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POLICY BRIEF - 17

# Biodiversity conservation in semi-arid landscape
# Central and North Eastern Dry Zones of Karnataka

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## Introduction

Biodiversity in semi-arid regions has immense ecological, socio-economic and cultural value. Arid and semi-arid regions cover around 40% of the terrestrial area of planet earth and support the livelihoods of two billion people, with 90% people living in developing countries. Dryland ecosystems support a variety of native flora and fauna that have in-built strategies to cope with the low rainfall and extreme temperature variability. Generally in the semi-arid region, the vegetation distribution is sparse and species grow to a limited height due to climatic stress / abiotic stress. In India, about 53 % of land area comprises two important ecoregions: the arid and semiarid regions. In Karnataka, more than 70% of the total geographical area is classified as arid or semi-arid which constitutes about 17-18 % of land under this category in India. In arid and semi arid regions, the species diversity has been on the decline due to environmental and anthropogenic factors.Scientific explorations on the inventory of biodiversity of drylands are sporadic. Hence, an inventory of biodiversity is of utmost importance for conservation and management of vulnerable arid and semi arid ecoregions. In this endeavour, the present study was undertaken to understand biodiversity, vegetation dynamics and land use/land cover change in Central Dry Zone and North Eastern Dry Zone of Karnataka.

## Objectives

- To study the phytosociology of plants in Central Dry Zone (CDZ) and North Eastern Dry Zone (NEDZ) of Karnataka.
- To explore, survey and document fauna from different land cover classes of the study area.
- To document endangered/threatened, endemic and rare species (plants and animals).
- To document the traditional ecological knowledge related to use, conservation and management of flora and fauna.
- To study the landscape dynamics of the study area using GIS and Remote sensing technology.

## Study area

### Central Dry Zone

Ecologically, five districts of Karnataka fall under Central Dry Zone, and one among them is Chitradurga. The study area in Chitradurga is located between 76$^0$ 34'49.86"E to 76$^0$51' 32.13"E and 14$^0$14'13.63"N to 14$^0$30'28.30"N near Ullarthi village of Challakere taluk(Fig 1). The study area experiences three seasons - summer (March to mid-June), monsoon season (June to October) and winter (October to February). December is the coolest month with average temperature at 17$^o$C (min) and May is the warmest month with average temperature at 43$^o$C (max). The average rainfall of Challakere taluk is about 569 mm. Agriculture constitutes the main land use in the study area and dependent on monsoon rains.

### North Eastern Dry Zone (NEDZ)

Three districts of Karnataka fall under NEDZ. The study region of NEDZ is located between 76$^0$ 36'12.50"E to 76$^0$ 53'06.96"E and 16$^0$35'59.00"N to 16$^0$52'18.29"N and falls in Yadgir and Gulbarga districts of Karnataka (Fig 1). The maximum area of the study region comes under Yadgir district. It has an average elevation of 455 metres (1,492 feet). The study region experiences three seasons – summer from March to mid-June, followed by the southwest monsoon from late June to late September and then dry winter until mid-February. The average rainfall is less than 650 mm. The temperature during summer ranges from 31$^o$ C to 42° C; during monsoon from 28$^o$ C to 32° C and in winter from 15$^o$ C to 26° C. Crop husbandry, animal husbandry, forests, pasture and the domestic sector are interlinked sub-systems of the village ecosystem.

## Methodology

The study area was divided into three zones: 0-5km Core Zone(CZ), 5-15 km Buffer Zone I(BZ-I) and 15-30 km Buffer Zone II(BZ-II) based on Survey of India toposheets and Arc GIS software. The entire geographical area of the CZ was studied, while the BZ- I and BZ- II were divided into 16 sectors each. The floral and faunal study was carried in various seasons for a period of two years.

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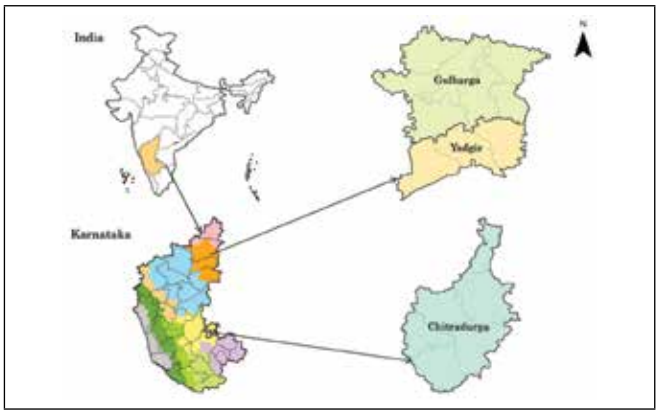


**Fig 1: Geographical location of CDZ and NEDZ in Karnataka**

## Floral analysis

The standard scientific methods were followed for conducting the phytosociological study and phenology across the species (BARC 2009).

## Faunal Analysis

The methods used to explore, survey, collect, preserve and identify various species adhere to the protocol (BARC 2009, Nautiyal et al. 2015).

Invertebrates were studied by using line transects of variable lengths, light traps, pit fall traps, baited traps and litter collection methods. An avian diversity study was carried by using line transect and point count methods. Data on mammals was recorded by vocal observations, analysis of pug marks, scats, pellets, live burrow counts, baiting and trapping. Fish species were surveyed by net fishing in water bodies. A below-ground biodiversity study was carried by collecting litter samples from the field without disturbing the central part 10X10cm grid of the different land ecosystems and transferred to the Berlese Funnel for further processing of the samples. Zooplankton sampling was conducted randomly in 4 lakes within 20 localities using bottle samplers and plankton nets.

## Preservation

Herbarium sheets were prepared for the collected plant specimens using standard method developed by Botanical Survey of India, while the invertebrates and fish species were preserved either dry or wet using 70% ethanol for detailed identification.

Data was analysed using variables such as Density, Abundance, Frequency and Importance Value Indices (IVI). The quantitative data analysis was carried by generating diversity indices like- Shannon-Wiener Index, Beta Diversity, Concentration of Dominance (Cd) and Simpson Reciprocal Index.

## Traditional ecological knowledge documentation

A questionnaire survey was conducted among the villagers to document the knowledge regarding the traditional use, conservation and management of flora and fauna of the study area.

## Key findings

### Central Dry Zone

### Plant biodiversity

- Through the phytosociological study in CDZ, 277 species of Angiosperms (51 species of trees, 42 shrubs, 153 herbs and 31 climbers) have been identified and their herbarium sheets were prepared.
- Plant species richness in the study area is found to be dominated by families Fabaceae (19), Poaceae (19), Euphorbiaceae (17), Asclepiadaceae (13), Asteraceae (12), Mimosaceae (12), Amaranthaceae (11), Caesalpiniaceae (09), Capparidiaceae (09), Apocynaceae (07), Malvaceae (07) and Boraginaceae (06).
- *Prosopis juliflora* is the most dominant species with an IVI of 38.4.
- The vegetation is of dry deciduous type. Leaf-fall for most of the tree species coincides with the dry season (January to February) while budding and leaf-flushing start from March and continues through April.
- Traditional ecological knowledge related to 32 medicinal plant species used in treatment of various ailments has been documented.
- Plant parts are often used in the preparation of medicines for curing various diseases in the primary health care system, with leaves being the most used (50%), followed by fruits (19%), stems (11%), roots (5%), barks (6%), seeds (6%) and rhizome (3%).
- *Santalum album* has been listed by IUCN under the Red List Category as a vulnerable species.

### Animal biodiversity

- Among invertebrates, Insecta consists of 84 species of 68 genera, 23 families and five orders, namely, Lepidoptera, Coleoptera, Hymenoptera, Orthoptera and Odonata. Of a total of 26 spider species belonging to 21 genera and 13 families, Lycosidae and Tetragnathidae are the most dominant families in the study area.
- Among vertebrates, six amphibian species have been identified belonging to three families, namely, Bufonidae, Ranidae and Rhacophoridae.
- A total of 21 reptile species belonging to 16 genera and 8 families have been identified.
- Gekkonidae is the most dominant reptile family of the study region.
- Aves, the most prevalent vertebrates in the region, comprise 79 species, belonging to 63 genera and 42 families.
- Eleven species of mammals belonging to nine different families were identified, with Accipitridae being the dominant family.
- Among six amphibian species, three species have been listed under schedule-IV of Indian Wild life Protection Act-1972 (IWPA-1972).
- Among 21 species of reptiles, one species (*Varanus bengalensis*) has been listed under Schedule-I, two species under schedule-II and nine species under schedule-IV of IWPA-1972.
- Among 79 species of birds, one species, the Indian Peafowl (*Pavo cristatus*), falls under schedule-I of IWPA 1972.
- Among 11 species of mammals, one species, the Black buck (*Antilope cervicapra*), has been listed under schedule-I of IWPA-1972, and another species, the Indian gray mongoose (*Herpestes edwardsii*), under schedule-II of IWPA -1972.
- The Land Use and Land Cover classification of the study area shows that from 1973 to 2012, the area under agriculture and settlement has registered a continuous increase i.e., 4563.07 ha and 922.86 ha respectively (Fig 2).

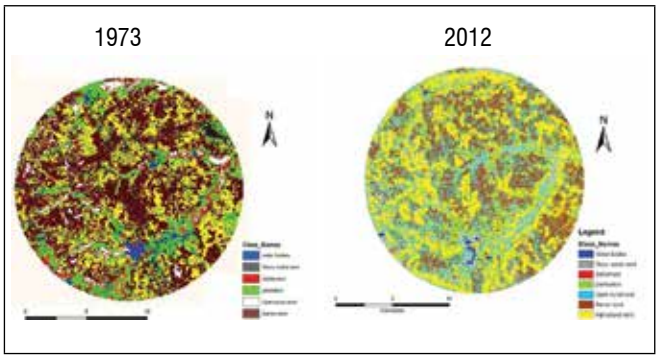


**Fig 2: Land Use Land Cover Map of CDZ in 1973 and 2012**

### North Eastern Dry Zone

### Plant biodiversity

- A total of 248 plant species belonging to different families and groups were identified.
- Angiosperms are dominant with 222 species belonging to 62 families followed by Pteridophytes (4), Bryophytes (1), Gymnosperms (1). Fourteen species of Phytoplankton and six species of Lichens are also recorded from the study area.
- The dominant 10 plant families identified in the study area are Euphorbiaceae (14 species), Fabaceae (12), Mimosaceae (12), Asteraceae (9), Asclepiadaceae (8), Convolvulaceae (8), Acanthaceae (7), Amaranthaceae (7), Caesalpinaceae (6) and Verbenaceae (4 species).
- The most dominant tree species include *Prosopis juliflora* with IVI of 104.93, followed by *Azadirachta indica* with IVI of 70.12.
- The study on traditional ecological knowledge documented the usage of 80 medicinal plant species in curing various minor and major ailments.
- Three (*Acacia ferruginea, Chloroxylon swietenia* and *Santalum album)* out of 248 species are considered as vulnerable and 17 as least concern, according to the IUCN red list.

### Animal biodiversity

- A total of 239 animal species belonging to different families and genera have been reported from the study region.
- The land cover change analysis does not show any increase in the total vegetation cover. In fact, the forest cover has shrunk by 33.5 per cent in the study region from 1973 to 2008. On the other hand, the settlement land-use has increased by 66.7 per cent in the region over the same period.
- A total of 46 species have been found under IUCN, IWPA and CITES. Out of these, one fish species (*Puntius denisonii*) and one animal species (*Acerodon jubatus*) have been recorded as endangered, as per IUCN.
- Three animal species have been listed under IWPA category as Schedule – I (*Hypolimnas missipus, Veranus bengalensis* and *Pavo cristatus*).

### Major causes behind declining biodiversity in semi-arid region

*Our field study and discussions held with the stakeholders clearly indicate that factors such as habitat loss or the habitat degradation, developmental activities, over exploitation of resources, pesticides use, , climate change have had severe impacts on the biodiversity of semi-arid landscapes (Fig 3).*

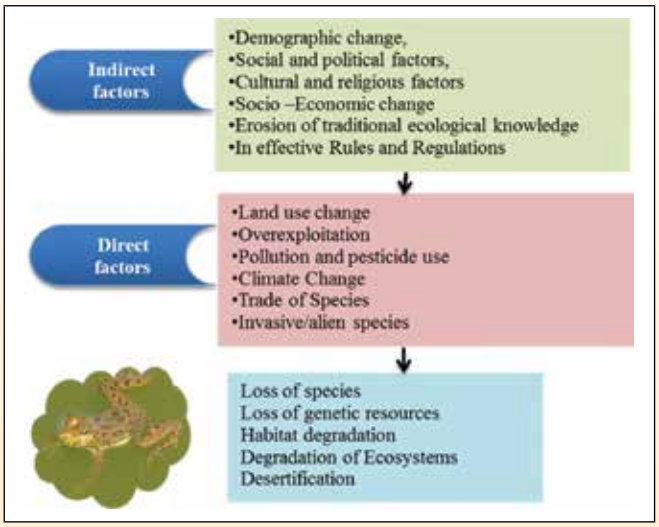


**Fig 3: Causes for biodiversity loss in semi-arid landscapes**

## Policy Recommendations

- Deforestation is extremely problematic in semi-arid regions as it leads to the expansion of desertification. Natural regeneration offers a cost effective method of afforestation and has the potential to become the predominant way of restoring degraded semi-arid landscapes (Latawiec et al. 2016). Natural regeneration helps in restoring the degraded farmlands, pastures and forest, which in turn leads to an increase in biodiversity, and an improvement in soil structure and fertility. Adequate efforts should be made for reducing the biotic pressure in semi arid region for natural regeneration in the landscape dominated by agriculture.
- The plant species categorized in the red list can be conserved by the development of seedlings in nursery. Vegetative propagation and seed germination techniques can be undertaken for the mass multiplication of these plant species.
- As the study area falls under the semi-arid region, the vegetation is sparsely distributed. Development and proper maintenance of the forest ecosystem and different forms of land cover would play an important role in conserving the biodiversity of semi arid ecosystems.
- Various fast growing tree species such as *Acacia spp, Casuarina equisetifolia* and *Melia dubia* have to be cultivated on a large scale. These tree species can help in meeting the fodder, fuel and timber demand of the population residing in the study area.
- Planting of the bio-accumulator species such as *Calotropis procera, Hibiscus esculentus, Amaranthus viridis, Hydrilla,* and *Chara* identified in the study area has to be encouraged.
- Agroforestry provides an opportunity for the sustainable use of resources and also meets the daily needs of the local population. *Azadirachta indica* and *Melia dubia*, identified in the study area, can be prioritized for development of agroforestry sector in semi arid region. Some of the advantages of agroforestry are that it increases soil fertility and decreases the pressure on forests for food, fodder, fuel etc. Various nitrogen-fixing plant species have to be planted in the landscape dominated by agriculture for soil fertility improvement and better productivity.
- Habitat improvement, threatened species conservation and green belt development can also play an important role in biodiversity conservation of the study area.

- Organising awareness programmes for local people on biodiversity conservation. The forest department and NGOs play an important role in creating awareness on the sustainable use of natural resources and the conservation of flora and fauna of the study area. Also, awareness on various policies and climate change has to be created among the local population.
- Community participation in planting drought resistant species (*Melia dubia*, *Pongamia pinnata*, *Azadirachta indica*, *Syzygium cumini*, *Bauhinia purpurea*, *Acacia spp*., *Albizia amara*, *Albizia lebbeck*, *Ficus religiosa* etc) at the landscape level should be given high importance.
- Measures to increase the population of birds, such as maintenance of healthy water bodies and planting of diverse native tree species, namely *Tamarindus indica* and *Thespesia populnea* that provide nesting and food for the birds have to be undertaken.
- The natural bird habitats such as local parks and open places have to be restored. Pollutant influx into lakes, usage of plastic have to be minimized as these can harm birds and fishes by entering into the food chain.
- A faunal monitoring program has to be initiated with an objective to regularly monitor the animal biodiversity of the study region.
- Species from the areas listed in IUCN Red list, IWPA and CITES have to be given importance for their conservation. Habitat wise conservation programmes have to be initiated in the region for species conservation and ecosystem sustainability.

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*Euphorbia antiquorum*

*Lepus nigricollis*

*Dicrurus macrocercus*

*Opuntia dillenii*

*Randia brandsii*

*Opuntia dillenii*

*Lonchura malabarica*

*Jamides celeno*


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