

# Preface

The study on “Biodiversity of Semiarid Landscape: Baseline Study for Understanding the Impact of Human Development on Ecosystems” covers the results compiled from datasets generated from rigorous empirical field studies. The study of biodiversity is meant to provide a reference point against which any future changes associated with any anthropogenic activity can be assessed and to offer information for subsequent monitoring of biodiversity performance. This research aimed to explore, survey, and quantify plant and animal specimens to document the species from aquatic and terrestrial ecosystems. The phytosociological assessment and analysis of diversity indices of different vegetation strata, i.e., trees, shrubs, herbs, climbers, tree saplings, and seedlings across the study region, are part of the objectives of the study. The study and analysis of the conservation status, i.e., to identify and document floral and faunal species (including threatened and endemic), was taken up as a research component. The documentation of traditional knowledge related to use, conservation, and management was also intended to be part of the study. The examination of land-use/land-cover class of the region for vegetation analysis was another objective of this research. The study area is located in North-East Dry Zone of Yadgir and Gulbarga districts in Karnataka, India, and spreads over about 2800 km<sup>2</sup>. The central point of the study area is located 16° 43' 35.40"N latitude and 76° 44' 40.91"E near Gogi Village in Shahapur taluk (Yadgir district) with average elevation of 460 m (1510 ft.) above mean sea level. The study region falls in Deccan Plateau, mostly covered by dry deciduous plants. Two rivers flow in the study region, and 11 major lakes are also located within the boundary of the studied semiarid landscape. With reference to soil orders of Karnataka State, NBSS & LUP, Nagpur, India, the soil of the study area comprises entisols, vertisols, and inceptisols.

Extreme climatic conditions are the characteristic features of the study region which is hot and receives low rainfall. The average rainfall is less than 650 mm with 40–55 rainy days in a year. The weather of the study area comprises of three seasons. Summer spans from late February to mid-June. It is followed by the southwest monsoon that ranges from late June to late September. It is then followed by dry winter weather until mid-January. The day temperature ranges from 26 °C in winter to 42 °C in summer.

The study area was divided into habitat types and in each habitat 30 quadrats consisting of subgroups—trees, shrubs/climbers, and herbs with sizes of quadrats  $10 \times 10$  m,  $5 \times 5$  m, and  $1 \times 1$  m, respectively were laid down for phytosociological study. When sampling trees and shrubs, the circumference and height of individuals of each species were recorded. Seasonal appearance of plants like flowering, fruiting, and appearance of young leaves was also recorded under phenological study. To study invertebrates, line transects of variable lengths, light traps, pitfall traps, baited traps, and litter collection methods were used. The avian diversity study was done by using line transect and point count methods. Data on big mammals were recorded by sound observation and analysis of pugmarks, scats, pellets, and vocals. The fishes were surveyed and identified by net fishing in major water bodies and exploring the fish markets. Belowground biodiversity was also studied. Litter samples were collected from the field without disturbing the central  $10 \times 10$  cm grid of the different land ecosystems and were transferred to the Berlese funnel for further cleaning and extraction of samples. For all the species, good photographs were taken. The plant species were preserved by preparing herbarium sheets using standard methods given by Botanical Survey of India. The invertebrates and fish species collected were preserved by dry or wet methods for identification and to deposit in regional centers of the Zoological Survey of India. Plants parts such as bark, roots, leaves, and fruits were also collected and preserved in the laboratory. Quantitative data on each species are described in detail. The survey was conducted in the selected villages of the region for documentation of traditional ecological knowledge and conservation and management of biodiversity. Detailed studies were carried out to explore, survey, and collect vertebrates, invertebrates, plants, zooplankton, and phytoplankton. The data collected were tabulated and used for calculating density, abundance, frequency, and importance value index (IVI). The analysis was done for preparing diversity indices such as Shannon–Wiener index, beta-diversity, concentration of dominance (Cd), and Simpson reciprocal index for different vegetation strata.

With the help of the phytosociological study, a total of 376 species of angiosperms (trees, shrubs, herbs, and climbers), 1 bryophyte, 4 pteridophytes, 1 gymnosperm, and 21 phytoplankton were recorded. The number of bryophyte and pteridophyte species recorded is low because the geoclimatic condition of the area is not suitable for those species. Species richness in the study area is dominated by the families belonging to Fabaceae (24), Euphorbiaceae (22), Asteraceae (20), Mimosaceae (18), Poaceae (16), Caesalpiniaceae (16), Convolvulaceae (15), Asclepiadaceae (13), Malvaceae (13), Amaranthaceae (13), Acanthaceae (12), Rubiaceae (10), and Verbenaceae (10). Unique code numbers were given to all the species collected during the study period. Plant biodiversity in this region is sparse and trees grow to limited height, which is a typical semiarid zone characteristic. Phenological data were recorded for tree and shrub species in the study region. The forest of the study region is of the dry deciduous type, and leaf-fall of most of the tree species coincides with the dry season (November to February), and budding and leaf-flushing start from March and continue until April. Majority of plant species were observed for their flowering and fruiting round the year. During field

studies, it was found that four species were flowering throughout the year. Seven tree species were flowering for seven months at different times of the year. Some of the species flowered for two months. Changes in ecosystems or habitats are known as beta-diversity ( $\beta$ -diversity). Trees show a high  $\beta$ -diversity value 2.4 however, for shrubs and herbs, the  $\beta$ -diversity values are recorded 1.56 and 2.25, respectively. The Shannon–Wiener index ( $H'$ ) for the study region is derived to estimate the species diversity. The  $H'$  values are in the range of 0.36–1.56.

The study area has several plant species with economic and traditional uses to meet the needs of local people. The species have multiple values in the form of timber wood (9 species), edible fruits (18 species), fuel wood (26 species), fodder (23 species), oral hygiene (11 species), and other uses. The timber requirement is met by tree species such as *Tectona grandis*, *Azadirachta indica*, and *Bauhinia racemosa*. Domestic fuel demand is met by plants namely, *Prosopis juliflora*, *Balanites aegyptiaca*, *Casuarina equisetifolia*, and *Lantana camara*. Apart from plants with traditional and economic values, there are 80 species of medicinal plants that are used for treating 19 ailments such as cold and cough, bone fracture/pain, jaundice, and diabetes. The uses, mode of preparation of medicine, and dosage to cure various ailments were also documented. *Santalum album*, *Acacia ferruginea*, and *Chloroxylon swietenia* are plant species in the study area that have been listed by IUCN under the Red List category as vulnerable species.

The faunal biodiversity study included classes—fishes, amphibians, reptiles, aves, and mammals under vertebrates; and arthropoda, mollusca, and annelida under invertebrates. Among the insects the butterflies and dragonflies were studied extensively during the study period. Around 164 insect species belonging to 13 orders, and 67 families were identified and documented for the study region. As many as 28 butterfly species belonging to six families of order Lepidoptera were recorded in the entire study area. The family Nymphalidae, represented by 13 species (46.43 % of the total butterfly species), was the most dominant one followed by Papilionidae (21.43 %) with 6 species, Pieridae (17.86 %) with 5, Lycaenidae (7.14 %) with two, Satyridae and Hesperidae (3.57 %) with one each. Seasonal appearance of butterflies was also studied for different species in different seasons, and it was observed that the Blue Pansy (*Junonia orithya*) and Peacock Pansy (*Junonia almana*) had two seasons—June to August and December to February. Of the 28 species of butterflies observed in the study area, the maximum numbers of butterflies were seen during September to February and peaking during December and January. The least number of butterflies was seen from March to May. A total of 13 species of dragonfly were recorded from the study region.

Eighty-two spider species (individuals including males, females, and juveniles) were collected from different types of habitats. All these species belong to 19 families of the order Araneae in class Arachnida. In addition to this, five species showed new characteristics but not identified so far. The Phylum Mollusca is represented by 17 different species belonging to 9 families collected from the Krishna and Bheema rivers, and lakes of the study region.

The total number of vertebrate species surveyed and listed in the entire study region was 111 belonging to different phyla—fishes (11), amphibians (5), reptiles

(13), aves (71), and mammals (11). The 11 fish species found in the study area come under 4 different families, namely Channidae, Cichlidae, Cyprinidae, and Siluridae. Among those 11 species, six are found only in rivers and the other five are found both in rivers and lakes. The least number of species was represented by the amphibians, which is expected from the semiarid region. Four of the five amphibian species belong to the family Anura. All of the 13 species of reptiles and six families belong to order Squamata. The species found in abundance were the house gecko, keeled Indian mabuya, and Indian monitor lizard. Aves, the most prevalent vertebrates in the region, comprised of 71 species, of which 15 were identified as aquatic, 31 as terrestrial, and four as both aquatic and terrestrial. The most abundant species belonged to the family Ardeidae and was represented by five aquatic and one terrestrial species. Among all the vertebrates, the avian species have a higher density. The region is home to seven migratory birds, five of which visit during April to September when the region gets a considerable amount of rain (29–142 mm). The study area is a habitat for 11 species of mammals of nine different families.

Geographical information system (GIS) and use of satellite data play an important role in understanding landscape dynamics. Landsat and LISS IV data were used for the current study to understand the changes in land use and land cover. The Survey of India (SOI) toposheets on 1:25,000 scale were procured from SOI, Bangalore office, and registered in the UTM Zone-44 N, WGS-84 Projection system. Precisely, georeferenced and radio-metrically calibrated (Level-1G products) satellite images were procured for the same season for the years 1973, 1980, 1992, and 2003/05/06/08. The thematic layers *viz.*, rivers, canals, water bodies, and road transportation were prepared for the study region, by sub-setting the toposheets and digitizing the various themes and creating geodatabase by using the ERDAS and ARC-GIS software. The combined unsupervised and supervised classification methods, popularly known as the hybrid classification method, were used in determining the extent of land cover. The land-use/land-cover change study shows that there has been no significant change in the area of water bodies (ponds/lakes), canal and rivers from 1973 to 2008. There has been an increase in the built-up areas/settlements in 2003 compared to 1973. In 2003, a landsat classified image showed that there has been shrinkage in areas with vegetation and barren land due to the conversion of such lands into agricultural land and other purposes, for example, construction of roads and other infrastructures. The degradation of forests in the study region is apparent from this study. This is due to anthropogenic pressure resulting in over-exploitation of forest resources. The land-use/land-cover change analysis does not show any increase in total vegetation cover. In fact, the forest cover has shrunk by 33.5 % in various localities, whereas the human settlement has increased by 66.7 % in some of the pockets of the study region. The area under barren land has decreased drastically, and current analysis showed the decrease for about 70–76 % in various parts of the study region. From the analysis, it is evident that a systematic and scientific approach is required for large-scale plantation of local species and revival of deciduous forests in the semiarid region for ecosystem sustainability, conservation of biodiversity, and sustainable flow of

ecosystem services. This work is based on the extensive fieldwork in the semiarid region, and data related to plants and animals were collected and analyzed. The integrated work on plants and animal biodiversity is the unique feature of this book. Therefore, this volume will be highly beneficial not only for the researchers from environmental/ecological sciences but also for the conservationists and policymakers.

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