Indian Plantarum

A compendium of Phytogeographic zones and Plant lists

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Preface

India, a country abundant in biodiversity, boasts a diverse array of bioclimates and vegetation types. Its landscape encompasses a wide range of environments, from the frigid deserts of Ladakh to the arid plains of Thar, and from the lush tropical evergreen forests of the Western Ghats to the deciduous forests in the Deccan Trap. With its varied physiography, including mountains, valleys, fertile plains, deserts, seas, oceans, plateaus, rivers, estuaries, swamps, and deltas, India spans almost all major climatic zones found in the world. The distinctive characteristics of these bioclimatic zones, influenced by factors such as temperature, water, light, wind, and soil, provide different growth conditions for various plant communities.

The book, entitled "Indian Plantarum – a compendium of Phytogeographic Zones and plant lists," focuses on the interplay of these factors in delineating the bioclimatic zones, referred to phytogeogrphic zones, across the country. There are 20 zones and 79 sub-zones. These are portrayed through detailed maps, offering a comprehensive understanding of the distribution of plants and their growth potential in different areas.

The book is organized into three chapters. In Chapter 1, readers will explore India's climatic variations, the factors influencing plant growth, the various vegetation types, and the phytogeographic zones of the country. Diagrams and maps support the explanations. Chapter 2 presents the distribution of these zones state-wise, accompanied by a brief description of each zone's characteristics. Important cities are marked on the maps for easy reference, enabling readers to determine which plants can thrive in their specific regions. Chapter 3 delves into the detailed characteristics and plant lists for each specific sub zone, including information on soil type, rainfall, temperature, length of growing period (LGP), distribution, and vegetation type. This chapter focuses on zones rather than political state boundaries, making it more user-friendly. The plant lists are categorized into Trees, Shrubs, Herbs, Creepers/Climbers, Grasses, and Others, with native species distinguished by an asterix.

The gradation of climatic conditions, particularly rainfall and temperature, defines the progression of zones and subzones in the book. Its practicality lies in its ability to aid in developing climate-responsive planting plans, making it an essential tool for landscape architects, planners, architects, civil engineers, botanists, ecologists, environmentalists, foresters, wildlife experts, and state horticulture departments involved in planting projects.

In conclusion, this book shall be a valuable resource for plant enthusiasts and professionals throughout the country. The comprehensive insights and detailed plant lists make it an indispensable guide for making informed decisions about climate-appropriate planting choices.

I request you to take a moment to read the note addressed to the readers at the conclusion of this book.

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Chapter 1
Introduction

I. Climate of India

II. Plants and environment

III. Vegetation types of India

IV. Phytogeographic zones and subzones of india

India is blessed to have a rich plant diversity. It encompasses nearly all vegetation types found across the globe, including tropical, subtropical, temperate, alpine and subalpine. Each of these vegetation type thrives within specific growing conditions such as temperature, water, light, wind, and soil; influenced by various factors, including India's geographical location, seasons, physiography, rivers and river systems, seas and oceans, as well as pressure belts and jet streams.

Within a specific region, a combination of these growing conditions forms a distinct zone. Each of these conditions exhibits temporal and spatial variations, spanning diurnal and seasonal ranges. In the case of India, the country can be divided into 20 broad phytogeographic zones and 79 subzones, as depicted in the accompanying maps. These zones exhibit strikingly different microclimates, positioning India as one of the world's most climatically diverse nations.

I. CLIMATE OF INDIA

1. **Geographical location:** India lies between 8°4' to 37°6' North latitudes and 68°7' to 97°25' East longitudes. The North-South extent is 3214 km and East-West extent is 2933 km. Tropic of cancer passes almost through the middle of the country, leading to a tropical climate. The entire country lies in the northern hemisphere.

2. **Seasons:** Seasons are due to the tilt of Earth, its rotation on tilted axis and the revolution around the sun. There are Four seasons in India, winter (December to February), summer (March to May), monsoon or rainy season (June to September), and a post-monsoon period (October and November).

3. **Physiography:** India is characterized by a great and diversified group of physical features. There are North and North Eastern mountains, the Northern plains, Peninsular Plateau, the Indian Desert, Coastal plains, and the Islands. (Figure 1)

a. North and North Eastern mountains: They comprise of The Himalayas, Trans Himalayas and North Eastern mountains.

- The Himalayas have 3 parallel ranges – the Greater Himalayas or the Himadri, with an average elevation of 6100 m and width of 120- 190 km; the Lesser Himalayas or the Himachal with an average elevation of 3700- 4500 m, and an average width of 50 km; the Outer Himalayas or the Shivalik, with an average elevation of 900-1200 m and average width of 10-50 km.
- The trans-Himalayan ranges are towards the North of Himalayas and comprise of the Zaskar range, the Ladakh range and the Karakoram range in the extreme north.
- Towards the northeast are the Purvanchal hills.

b. The Northern plains: The Northern plains are formed due to the Ganga and Brahmaputra rivers in the north, and Indus river system in the west. It is 2400 km long and the width varies from 150-300 km.

c. Peninsular Plateau: The Peninsular Plateau is a triangular shaped table land. River Narmada divides it into two parts: The Central Highlands and Deccan Plateau.

- The Central Highlands consist of the Aravallis, the Malwa Plateau and the Chhota Nagpur Plateau, the Vindhyas and the Satpura ranges.
- The Deccan Plateau is broadly divided into The Western Ghats that run parallel to the West coast for 1600 km with an average elevation of 1000 m; and the Eastern Ghats along the East coast are discontinuous with an average elevation of 600 m.
- The orientation, aspect, slope and steepness of these landforms play a major role in influencing the regional climate.

II. PLANTS AND ENVIRONMENT

Plants are intricately interconnected with their environment, relying on specific growing conditions to thrive and survive. These conditions encompass a range of climatic factors such as temperature, water, light, wind, as well as edaphic factors relating to the soil. Each of these elements plays a vital role in the life of plants, either independently or in combination with others. Furthermore, these conditions are subject to variations influenced by temporal and spatial factors, adding complexity to the plant-environment relationship. Biotic factors contribute to the modification and alteration of these environmental conditions, shaping the overall growth and development of plants.

The influence of environmental factors on plant life cycles is particularly evident in annuals. These plants complete their entire life cycle within a single season, responding to specific conditions such as humidity, soil moisture, temperature, and light. Throughout this cycle, they undergo growth, development, reproduction, seed production, and eventually reach the end of their life at the conclusion of the season. The timing and success of each stage are intricately linked to the availability and suitability of these environmental factors. By closely aligning their life cycle with the seasonal changes and adapting to the prevailing conditions, annual plants maximize their chances of survival and reproductive success within the limited timeframe.

The key environmental factors that impact plant growth are:

1. **Temperature:** Both air temperature and soil temperature affect plant growth and development. Different plants have specific temperature requirements for germination, growth, flowering etc. Extreme temperatures, such as frost or heat waves, can have detrimental effects on plants.
2. **Water:** The primary source of water in India, is precipitation in form of rain. Water is essential to plants as moisture in air or humidity and soil moisture. Adequate water availability is essential for survival of plants, photosynthesis, nutrient uptake, and maintaining turgidity, to name a few.
3. **Light:** Light is crucial for photosynthesis, the process through which plants produce energy-rich compounds. Plants require the correct duration, intensity, and quality of light for optimal growth and flowering. Light availability also influences plant responses like phototropism and photoperiodism.
4. **Wind:** Wind affects plants in various ways. Moderate wind can aid in pollination, seed dispersal, and gas exchange. However, strong winds can cause physical damage, desiccation, lodging (bending or flattening of plants), and the spread of diseases or pests.
5. **Soil:** Soil provides physical support, nutrients, and water to plants. Factors like soil texture (proportion of sand, silt, and clay), depth, organic matter content, pH level, salinity and ground cover influence the plant growth. Different plants have specific soil requirements based on these factors.

Understanding and managing these environmental factors is crucial for successful plant growth, agriculture, and ecosystem management and combating the climate change. In landscape planning and design, we can create suitable environments for plants to thrive and ensure sustainable plant growth and productivity by considering their growth requirements.

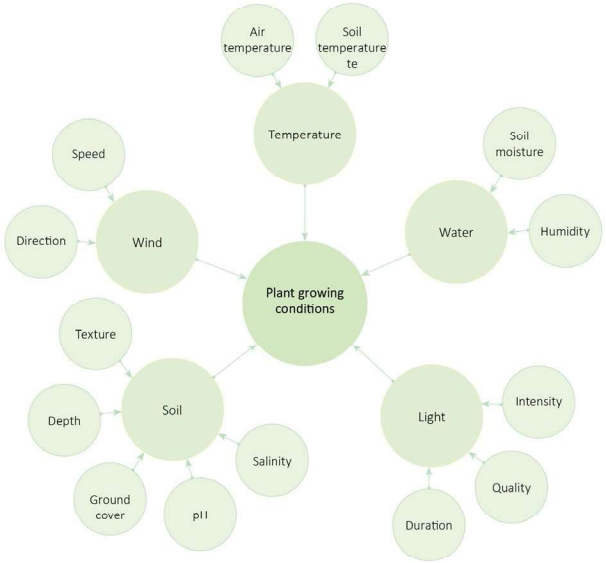

Figure 3: Plant growing conditions

1. Temperature

The average annual mean temperature in India is 23°C to 32°C during summer and -2°C to 15°C during winter. The low temperatures in the winters are more critical for the growth and survival of plants.

A. Importance of temperature to plants

- Growth: Temperature is a vital factor that affects plant growth. Each plant species has a specific temperature range within which it thrives. Temperatures below the minimum or above the maximum limit can hinder growth and potentially lead to plant death.
- Germination: Optimal soil temperature promotes seed germination,

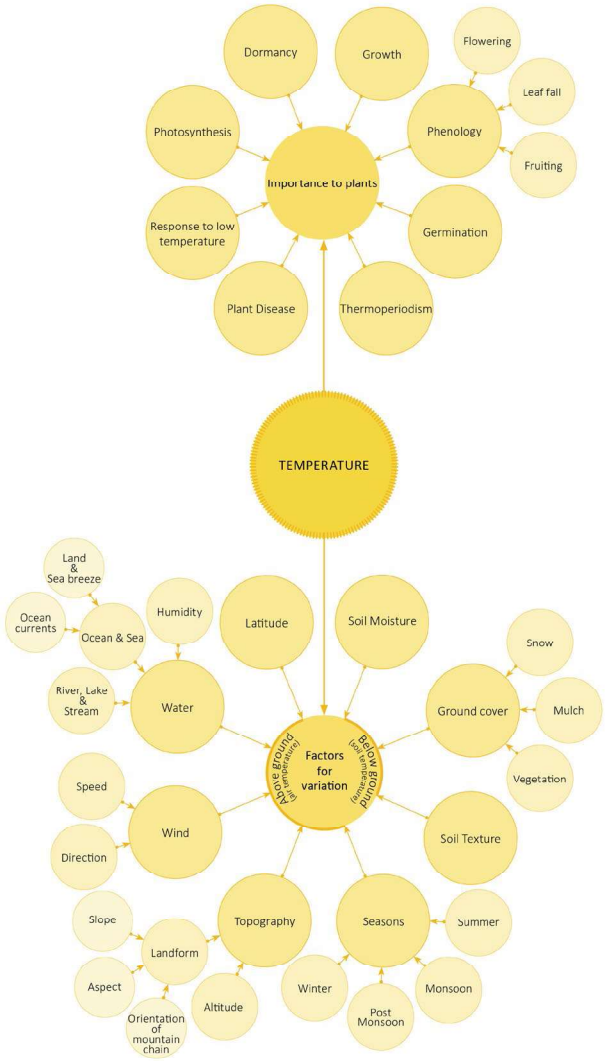

Figure 4: Temperature

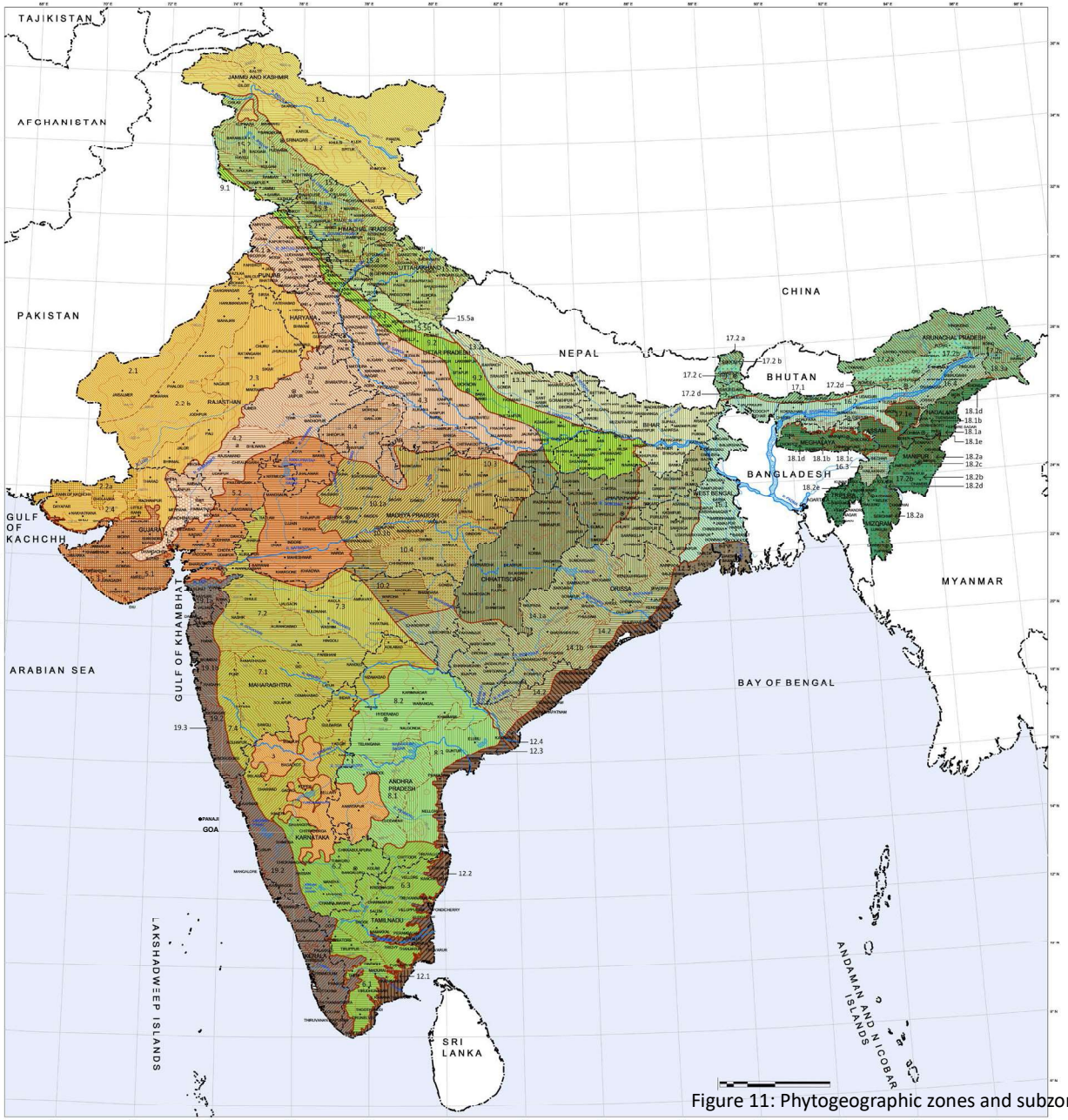

Figure 11: Phytogeographic zones and subzones of India

Chapter 2

Phytogeographic zones and subzones

I. Jammu and Kashmir
II. Himachal Pradesh, Haryana, Uttarakhand, Punjab, Delhi
III. Uttar Pradesh
IV. Rajasthan
V. Madhya Pradesh
VI. Gujarat
VII. Bihar, Jharkhand, West Bengal
VIII. Sikkim, Assam, Mizoram, Tripura, Manipur, Nagaland, Arunachal Pradesh, Meghalaya
IX. Maharashtra
X. Orissa, Chhatisgarh
XI. Goa, Andhra Pradesh, Telangana, Karnataka
XII. Kerala, Tamilnadu, Islands (Andaman & Nicobar, Lakshadweep)

Note: Some Union Territories are included in state maps

Figure 13: Phytogeographic zones of Jammu & Kashmir

I.
Jammu & Kashmir

Zone characteristics

Zone	Zone Type
1.1	Cold hyper arid
1.2	Cold arid
9.1	Hot dry/ moist sub-humid
15.1a	Cold and warm dry semi - arid/ dry sub - humid
15.2a	Temperate, moist dry sub - humid
15.2b	Warm moist sub - humid

Legend

- International boundary
- State boundary
- State capital
- River
- Contours
- Phytogeographic Zone
- Phytogeographic sub-zone

Chapter 3

Plant List for Phytogeographic Zones and Subzones

5.1 - Hot semi - arid region

Soil: Shallow and medium loamy to clayey black soils (Deep black soils as inclusion)

Mean temp: 24 - 25 ^{0}C

Rainfall: 600 - 700 mm

Growing Period: 90 - 120 days

Distribution:

Gujarat - Morvi, Rajkot, Gondal, Amreli, Jamnagar, Khambhalia , Junagadh, Sasangir, Bhavnagar, Surendranagar

Vegetation Type: Arid to semi - arid thorny forest, Dry deciduous teak forest, Wet evergreen forest

5.2 - Hot moist semi - arid region

Soil: Medium and deep, clayey black soil

Mean temp: 24 - 25 ^{0}C

Rainfall: 800 - 1000 mm

Growing Period: 120 - 150 days

Distribution:

Rajasthan - Bundi, Kota, Baran, Jhalawar, Pratapgarh, Banswara

Madhya Pradesh - Neemuch, Mandsaur, Ratlam, Dhar, Indore, Dewas, Shajapur, Maheshwar, Khargone, Khandwa, Harda, Barwani

Gujarat - Lunawada, Dahod, Godhara, Nadiad, Anand, Vadodara, Chota udaipur, Rajpipla, Bharuch

Vegetation Type: Arid to semi - arid thorny forest, dry deciduous forest, dry deciduous teak forest, de ciduous teak forest - intermediate between dry and moist categories

5.3 - Hot moist semi - arid region

Soil: Deep loamy coastal alluvium derived soil

Mean temp: 26 - 27 ^{0}C

Rainfall: 500 - 800 mm

Growing Period: 120 - 150 days

Distribution:

Gujarat - Naliya, Gandhidham, Dwarka, Porbandar, Jamnagar

Vegetation Type: Coastal forest

Zone 5

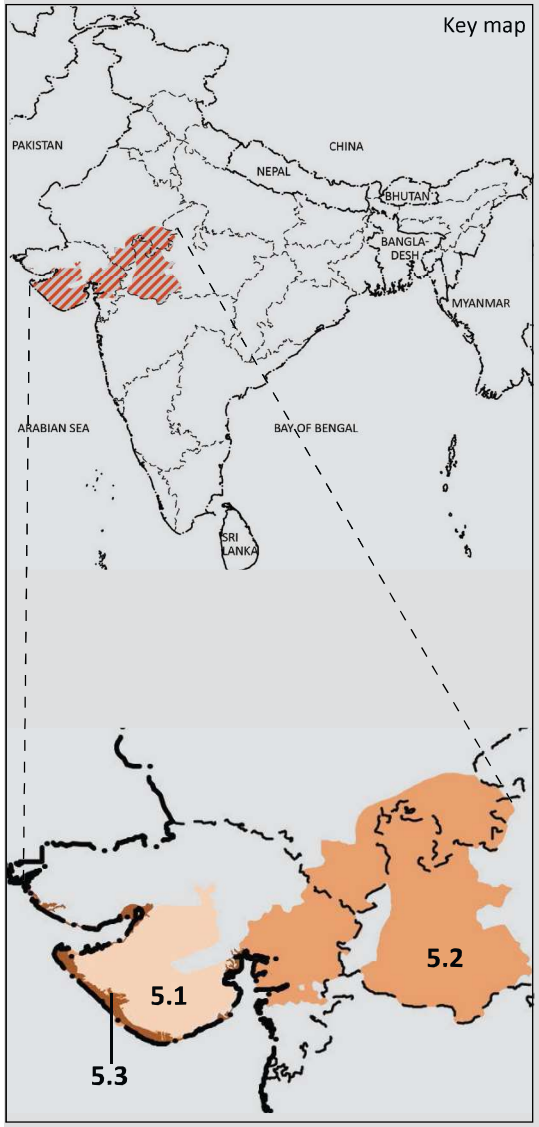

Figure 29: Phytogeographic zone 5

5.1 - Plant list

Trees

Acacia auriculiformis
*Acacia catechu**
*Acacia ferruginea **
*Acacia leucophloea **
*Acacia nilotica **
*Acacia planifrons **
Acacia senegal
*Acacia suma **
*Acacia sundra**
*Adina cordifolia**
*Aegle marmelos**
Ailanthus excelsa
Albizia lebbeck
*Albizia odoratissima**
*Albizia procera**
Alstonia scholaris
*Annona squamosa**
*Anogeissus latifolia**
*Atalantia monophylla **
*Azadirachta indica**
*Balanites aegyptiaca**
*Bauhinia racemosa**
Bauhinia variegata
*Bombax ceiba**
*Boswellia serrata**
*Bridelia sps**
*Buchanania lanzan**
*Butea monosperma**
Callistemon citrinus
*Canthium dicoccum**
*Capparis divaricata**
*Casearia tomentosa**
Cassia auriculata
*Cassia fistula**
Casuarina equisetifolia
*Chloroxylon swietenia**
Commiphora wightii
Cordia dichotoma
*Dalbergia latifolia**
*Dalbergia paniculata**
Delonix regia
*Dichrostachys cinerea**
*Dillenia pentagyqa**
*Diospyros chloroxylon**
*Diospyros melanoxylon**
*Diospyros montana**
*Dolichandrone atrovirens**
*Dolichandrone falcata**
*Erythroxylon monogynum**
Eucalyptus globulus
Ficus benghalensis
Ficus racemosa
Ficus religiosa
*Flacourtia jangomas**
Gliricidia maculata
*Gmelina arborea**
*Grewia tiliaefolia**
Holoptelea integrifolia
*Ixora arborea**
*Lagerstroemia parviflora**
Lagerstroemia speciosa
*Lannea coromandelica**
*Madhuca indica**
*Mangifera indica**
*Manilkara chloroxylon**
*Manilkara hexandra**
*Maytenus emarginata**
Melia azedarach
*Memecylon edule**
Millingtonia hortensis
*Mitragyna parvifolia**
Moringa oleifera
Morus indica
Murraya koenigii
*Nyctanthes arbor-tristis**
*Ougeinia oojeinensis**
*Parkinsonia aculeata**
Peltophorum pterocarpum
*Phyllanthus emblica**
Pithecelobium dulce
Polyalthia longifolia
Pongamia pinnata
*Prosopis cineraria**
Prosopis spicigera
*Pterocarpus marsupium**
Salvadora oleoides
Salvadora persica
*Santalum album**
Sapindus emarginatus
*Schrebera swietenioides**
*Soymida febrifuga**
Sterculia foetida
*Sterculia urens**
*Stereospermum chelonoides**
*Strychnos nux-vomica**
Syzygium cumini
Tabebuia sp.
Tamarix aphylla
*Tarenna asiatica**
*Tectona grandis**
Terminalia arjuna
*Terminalia bellirica**
Terminalia chebula
*Terminalia paniculata**
*Terminalia tomentosa**
*Wrightia tinctoria**
*Wrightia tomentosa**
*Xeromphis spinosa**
Ziziphus jujube
*Ziziphus mauritiana**
*Ziziphus xylopyrus**

Shrubs

Acacia concinna
*Acacia latronum**
*Acacia pennata**
Acalypha indica
*Aerva persica**
Alternanthera sp.
Asparagus racemosa
Asystasia sp.
Barleria prionitis
Caesalpinia bonducella
*Caesalpinia decapetala**
Caesalpinia pulcherrima
Caesalpinia sepiaria
*Capparis decidua**
*Capparis zeylanica**
*Carissa carandas**
*Cassia auriculata**
*Cassia tora**
*Cleistanthus collinus**
*Clerodendrum viscosum**
*Dodonaea viscosa**
Duranta repens
Euphorbhi hirta
*Euphorbia antiquorum**
*Euphorbia caducifolia**
*Euphorbia neriifolia**
*Flacourtia indica**
Flueggea virosa
*Gardenia turgida**
Hamelia patens
*Helicteres isora**

* **Native plants**