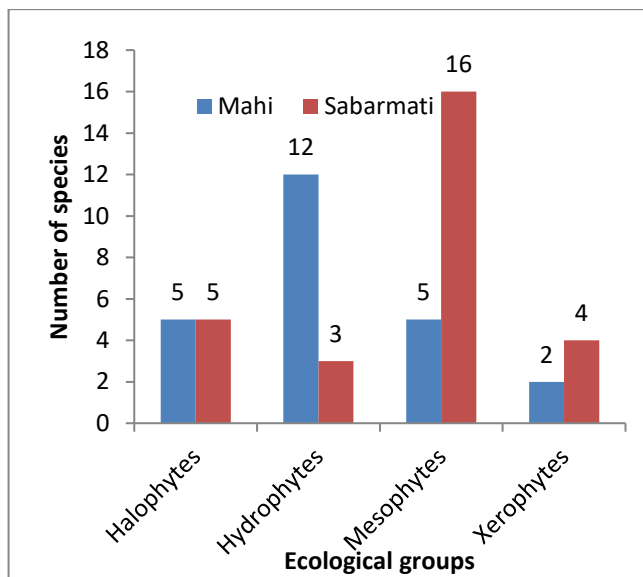


Figure 4b. Number of species belonging to various ecological groups in the estuarine and adjoining riparian area of each of Sabarmati and Mahi rivers

Sites wise account of plant species of different habits in Sabarmati Estuary

During present study, habit wise analysis showed that out of total of 28 species angiospermic plants recorded from the different sites of the Sabarmati estuary and adjoining riparian tract included 2 species of trees, 6 species of shrubs, 18 species of herbs and 2 species of grasses. The recorded plant species belonged to 4 ecological groups viz. 5 species were halophytes, 3 species were hydrophytes, 16 species were mesophytes and 4 species were xerophytes. Site-wise species diversity comparison is given below (Fig. 5 and Fig. 6):

Vadgam: A total of 6 species of flowering plants were recorded including 1 species of tree, 3 species of shrub and 2 species of grasses. The recorded species belonged to 3 ecological groups. Thus, out of the 6 species recorded, 3 species were halophytes, 1 species was mesophyte and remaining 2 species were xerophytes.

Tarakpur: A total of 4 species of flowering plants were recorded including 1 species of tree, 2 species of shrubs and 1 species of grass. All the 4 species recorded were halophytes.

Mitali: A total of 9 species of flowering plants were recorded including 1 species of tree, 3 species of shrubs, 3 species of herbs and 2 species of grasses. The recorded species belonged to 4 ecological groups. Out of the 1 species was hydrophyte, 4 species were halophytes, 3 species were mesophytes and 1 species was xerophyte.

Vataman: A total of 11 species of flowering plants were recorded including 9 species of herbs and 2 species of shrubs. The recorded species belonged to 3 ecological groups. 3 species of hydrophytes, 2 species of halophytes and 6 species of mesophytes.

Rinza: A total of 10 species of flowering plants were recorded including 1 species of tree, 1 species of shrub, 7 species of herbs and 1 species of grass. The recorded species belonged to 3 ecological groups. 1 species of hydrophyte and 9 species of mesophytes.

Vautha: A total of 11 species of flowering plants were recorded including 2 species of shrubs and 9 species of herbs. The recorded 11 species belonged to 3 ecological groups. 1 species of hydrophyte, 8 species were mesophytes and 2 species of xerophytes.

In the Sabarmati study area, Vataman and Vautha sites had maximum number of plant species (11 species each) where's Tarakpur site had the lowest number of plants species (4 species). Furthermore, Tarakpur and Mitali sites had maximum number of halophyte (4 species each), Vataman site had maximum number of hydrophyte (3 species), Rinza site had maximum number of mesophyte species (9

species) and Vadgam had maximum number of xerophyte species (2 species) were recorded.

Sites wise account of plant species of different habits in Mahi Estuary

During present study, habit wise analysis showed, that out of 24 species of angiospermic plants were recorded from the different sites of the Mahi estuary and adjoining riparian tract included 2 species of trees, 6 species of shrubs, 14 species of herbs and 2 species of grasses. The recorded plant species belonged to 4 ecological groups viz. 5 species were halophytes, 12 species were hydrophytes, 5 species were mesophytes and 2 species were xerophytes noted from the different sites of the Mahi estuary and adjoining riparian tract. Site-wise species diversity comparison given below (Fig. 5 and Fig. 6):

Kavi: A total of 3 species of flowering plants were recorded including 1 species of tree, 1 species of shrubs and 1 species of grass. The recorded 3 species belonged to halophytes ecological group.

Sarod: A total of 4 species of flowering plants were recorded including 1 species of tree, 2 species of shrubs and 1 species of grass. The recorded 4 species belonged to 2 ecological groups. 3 species were halophytes and 1 species of xerophytes.

Dabka: Dabka site had recorded only 2 flowering plants species i.e. shrub. The recorded 2 species belonged to 2 ecological groups. 1 species of halophytes and 1 species of xerophytes.

Dhuvaran: A total of 5 species of flowering plants were recorded including 1 species of tree, 2 species of shrub and 2 species of grass. The recorded 5 species belonged to 2 ecological groups. 4 species of halophytes and 1 species of mesophytes.

Jaspur: A total of 5 species of flowering plants were recorded including 4 species of herbs and 1 species of grass. The recorded 5 species belonged to 2 ecological groups. 2 species of hydrophytes and 3 species of mesophytes.

Fajalpur: A total of 15 species of flowering plants were recorded including 1 species of tree, 2 species of shrubs, 11 species of herbs and 1 species of grass. The recorded 11 species belonged to 3 ecological groups. Out of these 15 species recorded, 11 species were hydrophytes, 3 species were mesophytes and remaining 1 species xerophyte.

In the Mahi estuary, Fajalpur site had maximum number of plants species (15 species) and Dabka site had lowest number of plants species (2 species) were recorded. Furthermore, Dhuvaran site had maximum number of halophytes (4 species), Fajalpur site had maximum number of hydrophytes (11 species), Jaspur and Fajalpur sites had maximum number of mesophytes (3 species each) and Sarod, Dabka and Fajalpur sites had 1 species each of xerophyte species recorded.

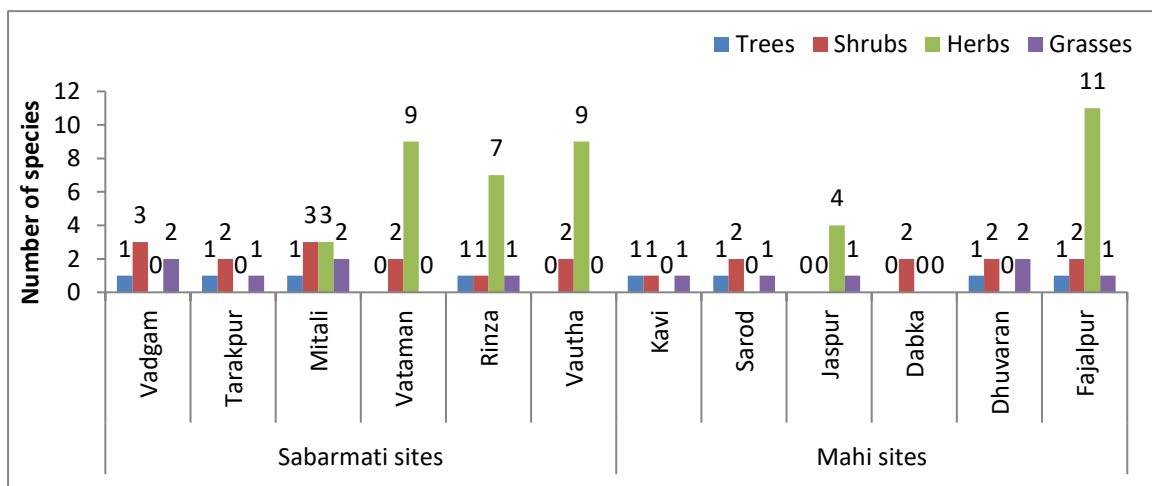


Figure 5. Sites wise number of angiospermic plant species of different habits in Sabarmati and Mahi Study areas.

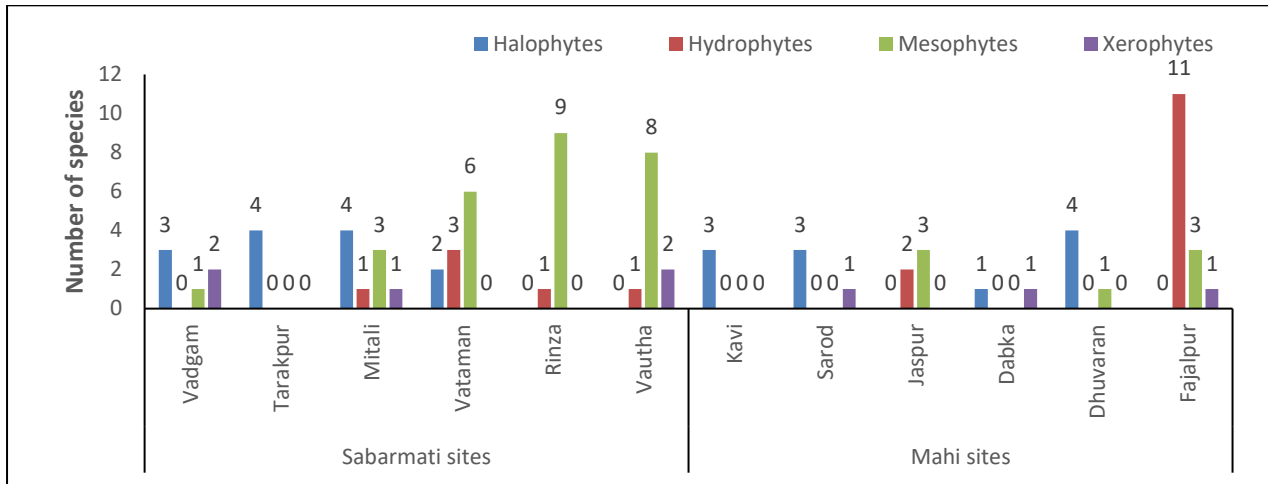


Figure 6. Sites wise number of angiospermic plant species of different ecological groups in Sabarmati and Mahi Study areas.

TABLE 1

LIST OF PLANTS SPECIES RECORDED IN SABARMATI AND MAHI STUDY AREAS

Sr. No.	Species Name	Family	Habit	Plant Types	Sabarmati Estuary						Mahi Estuary					
					Vadgam	Tarakpur	Mitali	Vataman	Rinza	Vautha	Kavi	Sarod	Dabka	Dhuvanran	Jaspur	Fajalpur
1	<i>Aeluropus lagopoides</i> (L.) Thwaites.	Poaceae	Grass	Halophyte	√	√	√	x	x	x	√	√	x	√	x	x
2	<i>Alhagi maurorum</i> Medik.	Fabaceae	Shrub	Xerophyte	x	x	x	x	x	√	x	x	x	x	x	x
3	<i>Allium cepa</i> L.	Amaryllidaceae	Herb	Mesophyte	x	x	x	x	√	x	x	x	x	x	x	x
4	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Amaranthaceae	Herb	Mesophyte	x	x	x	x	x	x	x	x	x	x	√	x
5	<i>Argemone mexicana</i> L.	Papaveraceae	Herb	Xerophyte	x	x	x	x	x	√	x	x	x	x	x	√
6	<i>Avicennia marina</i> (Forssk.) Vierh.	Acanthaceae	Tree	Halophyte	√	√	√	x	x	x	√	√	x	√	x	x
7	<i>Azolla pinnata</i> R. Br.,	Salviniaceae	Herb	Hydrophyte	x	x	x	x	x	x	x	x	x	x	x	√
8	<i>Bacopa monnieri</i> (L.) Wettst.	Plantaginaceae	Herb	Mesophyte	x	x	x	√	x	x	x	x	x	x	x	x
9	<i>Capparis decidua</i> (Forssk.) Edgew.	Capparaceae	Shrub	Xerophyte	√	x	x	x	x	x	x	x	x	x	x	x
10	<i>Ceratophyllum demersum</i> L.	Ceratophyllaceae	Herb	Hydrophyte	x	x	x	x	x	x	x	x	x	x	x	√
11	<i>Chenopodium album</i> L.	Amaranthaceae	Herb	Mesophyte	x	x	x	x	√	x	x	x	x	x	x	x
12	<i>Cressa cretica</i> L.	Convolvulaceae	Shrub	Halophyte	x	x	x	x	x	x	x	x	x	√	x	x
13	<i>Cucurbita maxima</i> Duchesne.	Cucurbitaceae	Herb	Mesophyte	x	x	x	x	x	√	x	x	x	x	x	x
14	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Grass	Mesophyte	√	x	√	x	√	x	x	x	x	√	√	√
15	<i>Cyperus difformis</i> L.	Cyperaceae	Herb	Hydrophyte	x	x	x	√	x	x	x	x	x	x	x	x
16	<i>Datura metel</i> L.	Solanaceae	Shrub	Mesophyte	x	x	x	√	√	√	x	x	x	x	x	√
17	<i>Eichhornia crassipes</i> (Mart.) Solms.	Pontederiaceae	Herb	Hydrophyte	x	x	√	√	√	√	x	x	x	x	√	√
18	<i>Heliotropium indicum</i> L.	Boraginaceae	Herb	Halophyte	x	x	x	√	x	x	x	x	x	x	x	x
19	<i>Hydrilla verticillata</i> (L.f.) Royle.	Hydrocharitaceae	Herb	Hydrophyte	x	x	x	x	x	x	x	x	x	x	x	√
20	<i>Ipomoea fistulosa</i> Mart. ex Choisy.	Convolvulaceae	Shrub	Hydrophyte	x	x	x	x	x	x	x	x	x	x	x	√
21	<i>Ludwigia adscendens</i> (L.) H.Hara.	Onagraceae	Herb	Hydrophyte	x	x	x	x	x	x	x	x	x	x	x	√

Sr. No.	Species Name	Family	Habit	Plant Types	Sabarmati Estuary						Mahi Estuary					
					Vadgam	Tarakpur	Mitali	Vataman	Rinza	Yantha	Kavi	Sarod	Dabka	Dhuvaram	Jaspur	Fajalpur
22	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	Herb	Mesophyte	X	X	X	X	X	√	X	X	X	X	X	X
23	<i>Medicago sativa</i> L.	Fabaceae	Herb	Mesophyte	X	X	X	X	√	X	X	X	X	X	X	X
24	<i>Najas minor</i> L.	Hydrocharitaceae	Herb	Hydrophyte	X	X	X	X	X	X	X	X	X	X	X	√
25	<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	Herb	Hydrophyte	X	X	X	X	X	X	X	X	X	X	X	√
26	<i>Nicotiana tabacum</i> L.	Solanaceae	Herb	Mesophyte	X	X	X	√	X	√	X	X	X	X	X	X
27	<i>Nymphoides cristatum</i> (Roxb.) O. Ktze.	Menyanthaceae	Herb	Hydrophyte	X	X	X	X	X	X	X	X	X	X	X	√
28	<i>Parthenium hysterophorus</i> L.	Asteraceae	Herb	Mesophyte	X	X	X	√	√	√	X	X	X	X	X	X
29	<i>Phyla nodiflora</i> (L.) Greene.	Verbenaceae	Herb	Mesophyte	X	X	√	√	X	√	X	X	X	X	X	X
30	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Fabaceae	Tree	Mesophyte	X	X	X	X	√	X	X	X	X	X	X	√
31	<i>Portulaca oleracea</i> L.	Portulacaceae	Herb	Mesophyte	X	X	√	X	X	√	X	X	X	X	X	X
32	<i>Potamogeton perfoliatus</i> L.	Potamogetonaceae	Herb	Hydrophyte	X	X	X	X	X	X	X	X	X	X	X	√
33	<i>Prosopis juliflora</i> (Sw.) DC.	Fabaceae	Shrub	Xerophyte	√	X	√	X	X	X	X	√	√	X	X	X
34	<i>Solanum americanum</i> Mill.	Solanaceae	Herb	Mesophyte	X	X	X	X	√	X	X	X	X	X	X	X
35	<i>Suaeda maritima</i> (L.) Dumort.	Amaranthaceae	Shrub	Halophyte	√	√	√	X	X	X	√	√	X	√	X	X
36	<i>Tamarix aphylla</i> (L.) H.Karst.	Tamaricaceae	Shrub	Halophyte	X	√	√	√	X	X	X	X	√	X	X	X
37	<i>Typha domingensis</i> L.	Typhaceae	Herb	Hydrophyte	X	X	X	√	X	X	X	X	X	X	√	X
38	<i>Vallisneria spiralis</i> L.	Hydrocharitaceae	Herb	Hydrophyte	X	X	X	X	X	X	X	X	X	X	X	√
39	<i>Vigna unguiculata</i> (L.) Walp.	Fabaceae	Herb	Mesophyte	X	X	X	X	X	√	X	X	X	X	X	X
40	<i>Xanthium strumarium</i> L.	Asteraceae	Herb	Mesophyte	X	X	X	√	√	X	X	X	X	X	√	X

IV.CONCLUSION

Fabaceae was found to be the dominant family in the study region considering Sabarmati and Mahi study area together. It was followed by Solanaceae family (4 species). The most predominant life form of the plant species reported includes herbs (70%). Among Sabarmati and Mahi study areas, Fajalpur site of Mahi river had higher number of herbaceous plant species (11 species). From the view point of the ecological groups maximum number of species was found for mesophytes followed by that of hydrophytes, halophytes and xerophytes.

V. ACKNOWLEDGEMENTS

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