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CONSERVATION AND MANAGEMENT STRATEGIES FOR THREATENED PLANT SPECIES OF KACHCHH DESERT ISLAND, GUJARAT, INDIA

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Abstract

Climatic variations and geo-morphological conditions of a particular geographic province determine the formation of different plant communities, and thereby form the different types of habitats. One of the indispensable prerequisites for conservation of a particular species is to understand different ecological parameters determine its population status and distribution pattern. The present study focuses on the status and distribution of threatened and medicinal plant species in various types of habitats and ecosystems of Kachchh Desert Island, Gujarat, India. Besides opportunistic observations of floral elements, conservation and management of some medicinal and threatened plant species is discussed. The study also depicts the understanding of role of environmental, ecological, economical, social and ethological factors which help to enhance the productive potential of a particular plant species alongwith its associated communities involving local people, tribal communities and local NGOs.

Key Words: Threatened Plant Species, Conservation, Management, Kachchh Desert Island, Gujarat, India

Introduction

Conservation and management of medicinal and threatened plant population depends on a clear understanding of role of various types of environmental, ecological, economical, social and ethological factors world over, which help to enhance the productive potential of a particular species and its associated communities (Daniels & Jayanthi, 1996). Climatic variations and geo-morphological conditions of a particular geographic province determine the formation of different plant communities, and thereby form the different types of habitats. One of the indispensable prerequisites for conservation of a particular species is to understand different ecological parameters determine its population status and distribution pattern.

In India, conservation measures for medicinal and threatened plants involve both *In-Situ* as well as *Ex-Situ* approaches; involve the protection of ample habitats through establishment of bio-parks, botanical gardens, nurseries, glass-houses and plant-tissue culture laboratories. Presently, besides the proliferated implementation of such bio-techniques to conserve the prevailing biodiversity of a region, it has been realized by researchers, conservationists, stack-holders and policy makers that the biological diversity will be protected well, if the dependent community of that particular area be involved. Keeping in mind, the Gujarat State Forest Department (GSFD) has initiated several Community-Based Programmes (CBP) such as Forest Protection Programmes (FPP), Joint Forest Management (JFM), Eco-Development Initiative (EDI) and Buffer Zone Management (BZM). Through such initiatives, it has been observed that the local communities inhabited in different forested pockets of the country possess more knowledge about their neighboring natural resources and thus by conserving the biota of confined habitats in indigenous ways (Leach *et al*., 1999).

In Maharashtra State, "*Mendha*" community has conserved their forest resources quite successfully through traditional knowledge despite they are devoid of higher governing authority such as '*Gram Panchayat*' to guide them through rules and regulations. This case of community involvement in protection of forest diversity is also registered in People's Biodiversity Register Programme (PBRP), devised by one of the eminent biodiversity specialist Shri Madhav Gadgil, Center of Ecological Science, Indian Institute of Science, Bengaluru, India (Gadgil *et al*., 2000). Basically, the PBRP is aimed to document the people's knowledge and their perceptions about history, utilization, status, factors affecting the changes in biotic composition, and natural and man-made forces affecting the biological diversity resources of their adjacent forest areas.

Study area

The Kachchh Desert Island lying at 24^0 41' 25" to 22^0 44' 11" north latitudes and 68^0 09' 46" to 71^0 54' 47" east longitudes; is the 2nd largest District of the country, located in the western-most geographical region of Gujarat State. The District spreads over 45,652 km^2, sharing its north and north-west border with Sindh (Pakistan) and the west and south-west border with the Arabian Sea. On the southern side, the District is bounded by Gulf of Kachchh (GOK) and in the east by Districts of Banaskantha and Mehsana and by Rajasthan State on its north-east. Thus, it has a unique geographical settings surrounded by water and saline wastelands. Administratively, the District is divided into 10 Talukas *viz*. Bhuj, Mundra, Mandvi, Abdasa, Lakhpat, Nakhatrana, Rapar, Bhachau, Anjar and Gandhidham (Census, 2000).

The present chapter discusses the status and distribution of threatened and medicinal plant species observed in different types of habitats and ecosystems of Kachchh Desert Island, Gujarat, India, under the CREB (Conservation of Rare and Endangered Biodiversity) (GES, MSU & GUIDE, 2002), and 'Ethno-botanical Study of Kachchh District (EBSK)' projects (Dixit & Rao, 2000; Silori & Rana, 2000; GUIDE, 2002).

1. Conservation strategies

With the clear understanding of environmental, ecological and social component with respect to the vegetation formation in the studied district (Kachchh) and widely available management options, the following strategies are suggested as conservation measures:

1.1. Conservation and Protection

1.1.1. *In-situ Conservation* (*Protected Areas*)

Narayan Sarovar Sanctuary (NSS) is one of the Protected Areas (PA) of Kachchh Desert Island; forms western-most boundary of Kachchh; covers 444.23 sq km; reported to harbour 255 plant species with 180 genera and 60 families (GEER & GUIDE, 2001); including 34 medicinal plants being used traditionally by tribal people to cure various ailments (Billore, 2000; Silori & Rana, 2000), and 13 threatened flora (GES, MSU & GUIDE, 2002). But inspite of being prevalent with rich floral biodiversity, biotic (anthropogenic) pressures such as cattle grazing, wood-cutting, fodder collection and mineral-based developmental activities have put enormous pressures therein. Considering the richness of existing floral components depleted by various biotic pressures, following management strategies are suggested for the conservation of threatened floral species of this P.A.

- A detailed survey of threatened floral species needs to be done to resolve its legal and conservative status.
- Habitats with high floral diversity should be identified, and should be notified as Mini Core Areas (MCA) of the Sanctuary.
- Strict protection should be given to MCAs to prevent wood-cutting, cattle grazing and collection of essential natural resources.
- Degraded natural habitats should be restored with the threatened species and their associated species under Species Plantation Programme (SPP) and Habitat Restoration Programme (HRP).
- Herbaceous cover (including grasses) constitutes 59% of floral components of NSS, including seven rare species (*Dipcadi erythraem, Helichrysum cutchicum, Heliotropium bacciferum, Helitropium rariflorum, Ipomoea Kotschyana, Indigofera caerulea, and Tribulus rajasthanensis*) (GEER & GUIDE, 2001). A systematic monitoring of such areas should be prioritized, and a proper management plan should be implemented for such potential and crucial habitats (Chaturvedi *et al*., 2001).
- Threatened herbaceous species such as *Ammannia desertorum, Convolvulus auricomus, Convolvulus stocksii, Limonia stocksii, Pavonia ceratocarpa* and *Sida tiagii* should also be given priority by enhancing methodical field study to execute Conservation-based Management Measures (CMM).
- Herbaceous cover provides Potential Grazing Grounds (PGG) as pasturelands for local livestock population. The local people should be made aware about the ecological and economic advantages of controlled and rotational grazing in such productive and beneficial rangelands.
- Around 31 villages with human population of 11,049 individuals directly or indirectly dependant for grass, firewood, fodder and other Non-Timber Forest Produce (NTFP) NSS. Based on the magnitude of dependency level, some village pockets s should be identified for execution of Eco-Development Initiatives (EDI).
- Creation of Eco-Development Committees (EDC) at village level, distribution of fuel-efficient stoves to tribal people, development of fodder and fuelwood plantation plots, and eco-restoration of grasslands need to be implemented (Peters, 1985).
- Alternatives for Economically Poor Villagers (EPV) should be initiated through involvement of Stake-holders to ensure equal employment (GEER & GUIDE, 2001).

1.1.2. *Protection of Reserved Forests* (RFs)

- NSS harbours seven Reserved Forests (RFs) like *Andhau*, *Babiya*, *Lifri*, *Mau*, *Nabhoi*, *Sherdi* and *Thumaka*, which supports potential population of six threatened plant species (*Ammannia desertorum, Convolvulus auricomus, Convolvulus stocksii, Limonia stocksii, Pavonia ceratocarpa* and *Sida tiagii*). Besides reporting of such Rare & Endangered (R & E) species of plants, intense uprooting, thatching, lopping, and cutting were observed accompanied with tremendous grazing pressures. A Species-specific Conservation Management Plan (SCMP) should be devised in and around RFs of NSS and its adjacent villages.
- Among RFs, *Andhau* RF supports five threatened plant species such as *Campylanthus ramosissimus, Commiphora wightii, Convolvulus stocksii, Heliotropium bacciferum* and *Indigofera caerulea*, and *Sherdi* RF harbours four species *(Citrullus colocynthis, Commiphora wightii, Ephedra foliata* and *Sida tiagii)* of R & E category. Such potential and impeding forest stretches should be re-surveyed to reassess their legal status.
- Based on species abundance, some natural areas within RFs need to be identified and be categorized into Abundant (A), Common (C) and Rare (R), which should be fringed by Natural Green Fence (NGF) by planting of *Euphorbia cadusifolia* species to act as Natural Fencing Protector (NFP).
- Local villagers (including laymen) should be made aware about prevention and consequences of malicious activities like cattle grazing and tree-cutting, by placing Sign Boards at the entry of potential territories.
- Concerned forest personals should be involved in incessant monitoring of prospective and potential sites to assess the legal status, and to understand the regeneration potential of threatened plant species.
- Identified (Protected) sites within RFs should be resorted for threatened plant species to act as Natural Seed Banks (NSB) or Gene Banks (GB) or Germplasm Reserves (GR) for the better sustenance and prevalence of R & E species in near future.

1.1.3. *Protection of Private Lands*

***Chadua Rakhal* (RF):** It is Privately-owned Forest Area (PFA) located near *Samatra* village in Nakhtrana Taluka; an undulating hilly tract with all types of macro- and micro – habitats; receives water inflow throughout the year from adjacent *Pragsar* Lake. At present, the *Rakhal* supports an array of diverse plant species (> 250). , including three species of threatened category (*Commiphora wightii, Convolvulus stocksii* and *Dipcadi erythraem*). For better maintenance of prevailed plant diversity and management of such areas enriched with

high floral diversity should be identified, and be monitored seasonally in likely private lands in entire Kachchh Desert Island.

1.2. Community Involvement

Of the 20 threatened plant species recorded during the present investigation, six species (*Dactyliandra welwitschii, Convolvulus auricomus* var. *volubilis, Corallocarpus conocarpus, Ephedra foliata* and *Commiphora wightii*) were reported from agricultural ecosystem in and around the hedges and bushes, which exhibits the clear indication and evident that agriculture terrains are also one of the potential habitats in Kachchh. Such potential and productive man-made ecosystems should be protected by natural means (NGF as discussed earlier) and also by legal regulations (Agriculture Management Plant – AMP & Agriculture Sustenance Policy - ASP). By implementing such policy frameworks, one can be efficient to provide proper care and protection to the vegetation cover along edges of agricultural lands by shielding the prevalent floral diversity of Kachchh Desert Island. Keeping in mind, following recommendations are suggested:

- People (mainly the Farmers & Domestic Breeders) involve in agricultural activities should be given training and practices in locating and identifying the plant species having ecological, economic, ethno-botanical and medicinal values. Moreover, they should be made aware of the plant species with '*Threatened*' status for the better conservation significance of plant diversity in Kachchh.
- Agricultural community should be encouraged and trained to initiate Plantation Programme for Threatened Species (PPTS), alongwith cultivation of economic and medicinal plants along the agricultural hedges as a Mass-Scale Practice (MSP).
- Eco-Financial Scheme (EFS) should be launched for the benefits of local community and pharmaceutical agencies by reimbursing sufficient monetary packages to the locales, and to promote the marketing value of economic as well as medicinal plants by involving the stack-holders at grass-root level.

1.3 Role of Non-Government Organizations (NGOs)

Kachchh Desert Island is bestowed with several numbers of NGOs (>100) spanning in almost all the Talukas, which were working as secluded private units till got affected by natural calamities such as frequent droughts, cyclones (1998 & 1999) and recurrent earthquakes (2001 to till date). At present, most of the NGOs (>60) have established a communal network for working together with one of the traditional organizations called '*Abhiyan*' as a part of Joint Venture Forum (JVF) under One Hood Approach (OHA) scheme.

Other leading NGOs like Kachchh Mahila Vikas Sanstha (KMVS), Sahjeevan, Vivekanand Research and Training Institute (VRTI), AgroCell, Kachchh Ecological Research Center (KERC) etc. are involved in Community-based Development Programme (CDP) in many villages of Kachchh Desert Island. Following recommendations are suggested for involvement of NGOs for better conservation of plant species of Kachchh:

- Although, many NGOs in Kachchh are involved in CDP for the upliftment of community, livelihood practices and local dependency, recommendations should be executed to initiate the developmental programmes focusing on sustainable use of existing natural resources (Food, Fibers, Fodder, Fuelwood), including revival and rejuvenation of natural habitats harbouring such natural assets.
- NGO groups should also be trained to instigate the plantation and conservation programmes for commercially important and Rare and Endangered (R & E) plant species (Bhandari *et al*., 1996).
- NGOs should participate in Species Awareness Campaign (SAC) for conservation of biological diversity at grass-root level in each village upto possible extent (Given, 1994).
- NGOs should be encouraged to schedule Species Awareness Programmes (SAP) among the villagers for commencement of Medicinal Plant Farms (MPF) in each village.
- They (NGOs) should act as a bridging link among local farmers, pharmaceutical companies and stake-holders to make them benefited by selling of medicinal plants to achieve adequate financial turnovers.

1.4 Involvement of Defense Authorities

Kachchh being the western-most bordered District of Gujarat State, is well-equipped with defense force (Army, Air force, Border Security Force – BSF, and Indian Navel Service – INS) posted in all the marginal and remote areas. These establishments cover extensive areas naturally covered with various types of ecosystems such as open forests, mixed forests, scrub forests, hilly forest tracts, open savannas, saline mud-flats, grasslands, *ranns* and *beyts*. Such areas should be protected and managed by controlling different anthropogenic pressures like cattle-grazing, wood-cutting, lopping, thatching, up-rooting, fishing, human settlements, etc. Such natural habitats can also be used for reintroduction and farming of threatened and medicinal plants to ensure long-term conservation management strategies under Protected Areas Network Plan (PANP). Following suggestions have been built-up for successful execution of above ideas:

- Defense personals should be involved in Environmental Awareness Campaigns (EAC) and be trained to identify the Rare and Endangered (R & E), threatened, vulnerable and important medicinal plant species in lucid manners with an aid of pictorial representations (Cancino *et al*., 1995).
- A systematic field survey should be carried out on seasonal basis involving personals of Gujarat State Forest Department (GSFD), defense authorities, plant taxonomists and naturalists at grass-root levels.
- A comprehensive database of Highly Threatened Species (HTS) should be prepared by initiating methodical monitoring of natural habitats (governed by defense people within their establishments) to understand the availability, population status and habitat potential for reintroduction of R & E plants.
- Of 20 threatened plant species, 6 species *(Ammannia desertorum, Convolvulus auricomus, Corallocarpus conocarpus, Indigofera caerulea, Limonium stocksii* and *Schweinfurthia papilionacea)* were documented with very low density. Reintroduction of such species within the establishment areas can provide potential habitat for natural propagation and revival of habitats. Such Defense Establishment Areas (DEA) could be proved as a Potential Gene Banks (PGB) for highly threatened species as well.
- Army (Infantry) personals should be trained to be avail of importance of nursery development, seed and vegetative propagation and monitoring of restored and reintroduced plant species and habitats therein.

1.5. Over-Exploitation of Bioresources

Due to varying perception of local communities, numerous plant species are being over-exploited from several natural habitats of Kachchh. Of these, many species are being exploited by local people for its commercialization as a source of income generation and their livelihood dependency. At present, *Commiphora wightii* (Gugal) is facing anthropogenic threats (over-exploitation) by locals (Atal *et al*., 1975; Anon, 1982; Dixit & Rao, 2000), including its illegal exploitation by pharmaceutical and perfumery industries (Sabnis & Rao, 1983), and being commercially exploited for gums and resins (GEER & GUIDE, 2001). Following implications are suggested for scheming anthropogenic threats:

- Potential habitats holding high density of Commercially Important Species (CIS) needs to be identified, and stringently be protected from illegal exploitation.

- Massive Species Plantation (MSP) and Eco-Restoration Programmes (ERP) should be undertaken in thriving habitats by involving local villagers, local authorities and NGOs upto promising extent.
- Commercial User Groups (CUG) should be formed and educated about sustainable and developmental use of R & E species. They should also be trained in perceiving the scientific approach towards harvesting of Threatened Plant Products (TPP) on seasonal basis.
- Harvesting of medicinally and economically important plants from the wild and natural habitats should be regulated under Legal Policy Framework (LPF) and Time Frame Method (TFM) for Controlled Commercial Exploitation (CCE).

2. Ecologically sensitive areas (ESA)

Biodiversity exhibits varying degrees of protection and management of Protected Areas (PAs), Reserved Forests (RFs) and Protected Forests (PFs) (Peters, 1985). A considerable proportion of biotic components manifested outside such areas exist without any protection measures. Realizing the limitation in declaring more areas as PAs or Notified Areas (NAs), the need of participation of local communities in conservation efforts was felt (Sygne, 1981), and the concept of Ecological Sensitive Area (ESA) was gaining popularity (Parthasarathy & Karthikeyan, 1997). During the present investigation, following areas have been reported to harbor diverse plant community including some threatened taxa. Since these are not notified still as PA legally, they are facing severe biotic pressures by intrusion activities from the local villagers. The list of such areas is mentioned hereunder with detailed information.

1. *Tapkeshwari Hill*: This is a natural hilly tract located nearby Bhuj city (The capital of Kachchh District) fringing its southern-most boundary; harbours very high floral diversity. In total about 250 plant species were reported during the present study. Further, it has also been found that this hilly terrain is proved to be a potential habitat by supporting nine threatened plant species and around 130 medicinal plants.

2. *Kala Dungar* (Black Hill): It is a natural hilly forest located around 90 km from Bhuj towards north, adjacent to Khavda village and India Bridge (Northern tip of western Gujarat bordering Pakistan). Geographically, the area forms marginal boundary with saline mud-flats towards northern side, and a natural hilly terrain southern downwards. Topologically, the hilly patches of Black Hill are dominated by Thorn Scrub Forest (TSF) with scattered patches

of floral elements represented by Dry Deciduous Forest (DDF) in inner valley, inclusive of more than 300 species.

3. *Banni Grassland*: This is the largest grassland of Asian continent, spanning 3,847 sq km, accounts for 8.4% of the total geographical area of Kachchh Desert Island. The area is legendary known for having an indigenous breed of Buffalo, locally known as 'Banni Breed'. Earlier, this area was found to have more than 40 species of grass, but at present only 10-15 grass species have been reported to be prevailed in this area (Pilo *et al*., 1998). Presently, this grassland supports around 200 plant species including threatened taxa (Joshi *et al*., 2001).

4. *Dhinodhar* (*Than*) Forest: This forest is located around 65 km from Bhuj towards its northern side and 15 km from Nakhtrana at south. The area is an untainted natural terrain with undulating hilly tracts interspersed with thorny and scrub plant species. Ecologically, the area is dominated by thorny scrub plants with dispersed floral species of dry deciduous type, represented by more than 250 plant species of economic and medicinal values.

5. *Khadir* Island (Rapar Taluka) and ***Navinal Dhuo* (Mundra Taluka):** These are the hilly forested tracts with natural undulating terrains; represented by different types of natural habitats such as Mixed Thorn Forest (MTF), Dry Deciduous Forest (DDF), Scrub Forest (SF), and Saline Grasslands (SG). The areas support considerable number of plant diversity represented by R & E species as well as some floral taxa having medicinal importance.

2.1 *Recommendations for ESA*

Considering the potentiality of above-mentioned areas (localities / habitats) in supporting high floral diversity, these sites should be declared as Ecologically Sensitive Areas (ESA) by implementation of Legal Policy Framework (LPF) by Gujarat State Forest Department (GSFD), as a joint venture with NGOs and local communities therein. Following steps should be given painstaking thoughts for successful management of ESA.

- *Banni* and *Kala Dungar* (Black Hill) are much larger areas compared to other studied habitats; having 52 and 12 villages, respectively. Villagers of these areas entirely depend on natural ecosystems and their bio-resources for their livelihood (mainly for livestock grazing and rearing). Since both these areas cover vast stretches of natural forested habitats, a systematic survey is needed to identify Potential Hot-Spots (PHS) (areas with high diversity and density of floral components including R & E species).
- Such hot-spots should be monitored on regular (monthly / seasonal) basis to draw-out the scenario of prevailing floral diversity, and livelihood dependency of villagers (local people).

- Potential habitats (proposed ESA) should be scrupulously surveyed to identify the potential stretches of natural bio-resources therein.
- Many Government, Non-Government and Research organizations (Banni Vikas Trust, DRDA, GEC, GEER, GES, GUIDE, KERA, KMVS, VRTI, etc.), are currently working with the local communities (*Jat, Pathan, Muslims, Sindhis*) of *Kala Dungar* (Black Hill) areas. In order to reduce the biotic pressures by local inhabitants on identified hot-spots, dependent community should work with such organizations by following Hand-in-Hand Protocol (HHP) to be availed of socio-economic benefits.
- All the identified hot-spots should be strictly protected from anthropogenic pressures like cattle-grazing, wood-cutting, collection of NTFP, etc., by providing Alternate Natural Resources (ANR) through on-going developmental programmes such as Border Area Development (BAD), Watershed Development (WSD), Drought Proofing (DP) and Grassland Development (GD).
- Village Level Committee (VLC) should be established at grass-root levels in each village in and around ESA to execute the methodical monitoring of prevailed biotic components therein.

3. Nursery development

At present, considerable numbers of nurseries are managed by Gujarat State Forest Department (GSFD) in many village pockets of Kachchh Desert Island; involved in procurement of seedlings, rearing and plantation of saplings, and propagation and production of fast-growing plant species (mainly trees) to meet the demands of local people for food, fibers, fodders, fuel-woods, timbers, and avenue plantations under Social Forestry Programmes (SFP), excluding shrubs, herbaceous and grass species. Of 70-80 plant species grown in these nurseries, around 20 species were found to be threatened, including *Commiphora wightii* (*Gugal*). Hence, long-time survival of such threatened species is unsure, unsafe and insecure in Kachchh Desert Island, if practices of nurturing such species continue without an imbibing Legal Policy Framework (LPF). Therefore, following suggestions will be an aided tool to conserve such threatened species under Social Forestry Scheme (SFS).

- Some plant nurseries should be developed exclusively for rearing R & E species on large-scale (mass-scale) on commercial basis, and be designated as Exclusive Nursery Units (ENU).
- Each nursery (ENU) should have Threatened Biodiversity Gene Pool Preservation Plot (TBGPP) as a part of Social Forestry Mandate (SFM).

- Especially for shrub, herb and grass species, Forest Department Nurseries (FDN) should initiate Research and Development Programmes (RDP) to standardize and stabilize different Plant Prorogation Techniques (PPT) for augmentation of threatened species on sustainable basis.

4. Development of botanical gardens

- *Sharad Baag* is a privately-owned botanical garden (POBG) forms the central terrain of Bhuj city in a close vicinity of *Hamirsar* Lake, Bhuj Taluka. Presently, the management authorities of this botanical garden practice the rearing of only ornamental and decorative plants for its commercial use (mainly to be exported to villages, towns and cities of Kachchh District). The management personals should be made aware about the ecological significance and commercial importance of threatened plant species present therein, and be encouraged to propagate more number of individuals of such species in garden.
- *Vijay Vilas Palace* (VVP) (one of the magnificent tourist spots in Mandvi Taluka, District Kachchh) is managed by private authorities. The palace was constructed in 1920 under the reign of Maharao Shri Khengarji (III), and was the main hub of 'Princely State of Cutch (Kachchh)' then. Presently, the potential habitats in and around VVP harbours more than 100 plant species, exhibits the peak diversity of floral components including some R & E species, and endemic species too. This area can be developed as Preservative for Plant Propagation (PPP) for sustainable survival of Rare, Endangered, Threatened, Endemic, Ethno-botanical, Medicinal and Economic plant species.
- Since these two places attract many tourists from each and every corner of the State (Gujarat) as well as Country (India) throughout the year, establishment of Tourist Interpretation Zone (TIZ) is suggested for more income generation to Gujarat Tourism Department (GTD).

5. Research priorities

Kachchh being the largest District of the state, and the vast area of which falls under wastelands, many areas are still unexplored in terms of ecological, environmental and socio-economic views (Chavan & Lal, 1998). Till date, only sketchy studies were carried-out on floral aspects of Kachchh Desert Island in past, focused on their general status, distribution, taxonomy and ethno-botany. Considering the erratic climatic conditions of the region, vast stretches covering natural habitats have still not been explored; devoid of ecological and environmental aspects on threatened and medicinal plant species. Keeping in view, following research plans are recommended.

- Intensive Status Survey (ISS) is suggested to understand the ecological status and environmental significance of rare, threatened, medicinal and commercial plants.
- Long-term Ecological Studies (LES) on highly threatened plant species *(Ammannia desertorum, Convolvulus auricomus, Corallocarpus conocarpus, Dactyliandra welwitschii, Limonium* stocksii, *Schweinfurthia papilionacea)* are needed to be prioritized for an effective Research Management Plan (RMP).
- The RMP should cover the population structure, species association, factors influencing natality, growth and mortality, seed production, seed viability, seed dispersal, seed germination and reproductive aspects, to have better aspects in devising Long-term Research Strategy (LRS).
- The LRS should focus on species- and area-specific threat factors, and their magnitude to prioritize the Conservation Management Plan (CMP) (Cropper, 1993).
- Although, several studies focusing on taxonomy and ethno-botany were carried-out in various provinces of Kachchh District (Babbar *et al*., 1994; Dixit & Rao, 2000; Silori & Rana, 2000; GUIDE, 1999, 2002; GEER & GUIDE, 2001; Joshi *et al*., 2001), still substantial lacunae with an urgent need are felt to study many aspects such as resource availability (qualitative and quantitative), resource collection, resource-use pattern, resource depletion, sustainable use, etc. Keeping all these aspects in mind, a Long-term Research Design covering all the requisite ecological and environmental components (LRD) is suggested.
- In addition to species-specific studies (including population dynamics and community structure), execution of People Biodiversity Register Programme (PBRP) in potential habitats of Kachchh Desert Island is needed. Initiation of such mandates could help in involvement of community people at grass-root level.

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