



FLORAL DIVERSITY OF THAR DESERT OF WESTERN RAJASTHAN, INDIA

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Thar desert is one of the ecosystem possessing highest biodiversity among the desert ecosystems of the world. The floristic survey of Thar desert was carried out during 2013-2015. A total of 62 families, 157 genera and 206 species were documented from the area. Three most dominant families of plants in the study area were Fabaceae (29 species), followed by Poaceae (26 species) and Asteraceae (15 species). The habit wise analysis of the results depicted that herbaceous vegetation (60.10%) were highest prevailing vegetation in Thar desert followed by shrubs (16.26%), trees (14.29%) and climber (9.36%). The results of the study will be helpful for conservation and sustainable utilization and management of the plant resources of the Thar desert of the western Rajasthan.

Keywords: Floral diversity; floristic survey; Thar desert.

Introduction

Deserts are natural ecosystems characterized by very scanty rainfall (less than 60cm), high evapo-transpiration rate, aridity and very meagre presence of vegetation. The western Rajasthan possesses sandy warm desert known as Great Indian Thar desert. It extends into the southern portion of Haryana and Punjab and into northern part of Gujarat state. The total area of the Thar desert is about 2,00,000 km², spread in western part of Indian sub-continent between 24° to 28° N latitude and 68° to 71° E longitude¹. It is the ninth largest desert of the world, but it has very fair biodiversity status. The average population density in Thar desert is 83 persons/km, while in other deserts of the world, the population density is just 7 persons/km.² In India, more than 60% of geographical area of the Thar Desert lies in

the Rajasthan state³. The Thar Desert has a very rich floral diversity including about 628 species, 352 genera and 87 families⁴. It mainly occupied by dry grassland or by grassland intermingled with trees and thorny bushes. One of the important geological features of the Thar desert is the presence of some ephemeral rivers including Luni, Sookdi, Ghagghar, Bandi and Jojri river, which plays an important role on micro-climatic conditions of the regions through which they traverse and hence, they affect the vegetation of these regions of the Thar desert⁵. According to report of the task force on grasslands and deserts (2006), the total protected area network in the Thar region is about 7.45% of total geographical area the desert. There is only one national park and five wildlife sanctuaries in Thar desert which comprises about 16076 km² area⁶. It

was observed that due to arrival of Indira Gandhi Canal Project (IGCP) in western Rajasthan, the desert ecosystem has been remarkably affected by changing the crop pattern, traditional grazing regime, introduction of alien species etc⁷. The canal project has influenced immigration of new people from different part of India, who do not have the conservation value system which the inhabitants of the Thar desert had⁸. The IGCP has accelerated the over-exploitation of Thar desert for agricultural activities, which simultaneously enhanced the cattle population in the region. The population of dairy animals like buffalos, goats and other ruminants has increased in the Thar region. The grazing pressure on the rangeland vegetation is estimated to 3.2 ACU/Ha as compared to the carrying capacity (0.3 to 0.5 ACU/Ha), which leads to declination of floral diversity⁹. The result

of such activities has almost degraded the natural fields of *Lasiurus indicus* grass, which was dominated grass of the Thar region. It is therefore, the need of the time to conserve natural resources of the desert ecosystem. Many workers have done a remarkable work on the floral diversity of the Thar desert^{4,10-15}. Vegetation diversity plays a vital role in maintaining ecological balance in any natural ecosystem. Therefore, ecological studies and systemic floristic inventory must be carried out on regular interval to assess changes in diversity due to natural as well as anthropogenic factors¹⁶. Keeping in view of the importance of ecological study to considerate the mutual relationship between nature and inhabitants, the information on floral diversity was collected in relation to different habitats of the Thar desert of Rajasthan (Fig.1).

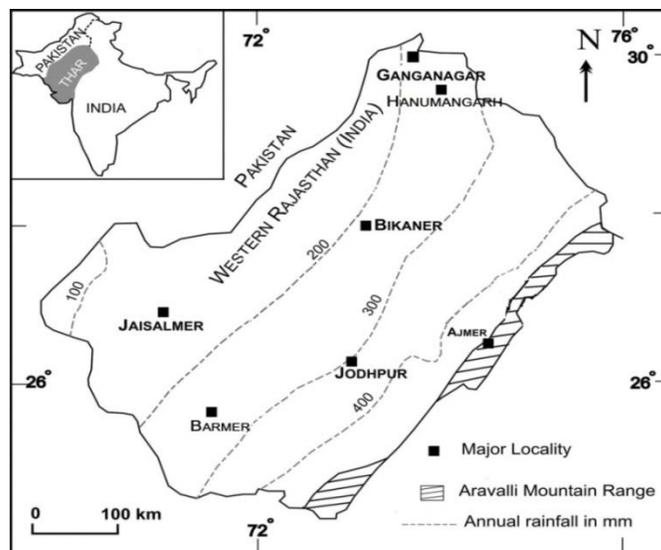


Fig.1. Expansion of the Thar desert in Rajasthan¹⁷

Climate of Thar desert

The climate of Thar desert is arid which is characterized by low and erratic rainfall, frequent drought, extremes of diurnal and annual temperatures, high wind velocity and

low humidity. During summer (March to June), the maximum temperature generally varies between 45°C and 50°C, while temperatures in winters (November-February) ranges between 15° – 25°C. More

than 88% of total annual rainfall (which is less than 25cm) of Thar desert is received during Monsoon season (July to October)¹⁸. Since last fifty years, the climatic regime has adversely affected, especially due to anthropogenic causes, at local as well as global level. A report of the Inter-Governmental Panel on Climate Change has projected hotter days and warm nights and a reduction in rainfall in Thar region by 21st century¹⁹. It is reported that the consequences of climate change may be very adverse for the biological diversity of the Thar desert²⁰.

Edaphology of Thar desert of Rajasthan

Edaphology is concerned with the influence of soils on living things, particularly vegetation. The soil of the Thar desert is characterized by poor soil fertility. It is dominantly sandy with 60-90% fine sand and 2-10% of silt-clay in the topsoil.⁹ and it has very less organic matter. The Thar desert is characterised by semi-stabilized to frequently sifting sand dunes. The soil of the Thar desert has low to medium available phosphorus and medium to high available potassium⁹. The average pH of soil of the desert ranges from 7.6 to 8.5²¹. Salinity and sodicity of the soil in some areas of the desert is higher, which is mostly confined to areas with depressions or 'Playa' (Fig. 2).



Fig. 2. Land spoiled by salt deposition near Badopal *playa*, Hanumangarh

Results and Discussion

The floristic survey of Thar desert was carried out during 2013-2015. A total of 62 families, 157 genera and 206 species were documented from the area. Among the existing families, Fabacea is the largest family with 29 species followed by Poaceae (26 species) and Asteraceae (15 species), Amaranthaceae (10 species), Cucurbitaceae (9 species), Convolvulaceae (6 species), Boraginaceae, Euhorbiaceae and Lamiaceae (5 species each), Acanthaceae, Brassicaceae, Capparaceae, and Zygophyllaceae (4 species each), Solanaceae, Apocynaceae,

Asclepiadaceae, Menispermaceae, Tiliaceae Malvaceae and Chenopodiaceae (3 species each), Aizoaceae, Casalpinnaceae, Cleomaceae, Cyperaceae, Hydrocharitaceae, Moraceae, Nymphaeaceae, Molluginaceae, Pedaliaceae, Plntaginaceae, Rhamnaceae, Salvedoraceae and Tamaricaceae (2 species each), while rest of 29 families are represented with one species. The habit wise analysis (Fig. 2) of the study shows that herbaceous vegetation (60.10%) were highest prevailing vegetation in Thar desert followed by shrubs (16.26%), trees (14.29%) and climber (9.36%).

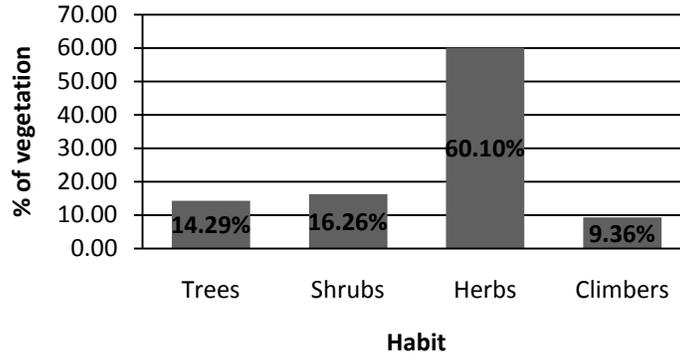


Fig. 2. Habit-wise comparison of vegetation of Thar desert of Rajasthan

The results of the present investigation is fairly supported by earlier studies carried out on floral diversity of the Thar desert^{22,23}. A

detail of common flora of the Thar desert of western Rajasthan and their status has inventoried in Table-1.

Table-1: Common flora of the Thar desert of western Rajasthan

S. No.	Plant Species	Family	Local name	Habit	IUCN status*
1.	<i>Abutilon indicum</i>	Malvaceae	Kanghi	Herb	NE
2.	<i>Acacia jacquemontii</i>	Fabaceae	Bu-banwali	Shrub	NE
3.	<i>Acacia leucophloea</i>	Fabaceae	Urajio	Tree	NE
4.	<i>Acacia nilotica</i>	Mimosaceae	Banwal	Tree	NE
5.	<i>Acacia nilotica</i> subsp. <i>Cupressiformis</i>	Fabaceae	Kikar, Ramkanta, Ramkati Babul	Tree	NE
6.	<i>Acacia senegal</i>	Fabaceae	Kumta, Kumatia	Tree	NE
7.	<i>Acalypha indica</i>	Euphorbiaceae	Muktajhuri, Kokli, Kuppi	Herb	NE
8.	<i>Achyranthes aspera</i>	Amaranthaceae	Modo kanto, Adhijhara, Katio bhuratio	Herb	NE
9.	<i>Acrachne racemosa</i>	Poaceae	Chinki	Herb	NE
10.	<i>Aerva lanata</i>	Amaranthaceae	Chhoti Bui	Herb	NE
11.	<i>Aerva persica</i>	Amaranthaceae	Safed Bui, Buari	Herb	NE
12.	<i>Aerva pseudotomentosa</i>	Amaranthaceae	Bui	Herb	NE
13.	<i>Ageratum conyzoides</i>	Asteraceae	Visadodi	Herb	VU
14.	<i>Ailanthus excelsa</i>	Simaroubaceae	Adusa	Tree	NE
15.	<i>Albizia lebbek</i>	Fabaceae	Sares	Tree	NE
16.	<i>Aloe vera</i>	Liliaceae	Patha	Herb	NE
17.	<i>Amaranthus viridis</i>	Amaranthaceae	Chaulie	Herb	NE
18.	<i>Anisomeles indica</i>	Lamiaceae	Ghabro	Herb	NE
19.	<i>Anogeissus pendula</i>	Combretaceae	Dhokda, Dhawada	Tree	NE
20.	<i>Argemone mexicana</i>	Papaveraceae	Satyanashi	Herb	NE
21.	<i>Argyrea nervosa</i>	Convolvulaceae	Ghav bel	Climber	NE
22.	<i>Aristida adscensionis</i>	Poaceae	Lampro	Herb	NE
23.	<i>Aristida funiculata</i>	Poaceae	Lamp	Herb	NE
24.	<i>Arnebia hispidissima</i>	Boraginaceae	Rambus	Herb	NE

S. No.	Plant Species	Family	Local name	Habit	IUCN status*
25.	<i>Asparagus racemosus</i>	Asparagaceae	Satawari	Climber	NE
26.	<i>Atylosia platycarpa</i>	Fabaceae	Sukli Sengha	Herb	NE
27.	<i>Azadirachta indica</i>	Meliaceae	Neem	Tree	NE
28.	<i>Bacopa monnieri</i>	Plantaginaceae	Brahmi	Herb	LC
29.	<i>Balanites aegyptica</i>	Zygophyllaceae	Hingota	Tree	NE
30.	<i>Barleria prionitis</i>	Acanthaceae	Bajradanti	Herb	NE
31.	<i>Bauhinia racemosa</i>	Fabaceae	Asundro	Tree	NE
32.	<i>Blepharis repens</i>	Acanthaceae	Bhangari	Herb	NE
33.	<i>Boerhavia diffusa</i>	Nyctaginaceae	Santhi, Punarnava	Herb	NE
34.	<i>Borreria articularis</i>	Rubiaceae	Poi, Safed bachla	Herb	NE
35.	<i>Brachiaria ramosa</i>	Poaceae	Murat	Herb	LC
36.	<i>Butea monosperma</i>	Fabaceae	Dhak	Tree	NE
37.	<i>Cadaba fruticosa</i>	Capparaceae	Dabi	Shrub	NE
38.	<i>Calligonum polygonoides</i>	Polygonaceae	Phog	Shrub	NE
39.	<i>Calotropis procera</i>	Asclepiadaceae	Aak, aakda	Shrub	NE
40.	<i>Capparis decidua</i>	Capparaceae	Ker	Shrub	NE
41.	<i>Cassia auriculata</i>	Caesalpinaceae	Anwal	Shrub	NE
42.	<i>Cassia fistula</i>	Fabaceae	Amaltas	Tree	NE
43.	<i>Cassia italica</i>	Fabaceae	Bhinda Anwal, Sonela	Herb	NE
44.	<i>Cassia occidentalis</i>	Fabaceae	Kesudo	Herb	NE
45.	<i>Cassia siamea</i>	Fabaceae	Kasod	Tree	NE
46.	<i>Cassia tora</i>	Caesalpinaceae	Phunwad	Herb	NE
47.	<i>Celosia argentea</i>	Amaranthaceae	Garkha, Imarti	Herb	NE
48.	<i>Cenchrus biflorus</i>	Poaceae	Bhurat	Herb	NE
49.	<i>Cenchrus ciliaris</i>	Poaceae	Dhaman	Herb	NE
50.	<i>Cenchrus prieri</i>	Poaceae	Lambio-bhurat	Herb	NE
51.	<i>Cenchrus setigerus</i>	Poaceae	Bhurtio	Herb	NE
52.	<i>Chenopodium album</i>	Amaranthaceae	Chilaro	Herb	NE
53.	<i>Chenopodium album</i>	Chenopodiaceae	Bathua	Herb	NE
54.	<i>Cistanche tubulosa</i>	Orobanchaceae	Lonki ro mut	Herb	NE
55.	<i>Citrullus colocynthis</i>	Cucurbitaceae	Tumba	Climber	NE
56.	<i>Citrullus fistulosus</i>	Cucurbitaceae	Tindsi	Climber	NE
57.	<i>Citrullus lanatus</i>	Cucurbitaceae	Matiro	Climber	NE
58.	<i>Cleome gynandra</i>	Cleomaceae	Bagra	Herb	NE
59.	<i>Cleome viscosa</i>	Cleomaceae	Hulhul, Bagro	Herb	NE
60.	<i>Clerodendrum phlomidis</i>	Lamiaceae	Arni, Arno	Shrub	NE
61.	<i>Coccinia grandis</i>	Cucurbitaceae	Golan, Gol	Climber	NE
62.	<i>Cocculus hirsutus</i>	Menispermaceae	Bajar bel	Climber	NE
63.	<i>Cocculus pendulus</i>	Menispermaceae	Pilwan	Climber	NE
64.	<i>Commelina benghalensis</i>	Commelinaceae	Bakhana	Herb	LC
65.	<i>Commiphora wightii</i>	Burseraceae	Guggal	Shrub	DD

S. No.	Plant Species	Family	Local name	Habit	IUCN status*
66.	<i>Convolvulus deserti</i>	Convolvulaceae	Hiranpagi, Shankhpushpi	Herb	NE
67.	<i>Corchorus depressus</i>	Tiliaceae	Bahuphali, Cham- ghas	Herb	NE
68.	<i>Corchorus trilocularis</i>	Tiliaceae	Hade-ka-khet	Herb	NE
69.	<i>Cordia dichotoma</i>	Ehretiaceae	Goonda	Shrub	NE
70.	<i>Cordia gharaf</i>	Boraginaceae	Gundi	Shrub	NE
71.	<i>Coronopus didymus</i>	Brassicaceae	Pitpapra	Herb	NE
72.	<i>Cressa cretica</i>	Convolvulaceae	Rudanti	Herb	LC
73.	<i>Crotalaria burhia</i>	Fabaceae	Sanio, Jhunda, Chag	Herb	NE
74.	<i>Crotalaria medicaginea</i>	Fabaceae	Gungario	Herb	NE
75.	<i>Cucumis callosus</i>	Cucurbitaceae	Kachri	Climber	NE
76.	<i>Cucumis melo</i> var. <i>agrestis</i>	Cucurbitaceae	Khaakhdi, Chibbadi	Climber	NE
77.	<i>Cucumis melo</i> var. <i>Cultus</i>	Cucurbitaceae	Kachro, Chibdi, Khakhdi	Climber	NE
78.	<i>Cucumis prophetarum</i>	Cucurbitaceae	Khad-Kachar	Climber	NE
79.	<i>Cuscuta reflexa</i>	Cuscutaceae	Amar-bel	Climber	NE
80.	<i>Cyamopsis tetragonoloba</i>	Poaceae	Gwar	Herb	NE
81.	<i>Cymbopogon</i> <i>jawarancusa</i>	Poaceae	Buraro	Herb	NE
82.	<i>Cynodon dactylon</i>	Poaceae	dubdi, dhob	Herb	NE
83.	<i>Cyperus bulbosus</i>	Cyperaceae	Moth, Motho	Herb	LC
84.	<i>Cyperus rotundus</i>	Cyperaceae	motha, Mandusi, Chhab	Herb	LC
85.	<i>Dactyloctenium</i> <i>aegyptium</i>	Poaceae	Makaro, Manchi	Herb	NE
86.	<i>Dactyloctenium indicum</i>	Poaceae	Tantia, ganthio	Herb	NE
87.	<i>Dalbergia sissoo</i>	Fabaceae	Shisham, Tali	Tree	NE
88.	<i>Datura stramonium</i>	Solanaceae	Dhaturo	Shrub	NE
89.	<i>Delonix regia</i>	Fabaceae	Gulmohar	Tree	VU
90.	<i>Dichanthium annulatum</i>	Poaceae	Karad	Herb	NE
91.	<i>Dichrostachys cinerea</i>	Fabaceae	Kolai	Shrub	LC
92.	<i>Dicoma tomentosa</i>	Asteraceae	Kantelo, Kantio	Herb	NE
93.	<i>Digera muricata</i>	Amaranthaceae	Lolaru	Herb	NE
94.	<i>Digitaria bicornis</i>	Poaceae	Jheranio	Herb	NE
95.	<i>Dipterygium glaucum</i>	Capparaceae	Moto chag	shrub	NE
96.	<i>Echinops echinatus</i>	Asteraceae	Unt-kanto	Shrub	NE
97.	<i>Eclipta alba</i>	Asteraceae	Jal Bhangro	Herb	NE
98.	<i>Enicostemma axillare</i>	Gentianaceae	Naame	Herb	NE
99.	<i>Eragrostis ciliaris</i>	Poaceae	Lutio-lamp	Herb	NE
100.	<i>Eragrostis minor</i>	Poaceae	Poongyo	Herb	NE
101.	<i>Eragrostis tremula</i>	Poaceae	Chualio	Herb	NE
102.	<i>Eruca vesicaria</i>	Brassicaceae	Tara-meera	Herb	NE
103.	<i>Eucalyptus camaldulensis</i>	Myrtaceae	Safeda	Tree	NE
104.	<i>Euphorbia caducifolia</i>	Euphorbiaceae	Danda thor	Shrub	NE
105.	<i>Euphorbia granulata</i>	Euphorbiaceae	Dudheli	Herb	NE

S. No.	Plant Species	Family	Local name	Habit	IUCN status*
106.	<i>Euphorbia hirta</i>	Euphorbiaceae	Dudhi	Herb	NE
107.	<i>Evolvulus alsinoides</i>	Convolvulaceae	Phooli	Herb	NE
108.	<i>Fagonia cretica</i>	Zygophyllaceae	Dhamaso	Herb	NE
109.	<i>Farsetia hemiltonii</i>	Brassicaceae	Hiran chabbo	Herb	NE
110.	<i>Ficus bengalensis</i>	Moraceae	Bar, Barlo	Tree	NE
111.	<i>Ficus religiosa</i>	Moraceae	Pipal	Tree	NE
112.	<i>Gisekia pharnaceoides</i>	Gisekiaceae	Morang, Sareli	Herb	NE
113.	<i>Glinus lotoides</i>	Molluginaceae	Jima, Bakada	Herb	NE
114.	<i>Glossonema varians</i>	Apocynaceae	kheerdi, Dodha	Herb	NE
115.	<i>Grewia tenax</i>	Tiliaceae	Gangan	Shrub	NE
116.	<i>Haloxylon salicornicum</i>	Chenopodiaceae	Khar, Lana	Herb	NE
117.	<i>Heliotropium crispum</i>	Boraginaceae	Kali bui	Herb	NE
118.	<i>Heliotropium subulatum</i>	Boraginaceae	Kali bui, Kharchan	Herb	NE
119.	<i>Holoptelea integrifolia</i>	Ulmaceae	Bandar Bati	Tree	NE
120.	<i>Hydrilla verticillata</i>	Hydrocharitaceae	Jhangi, Kureli	Herb	LC
121.	<i>Indigofera cordifolia</i>	Fabaceae	Bekar	Herb	NE
122.	<i>Indigofera linifolia</i>	Fabaceae	Lambio-bekario	Herb	LC
123.	<i>Indigofera linnaei</i>	Fabaceae	Bekario	Herb	NE
124.	<i>Indigofera oblongifolia</i>	Fabaceae	Goilia	Herb	LC
125.	<i>Ipomoea eriocarpa</i>	Convolvulaceae	Rota belari	Climber	NE
126.	<i>Ipomoea pes-tigridis</i>	Convolvulaceae	Panchpatia bel	Climber	NE
127.	<i>Justicia simplex</i>	Acanthaceae	Gungi-bunti	Herb	NE
128.	<i>Lantana Camara</i>	Verbenaceae	Raimunia	Shrub	NE
129.	<i>Lasiurus scindicus</i>	Poaceae	Sewan	Herb	NE
130.	<i>Launea nudicaulis</i>	Asteraceae	Van gobhi	Herb	NE
131.	<i>Launea procumbens</i>	Asteraceae	Janlee gobhi	Herb	NE
132.	<i>Lawsonia inermis</i>	Lythraceae	Mehandi	Shrub	NE
133.	<i>Lepidagathis trinervis</i>	Acanthaceae	Aewal kangio	Herb	NE
134.	<i>Lepidium sativum</i>	Brassicaceae	Asaliyo	Herb	NE
135.	<i>Leptadenia pyrotechnica</i>	Asclepiadaceae	Kheemp	Shrub	NE
136.	<i>Leucas aspera</i>	Lamiaceae	Dargal	Herb	NE
137.	<i>Maerua oblongifolia</i>	Capparaceae	Orapa	Climber	NE
138.	<i>Martynia annua</i>	Martyniaceae	Bagh-nakkhi	Shrub	NE
139.	<i>Maytenus emarginatus</i>	Celastraceae	Kankero	Shrub	NE
140.	<i>Melia azedarach</i>	Meliaceae	Bakayan	Tree	NE
141.	<i>Melilotus indica</i>	Fabaceae	Marvo	Herb	NE
142.	<i>Mollugo cerviana</i>	Molluginaceae	Chiria-ro-khet	Herb	NE
143.	<i>Moringa oleifera</i>	Moringaceae	Sanjano	Tree	NE
144.	<i>Mukia maderaspatana</i>	Cucurbitaceae	Ank phutani bel	Climber	NE
145.	<i>Nelumbo nucifera</i>	Nymphaeaceae	Kamal	Herb	NE
146.	<i>Nymphaea pubescens</i>	Nymphaeaceae	Be	Herb	NE
147.	<i>Ochthochloa compressa</i>	Poaceae	Ghora dhob	Herb	NE
148.	<i>Ocimum americanum</i>	Lamiaceae	Bapchi, Shyam tulsi	Shrub	NE
149.	<i>Ocimum sanctum</i>	Lamiaceae	Ram tulsi	Shrub	NE
150.	<i>Oligochaeta ramosa</i>	Asteraceae	Unt-kantilo	Herb	NE
151.	<i>Opuntia elatior</i>	Cactaceae	Nagfani	Shrub	LC

S. No.	Plant Species	Family	Local name	Habit	IUCN status*
152.	<i>Oropetium thomaeum</i>	Poaceae	Surshia	Herb	NE
153.	<i>Panicum antidotale</i>	Poaceae	Garmano	Herb	NE
154.	<i>Parkinsonia microphylla</i>	Fabaceae	Rambabool	Tree	NE
155.	<i>Parthenium hysterophorus</i>	Asteraceae	Gajar ghas, Congress Ghas	Herb	NE
156.	<i>Pavonia odorata</i>	Malvaceae	Chiriki Nahl	Herb	NE
157.	<i>Pedaliium murex</i>	Pedaliaceae	Bada Gokharu	Herb	NE
158.	<i>Pergularia daemia</i>	Apocynaceae	Akadi	Climber	NE
159.	<i>Perotis indica</i>	Poaceae	Lonki-puncho, billi ki ankh	Herb	NE
160.	<i>Physalis minima</i>	Solanaceae	Chirphoti	Herb	NE
161.	<i>Pithecellobium dulce</i>	Fabaceae	jangal jalebi, Pardesi amli	Tree	NE
162.	<i>Plantago ovata</i>	Plantaginaceae	Isabgol	Herb	NE
163.	<i>Polygala erioptera</i>	Polygalaceae	Boyasan	Herb	NE
164.	<i>Portulaca oleracea</i>	Portulacaceae	Luni	Herb	NE
165.	<i>Prosopis cineraria</i>	Fabaceae	Khejari	Tree	NE
166.	<i>Prosopis juliflora</i>	Fabaceae	Angreji bawal	Shrub	NE
167.	<i>Pulicaria arabica</i>	Asteraceae	Soneli	Herb	NE
168.	<i>Pulicaria crispa</i>	Asteraceae	Dhola lizru, Soneli	Herb	NE
169.	<i>Pupalia lappacea</i>	Amaranthaceae	Undio bhurat	Herb	NE
170.	<i>Rhus mysurensis</i>	Anacardiaceae	Dansara	Shrub	NE
171.	<i>Ricinus communis</i>	Euphorbiaceae	Arandi, Arand	Shrub	NE
172.	<i>Saccharum spontaneum</i>	Poaceae	Dharbi-ghas	Herb	LC
173.	<i>Salsola baryosma</i>	Chenopodiaceae	Lani	Shrub	NE
174.	<i>Salvadora oleoides</i>	Salvadoraceae	Meethi jaal	Tree	NE
175.	<i>Salvadora persica</i>	Salvadoraceae	Khari jaal	Tree	NE
176.	<i>Sarcostemma acidum</i>	Asclepiadaceae	Art Thor	Shrub	NE
177.	<i>Sesamum indicum</i>	Pedaliaceae	Til	Herb	NE
178.	<i>Sesuvium sesuvioides</i>	Aizoaceae	Lunio	Herb	NE
179.	<i>Sida cordata</i>	Malvaceae	Adio bal	Herb	NE
180.	<i>Solanum surattense</i>	Solanaceae	Adkuntali	Herb	NE
181.	<i>Sonchus oleraceus</i>	Asteraceae	aakadio	Herb	NE
182.	<i>Sporobolus diander</i>	Poaceae	Undar-puncho	Herb	NE
183.	<i>Suaeda fruticosa</i>	Amaranthaceae	Lunaki	Herb	NE
184.	<i>Tamarix aphylla</i>	Tamaricaceae	Farash	Tree	NE
185.	<i>Tamarix dioica</i>	Tamaricaceae	Lai, Arseli	Shrub	NE
186.	<i>Tecomella undulata</i>	Bignoniaceae	Rohida	Tree	NE
187.	<i>Tephrosia purpuria</i>	Fabaceae	Bhaker biyani, Bisoni, Sarpankho	Herb	NE
188.	<i>Tinospora cordifolia</i>	Menispermaceae	Giloy	Climber	NE
189.	<i>Tragus biflorus</i>	Poaceae	Charchara	Herb	NE
190.	<i>Trianthema portulacastrum</i>	Aizoaceae	Sato, hato	Herb	NE
191.	<i>Tribulus terrestris</i>	Zygophyllaceae	Kanti, Chota Gokhru	Herb	NE
192.	<i>Trichodesma amplexicaule</i>	Boraginaceae	Sial kanto	Herb	NE

S. No.	Plant Species	Family	Local name	Habit	IUCN status*
193.	<i>Tridax procumbens</i>	Asteraceae	Larde olapsi	Herb	NE
194.	<i>Trigonella foenum-graecum</i>	Fabaceae	Methi	Herb	NE
195.	<i>Typha angustata</i>	Typhaceae	ero ghas, Pann, Patera	Herb	NE
196.	<i>Vallisneria spiralis</i>	Hydrocharitaceae	Sewal	Herb	LC
197.	<i>Verbesina encelioides</i>	Asteraceae	Jungli surajmukhi	Herb	NE
198.	<i>Vernonia cinerea</i>	Asteraceae	Sahdevi	Herb	NE
199.	<i>Vigna trilobata</i>	Fabaceae	Janlee moth	Herb	NE
200.	<i>Viola cinerea</i>	Violaceae	Khokali, Khokla	Herb	NE
201.	<i>Withania somnifera</i>	Solanaceae	Ashwagandha	Herb	NE
202.	<i>Wrightia tinctoria</i>	Apocynaceae	Bhakar aak	Tree	LR/LC
203.	<i>Xanthium strumarium</i>	Asteraceae	Chhota dhatura	Shrub	NE
204.	<i>Ziziphus mauritiana</i>	Rhamnaceae	Beri, bordi	Shrub	NE
205.	<i>Ziziphus nummularia</i>	Rhamnaceae	Jhad-beri, bordi	Shrub	NE
206.	<i>Zygophyllum simplex</i>	Zygophyllaceae	Lonk, Lunwo	Herb	NE

Floral diversity and structure of plant Community of the Thar region

The Thar desert have arid climate, therefore, the vegetation of the region is adapted to xerophytic conditions²⁴. The Thar desert has a specific characteristics with a variety of environmental stresses including low precipitation, high temperature, extreme aridity, low availability of nutrients and high evapo-transpiration rate²⁵. The vegetation of the region are adapted to these edapho-climatic extremities, which helps the plants to grow and sustained in the adverse xerphytic conditions²⁶. It is reported that the Thar desert represents only 5% of the flora of India, which has about 17,500 flowering plants²⁷. It is reported that most of the plants

of the Thar desert are having different medicinal properties and therefore, they are being used by tribes for curing their ailments^{28,29}. The isohyets map of Rajasthan shows that the eastern part of the desert receives high rainfall (up to 400 mm) as compared to western part (about 100 mm) and hence, vegetation cover is comparatively dense in eastern part³⁰.

Halophytic vegetation

The Thar desert has many depressions or 'Playa', where salinity is very high. About 7,20,000 ha area of the desert is saline and is used for production of table salt³¹. Some vegetation is adapted to grow in such saline area (Fig.3).



Fig. 3. Saline water at Loonkaransar, Bikaner

The most common halophytes of the Thar desert are *Tamarix aphylla*, *Tamarix dioica*, *Trianthema triquetra*, *Cressa cretica*, *Portulaca oleracea*, *Portulaca meridiana*, *Haloxylon recurvum*, *Haloxylon salicornicum*, *Suaeda fruticosa*, *Sesuvium sesuvioides*, *Salsola baryosma*, *Zaleya redimita*, and *Zygophyllum simplex*.³²⁻³⁴

Vegetation on sand dunes

The desert of Rajasthan is characterized by semi-stable to frequently shifting sand dunes. Therefore, the vegetation cover on such dunes is very low. The average height of these sand dunes varies between 70-120 m.



Fig. 4. *Aerva persica* and *Tephrosia purpurea* dominated sand dune near Artwav village, Jalore

It is reported that about 44% area of the Thar desert is occupied by sand dunes³⁵. Ephemeral vegetation can be observed here during rainy season (Fig. 4 & 5). Some common vegetation on sand dunes of Thar desert including *Aerva persica*, *Aerva pseudotomentosa*, *Aerva javanica*, *Acacia jacquemontii*, *Boerhavia diffusa*, *Calligonum polygonoides*, *Cenchrus setigerus*, *Cenchrus ciliaris*, *Crotalaria burhia*, *Cyperus rotundus*, *Gisekia pharnaceoides*, *Mollugo cerviana*, *Lasiurus indicus*, *Panicum turgidum*, *Pedaliium murex*, *Tephrosia purpurea* can be observed during Monsoon period^{13,15,36}.



Fig. 5. *Crotalaria burhia* dominated sand dune near Gudamalani, Barmer

Vegetation of interdunal flats

Interdunal flats of the desert holds hard and compacted surfaces as compared to sand dunes (Fig.6 and Fig.7). These flats retain the rainwater for longer time than sand-dunes. The dominant vegetation of such flats are *Aristida funiculata*, *Arnebia hispidissima*, *Aerva javanica*, *Aerva persica*, *Aerva pseudotomentosa*, *Convolvulus deserti*, *Crotalaria burhia*, *Cappais decidua*, *Calotropis procera*, *Cymbopogon jawarncusa*, *Dactyloctenium indicum*, *Eragrostis ciliaris*, *Eragrostis minor*,

Eragrostis pilosa, *Evolvulus alsinoides*, *Fagonia cretica*, *Farsetia hamiltonii*, *Heliotropium bacciferum*, *Indigofera cordifolia*, *Indigofera linnaei*, *Leptedenia pyrotechnica*, *Ochocloa compressa*, *Pulicaria crispa*, *Tribulus terrestris*, *Tephrosia purpurea*, *Zizyphus nummularia*^{13,37}. The dominant tree of the Thar is *Prosopis cineraria*. However, in some areas of the desert, other tree flora including *Salvedora oleoides*, *Salvedora persica*, *Zizyphus mauritiana*, *Tecomella undulata*, *Balanites aegyptiaca*, *Acacia*

senegal, *Acacia nilotica*, *Acacia tortilis* etc are in co-existence with *Prosopis cineraria*¹³⁻¹⁵. Some climbers including *Asparagus racemosus*, *Citrullus colocynthis*, *Cucumis*

callosus, *Cucumis profetarum*, *Ipomoea pestigridis*, *Ipomoea eriocarpa* *Mukia maderaspatana* and *Pergularia daemia* can be observed in the Thar desert⁵.



Fig. 6. A view of inter-dunal flat near Rama village, Jaisalmer



Fig.7. *Zizyphus nummularia* and *Octhocloa compressa* dominant flat near Nal village, Bikaner

Aquatic vegetation

The Thar desert is very poor in water resources. Permanent water bodies are rare in the Thar desert. Indira Gandhi Canal Project (IGCP) is the major water supply system for both agricultural and drinking water purpose in most of the districts of the desert part of the Rajasthan (Fig. 8). Recently, the Narmada Canal Project has extended to meet the need of water in some parts of Jalore and Barmer districts. Some rivers in Thar desert of Rajasthan are also prevailing, which has very limited flow during Monsoon period and they remain dry for most of the time of the year. Some lakes including Kaylana (Jodhpur) (Fig. 9), Kolayat and Gajner (Bikaner), Gadisar (Jaisalmer) are possessing water throughout the year and hence some weeds and aquatic vegetation in the region can be observed. The common aquatic vegetation noticed in the water bodies including canals, major lakes and pond of Thar desert are

Ceratophyllum demersum, *Hydrilla verticillata*, *Ipomea aquatic*, *Eichornia crassipes*, *Lemna minor*, *Nelumbo nucifera*, *Nymphaea nauchii*, *Pistia stratiotes*, *Potamogeton crispus*, *Spirodela polyrhiza*, *Typha anguistata* and *Vallisneria Americana*^{38,39}. It was observed that Kolayat lake of Bikaner is dominated by *Nelumbo nucifera*, while IGNP canal and its minor branches are having *Typha anguistata* near banks of the canal. It was also noticed that near banks of almost all the water bodies of the Thar was dominated by *Cynodon dactylon* grass.

Vegetation on hillocks of the Thar desert

The eastern border of the Thar desert of Rajasthan touches the Aravalli range. It is noticed that the desert has some discontinued hillocks and small hills near Jodhpur (Fig.10), Sewana (Jalore), Chohtan and Kiradu (Fig.11) (Barmer). The important vegetation noticed on these hills are *Acacia senegal*, *Euphorbia caducifolia*,

Grewia tenax, Barleria prionites, Brachiaria ramosa, Commiphora wightii, Aristida funiculata, Asparagus recemosus, Lapidagathis trinervis, Melanocenthris jacquemontii, Pupalia lappacea, Tragus

biflorus, Maytenus emarginata, Dicoma tomentosa, Crotalaria medicagenia, Euphorbia hirta, Bidens biternata, Tetrapogon tenellus, Cymbopogon jwarancusa etc⁴⁰.



Fig. 8. A view of Indira Gandhi Canal, Hanumangarh



Fig. 9. Aquatic vegetation in Kaylana lake, Jodhpur

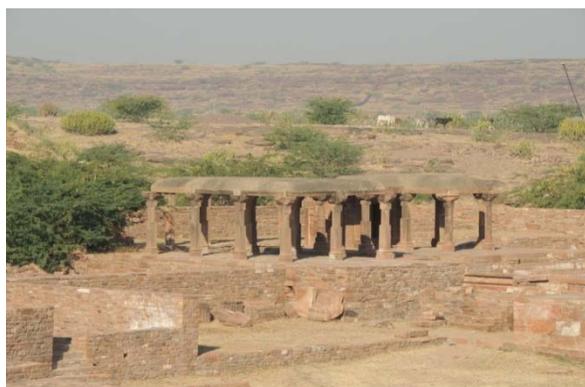


Fig. 10. Vegetation at hills near Mandor, Jodhpur



Fig. 11. A view of Kiradu hills near Barmer

Vegetation of Magras

Magras are hard landscape with gravel and stony surface (Fig.12 and Fig.13). These surfaces are so stiff that roots of most of the plants do not easily penetrate it. Therefore the vegetation covers on such surfaces are scanty. However, trenches made from runoff during Monsoon period creates the substratum favourable for some grasses and herb including *Sporobolus diander*, *Oropetium thomaeum*, *Crotalaria*

medicagenia, Eragrostis minor, Eragrostis pilosa, Evolvulus alsinoides, Fagonia cretica, Farsetia hamiltonii, Heliotropium bacciferum, Indigofera cordifolia, Octacloa compressa, Corchorus depressus, Lapidagathis trinervis, Tragus biflorus etc⁴¹.

Invasive alien flora of Thar desert

Due to improved irrigation facilities and canal irrigation in the western Rajasthan, many alien vegetation have invaded in the region. It is reported that biological invasion



Fig. 12. A view of *Magra* vegetation at Tembda Village, Jaisalmer



Fig. 13. *Magra* vegetation near Baap-Malar, Jodhpur

of alien species is the second worst threat after habitat destruction, which is responsible for the loss of native species⁴². These invasive species have wider range of ecological amplitude. Hence, once they invade in the region, they consistently reproduce and sustain populations over many generations without direct interference by humans^{43,44}. The native flora of the Thar desert of western Rajasthan is facing a severe threat from such invasive alien flora.

Prosopis chilensis is the most abundant alien species, which is rapidly spreading in the region and is highly adopted to survive almost in any condition⁴⁵. The common invasive flora reported from the Thar desert are *Prosopis chilensis*, *Acanthospermum hispidum*, *Ageratum conyzoides*, *Alternanthera pungens*, *Argemone Mexicana*, *Calotropis gigantea*, *Calotropis procera*, *Cassia obtusifolia*, *Cassia occidentalis*, *Cassia tora*, *Chloris barbata*, *Cleome viscosa*, *Echinops echinatus*, *Ipomoea eriocarpa*, *Ipomoea pestigridis*, *Lantana camara*, *Parthenium hysterophorus*, *Prosopis juliflora* / *Prosopis chilensis*, *Solanum surattense*, *Typha angustata* and *Xanthium strumarium*⁴⁶.

Biological reasons of loss of important flora from desert

The Thar desert is one of the most fragile desert biome of the world. Beside anthropogenic activities, there are many natural causes which are responsible for loss of biological diversity. Due to immense biotic interference, about 31 species of total 84 economically important species have become either vulnerable or endangered⁴⁷. Infestation by insects on flowers, fruits and seeds may causes deformities in them and anomalous physiological changes in the plants themselves^{48,49}. It is reported that about 17 species and 8 botanical varieties are endemic to the Indian Thar Desert³¹.

Some biological indiscretions in such plants are responsible for their reduced distribution. The major biological indiscretions including genetic variation and skimpy seed production may results in crisis in seed germination, e.g. *Salvadora persica* and *Salvadora oleoides*⁵⁰, *Commiphora wightii*^{51,52}, *Withania coagulans* and *Ephedra foliata*⁴⁷ (Singh, 2004), *Tecomella undulata*⁵³; seed infestation by insects e.g. *Acacia Senegal*⁵⁴; low seed viability e.g. *Anogeissus pendula*⁵⁵.

Conservation efforts

Increasing population and their growing demand for food, grains, vegetable, fruits etc from limited land resources has pose a

severe threat on biological diversity. Regular assessment of biological diversity in any ecosystem is very necessary for collecting valuable information on current status of species for frequency, density, abundance, distribution, environmental stress on them, results of conservational efforts etc. Some natural causes that affect the innate distribution of floral species must be recognised. It is also required that along with the anthropogenic activities, some natural aspect responsible for the loss of biological diversity should also be identified and mitigated to conserve the biological diversity of the Thar region. Infestation by insects on flowers, fruits and seeds may causes deformities in them and anomalous physiological changes in the plants, which are responsible for less and immature seed production. Therefore, efforts to study the seed physiology and reproductive biology of threatened and endangered plants are the need of the time to select and propagate resistant plants. Application of biotechnology and bio-engineering are playing a vital role in conserve and preserve the germplasm of threatened and endangered flora. Some conventional methods (preservation of seeds and pollens) and non-conventional methods (Cryo-preservation of embryo, callus, shoot tips) must be used to preserve and conserve the germplasm of endangered and threatened species.

Conclusion

Thar desert is possessing fair biodiversity of flora as well as fauna. To meet the needs of increasing population, there are severe threats exerting on biodiversity. Land resources are limited and anthropogenic factors such as industrialization, infrastructural developments, colonization, highways and railways development etc alter habitat, fragment landscapes and threaten biodiversity. Therefore, assessment

of biological diversity on regular basis is the need of the time. The valuable information on current status of different species, their distribution, frequency, density, abundance, environmental stress on them, etc may be helpful for the conservation of natural resources including flora and fauna of the region. Application of biotechnology and bio-engineering may also boost up the conservation of threatened and endangered species. The findings of the study will also be helpful for researchers and policymaker for further improvement and development of effective policies on conservation of the biological diversity of Thar desert.

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