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Introduction

1.1 Introduction

Ignorance of economic potential and ecological functions of plants has resulted decline in genetic diversity and extinction of numerous plant species. Many natural and artificial factorsare responsible for limiting the distribution and survival of various species. Destruction of various habitats is due to construction of dams, encroachment of forests for agriculture, over-grazing and deforestation for timber. In addition, many natural causes such as protracted periods of rain and drought, spreading of desert lands, forest fire, land upheaves, reclamation of marsh-lands, also contribute to the extinction of many species. Further, spread of fertilizers, pesticides and fungicides and industrial effluents; invasion of alien species; spread of plant pests and diseases have also been sources of threat to our indigenous flora. While such anthropogenic and natural processes in the past had resulted in extinction of plants, the resulting new environmental conditions has led to isolation and further extinction of many species.

Threatened taxa are represented by two groups; the first includes endemic species and deserves top priority in conservation. While the second group consists of the disappearing species whose distribution is both within and outside the political boundary or region and the extent of occurrence and area of occupancy of which are small. But in the present study, the prime concern is over the endemic species which occupy limited and specific habitats. Any disturbance or imbalance in their narrowly confined ecosystem will lead to their extinction and hence such narrow or strict endemics are assessed as threatened.

Conservation of flora has received comparatively less attention than that of fauna, becauseplants lack the popular appeal of many animal groups (Goettsch *et al.*, 2015), for instance, Asiatic Lions in Gujarat.Consequently, plant conservation is underresourcedwith contrast to animals (Havens *et al.*,2014). Yet plants are of fundamental importance to life on earth. They form the backbone of Earth's ecosystems and provide a wide range of ecosystem goods and services. Animals may provide us meat, leather, fur and other products, but none of these arenecessities for human survival and well-being, while many plantproducts are essential. Plants provide us food, genetic material for crop improvement, medicines, clothing and shelter; also they have great economic and cultural value.

Global Strategy for Plant Conservation (GSPC) agreed at the CBD meeting in Nagoya (2010), its first target for 2020, an online flora of all known plants (www.cbd.int/gspc/targets.html). This target maybe achievable, but equally it omits unknown species, which are still many. Recent estimatesfor angiosperms suggests there are around 450,000 species, of which 10-20% still remains undiscovered (Pimm and Joppa, 2015), gymnosperms (1000species; Christenhusz *et al.*, 2011), ferns (10,000 species; Rankerand Sundue, 2015), lycophytes (1300 species), mosses (9000 species;Magill, 2010), hornworts (200-250 species; Villarreal *et al.*,2010), and liverworts (7500; Von Konrat *et al.*, 2010) suggest thatthe global total for all land plants is around 500,000 species. Thiscompares with around 10,000 bird species and 5400 mammals.Indeed, the only taxonomic groups whose diversities are thought tosubstantially exceed that of land plants are the largely plantdependentfungi (1.5-5.1 m; Hawksworth, 2012) and beetles (*ca.*1.5 m; Stork *et al.*, 2015).

Pimm and Joppa (2015) estimated that two-thirds of all angiosperms are found within the tropics. Fern diversity is even more highly concentrated in the tropics (Kreft *et al.*, 2010) while, among the bryophytes, liverwort diversity is highest in the tropics but mosses show no clear latitudinal gradient (Geffert *et al.*, 2013; Chen *et al.*, 2015). Distribution of plants across the tropical regions is highest in the Neotropics and the Asia-Pacific region. For example, Slik *et al.* (2015) estimated that there are 40,000-53,000 tree species in the tropics that is 96% of all the tree species on Earth (Poorter *et al.*, 2015) with similar numbers (19,000-25,000) in the Neotropics and the Asia Pacific. Although plant diversities are lower on individual islands, endemism is high and around 50,000 species of vascular plants are island endemics (Sharrock *et al.*, 2014).

1.2 Endemism

Endemism was introduced two centuries ago to explain taxa that are restricted to small geographical areas. De Candolle (1855) applied the concept of endemism in describing the distribution of organisms to a restricted habitat or geographic area isolated through ecological or temporal barriers (Cain, 1940, 1944); some of his phytogeographers (Willis, 1922; Wulff, 1943; Stebbins, 1942, 1950) have also used the concept of endemic plants.Endemic species is the one restricted to a particular geographic area, which can be defined by political boundaries, such as country, state or by ecological boundaries (Gaston 1991; Heywood, 1993; Beck *et al.* 2007; Young 2007); definitions are personalized to particular needs. Endemic species are entirely dependent on a single area for their survival, and by virtue of their restricted ranges, are often the most vulnerable (Myers, 1988).The degree of plant endemism for an area is often cited as a measure of the uniqueness of the flora, and thus important for prioritizing conservation sites (Myers *et al.* 2000; Brooks *et al.* 2002; Knapp 2002; Young *et al.* 2002).

Endemic plants are of considerable phytogeographical importance, and form the basic component of any flora and determine its degree of uniqueness. With enforcement of the Convention on Biological Diversity in 1992, and of the sovereign rights of nations to their bio-resources, endemism has received renewed attention throughout the world. The countries/regions rich in endemism have attained great importance in biodiversity studies. The resource value of some of the endemic plants of India is for medicinal, ornamental, floricultural, food, fodder and forage values, and wild relatives of crop plants (Singh *et al*, 2015).

Phylogenetic sequence analysis, taxonomy, habitat, geographical and fossil history are the main systematic criteria to delimit endemic taxa (Singh *et al.*, 2015). The concept of dichotomy in endemic plants was first coined by Engler (1882), which has been used extensively by other geographers *i.e.*, Stebbins and Major (1965), Kruckeberg and Robinowitz(1985).Endemics are categorized according to their spatial distribution, inferred evolutionary age and affinities and abundance(Faverger and Constandriopoulos, 1961).

Palaeoendemics (also known as relictural endemics) are characterized by a woody habitat (Stebbins and Major, 1965), low level of polyploidy or loss of genetic viability (Kruckeberg and Rabinowitz, 1985), showing non-continuous distribution in geographically isolated regions occurring in islands and mountain peaks (Kruckeberg, 2002). They usually belong to monotypic genera, families (Lopez *et al.*, 2011) and may have also fossil evidences provided by very long divergence homologous living taxa (Bramwell, 1972; Stebbins and Major, 1965).

In contrast, neoendemics are characterized by polyploidy in nature with perennial herb/shrub habitats (Stebbins and Major, 1965), and belong to polytypic genera, forming a species complex with no clear taxonomic boundaries (Lopez *et al.*, 2011). These are closely related taxa occurring in the same or adjacent regions, frequentlyforming groups of vicarious taxa (Cowling and Holmes, 1992; Kruckeberg, 2002). These are sensitive species;even minor climatic shifts can change local microclimatic conditions beyond the limits of tolerance, so that they either migrate or evolve new ranges of tolerance(Stebbins and Major, 1965). Neoendemicspecies show more fragmented population, and their presence indicates climatic and environmental stress on a particular region. They are usually linked with geologically young habitats (Verlaque *et al.*, 1997), and may experience further expansion before their potential distribution areas are reached (Kruckeberg and Rabinowitz, 1985). These endemics are also called autochthonous endemics (Engler, 1882), secondary endemics (Drudes, 1890), or progressive endemics (Diels, 1908).

1.2.1 Categories of endemism based on the range of Occurrence

The occurrence of an endemic species may vary from a very smalland localized area to a larger geographical region comprising of several countries.Depending on the rage of occurrence, Chowdhury and Murti (2000) classified the endemic species into the following categories:

- **Point endemism:** In this category a species is restricted to a specific habitat.

- **Biotope endemism:** It is also called geographic endemism. In this category, the endemic species are found in a particular geographic region such as mountain ranges, islands, lakes etc.
- **Biogeographic region endemism:** Such taxa are endemic to broader regions encompassing a broad range of habitats with common bio-climatic characteristics.
- **Political area endemism:** These endemics occur in the political boundary of a country, province or administrative units.
- **Regional endemism:** These endemics are restricted to a very large phytogeographical region, subcontinent etc encompassing more than one country.

Studies on endemics are useful to understand the history of past vegetation, identify taxonomic relationships, characterize floristic regions, determine optimal design of conservation units and prioritize conservation strategies (Richardson, 1978; Street, 1978; Dhar and Kachroo, 1983; Gentry, 1986; Takhtajan, 1986; Dhar, 2002). Endemic diversity of a region (state or nation) is its exclusive biological capital (Nayar, 1996).These species, confined to highly threatened ecosystems, will almost certainly be the first to be hit by extinction processes, and hence need rapid and effective conservation action (Heywood and Watson, 1995). Conservationists have initiatedto use data on the geography of biodiversity to set priorities for locating protected areas (Brooks *et al.*, 2006).

Confinement of endemic species to a single habitat makes them extremely threatened to environmental change. Given that endemism and extinction risk are closely coupled (IUCN, 2001), actions to minimize global extinction need to focus on patterns in endemism and range-restricted species (Pimm *et al.*, 1995; Myers *et al.*, 2000). The major issue with endemism is that most species are not scientifically described, and consequently minimal information is available about their ecology or geographical distributions (Pimm and Brooks, 2000). Stuart *et al.* (2010) noted that only 3.9% of 282,000 known species have been studied and evaluated for their conservation status.

It is important to conserve endemic flora, and to accurately identify them in order to accord them conservation priorities (Borokini, 2014).Our knowledge of the regions of high endemism and our recognition of the importance of endemism for conservation purposes has grown but still remains inadequate.

1.3 Threatened species

A species is threatened either because it lives in a very limited habitat (natural cause), or, because its habitat has been converted by humans to other uses (anthropogenic cause). Basically, using the word 'threatened' is a statement about the geographic distribution and population size of a particular species. A threatenedspecies may have broad distribution but never abundant where found; narrow distribution, but abundant where found; narrow distribution, and not abundant where found (Fiedler, 1995). Narrow geographic range is one of the key factors that characterize threatened species (Rabinowitz, 1981; Fiedler and Ahouse, 1992; Gaston, 1997) and indicates increased vulnerability to extinction.

The first step to initiating conservation actions for threatenedtaxa is to identify species that are in decline or facing extinction risk (Caughley 1994, Brooks*et al.* 2006). Key to this process is the use of objective,quantifiable, and consistent criteria to assess the statusof a species. Globally, the SSC of the world conservation union (IUCN) publishes an inventory of flora and fauna facing extinction risk. This inventory is referred to as the IUCN RedList of threatened species and is published on the Internet (www.iucnredlist.org). It classifies globally and regionally threatened plant and animal species and is regarded as the most comprehensive andauthoritative list (Lamoreux *et al.* 2003,Rodrigues *et al.* 2006). IUCN has developed a clear andstandardized framework for the assessment of speciesstatus which increasingly relies on rigorous scientificinput (rather than subjective expert opinion) and hasbecome more recognized by the scientific communityas a valuable and necessary tool in biodiversity conservationand research (Rodrigues *et al.* 2006).

Nowadays, the Red List is increasinglybeing used not only as a system for assigning threatened status, but also for assisting conservation biology (Hayward *et al.* 2007). Red List indices could also be usedto evaluate progress towards meeting biodiversity targets (Butchart *et al.*2004).For the Red List assessments tobe useful in conservation, data used to evaluate andassign threatened status must be rooted in sound,robust science.

IUCN established the Red List to accomplish the following goals:

- Identify and document those species most in need of conservation attention if global extinction rates are to be reduced; and
- Provide a global index of the state of change of biodiversity

Recent estimates suggest there are approximately386,000plant species on Earth (The Plant List, 2013). Among them24,230 have been assessed using the Red List criteria (IUCN Red List, 2017-3) to determine their conservation status, which is 6.3% of the total plant diversity. While in the case of angiosperms, there are approximately 352,000 species, of which 22,566 have been evaluated for risk assessment which is again 6.4% of the total diversity of flowering plants. Akey factor in the lack of progress in the production of species conservation assessmentsis the scarcity of user friendly, but powerful, analytical tools which are readily availableto scientists and communities to carry out these assessments (Steven Bachman *et al.* 2011).With the increasing loss in biodiversity across the globe (CBD, 2010) it is essential that we boost the Red List assessments, as it will enable us to quickly identify species at greater risk so that it may help us reach conservation goals.

IUCN is continuously engaged with identifying the species that are facing extinction risk in order to make conservation efforts more efficient. Since its creation, the union has attempted to list species that are threatened with extinction globally. The criteria used to define the categories of threatened species get updated periodically with some modifications (IUCN, 2001) and thus the threatened species lists are accordingly upgraded. Hence it is the most recent attempt to inventorize threatened plant species of the world.

1.4 Conservation

One of the major factors affecting biodiversity conservation today is global change—demographic, land-use and climatic yet the biodiversity movement and most conservation planners have so far largely failed to factor global change into their planning models and strategies (Hannah *et al.* 2002). Global change is causing a major transformation of the Earth's environment as a result of the numbers and growth of the human population (Steffen *et al.* 2004) and will have effects on both ecosystems and species and their populations and genes, and consequently on efforts to conserve these. Degradation, fragmentation, simplification and loss of terrestrial and aquatic habitats, caused by urbanization, industrialization and expanding agriculture will place many species at risk and even lead to the possible collapse of major ecosystems (Schellnhuber 2002).

For species that are threatened as a consequence of habitat loss, then it is essential to ensure that the remaining habitat issecured and, population reinforcement and other additional measures maybe required. However, it is clear that for many wild species the best wecan hope is not some targeted form of action, but simply to ensure theirpresence in protected areas, provided the area itself is not facing any threat, and subject to the dynamics of the system and the extent ofhuman pressures, some degree of protection may be afforded (Heywood andDulloo 2005).

It is now broadly accepted thatclimate change isthe biggest threat to ecosystems, species andbiodiversity (IPCC 2002). Current patterns of habitat loss,fragmentation and loss of species diversity will be exacerbated by climatechange. Global warming isexpected to accelerate extinction rates significantly. The interaction between species and its ecosystem, under these changingcircumstances will lead to unusual situations that willchallenge conservationists. Hence, detailed case studies and long-term monitoring are required.

With the disruption of habitats, an increase in alien invasive species and others with high dispersal abilities is likely and this willimpact on indigenous species. It will have major impacts on conservation strategies such as protectedareas, botanic gardens, genebanks, tissue culture, and seed forests. If protected areas are put at risk, then any species conservationactions being undertaken in them may be adversely affected (Heywood andDulloo *loc. cit.*).

I*n-situ* conservation of habitats and ecosystems is oftenconsidered the best method to conserve species. Consequently *ex-situ*conservation measures are not as well developed as those undertaken for *in-situ* conservation. Though there are potential problems with *ex-situ*conservation in maintaining genetic variation, or achieving success withreintroductions of species into natural habitats, such measures can usefullyassist in the temporary restoration of ecosystem services (Roche *et al.* 1997).

The effects of global change onagricultural patterns and agrobiodiversity will be significant, but insome regions it will be possible to mitigate the adverse effects by adaptationmuch more effectively than in the case of natural ecosystems (Heywood andDulloo *loc. cit.*).

For mostwild species we can look into is their presence in some form ofprotected area where, provided the area itself is not under threat and the extent of human pressures, somedegree of protection may be afforded. This approach has been widely advocated and is known as the hands-off/benign neglect approach Holden *et al.* (1993).In simple words, species that are not facingrisk of immediate extintion, the best policy is to leave it undisturbed in the wild toconserve itself. It is also known as 'passive' conservation(Maxted *et al.* 1997) in that the presence of particular species in theprotected area is coincidental. As contrast with 'active' conservation inwhich positive action promotes the sustainability of the target species and maintenance of the natural or artificial ecosystems sheltering these species.

A report carried out by WWF and IUCN revealedthat less than one quarter of declared national parks, wildlife refuges, andother protected areas in ten key forested countries were well managed, while many had no management at all. This shows that only one percent of these areasaresecure from threats such as human habilitation, agricultural encroachment, logging,hunting, mining and tourism. Another report on'How effective are protected areas?' by WWFprovides a preliminary analysis of the management effectiveness of nearly200 forest protected areas in 34 countries using a tracking tool developed bythe World Bank and the IUCN World Commission on Protected Areas (WWF2004).

Without effective management, protected areas in someregions will be put at risk as a result of global change (Malcolm and Markham2000; IUCN 2003). Therefore,meager presence of targetedspecies in a protected area does not guarantee its conservation. Perhaps, some form of management of the species is required to ensure its conservation, in real sense.

1.4.1 *In-situ* conservation

Conservation of genetic resources through their maintenance within natural or artificial habitat in which they occur is referred to as *in-situ* conservation. This includes protected areas, national parks, sanctuaries and biosphere reserves. Targets 7, 8 and 9 of GSPCare related to *in-situ* and *ex-situ* conservation of target species. Of which, target 7 is aimed to conserve 60% of the world's threatened species *In-situ*.Protected areas are often poorly managed, that depends on adequate human and financial resources. Moreover, there exists a heavy pressure due to invasive alien species, habitatdegradation and destruction. Also, there is an urgent need to conserve the economically important wild species that are neither cultivated nor in protected areas.Restoration or rehabilitation of habitats has growing attention and often environmental legislationrequires habitat rehabilitation/restoration of areas affected by activities suchas mining to be undertaken to mitigate the damage caused. Likewise, speciesrecovery programs may require not only management and reinforcementof populations but also rehabilitation/restoration of the habitats in which theoften fragmented populations occur (Heywood and Dulloo 2005).

The main aim of *in-situ* conservation is to protect and monitor the species populations intheir natural habitats, thus allowing species to adapt to gradual changes in environmental conditionssuch as global warming, rainfall patterns, etc. It should not beassumed that the conservation objective is simply to maintain the species insuch a way that they will continue to evolve as natural viable populations; rather it should be more on sustaining the use for thebenefit of various stakeholders (Freese, 1997).

1.4.2 *Ex-situ* conservation

Conservation outside their habitats by propagatingspecies in arboretum, botanical gardens, nurseries, tissue culture, genetic engineering, or in the form of germplasm banks for seeds is referred to as *ex-situ* conservation.Plants protected *ex-situ*, for instance in botanic garden, also supplement *in-situ* conservation(Smith *et al.* 2003, Sarasan *et al.* 2006, Engler1882, Li and Pritchard 2009). As from *ex-situ*collections, conserved in the form of living plants,stored seeds and tissue cultures, plants can be reintroducedto their native habitats (Cochrane *et al.* 2007, Guerrant and Kaye 2007).

Ex-situ conservation plays an essential role in conserving our indigenous biodiversity.*Ex-situ*plant collectionsare also sources for recovery of threatened species, habitat restoration, crop improvement, new productdevelopment, and a wide variety of research studies. Researchers can obtainaccess to endemic and threatened species without disturbing or damaging wild populations. In terms of long-term storage, *ex-situ*plant conservation in seed banks isadvantageous in terms of efficiency and economy (PGRC, 2005).*Ex-situ* conservation methods samples genetic diversity of species usingcertain criteria and store/propagate the collected material outside the naturalenvironments in which the species grows.Importance of *ex-situ*collections for conservation *in-situ* was realized whencollections in botanical gardens and arboreta helped implementation ofpopulation management and recreation (Millar and Libby 1991).

1.5 Study area

Gujarat lies between 20°02' and 24°41' North latitudes, and 68°08' and 74°23' East longitudes covering a land area of 196,024 sq. km, located on the west coast of India. It has a coastline measuring *ca.* 1650 km which is the longest among all the coastal states of the country. The most prominent feature of the coastline are the two Gulfs (of a total of three for the country), the Gulf of Khambhat and Gulf of Kachchh (earlier spelt as Kutch) which together cover around two-thirds of the coastline of the state and which teem with marine life, coastal wetlands, natural land forests, geologic, physiographic and climatic diversities. The state has a well-marked geographic zone, covered by effective barriers like the Arabian Sea on the West and South-West boundary. To the extreme south-east of Gujarat are the hills of Sahyadri. These hills add a great deal to the forest wealth of Gujarat. Further north, the Satpura range separates the state from Khandesh track of Maharashtra. In the north the plains are broken by irregularly shaped hills which form part of the Satpura and Vindhya hills. The Aravalli ranges run along the north-eastern fringe of the state. Between these irregularly shaped hills are the alluvial valleys built up by Tapti, Narmada, Mahi, Sabarmati and Saraswati rivers draining into the Arabian sea. The Saurashtra Peninsula is connected with the mainland by a neck of low lying lands. In the region, there are famous hills of Gir, Girnar, Barda and Shetrunjaya. Kachchh is practically undulating rocky area with many small hills and with the Rann of Kachchh lying on the northern end, consisting of a vast expanse of tidal mud flats with saline efflorescence.

The state is endowed with great diversity of flora as well as fauna distributed over 19,178 sq. km. Gujarat signifiesalmost 16.8% of the National flora in its varied phytogeographical regions such as desert, semi-arid scrublands, coastal-reef-rich mangrove belts and dry-moist deciduous forests interspersed with fertile agricultural fields. 8.78% of its total geographical area is covered by four national parks and 21 sanctuaries, which are endowed with rich flora and fauna. The state has got great variation in vegetation ranging from desert, semi-arid, mangroves, coral-reef rich coast and dry-moist deciduous forests.Gujarat comprises 33 districts, of which Kachchh is the largest holding 23 percent, while Dangs is the smallest holding less than one percent of its total geographical area.

1.5.1 Climate

Gujarat is situated along the Tropic of Cancer (crossing northern Gujarat and Kachchh), and experiences a varied climate. Summer temperatures are high and vary from 27°C & 42°Cand have been known to reach as high as 48°C, while winter temperatures vary from 14°C to 29°C, although freezing levels have also been recorded in the state. Rains are moderate to heavy between June and September. Kachchh and northern Gujaratare very dry, with less than 500 mm rain a year;whereas in southern Gujarat, rainfall averages 2000 mm a year. The Dangs records highest average of about 190 cm. All over the state the average rainfall varies from 33 to 152cm. Some areas in Ahmedabad, Mehsana, Banaskantha, Panchmahals, Surendranagar, Jamnagar and Kachchh districts face chronic shortage of water because of inadequate rains. These factors account for the wide diversity in the climate of Gujarat. Due to proximity to Arabian Sea, the climate of Gujarat is mainly moist in the southern districts as compared to north because of adjoining desert. In Gujarat, a year can be roughly divided into the winter season (November to February), summer season (March to May), southwest monsoon season (June to September), and the transitional month of October. Gujarat state has been broadly classified into 5 different agroclimatic zonesbased on biogeographical condition.

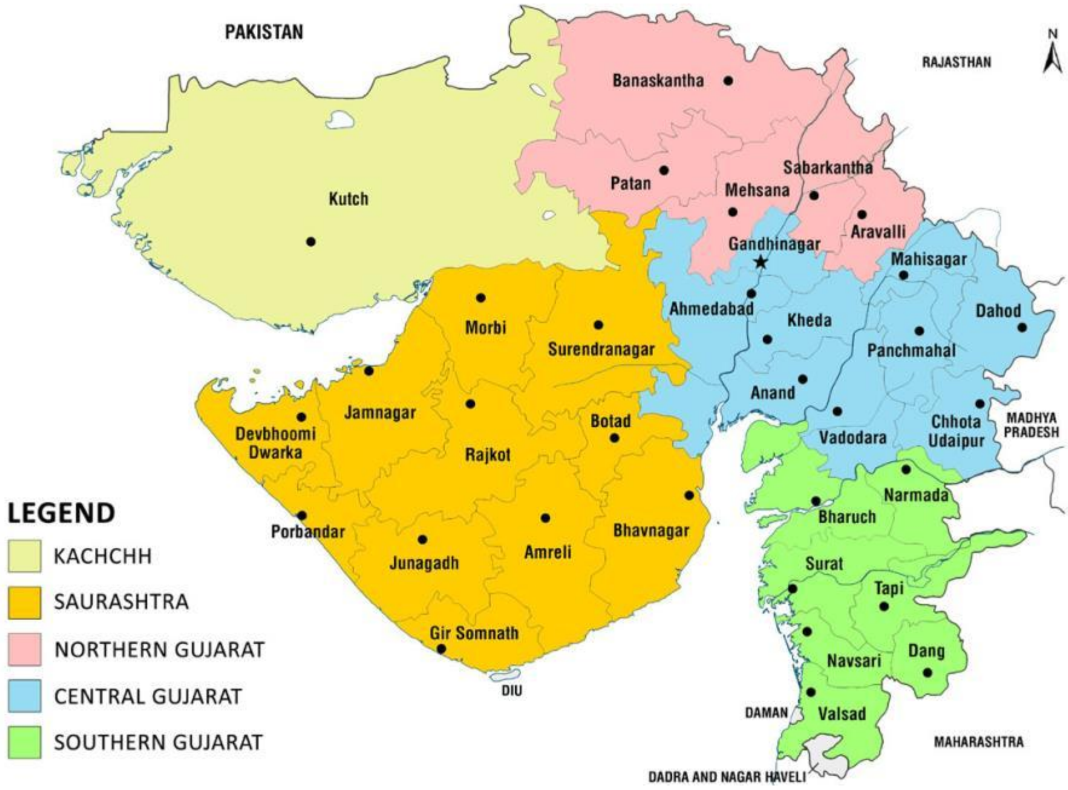

Figure 1: Study Area (Gujarat state divided into 5 agro-climatic zones)

Kachchh: Itis surrounded by sea water on three sides and by land on one side. It is largely barren except for a fertile band along the Gulf of Kachchh in the Arabian Sea, Mandvi, Bhuj in the Gujarat state. This region receives very little annual rainfall between 300 and 400 mm, rendering it totally arid. The total geographic area of the region is 40,890 sq. km. Since sandy and saline soils are not supportive of agricultural activities the region has the lowest geographical area under agriculture. The Kachchh region consists of the Ranns, which are salt-encrusted wastelands and rises only a few meters above sea level.

Figure 2: DHINODHAR HILL, KACHCHH

Figure 3: BANNI, KACHCHH

Saurashtra (also known as Kathiawar)**:** The Saurashtra region includes the districts of Amreli, Bhavnagar, Rajkot, Jamnagar, Surendranagar, Junagadh, and Porbandar. The total geographic area of the region consists of 60,950 sq. km. The climate here is dry sub-humid with very low average rainfall at 500 to 800 mm annually. The soil here is predominantly shallow to medium black and calcareous.Overall Saurashta is represented by Grassland owing poor soil depth and semi-arid condition. There are few pockets of Forest in Saurashtra which includes semi-moist forest of Gir and Girnar Sanctuary and scruby mixed deciduous forest of Barda Sanctuary.

Figure 4: GIRNAR, JUNAGADH

Figure 5: JAMJODHPUR, SAURASHTRA

Northern Gujarat: The Aravali is the oldest mountain ranges of world which came to existence 600 million years ago. The range runs in the south-north direction and over 800 km from Palanpur (in the southern limit) to the rocky outcrops near Haryana.The northern Gujarat includes the districts of Sabarkantha, Mehsana, Banaskantha, Aravalli and Patan. Its total geographic area comprises 28,910 sq. km. It receives 500 to 800 mm of annual average rainfall and the climate varies from arid to semi-arid. Grey Brown loamy, alluvial soils are predominant in this region.In this region, *Anogeissus pendula* areoften cut due to its sturdy wood, and such forests occur as regenerated coppice those form rather scrub of*A. pendula*. Many times cutting is coupled with grazing on gentle hill slopes that results invery stunted or creeping formswhich can be observed on gentle hills of Idar,along Sabarmati river and in some parts ofBanaskantha.

Figure 6: JESSORE, NORTH GUJARAT

Central Gujarat: The Central Gujarat region includes the districts of Kheda, Anand, Vadodara, Ahmedabad, Gandhinagar, Mahisagar, Chhota Udepur, Panchmahals and Dahod. The total geographic area of the region comprises 34,130 sq. km. Annual rainfall averages from 800 to 1000 mm and the climate is semi-arid while the soil is medium black in nature.The forested area is not extensive in the region and this region leads in agricultural development. Here patches of scrub remain stunted with sparsely present bamboos.

Figure 7: Central Gujarat (Pavagadh)

Southern Gujarat: The southern region includes the districts of Surat, Bharuch, Valsad, Dangs, Tapi, Narmada and Navsari. Its total geographic area is 23,220 sq. km. Annual rainfall averages between 1,000 and 1,500 mm and the climate varies from semi-arid to dry sub humid. Deep black and coastal alluvial soil is predominant in this region.The region has the highest forested area in the state, which are moist, dominated by bamboo in some areas, especially at foot-hill and along streams.

Figure 8: PIPLAIDEVI, DANGS

1.6 Objectives

In order to conserve endemic and threatened species, a systematic compilation and thorough understanding of geographic range, decline/loss of habitat, population size, population reduction, mature individuals, on-going threats and probability of extinction in the wild is essential. Lack of recent documentation is one of the main reasons for the status of endemic and threatened species to be minimal. Hence, the present work has been undertaken with the following **objectives**:

- Analyze the status of Indian endemics occurring in Gujarat.
- Evaluate the status of angiosperm taxa found in Gujarat as per BSI/IUCN Red List.
- Status and distributional pattern of regional endemics and Indian endemic species occurring in Gujarat.
- IUCN Red List assessment of some endemic and threatened plant species of Gujarat.
- *In-situ* and *Ex-situ* conservation of endemic and threatened species of Gujarat.
- Awareness of endemic and threatened plants of Gujarat.