

FLORISTIC AND PHYTO-SOCIOLOGICAL ASSESSMENT OF VEGETATION OF KEENJHAR LAKE AND SURROUNDING AREA (THATTA, SINDH), PAKISTAN

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ABSTRACT

Keenjhar Lake is one of the major fresh water reservoirs located at Thatta district of Sindh province, spread on area of about 140 km². It has been designated as Ramsar site in 1976 and a wildlife sanctuary in 1977. The Lake is a vital wetland area of great ecological, biological and economic significance. It is a major source of domestic and industrial water supplies to Karachi metropolitan. It is an important breeding and wintering area for a wide variety of birds, reptiles and mammals. Local communities especially fishermen are dependent on this important wetland for their sustenance. A detailed study was undertaken by "the Indus for All Programme of WWF-Pakistan" during 2006, 2007 and 2008 to record and document floral diversity and delineate the plant communities in and around Keenjhar Lake. A total of 7 plant communities were identified which represent a variety of habitats around the Keenjhar Lake. Significant findings during the survey included *Luffa echinata*, *Populus euphratica*, and *Tamarix sarenensis* which were recorded for the first time at this site. A new *Sporobolous* species was also documented which is a new addition to our knowledge. Keenjhar Lake exhibits a variety of habitats due to the presence of freshwater and its surrounding sandy, rocky and hilly areas. The small hills in the vicinity of Lake present an entirely different flora compared to that found in the low lying areas near water margins. In spite of being a freshwater Lake, patches of saline land are present at various points of its periphery that add to habitat diversity. The study presents the floristic and phytosociological details of Keenjhar lake area.

Keywords: Keenjhar lake, floral diversity, vegetation, wetland, Ramsar site

INTRODUCTION

Keenjhar Lake (also called Kalri lake) is situated 113 Km from Karachi in the Thatta District of Sindh province, about 20km from Thatta city. It lies between 27° 47' N latitude and 68° 02' E longitude (Michael, 1967). It is one of the largest fresh water lakes of the country having an area of about 140 km² (Anon. 1999). It is located in a stony desert composed of alternating limestone and sandstone. Historically it was formed by the combination of two lakes Sonheri and Keenjhar. Its main source is Indus River with some proportion of water from adjacent hills and torrents. It was declared Wildlife Sanctuary in 1977 under Sindh Wildlife Protection Ordinance, 1972. The sanctuary has a buffer zone of 5 km. It has also been designated as a Ramsar site in 1976 (Anon. 1999).

The climate of this site is arid due to scanty rain fall. Temperature is comparatively mild in the close vicinity of lake as compared to other parts of Sindh, it was selected as one of the site for detailed survey in the first phase of Indus For All Programme due to its status as a Ramsar sites and an expected rich plant biodiversity due to its location at the confluence of keerthar foothills and the Indus flood plain the showing a wide diversity of habitats.

MATERIALS AND METHODS

The survey of this site was conducted in September 2006, summer season of 2007 and spring season of 2008. Global Positioning System (GPS) was used in determining exact location of the sampling points. The species were identified with the help of various regional Floras (Jafri, 1966; Ali & Nasir, 1989-1991; Ali & Qaiser, 1992-1998, 2000-2007; Nasir & Ali 1970-1989; Matthew, 1981-83; Batanouny, 1981; Boulos, 1991; Shetty & Singh, 1987 & 1991; Bhandari, 1987; Qureshi, 2004). The collected specimens were deposited in the Karachi University Herbarium.

Field vegetation parameters like plant composition, cover, frequency and density were recorded along each transect line of 50 m using the line intercept method (Canfield 1940, Mueller-Dumbois & Ellenburg, 1974; Kent & Coker, 1992) and placing 1 m² quadrat at every 10 m interval on the same transect. Plant biomass was assessed by clipping the palatable vegetation falling in each quadrat and then taking mean biomass of 5 quadrats of each transect (Anon. 1962, Anon. 1968, Thalen and Junk 1979, Cook & Stubbendieck 1986, Saeed *et al.* 1987, Rashid *et al.*, 1988, Bonham 1989, Khan *et al.* 1989, Marwat *et al.* 1990, Wahid 1990; Dasti & Agnew 1994). In case of grasses, and palatable herbs clipping was carried out leaving 30 cm stubble height while in case of palatable shrubs and trees

only fresh growth of current year was removed (Holechek and Briske 1989; ESCAP 1994). The fresh samples of clipped vegetation were oven dried at 60 °C for 48 h to ascertain the dry matter yield (DMY) of each sample. The DMY was then calculated on hectare basis.

Cover, composition, frequency, relative cover, relative frequency, and relative density were determined (Smith, 1974; Shaukat *et al.* 1976; Chul & Moody 1983; Shukla & Srivastava 1992). The relative parameters were summed up to obtain importance value of each species. The 'Two Ways Indicator Species Analysis (TWINSPAN)' was used to delineate the plant communities on the basis of IVI, for each of the study seasons over three years.

RESULT AND DISCUSSION

Vegetation assessment of Keenjhar Lake was carried out over three years (2006, 2007 and 2008). The cumulative number of species after these assessments comes to be 263 in 165 genera and 55 families. Among these, Pteridophytes are represented by one species in one genus and one family, Dicot Angiosperms by 185 species in 120 genera and 44 families and Monocot Angiosperms by 77 species in 44 genera and 10 families. The complete list of species is given in Table: 2. Poaceae with 51 species comes to be the largest family followed by Fabaceae with 20 species, Asteraceae and Cyperaceae with 15 species each, and Convolvulaceae with 12 species. Among genera, *Cyperus* with 9 species is the largest followed by *Tamarix*, *Heliotropium* and *Eragrostis* with 6 species each, then *Euphorbia*, *Indigofera* and *Convolvulus* with 5 species each. In addition to natural flora, nine species of cultivated plants were also recorded (Table: 1).

The Lake has a rich flora of submerged, floating and emergent aquatic plants such as *Potamogeton spp.*, *Najas minor*, *Nelumbo nucifera*, *Nymphaea spp.*, *Cyperus spp.*, *Phragmites spp.*, *Typha spp.*, etc. These provide both food and shelter to fauna species. Many birds reside in the thick growth of *Typha* and *Phragmites*. The land around the Lake has a rich diversity of semiaquatic to dry land plant species.

This site presents a rich diversity of habitats due to the presence of a large freshwater Lake and its surrounding sandy, rocky and hilly areas. The small hills in the vicinity of Lake present an entirely different flora compared to that found in the low lying areas near water margins. In spite of being a freshwater Lake, patches of saline land are present at various points of its periphery that add to habitat diversity. This is why a rich floristic diversity is recorded from this site totalling 263 species from 2006 to 2008. This number may increase after regular monitoring over next few years in different seasons. Out of 263 species, 56 can be recognized as aquatic and wetland species collected from water and surrounding moist soils. Rest of the species are dry land species collected from dry areas away from water margins. About 14 species are rare species which may become locally endangered in near future, particularly *Barleria hochstetteri*, *Barleria prionitis*, *Farsetia hamiltonii*, *Pycreus dwarkensis*, *Elionurus royleanus*, *Leptothrium senegalensis*, and *Anticharis linearis*. Among various families, Poaceae have shown the highest diversity which is in conformity with the typical pattern of arid lands. The islands in the Lake have their own floristic diversity. One comparatively large island near to the picnic point is somewhat rocky with calcareous hillocks bear dry land species like *Salvadore oleoides*, *Euphorbia caducifolia*, *Cadaba fruticosa*, *Hibiscus micranthus*, *Abutilon fruticosum*, *Barleria prionitis*, *Chrysopogon aucheri*, etc. In addition to these a number of annual species appear after summer rains. On periphery of the island, however, wetland species like *Oxystelma esculentum*, *Phragmites karka*, *Ipomoea carnea*, *Merremia hederacea*, *Phyllanthus maderaspatensis* etc. are present. Other islands, particularly those towards Chhillia are occupied mostly by wetland species like *Typha dominghensis*, *Phragmites karka*, *Phyllanthus reticulatus*, *Cyperus articulatus*, *Merremia hederacea*, *Populus euphratica*, *Tamarix spp.* along with *Acacia nilotica*. *Typha* and *Phragmites* frequently form dense thickets which provide sheltered nesting place for a number of birds species. Annual species *Luffa echinata* is particularly prominent in the post-monsoon season. It is an extensive climber which spreads upon other larger plants. Among plants with floating leaves *Nelumbo nucifera* is the most prominent; its seeds and rhizomes are edible, the latter used as vegetable. Among submerged plants *Potamogeton pectinatus* is the most abundant. The alien invasive species *Salvinia molesta* and *Eichhornia crassipes* are quite frequent, particularly the former.

The local people depend upon the natural vegetation in various ways besides livestock grazing. *Typha* and *Phragmites* are used for making mats and rugs; and these along with *Saccharum* and *Tamarix spp.* are extensively used for thatching and hut-making. *Tamarix spp.* are also used as fuel. *Acacia nilotica* and *Populus euphratica* are valuable timber species. Rhizomes and petioles of *Nelumbo nucifera* are used as vegetable.

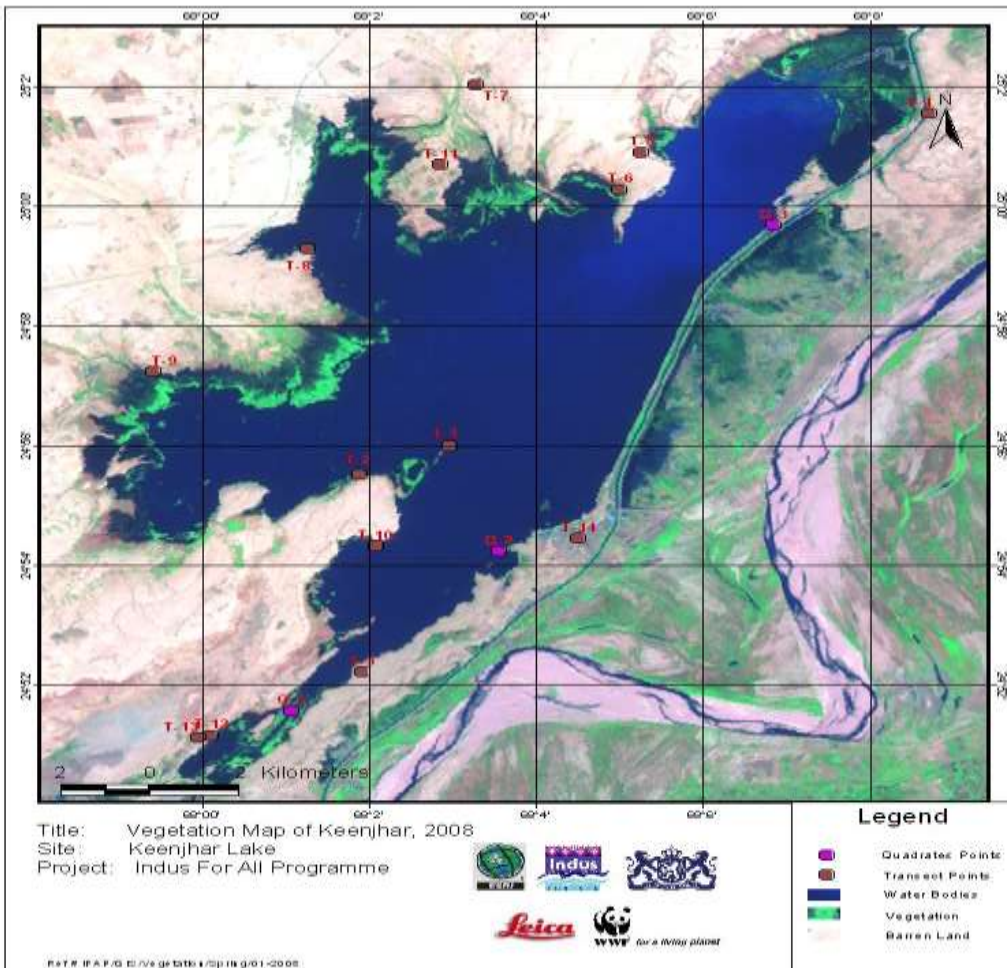
Significant findings

***Luffa echinata*:** According to the Flora of Pakistan records, it was considered a rare species recorded only from Chitral, Swat and Tharparkar. However, this study revealed it to be abundantly present in Keenjhar (particularly in the part of Lake towards Chhillia bund).

***Populus euphratica*:** This species is also recorded for the first time from Keenjhar Lake where it was found to be abundantly present on small islands towards Chilliya bund, Soneri and Amir Pir areas.

***Sporobolus* sp:** This is a new species that would be described later.

***Tamarix sarenensis*:** It is an endemic species of Sindh recorded from Keenjhar Lake, for the first time in the recent study, earlier it was known only from its type locality, that is lake Saren in Therparkar district.



PLANT COMMUNITIES

TWINSPAN analysis revealed following plant communities of the Keenjhar Site.

1. *Cyperus – Cynodon – Phyllanthus Plant Community (Fall 2006)*

This plant community is representative of relatively gravelly grounds with lot of grasses and annuals. This plant community is highly relished by livestock; therefore, overgrazing was very common in places where this community was found. Associated flora over these sites included species like *Ipomoea* (shrubs), *P. juliflora*, *Cleome viscosa*, *Amaranthus* sp., *Corchorus trilocularis*, *Corchorus depressus*, *Indigofera hochsteteri*, *Blepharis*, *Atriplex* sp., *Euphorbia granulata*, *Euphorbia caducifolia*, *Acacia nilotica*, *Salvadora persica*, *Phyllanthus*, *Rhynchosia minima*, *Heliotropium* sp., *Oxystelma*, *Pentatropis spiralis*, *Achyranthis* sp., *Senra incana*, *Corchorus trilocularis*, *Coccinia*, and *Launaea* sp. Forage production of this plant community varied from 51 Kg/ha to 203 Kg/Ha.

2. *Zygophyllum – Grewia Plant Community (Fall 2006)*

This plant community present on raised grounds or embankments and occupied by plant species like *Euphorbia caducifolia*, *Prosopis Juliflora*, *Launaea procumbens*, *Pentatropis spiralis*, *Polygala erioptera*, *Polycarpaea spicata*, *Hibiscus scindicus*, *Convolvulus glomeratus*, *Aristida sp.*, *Eragrostris*, *Tetrapogon tenellus*, *Corchorus sp.*, *Lycium sp.*, *Solanum cordatum*, *Solanum surattense*, *Oxystelma*, *Asparagus*, *Heliotropium sp.*, *Digera muricata*, *Senra incana*, *Grewia tenax*, *Heliotropeum ophioglossum*, *Iphiona granitoides*, *Blepharis scindica*, *Maerua arenaria*, *Zygophyllum propinquum*, *Argyrolobium roseum*, *Tavernaria cuneifolia*, *Aerva javanica* and *Commicarpus boissieri*. Forage production of the sites represented by this plant community varied from 93 Kg/Ha to 194 Kg/Ha.

3. *Eragrostis – Cyperus – Zygophyllum Plant Community (Fall 2006)*

This plant community also represented the same sites as those in the *Zygophyllum – Grewia*. The sites were dominated with annuals, grasses and shrubs and comprised of gravely well-drained soils. Mostly these sites were overgrazed.

4. *Cynodon – Launaea Plant Community (Summer 2007)*

This community was represented on bench lands and plateaus. The associated plant species of this community included *Prosopis glandulosa*, *P. juliflora*, *Indigofera cordifolia*, *I. hochstetteri*, *I. oblongifolia*, *Pentatropis nivalis*, *Senra incana*, *Euphorbia caducifolia*, *Digera muricata*, *Corchorus depressus*, *C. tridens*, *Commicarpus boissieri*, *Zygophyllum propinquum*, *Z. simplex*, *Commicarpus boissieri*, *Senna holosericea*, *Tribulus terrestris*, *Iphiona grantioides*, *Phyla nodiflora*, *Bacopa monnieri*, *Taverniera cuneifolia*, *Suaeda fruticosa*, *Amaranthus graecizans*, *Fagonia indica*, *Cleome scaposa*, *C. viscosa*, *Parkinsonia aculeata*, and *Salvadora persica*. In addition, the common grasses, consisted of species like *Aeluropus lagopoides*, *Aristida adscensionis*, *Brachiaria eruciformis*, *Cenchrus ciliaris*, *Cynodon dactylon*, *Dactyloctenium aegyptium*, *D. scindicum*, *Echinochloa colonna*, *Paspalum virginatum*, *Paspalidium germinatum*, and *Eragrostis japonica*. Forage production of these sites varied from 73 Kg/ha to 248 Kg/Ha showing overgrazing by livestock.

5. *Oxystelma – Fagonia Plant Community (Summer 2007)*

The associated plant species of these sites were represented by plants like *Prosopis juliflora*, *Euphorbia caducifolia*, *Acacia Senegal*, *Lycium edgeworthii*, *Commiphora stocksii*, *Grewia tenax* and *Iphionia grantioides*. The herbaceous cover comprised of *Rhynchosia minima*, *Heliotropium ophioglossum*, *Euphorbia granulata*, *E. clarkeana*, *Blepharis scindica*, *Indigofera hochstetteri*, *Corchorus depressus*, *C. tridens*, *Seddera latifolia*, *Boerhavia procumbens*, *Polygala erioptera*, *P. irregularis*, *Senna holosericea*, *Pentatropis spiralis*, *Cleome scaposa*, *Corbichonia decumbens*, *Indigofera oblongifolia*, *Convolvulus glomeratus*, *Cucumis prophetarum*, *Zygophyllum propinquum* and *Z. simplex*. The sedges and grass group was comprised of *Cyperus bulbosus*, *C. rotundus*, *Aristida adscensionis*, *Eragrostis ciliaris*, *Ochthochloa compressa*, *Tragus roxburghii*, *Dichanthium annulatum*, *D. foveolatum* and *Cenchrus ciliaris*. Forage production varied from 73 to 522 Kg/Ha.

6. *Prosopis juliflora – Fagonia indica - Aristida adscensionis Plant Community (Spring 2008)*

This plant community was represented on hard ground dominated by gravels. *Polygonum effusum*, *Alhagi maurorum*, *Cressa cretica*, *Zygophyllum simplex*, *Heliotropium curassavicum*, *Prosopis glandulosa* and *Tamarix alii* were the associated species.

7. *Cynodon dactylon – Phyla nodiflora Plant Community (Spring 2008)*

This community represented sites which were occupied mainly by grasses and herbs, though some shrubs were also present. The dominant flora comprised of species like *Phyllanthus madraspatensis*, *Prosopis cineraria*, *Salvadora persica*, *Persicaria glabra*, *Launea procumbens*, *Sida ovata*, *Prosopis juliflora*, *Tamarix sp*, *Bulboschoenus affinis*, *Schoenoplectus litoralis*, *Heliotropium ovalifoilum*, *Rhynchosia minima*, *Cynodon dactylon*, associated species were *Cyperus articulatus*, *Paspalidium gemimatum*, *Persicaria glabra*, *Cyperus alopecuroides*, *Bacopa monnieri*, *Cyperus exaltatus*, *Alternanthera sessilis*, *Alhagi maurorum* and *Panicum turgidum*. Forage production varied from 420 to 612 Kg/Ha.

Table 1. Cultivated plant species recorded at Keenjhar Lake

Sr #	Family	Plant species	Life form	Habit
1	Boraginaceae	<i>Cordia myxa</i> L.	Phanerophyte	Small tree
2	Caesalpiniaceae	<i>Cassia alata</i> Linn.	Phanerophyte	Shrub
3	Caesalpiniaceae	<i>Parkinsonia aculeata</i> L.	Phanerophyte	Tree
4	Fabaceae	<i>Sesbania bispinosa</i> (Jacq.) W.F. Wight	Phanerophyte	Subshrub
5	Mimosaceae	<i>Leucaena leucocephala</i> (Lam.) ed Wit.	Phanerophyte	Tree
6	Moraceae	<i>Ficus benghalensis</i> L.	Phanerophyte	Tree
7	Moraceae	<i>Ficus religiosa</i> L.	Phanerophyte	Tree
8	Pedaliaceae	<i>Sesamum indicum</i> L.	Therophyte	Herb
9	Verbenaceae	<i>Clerodendrum inerme</i> Gaertn	Phanerophyte	Shrub

CONCLUSION

The vegetation in and around Keenjhar Lake is in the process of deterioration at a very fast pace. Although this ecosystem is rich in floral diversity with respect to number of species recorded (263 species). However, out of 87 species recorded in transects, there were 34 species in the category of rare and 35 species rated as vulnerable. This is indicative of the fact that this fresh water wetland ecosystem is losing its productive potential. Immediate rehabilitation measures are required like control on overgrazing and discouraging alien plant species like *Eucalyptus* and *Mesquite* etc. The planting of fodder tree species and reseeding of palatable grasses should be promoted on farm fields through community participation in the area to overcome the grazing pressure.

Table 2. List of Flora of Keenjhar Lake.

S.#	Family	Plant species	Life form	Habit
1.	Acanthaceae	<i>Barleria acanthoides</i> Vahl	Phanerophyte	Shrub
2.	Acanthaceae	<i>Barleria hochstettri</i> Nees	Chamaephyte	Shrub
3.	Acanthaceae	<i>Barleria prionitis</i> L.	Phanerophyte	Shrub
4.	Acanthaceae	<i>Blepharis sindica</i> Stocks ex. T. Anders.	Therophyte	Herb
5.	Acanthaceae	<i>Ruellia patula</i> var. <i>alba</i> Saxton	Chamaephyte	Shrub
6.	Aizoaceae	<i>Trianthema portulacastrum</i> L.	Therophyte	Herb
7.	Aizoaceae	<i>Trianthema triquetra</i> Rottl. and Willd.	Therophyte	Herb
8.	Aizoaceae	<i>Zaleya pentandra</i> (L.) Jeffery.	Chamaephyte	Herb
9.	Amaranthaceae	<i>Achyranthes aspera</i> L.	Chamaephyte	Subshrub
10.	Amaranthaceae	<i>Aerva javanica</i> (Burm.f.) Juss ex J.A. Schultes	Phanerophyte	Shrub

S.#	Family	Plant species	Life form	Habit
11.	Amaranthaceae	<i>Alternanthera sessilis</i> (L.) DC.	Chamaephyte	Herb
12.	Amaranthaceae	<i>Amaranthus graecizans</i> L.	Therophyte	Herb
13.	Amaranthaceae	<i>Amaranthus viridis</i> L.	Therophyte	Herb
14.	Amaranthaceae	<i>Digera muricata</i> (L.) Mart.	Therophyte	Herb
15.	Apocynaceae	<i>Rhazya stricta</i> Decne	Phanerophyte	Shrub
16.	Araceae	<i>Pistia stratiotes</i> L.	Hydrophyte	Herb
17.	Arecaceae	<i>Nanorrhops ritcheana</i> (Griff.) Aitch.	Phanerophyte	Shrub
18.	Arecaceae	<i>Phoenix sylvestris</i> L.	Phanerophyte	Tree
19.	Aristolochiaceae	<i>Aristolochia bracteolata</i> Lamk.	Cryptophyte	Herb
20.	Asclepiadaceae	<i>Calotropis procera</i> (Ait.) Ait.f.	Phanerophyte	Shrub
21.	Asclepiadaceae	<i>Caralluma edulis</i> (Edgew.) Benth. & Hook.	Chamaephyte	Herb
22.	Asclepiadaceae	<i>Glossonema varians</i> (Stocks) Hook.f.	Chamaephyte	Herb
23.	Asclepiadaceae	<i>Leptadenia pyrotechnica</i> (Forsk.) Dcne.	Phanerophyte	Shrub
24.	Asclepiadaceae	<i>Oxystelma esculentum</i> (L.f) R.Br.	Cryptophyte	Climbing herb
25.	Asclepiadaceae	<i>Pentatropis nivalis</i> (J.F.Gmel.) Field & J.R.I.Wood	Chamaephyte	Climbing herb
26.	Asparagaceae	<i>Asparagus dumosus</i> Baker	Cryptophyte	Shrub
27.	Asteraceae	<i>Blumea obliqua</i> (L.) Druce	Chamaephyte	Herb
28.	Asteraceae	<i>Conyza aegyptiaca</i> Ait.	Chamaephyte	Herb
29.	Asteraceae	<i>Echinops echinatus</i> Roxb.	Therophyte	Tall herb
30.	Asteraceae	<i>Eclipta prostrata</i> (L.) L.	Chamaephyte	Herb
31.	Asteraceae	<i>Grangea maderaspatana</i> (L.) Poir.	Therophyte	Herb
32.	Asteraceae	<i>Iphiona grantioides</i> Boiss	Chamaephyte	Subshrub
33.	Asteraceae	<i>Launaea procumbens</i> (Roxb.) Amin	Chamaephyte	Herb
34.	Asteraceae	<i>Launaea remotiflora</i> (DC.) Stebbins	Therophyte	Herb
35.	Asteraceae	<i>Pluchea arguta</i> Boiss.	Chamaephyte	Subshrub
36.	Asteraceae	<i>Pluchea wallichiana</i> DC	Phanerophyte	Shrub
37.	Asteraceae	<i>Pulicaria boissieri</i> Hook.f.	Chamaephyte	Herb
38.	Asteraceae	<i>Sonchus asper</i> Fig.	Therophyte	Herb
39.	Asteraceae	<i>Sonchus oleraceus</i> L.	Therophyte	Herb
40.	Asteraceae	<i>Vernonia cinerascens</i> Schultz. Bip.	Phanerophyte	Shrub
41.	Asteraceae	<i>Xanthium strumarium</i> L.	Phanerophyte	Shrub
42.	Avicenniaceae	<i>Avicennia marina</i> L.	Phanerophyte	Tree
43.	Boraginaceae	<i>Coldenia procumbens</i> L.	Chamaephyte	Herb
44.	Boraginaceae	<i>Cordia gharaf</i> (Forsk.) Ehren. ex Asch.	Phanerophyte	Tree
45.	Boraginaceae	<i>Heliotropium calcareum</i> Stocks	Chamaephyte	Subshrub
46.	Boraginaceae	<i>Heliotropium crispum</i> Desf.	Chamaephyte	Subshrub
47.	Boraginaceae	<i>Heliotropium curassavicum</i> L.	Chamaephyte	Herb
48.	Boraginaceae	<i>Heliotropium ophioglossum</i> Stocks ex Boiss.	Chamaephyte	Herb
49.	Boraginaceae	<i>Heliotropium ovalifolium</i> Forsk.	Chamaephyte	Herb
50.	Boraginaceae	<i>Heliotropium strigosum</i> Willd.	Chamaephyte	Herb
51.	Boraginaceae	<i>Sericostoma pauciflorum</i> Stocks ex Wight	Chamaephyte	Subshrub
52.	Boraginaceae	<i>Trichodesma indicum</i> (L.) R. Br.	Chamaephyte	Subshrub
53.	Brassicaceae	<i>Farsetia hamiltonii</i> Royle	Therophyte	Herb

S.#	Family	Plant species	Life form	Habit
54.	Burseraceae	<i>Commiphora stocksiana</i> (Engler) Engler	Phanerophyte	Large shrub – tree
55.	Burseraceae	<i>Commiphora wightii</i> (Arn.) Bhandari	Phanerophyte	Shrub – tree
56.	Caesalpinaceae	<i>Senna holosericea</i> (Fresen.) Greuter	Chamaephyte	Subshrub
57.	Caesalpinaceae	<i>Senna italica</i> Mill.	Chamaephyte	Subshrub
58.	Capparidaceae	<i>Cadaba fruticosa</i> (L.) Druce	Phanerophyte	Shrub
59.	Capparidaceae	<i>Capparis decidua</i> (Forsk.) Edgew.	Phanerophyte	Large Shrub
60.	Capparidaceae	<i>Capparis spinosa</i> L.	Phanerophyte	Subshrub
61.	Capparidaceae	<i>Cleome brachycarpa</i> Vahl ex DC.	Chamaephyte	Herb
62.	Capparidaceae	<i>Cleome scaposa</i> DC.	Therophyte	Herb
63.	Capparidaceae	<i>Cleome viscosa</i> L.	Therophyte	Herb
64.	Capparidaceae	<i>Gynandropsis gynandra</i> (L.) Briq.	Therophyte	Herb
65.	Capparidaceae	<i>Maerua arenaria</i> (DC) Hook.f. & Thoms	Phanerophyte	Shrub
66.	Caryophyllaceae	<i>Polycarpha spicata</i> Wight & Arn.	Therophyte	Herb
67.	Caryophyllaceae	<i>Spergularia marina</i> (L.) Griseb.	Therophyte	Herb
68.	Chenopodiaceae	<i>Atriplex stocksii</i> Boiss.	Chamaephyte	Subshrub
69.	Chenopodiaceae	<i>Chenopodium album</i> L.	Therophyte	Herb
70.	Chenopodiaceae	<i>Chenopodium murale</i> L.	Therophyte	Herb
71.	Chenopodiaceae	<i>Haloxylon stocksii</i> (Boiss.) Benth. & Hooker	Phanerophyte	Shrub
72.	Chenopodiaceae	<i>Salsola imbricata</i> Forsk.	Phanerophyte	Shrub
73.	Chenopodiaceae	<i>Suaeda fruticosa</i> Forsk. Ex J.F. Gmelin	Phanerophyte	Shrub
74.	Convolvulaceae	<i>Convolvulus arvensis</i> L.	Chamaephyte	Twining herb
75.	Convolvulaceae	<i>Convolvulus glomeratus</i> Choisy.	Chamaephyte	Twining herb
76.	Convolvulaceae	<i>Convolvulus prostratus</i> Forssk.	Chamaephyte	Herb
77.	Convolvulaceae	<i>Convolvulus rhyniospermus</i> Hochst. ex Choisy	Chamaephyte	Herb
78.	Convolvulaceae	<i>Convolvulus scindicus</i> Boiss.	Chamaephyte	Subshrub
79.	Convolvulaceae	<i>Cressa cretica</i> L.	Therophyte	Herb
80.	Convolvulaceae	<i>Ipomoea aquatica</i> Forsk.	Hydrophyte	Herb
81.	Convolvulaceae	<i>Ipomoea carnea</i> Jacq.	Phanerophyte	Large Shrub
82.	Convolvulaceae	<i>Ipomoea sindica</i> Stapf	Therophyte	Climber
83.	Convolvulaceae	<i>Merremia aegyptia</i> (L.) Urban	Therophyte	Climber
	Convolvulaceae	<i>Merremia hederacea</i> (Burm.f.) Hall.f.	Chamaephyte	Climber
84.	Convolvulaceae	<i>Seddera latifolia</i> Hochst. & Steud.	Chamaephyte	Subshrub
85.	Cucurbitaceae	<i>Citrullus colocynthis</i> (L.) Schrad.	Therophyte	Herb
86.	Cucurbitaceae	<i>Coccinia grandis</i> (L.) Voigt	Phanerophyte	Climber
87.	Cucurbitaceae	<i>Cucumis melo</i> var. <i>agrestis</i> Naud.	Therophyte	Climber
88.	Cucurbitaceae	<i>Cucumis prophetarum</i> L.	Chamaephyte	Climber
89.	Cucurbitaceae	<i>Luffa echinata</i> Roxb.	Chamaephyte	Climber
90.	Cucurbitaceae	<i>Mukia maderaspatana</i> (L.) M.J.Roem.	Chamaephyte	Climber
91.	Cyperaceae	<i>Bolboschoenus affinis</i> (Roth.) Drobov	Cryptophyte	Sedge
92.	Cyperaceae	<i>Bolboschoenus glaucus</i> (L.) S.G. Smith	Cryptophyte	Sedge

S.#	Family	Plant species	Life form	Habit
93.	Cyperaceae	<i>Cyperus alopecuroides</i> Rottb.	Cryptophyte	Sedge
94.	Cyperaceae	<i>Cyperus articulatus</i> L.	Cryptophyte	Sedge
95.	Cyperaceae	<i>Cyperus exaltatus</i> L.	Cryptophyte	Sedge
96.	Cyperaceae	<i>Cyperus bulbosus</i> Vahl.	Cryptophyte	Sedge
97.	Cyperaceae	<i>Cyperus laevigatus</i> L.	Cryptophyte	Sedge
98.	Cyperaceae	<i>Cyperus longus</i> L.	Cryptophyte	Sedge
99.	Cyperaceae	<i>Cyperus pygmaeus</i> Rottb.	Hemicryptophyte	Sedge
100.	Cyperaceae	<i>Cyperus rotundus</i> L.	Cryptophyte	Sedge
101.	Cyperaceae	<i>Cyperus stoloniferus</i> Retz.	Cryptophyte	Sedge
102.	Cyperaceae	<i>Eleocharis geniculata</i> (L.) Roem. & Schult.	Hemicryptophyte	Sedge
103.	Cyperaceae	<i>Fimbristylis bisumbellata</i> (Forssk.) Bubani	Hemicryptophyte	Sedge
104.	Cyperaceae	<i>Pycreus dwarkensis</i> (Sahni & Naithani) Hooper	Hemicryptophyte	Sedge
105.	Cyperaceae	<i>Schoenoplectus litoralis</i> subsp <i>thermalis</i> (Trabut) S.Hooper	Cryptophyte	Sedge
106.	Elatinaceae	<i>Bergia suffruticosa</i> (Delile) Fenzl.	Chaemaephyte	Subshrub
107.	Euphorbiaceae	<i>Euphorbia caducifolia</i> Haines	Phanerophyte	Large Shrub
108.	Euphorbiaceae	<i>Euphorbia clarkeana</i> Hk.f.	Therophyte	Herb
109.	Euphorbiaceae	<i>Euphorbia granulata</i> Forsk.	Therophyte	Herb
110.	Euphorbiaceae	<i>Euphorbia hirta</i> L.	Therophyte	Herb
111.	Euphorbiaceae	<i>Euphorbia serpens</i> Kunth	Therophyte	Herb
112.	Euphorbiaceae	<i>Phyllanthus maderaspatensis</i> L.	Therophyte	Herb
113.	Euphorbiaceae	<i>Phyllanthus reticulatus</i> Poir.	Phanerophyte	Shrub
114.	Fabaceae	<i>Alhagi maurorum</i> Medic.	Phanerophyte	Subshrub
115.	Fabaceae	<i>Alysicarpus ovalifolius</i> (Schumach.) J. Leonard	Therophyte	Herb
116.	Fabaceae	<i>Argyrobolium roseum</i> (Camb.) Jaub. & Spach.	Therophyte	Herb
117.	Fabaceae	<i>Crotalaria burhia</i> Ham. Ex Bth.	Phanerophyte	Subshrub
118.	Fabaceae	<i>Crotalaria medicaginea</i> Lam.	Therophyte	Herb
119.	Fabaceae	<i>Cyamopsis tetragonoloba</i> (L.) Taub.	Therophyte	Herb
120.	Fabaceae	<i>Indigofera argentea</i> Burm.f.	Chamaephyte	Herb
121.	Fabaceae	<i>Indigofera cordifolia</i> Heyne ex Roth	Therophyte	Herb
122.	Fabaceae	<i>Indigofera hochstetteri</i> Baker	Therophyte	Herb
123.	Fabaceae	<i>Indigofera linifolia</i> (L.f.) Retz.	Therophyte	Herb
124.	Fabaceae	<i>Indigofera oblongifolia</i> Forsk.	Phanerophyte	Shrub
125.	Fabaceae	<i>Rhynchosia minima</i> (L.) DC.	Chamaephyte	Climber
126.	Fabaceae	<i>Melilotus alba</i> Desr.	Therophyte	Herb
127.	Fabaceae	<i>Melilotus indica</i> (L.) All.	Therophyte	Herb
128.	Fabaceae	<i>Taverniera cuneifolia</i> (Roth.) Arnott	Phanerophyte	Subshrub
129.	Fabaceae	<i>Tephrosia purpurea</i> (L.) Pers.	Chamaephyte	Subshrub
130.	Fabaceae	<i>Tephrosia strigosa</i> (Dalz.) Sant. & Mahcshw.	Therophyte	Herb
131.	Fabaceae	<i>Trifolium alexandrianum</i> L.	Therophyte	Herb
132.	Fabaceae	<i>Trifolium fragiferum</i> Linn	Therophyte	Herb
133.	Fabaceae	<i>Vigna trilobata</i> (L.) Verdc.	Therophyte	Herb

S.#	Family	Plant species	Life form	Habit
134.	Gentianaceae	<i>Enicostemma hyssopifolium</i> (Willd.) Verdoon	Hemicryptophyte	Herb
135.	Hydrocharitaceae	<i>Hydrilla verticillata</i> (L.f.) Royle	Hydrophyte	Herb
136.	Illecebraceae	<i>Cometes surattensis</i> L.	Therophyte	Herb
137.	Lamiaceae	<i>Salvia santolinifolia</i> Boiss.	Chamaephyte	Subshrub
138.	Malvaceae	<i>Abutilon bidentatum</i> A. Rich.	Phanerophyte	Subshrub
139.	Malvaceae	<i>Abutilon fruticosum</i> Guill. & Perr	Phanerophyte	Subshrub
140.	Malvaceae	<i>Abutilon indicum</i> (Linn.) Sweet	Phanerophyte	Subshrub
141.	Malvaceae	<i>Abutilon muticum</i> (Del.ex DC.) Sweet	Phanerophyte	Subshrub
142.	Malvaceae	<i>Hibiscus micranthus</i> L.f.	Chamaephyte	Subshrub
143.	Malvaceae	<i>Hibiscus scindicus</i> Stocks	Chaemaephyte	Subshrub
144.	Malvaceae	<i>Pavonia Arabica</i> Hochst. & Steud.	Chamaephyte	Subshrub
145.	Malvaceae	<i>Senra incana</i> Cav.	Phanerophyte	Subshrub
146.	Malvaceae	<i>Sida ovata</i> Forssk.	Phanerophyte	Subshrub
147.	Mimosaceae	<i>Acacia nilotica</i> (L.) Del. subsp. <i>Indica</i> (Benth.) Branan	Phanerophyte	Tree
148.	Mimosaceae	<i>Acacia senegal</i> (L.) Willd.	Phanerophyte	Tree
149.	Mimosaceae	<i>Prosopis cineraria</i> (Linn.) Druce.	Phanerophyte	Tree
150.	Mimosaceae	<i>Prosopis glandulosa</i> Torr.	Phanerophyte	Large Shrub
151.	Mimosaceae	<i>Prosopis juliflora</i> Swartz	Phanerophyte	Large Shrub
152.	Molluginaceae	<i>Corbichonia decumbens</i> (Forsk.) Exell	Therophyte	Herb
153.	Molluginaceae	<i>Gisekia Pharnaceoides</i> L.	Therophyte	Herb
154.	Molluginaceae	<i>Glinus lotoides</i> (L.) O.Kuntze.	Chamaephyte	Herb
155.	Molluginaceae	<i>Limeum indicum</i> Stocks ex. T. And.	Chamaephyte	Herb
156.	Najadaceae	<i>Najas minor</i> All.	Hydrophyte	Herb
157.	Nelumbonaceae	<i>Nelumbo nucifera</i> Gaertn.	Hydorphyte	Herb
158.	Nyctaginaceae	<i>Boerhavia procumbens</i> Banks ex Roxb.	Cryptophyte	Herb
159.	Nyctaginaceae	<i>Commicarpus boissieri</i> (Heimerl) Cufod.	Phanerophyte	Herb
160.	Nymphaeaceae	<i>Nymphaea lotus</i> Hook. f. & Thoms.	Hydrophyte	Herb
161.	Plumbaginaceae	<i>Limonium stocksii</i> (Boiss.) O.Kuntze	Chamaephyte	Subshrub
162.	Poaceae	<i>Aeluropus lagopoides</i> (L.) Trin. Ex Thw.	Cryptophyte	Grass
163.	Poaceae	<i>Aristida adscensionis</i> L.	Therophyte	Grass
164.	Poaceae	<i>Aristida funiculata</i> Trin. & Rupr.	Therophyte	Grass
165.	Poaceae	<i>Aristida mutabilis</i> Trin. & Rupr.	Therophyte	Grass
166.	Poaceae	<i>Brachiaria ovalis</i> (R. Br.) Stapf	Therophyte	Grass
167.	Poaceae	<i>Brachiaria ramosa</i> (L.) Stapf	Therophyte	Grass
168.	Poaceae	<i>Brachiaria reptans</i> (L.) Gardner & Hubbard	Therophyte	Grass
169.	Poaceae	<i>Cenchrus ciliaris</i> L.	Hemicryptophyte	Grass
170.	Poaceae	<i>Cenchrus pennisetiformis</i> Hochst. & Steud. ex Steud	Hemicryptophyte	Grass
171.	Poaceae	<i>Cenchrus setigerus</i> Vahl.	Hemicryptophyte	Grass
172.	Poaceae	<i>Chloris barbata</i> Sw.	Haemicryptophyte	Grass
173.	Poaceae	<i>Chrysopogon aucheri</i> (Boiss.) Stapf	Hemicryptophyte	Grass

S.#	Family	Plant species	Life form	Habit
174.	Poaceae	<i>Cymbopogon jwarancusa</i> (Jones) Schult.	Hemicryptophyte	Grass
175.	Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Hemicryptophyte	Grass
176.	Poaceae	<i>Dactyloctenium aegyptium</i> (L.) Willd	Therophyte	Grass
177.	Poaceae	<i>Dactyloctenium aristatum</i> Link	Therophyte	Grass
178.	Poaceae	<i>Dactyloctenium scindicum</i> Boiss.	Hemi cryptophyte	Grass
179.	Poaceae	<i>Desmostachya bipinnata</i> (L.) Stapf	Cryptophyte	Grass
180.	Poaceae	<i>Dichanthium annulatum</i> (Forsk.) Stapf	Hemicryptophyte	Grass
181.	Poaceae	<i>Dichanthium foveolatum</i> (Del.) Roberty	Hemicryptophyte	Grass
182.	Poaceae	<i>Diplachne fusca</i> (L.) P.Beauv. ex Roem & Schult.	Cryptophyte	Grass
183.	Poaceae	<i>Echinochloa colonum</i> (L.) Link	Therophyte	Grass
184.	Poaceae	<i>Eleusine indica</i> (Linn.) Gaertn.	Therophyte	Grass
185.	Poaceae	<i>Elionurus royleanus</i> Nees ex A.Rich.	Therophyte	Grass
186.	Poaceae	<i>Eragrostis cilianensis</i> (All.) Lut. ex F.T. Hubbard	Therophyte	Grass
187.	Poaceae	<i>Eragrostis ciliaris</i> (L.) R. Br.	Therophyte	Grass
188.	Poaceae	<i>Eragrostis japonica</i> (Thunb.) Trin.	Therophyte	Grass
189.	Poaceae	<i>Eragrostis minor</i> Host	Therophyte	Grass
190.	Poaceae	<i>Eragrostis pilosa</i> (L.) Beauv.	Therophyte	Grass
191.	Poaceae	<i>Eragrostis tenella</i> (L.) P. Beauv. ex Roem.	Therophyte	Grass
192.	Poaceae	<i>Eriochloa procera</i> (Retz.) C. E. Hubbard	Hemicryptophyte	Grass
193.	Poaceae	<i>Lasiurus scindicus</i> Henr.	Hemicryptophyte	Large Grass
194.	Poaceae	<i>Leptothrium senegalensis</i> (Kunth) W.D. Clayton	Hemicryptophyte	Grass
195.	Poaceae	<i>Ochthochloa compressa</i> (Forsk.) Hilu	Therophyte	Grass
196.	Poaceae	<i>Panicum antidotale</i> Retz.	Hemicryptophyte	Grass
197.	Poaceae	<i>Panicum turgidum</i> Forsk.	Hemicryptophyte	Grass
198.	Poaceae	<i>Paspalidium flavidum</i> (Retz.) A. Camus	Hemicryptophyte	Grass
199.	Poaceae	<i>Paspalidium geminatum</i> (Forsk.) Stapf	Hemicryptophyte	Grass
200.	Poaceae	<i>Paspalum vaginatum</i> Swartz.	Hemicryptophyte	Grass
201.	Poaceae	<i>Phragmites australis</i> (Cav.) Trin.	Cryptophyte	Large Grass
202.	Poaceae	<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	Cryptophyte	Large Grass
203.	Poaceae	<i>Saccharum benghalense</i> Retz.	Hemicryptophyte	Large Grass
204.	Poaceae	<i>Saccharum griffithii</i> Munro ex Boiss.	Hemicryptophyte	Large Grass
205.	Poaceae	<i>Saccharum spontaneum</i> L.	Hemicryptophyte	Large Grass
206.	Poaceae	<i>Sporobolus helvolus</i> (Trin.) Dur. & Schinz	Hemicryptophyte	Grass
207.	Poaceae	<i>Sporobolus kentrophyllus</i> (K. Schum.) W.D. Clayton	Hemicryptophyte	Grass
208.	Poaceae	<i>Sporobolus nervosus</i> Hochst.	Hemicryptophyte	Grass
209.	Poaceae	<i>Sporobolus sp. nov.</i>	Hemicryptophyte	Grass

S.#	Family	Plant species	Life form	Habit
210.	Poaceae	<i>Tetrapogon tenellus</i> (Koen. Ex Roxb.) Chiov.	Therophyte	Grass
211.	Poaceae	<i>Tragus roxburgii</i> Panigrahi	Therophyte	Grass
212.	Poaceae	<i>Urochondra setulosa</i> (Trin.) C.E. Hubb.	Hemicryptophyte	Grass
213.	Polygalaceae	<i>Polygala erioptera</i> DC.	Therophyte	Herb
214.	Polygalaceae	<i>Polygala irregularis</i> Boiss	Chamaephyte	Herb
215.	Polygonaceae	<i>Persicaria glabra</i> (Willd.) Gomes de la Maza	Phanerophyte	Herb
216.	Polygonaceae	<i>Polygonum effusum</i> Meisn	Chamaephyte	Herb
217.	Polygonaceae	<i>Polygonum plebejum</i> R. Br.	Chamaephyte	Herb
218.	Polygonaceae	<i>Rumex dentatus</i> L.	Therophyte	Herb
219.	Pontederiaceae	<i>Eichhornia crassipes</i> (Mart.) Solma	Hydrophyte	Herb
220.	Portulacaceae	<i>Portulaca oleracea</i> L.	Therophyte	Herb
221.	Potamogetonaceae	<i>Potamogeton lucens</i> L.	Hydrophyte	Herb
222.	Potamogetonaceae	<i>Potamogeton natans</i> L.	Hydrophyte	Herb
223.	Potamogetonaceae	<i>Potamogeton perfoliatus</i> L.	Hydrophyte	Herb
224.	Rhamnaceae	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	Phanerophyte	Shrub
225.	Rubiaceae	<i>Kohautia retrorsa</i> (Boiss.) Bremek.	Phanerophyte	Subshrub
226.	Salicaceae	<i>Populus euphratica</i> Olivier	Phanerophyte	Tree
227.	Salvadoraceae	<i>Salvadora oleoides</i> Decne.	Phanerophyte	Tree
228.	Salvadoraceae	<i>Salvadora persica</i> L.	Phanerophyte	Tree
229.	Salviniaceae	<i>Salvinia molesta</i> Mitchell	Hydrophyte Fern	Herb
230.	Scrophulariaceae	<i>Anticharis linearis</i> (Benth.) Hochst. ex Aschers.	Therophyte	Herb
231.	Scrophulariaceae	<i>Bacopa monnieri</i> (L.) Wettstein	Chamaephyte	Herb
232.	Scrophulariaceae	<i>Schweinfurthia papilionacea</i> (L.) Merrill	Chamaephyte	Herb
233.	Solanaceae	<i>Datura fastuosa</i> L.	Phanerophyte	Shrub
234.	Solanaceae	<i>Lycium edgeworthii</i> Dunal	Phanerophyte	Shrub
235.	Solanaceae	<i>Physalis divaricata</i> D. Don	Therophyte	Herb
236.	Solanaceae	<i>Physalis peruviana</i> L.	Therophyte	Herb
237.	Solanaceae	<i>Solanum cordatum</i> Forssk.	Phanerophyte	Straggling Shrub
238.	Solanaceae	<i>Solanum nigrum</i> L.	Therophyte	Herb
239.	Solanaceae	<i>Solanum surattense</i> Burm.f.	Chamaephyte	Herb
240.	Solanaceae	<i>Withania somnifera</i> (L.) Dunal	Phanerophyte	Subshrub
241.	Tamaricaceae	<i>Tamarix alii</i> Qaiser	Phanerophyte	Shrub
242.	Tamaricaceae	<i>Tamarix indica</i> L.	Phanerophyte	Shrub
243.	Tamaricaceae	<i>Tamarix pakistanica</i> Qaiser	Phanerophyte	Shrub
244.	Tamaricaceae	<i>Tamarix passernioides</i> Del. ex Desv.	Phanerophyte	Shrub
245.	Tamaricaceae	<i>Tamarix sarenensis</i> Qaiser	Phanerophyte	Shrub
246.	Tamaricaceae	<i>Tamarix sp. Nov.</i>	Phanerophyte	Shrub
247.	Tiliaceae	<i>Corchorus aestuans</i> L.	Therophyte	Subshrub
248.	Tiliaceae	<i>Corchorus depressus</i> (L.) Stocks	Chamaephyte	Herb
249.	Tiliaceae	<i>Corchorus tridens</i> L.	Therophyte	Herb
250.	Tiliaceae	<i>Corchorus trilocularis</i> L.	Therophyte	Herb
251.	Tiliaceae	<i>Grewia erythraea</i> Schweinf	Phanerophyte	Shrub

S.#	Family	Plant species	Life form	Habit
252.	Tiliaceae	<i>Grewia tenax</i> (Forssk.) A. & S.	Phanerophyte	Shrub
253.	Tiliaceae	<i>Grewia villosa</i> Willd.	Phanerophyte	Shrub
254.	Typhaceae	<i>Typha dominghensis</i> Pers.	Cryptophyte	Reed
255.	Verbenaceae	<i>Phyla nodiflora</i> (L.) Greene	Chamaephyte	Herb
256.	Violaceae	<i>Viola stocksii</i> Boiss.	Therophyte	Herb
257.	Zygophyllaceae	<i>Fagonia indica</i> Burm.f.	Chamaephyte	Herb
258.	Zygophyllaceae	<i>Tribulus longipetalus</i> Viv.	Therophyte	Herb
259.	Zygophyllaceae	<i>Tribulus ochroleucus</i> (Maire) Ozenda & Quezel	Therophyte	Herb
260.	Zygophyllaceae	<i>Tribulus terrestris</i> L.	Therophyte	Herb
261.	Zygophyllaceae	<i>Zygophyllum propinquum</i> Decne.	Chamaephyte	Subshrub
262.	Zygophyllaceae	<i>Zygophyllum simplex</i> L.	Therophyte	Herb

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