CHAPTER 1
INTRODUCTION

1.1 BIODIVERSITY

The term “Biodiversity” consist of two words, first “bio” means living organisms and second “diversity” means variability, the conclusion is variability found among living organisms or species. Biodiversity is the diversity of species on our earth, it include all types of living organisms, like plants, animals, birds, micro-organisms etc., their genes, their habitats, and all the ecosystems (forests, grasslands, desert, aquatic, wetlands etc.). The most straight forward definition of biodiversity is the varieties of living species at all levels of biological organization. “Biological diversity” term was first coined by Lovejoy 1980. It is commonly used to describe the number of communities or species (living organisms). "Biological diversity" is the variability among living organisms from all sources including, inter alia, forest, grassland, desert, marine, freshwater and other ecosystems and the ecological complexes of which they are part (Lovejoy and Padua, 1980).

The term “Biodiversity” was first used by Wilson in the literature in the year 1988, the concept of biological diversity from which it arose had been developing since the nineteenth century and continues to be widely used. Biodiversity means the variety of life or variability among living organisms, at all levels of community, classified both by evolutionary and ecological criteria. At the level of biological populations, genetic variation among individual living organisms and among lineages contributes to biodiversity as both the signature of evolutionary and ecological history and the basis of future adaptive evolution (Wilson and Peter, 1988). Biodiversity did not become familiar term to general people until the United Nations conference on the Environment and Development held at Reo de Janeiro (Brazil), 1992. The Reo conference laid immense stress on the biological diversity of our planet and the need to preserve it. Biodiversity may also be defined as the sum total of species, richness i.e. the number of plants, animals, birds, and microorganisms’ species, occurring in given region or area, country, continent or the entire globe. Millions of years of organism evolution have handed down to us a vast variety of plants, animals, birds, and microorganism species. Only about 3 to 12% of the total numbers of species present on our earth still

have been described (Gaston and Spicer, 2004) (United Nations Conference on Environment and Development, 1992) (Chandrakar, 2012).

1.1.1 Few Statements About Biodiversity

Biodiversity or biological diversity includes variety and variability within and among living organisms of the ecosystems and ecological systems they comprise. Defining *biological diversity* as "the total variability of life on earth" (Heywood *et al.* 1995).

The word "Bio'' is derived from the Greek word *bios*, meaning life or living organisms, and the activities and interactions of living organisms. In definitions of biodiversity, diversity has been characterized as (1) the number of different types of items, (2) the number of different types of items and their relative abundance, and (3) variety. In the scenario of biodiversity, diversity characterization included the structural complexity of landscapes (Huston, 1994). It has become widespread practice to define biodiversity in terms of *genes, species, and ecosystems,* for example, ''the abundance, variety, and genetic constitution of native animals and plants'' (Dodson *et al.* 1998).

Biodiversity is a characteristic of an area in reference to the diversification within and among living organisms, aggregation of living organisms, biotic communities, and biotic processes, whether naturally occurring or modified by humans. Biodiversity can be measured in terms of genetic diversity, the identity and number of different types of species, assemblages of species, biotic communities and processes, and the amount (e.g., abundance, biomass, cover, and rate) and structure of each. It can be observed and measured at any spatial scale ranging from microsites and habitat patches to the entire biosphere (DeLong, 1996).

According to Noss and Cooperrider the biodiversity is the number of different species occurring in some location to all of the diversity and variability in nature and the variety of life and its processes. The comprehensive explanation of biodiversity is "the variety of living things, the genetic differences among them, the societies and ecosystems in which they found, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting'' (Noss and Cooperrider, 1994).

1.1.2 Biological Diversity or Biodiversity Can be Observed at Three Levels;

1. Ecosystem or ecological diversity
2. Species diversity
3. Genetic diversity

1.1.2.1 Ecosystem or Ecological Diversity - Ecosystem diversity refers to the various types of ecosystems and variety of habitats on earth or number of ecosystems present in a particular area. It is often evaluated through measures of the diversity of the communities or component species. This diversity may involve assessment of the relative abundance of different communities or species as well as consideration of the types of communities or species. Ecological diversity can be described as particular or specific geographical area, or a political entity such as a country, a state, a city, a village or a kasba (Gujjar and Jat, 2012).

1.1.2.2 Species Diversity - The basic unit of classification is species, it defined as a group of individual organisms that mate and produce offspring with one another. It refers to the variety of species within a particular geographical area. The total number of species of plants, animals, birds and microorganisms that are found in a particular area is called its species diversity. It is possible to count the number of species within specific given area (Sharma and Josh, 2006).

1.1.2.3 Genetic Diversity - Genetic diversity refers to the genetic variations within the species. Various kind of gene combinations found within individuals of species, that's why each member of species differs widely from each-other in its genetic makeup, and it is called genetic diversity. The gene pattern of each member of a species is different and every individual has specific characteristics (Somvanshi and Dhupper, 2013).

1.1.3 Methods of Biodiversity Conservation

1.1.3.1 *In-Situ* Conservation – This is the most effective way to conservation of biodiversity and the most appropriate way to maintain the wild floral and faunal species in their own habitat. Conservation of species in their natural habitat is called in-situ conservation. It is on site conservation of biodiversity in their natural habitats. In this process of conservation, the rich or unique biodiversity areas are declared as protected areas by the government or local communities. *In-situ* conservation is less expensive than *Ex-situ* conservation. National Parks, Wildlife Sanctuaries, Biosphere Reserves, Community Reserves, Conservation Reserves, Marine Protected Areas, Tiger Reserves,

Elephant Reserves, Ramsar Wetland Sites, Natural World Heritage Sites and Sacred Groves are the fine examples of *in-situ* conservation (Chandrakar, 2012), (Somvanshi and Dhupper, 2013).

1.1.3.2 *Ex-Situ* Conservation - Conservation of floral and faunal species outside of their natural habitats called *ex-situ* conservation. It involves holding to these species in botanical gardens and zoological gardens or arboretums or reserve, in the form of seeds and genes in the seed bank and gene bank, or some other suitable forms by means of tissue culture techniques. *Ex-situ* conservation maintains the viable population of species threatened in the wild including species for which there is presently no hope of *in-situ* conservation. These places also educate people about wildlife. Examples - Gene bank or Seed bank, Germ-plasm storage and live museums etc. (Somvanshi and Dhupper, 2013), (Gujjar and Jat, 2012).

1.1.4 Categories for Threatened Species by IUCN

International Union for Conservation of Nature and Natural Resources (IUCN 1994) categorized species under threat as Endangered (EN), Critically Endangered (CR), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Extinct in the Wild (EW), and Extinct (EX). Two other categories are Not Evaluated (NE) and Data Deficient (DD).

(a) Endangered (EN) – Species are on verge of extinction, and facing a high risk of extinction in the wild. The best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered.

(b) Critically Endangered (CR) - Species are on verge of extinction, and facing a high risk of extinction in the wild. The best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered.

(c) Vulnerable (VU) – Not endangered but, facing a high risk of extinction in the future. The best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered.

(d) Near Threatened (NT) – Species NT when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

(e) Least Concern (LC) – A species Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

(f) Extinct in the Wild (EW) - A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times, throughout its historic range have failed to record an individual.

(g) Extinct (EX) - Species should be classified as extinct only once exhaustive surveys throughout the species' known historic range have failed to record an individual.

(h) Not Evaluated (NE) - A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

(i) Data Deficient (DD) - A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status (International Union for Conservation of Nature, 2016).

1.1.5 Important Laws and Rules in India for Biodiversity Conservation

(a) For the conservation of biodiversity

Act - Biological Diversity Act, 2002

Rule - Biological Diversity Rules, 2004

(b) For the conservation of Wildlife

Acts

The Wildlife (Protection) Act, 1972, as amended in 1993

The Wild Life (Protection) Amendment Act, 2002

The Wild Life (Protection) Amendment Act, 2006

Rules

The Wildlife (Transaction and Taxidermy) Rules, 1973

The Wildlife (Stock Declaration) Central Rules, 1973

The Wildlife (Protection) Licensing (Additional Matters for Consideration) Rules, 1983

Recognition of Zoo Rules, 1992

The Wildlife (Protection) Rules, 1995

The Wildlife (Specified Plants - Conditions for Possession by Licensee) Rules, 1995

The Wildlife (Specified Plant Stock Declaration) Central Rules, 1995

The Declaration of Wild Life Stock Rules, 2003

The National Board for Wild Life Rules, 2003

Recognition of Zoo Rules, 2009

(c) For the conservation of Forest

Acts

The Indian Forest Act, 1927

Forest (Conservation) Act, 1980, amended 1988.

State/Union Territory Minor Forest Produce (Ownership of Forest Dependent Community) Act, 2005 -Draft

Rules

Forest (Conservation) Rules, 1981, amended 1992

Forest (Conservation) Rules, 2003

(d) For the conservation of Environment

Act - The Environment (Protection) Act, 1986, amended 1991

Rule - The Environment (Protection) Rules, 1986 (Rules and Regulations, 2016)

1.1.6 Categories for Threatened Species According to The Wildlife (Protection) Act, 1972,

Schedule I

Part I – Mammals, Examples – Golden Cat, Tiger, Desert Cat, Cheetah, Hog Deer etc.

Part II – Amphibians and Reptiles, Example – Gharial, Golden Gecko, Pythons etc.

Part II A – Fishes, Examples – Whale Shark, Sea Horse, Giant Grouper etc.

Part III – Birds, Examples – Andaman Teal, Bengal Florican, Forest-spotted Owlet etc.

Part IV – Crustacea and Insects, Examples – Butterflies and Moths

Part IV A – Coelenterates, Examples –Sea Fan, Black Coral, Fire Coral etc.

Part IV B – Mollusca, Examples – Cassis cornuta, Tridacna Maxima etc.

Part IV C – Echinodermata, Examples – Sea Cucumber (all holothurians).

Schedule II

Part I, Examples – Bengal Porcupine, Bonner macaque, Common langur etc.

Part II, Examples – Common Fox, Rat snake, Indian cobras, Sperm whale etc.

Schedule III, Examples – Chital, Hyaena, Nilgai, Wild Pig, Barking deer etc.

Schedule IV, Examples – Hedgehog, Indian porcupine, pole cats, many birds etc.

Schedule V, Examples – Common crow, Fruit bats, Mice, Rats etc.

Schedule VI, Examples – Blue Vanda, Pitcher plants, Kuth, Baddommes' cycad etc. (Universal, 2014).

At present there are about 1.8 million species known and documented by various scientists in the world. According to their estimation, the total number of species on our planet varies from 2.0 to 20 million, thus the most of the floral and faunal species are yet to be identified. The ecological diversity of the India is ranging from sea level to the highest mountain ranges in the world, hot and arid conditions in the northwest to cold arid conditions in the trans-Himalayan region, tropical wet evergreen forests in Northeast and the Western Ghats, mangroves of Sundarbans and freshwater aquatic to marine ecosystems (Sharma and Singh, 2000), (Rathore and Jasrai, 2013). The biodiversity of India is very rich and diverse. The special geographical conditions of India on worlds map, are responsible for the rich and diverse biodiversity. India

occupies only 2.4% of the world geographical area and supports a variety of habitats and ecosystems like forest, grassland, desert, marine, wetland, river, stream, lake, and pond etc., each with unique and rich biodiversity. More than 50% Indian floral diversity is mostly concentrated in 4 hotspots. About 47,513 floral and 97,514 faunal species are documented in India. About 23% (11273) of floral species are endemic. Among the flowering plant species, about 22% are not found elsewhere in the world (Arisdason and Lakshminarasimhan, 2016), (Solow *et al.* 1993). Total 16,26,251 faunal species are documented in the world, of these 97,514 are present in India. 386 amphibian, 562 reptile, 1340 aves, and 427 mammal species are listed in India (Zoological Survey of India, 2016).

There are vast varieties of cultivated crops and domestic animals, including 30,000 to 50,000 species of rice, 34,000 verities of cereals, 22,000 varieties of pulses and a number of vegetables and fruits. In domestic animals, there are 27 breeds of cattle, 40 breeds of sheep, 22 breeds of goats and 8 varieties of buffalos. India has 10 biogeographic zones. The classification of these areas is based on the vegetation, climate, geography, and the faunal species that live in them. Each of these zones contains a variety of ecosystems, which have many unique species of flora and fauna (Gujjar and Jat, 2012), (Sharma and Josh, 2006). Our country stands among top 10 floral species-rich nations (Kaushik, 2006). Currently, India has 103 National Parks, 543 Wildlife Sanctuaries, 18 Biosphere Reserves, 26 Community Reserves, 67 Conservation Reserves, 25 Marine Protected Areas, 50 Tiger Reserves, 32 Elephant Reserves, 26 Ramsar Wetland Sites, 7 Natural World Heritage Sites, 107 Important Coastal and Marine Biodiversity Areas and more than 2 lakhs Sacred Groves. All these areas harbour rich and unique biodiversity (ENVIS Centre on Wildlife & Protected Areas, 2016) (MoEF and Kalpavriksh, 2004).

Rajasthan is the largest state of our country, covering about 10.41% (342239 Km^2) geographical area of the country. Only 31151 Km^2 area of the state is covered with forest. A large part of the state fall under arid and semi-arid zones. The biodiversity of Rajasthan is unique and diverse because of its physiographic features. The state harbour with forest, desert, valleys, mountains and thick green areas. The presence of the great Thar Desert, Aravallis Mountain Range, Sambhar Lake and Wetland in Keoladeo makes the state very special. About 3000 floral and faunal species are documented in this state (Sharma and Upadhyay 2014). The floral diversity of Rajasthan was studied

by Singh and Pandey in the year of 1998. Ambient data of the floral species of Rajasthan were published by Botanical Survey of India in three volumes (Shetty and Singh 1987, 1991, 1993). Floral species of Rajasthan was also described by Sharma in "The Flora of Rajasthan" and Bhandari in "Flora of the Indian Desert" (Sharma, 2002), (Bhandari, 1978). In all 87 mammal, 140 fish, 477 birds, 14 amphibians, and 67 reptile species are present in Rajasthan (Sharma *et al*., 2013). Fauna of Desert National Park and Sambhar Lake were also quoted (Zoological Survey of India, 2004, 2005). In all 24 reptile species were identified at Ajmer Aravalis range. Of these 16 species of lizards and 08 species of snakes were documented (Sharma, 2016). Faunal diversity, Status, Threats and Conservation of Thar Desert were described (Sharma, 2013). Ambient data of the mammals of Rajasthan was studied (Sharma *et al*., 2002). 40 Mammalian species of Shekhawati region was listed (Dev & Singh, 2016). Mammals of Sariska Tiger Reserve were described (Dular, 2013). The degradation of biodiversity is one of the major problems in the present scenario. Unsustainable utilization, over-exploitation of natural resources, illegal anthropogenic interventions and pollution are the main causes for the loss of biodiversity. The population pressure plays a key role in the loss of natural habitats. The rapid decline and disappearance of wild species is a great concern facing the world. Many wild species of animals and birds are on the verge of extinction due to our inhumanity. Protected areas play a significant role in the conservation of biodiversity all over the world.

1.2 SACRED GROVES

Sacred groves are the finest example of community based *in-situ* conservation of biodiversity. These groves are locally known as Oran's in Rajasthan (Malhotra *et al*, 2001). These are fine forest patches of varying sizes, protected by local religious communities and have the significant religious connotation with these communities. Illegal human interferences are prohibited within these groves, developmental activities are also not allowed. These are the mini-forests with rich and unique biodiversity and conserved by the specific religious community without any external support. The religious beliefs and traditional values of these societies are closely associated with these patches.

The area of these groves can vary from one single tree to hundreds of hectares of forests. These are also culturally important, many traditional programmes are often arranged by

local people within these patches. These groves are also associated with taboos, rituals and religious beliefs and are also supported by mystic folklore. Around 25000 sacred groves have been reported from different parts of Rajasthan (Pandey, 1998). It is often believed that during shifting primary forest was left undisturbed by the local inhabitants and protected them due to the belief that the deities reside in these forests it also establishes that the sacred groves are the result of the instinctive behavior of the local religious communities (Gadgil and Vartak, 1975), (Gadgil and Vartak, 1976).

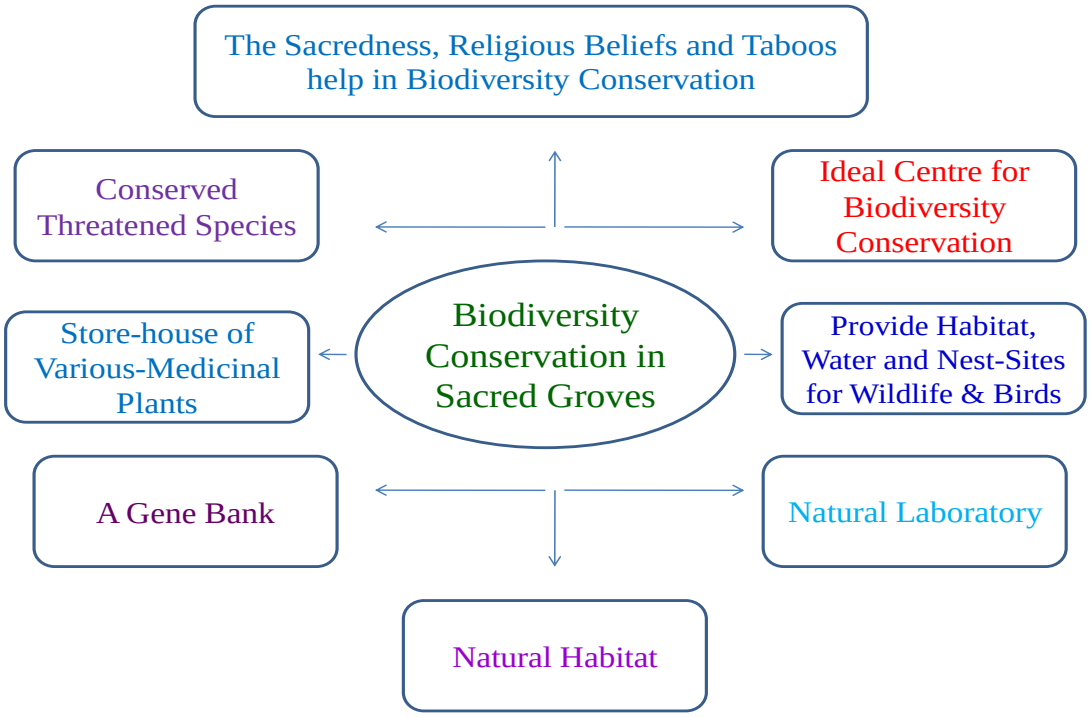
Sacred groves (SGs) have been preserved over generations in India. The tradition of sacred groves in India was even before the Vedic period. In these groves, villagers perform annual rituals and ceremonies to appease the residing deity to ensure the well-being of the community (Malhotra *et al,* 2001), (Ramakrishnan, 1998).

A great variety of flowering plants were cultivated in these patches and flowers from them were offered to the deity, each grove has a residing deity and folklore associated with it. Various religious and cultural festivals are also carried out in these groves, to please the local Gods. These groves are found in all parts of India, such as Aravalli Mountain to Thar Desert. The pipal tree has a significant religious connection and conspicuous position in Indian traditional culture from last 5000 years.

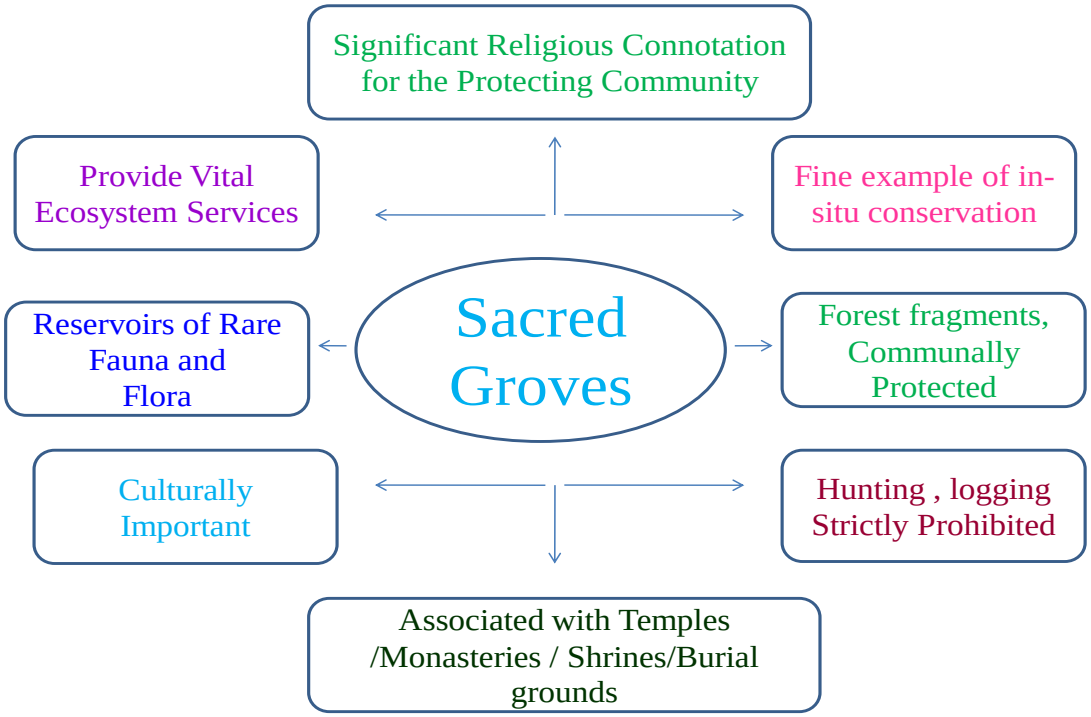
The great Buddha also found enlightenment under this tree (Nature worship, 2006). The conservation of forest areas, sacred groves and trees probably dates back to the pre-epic period in Indian history. The transformation of the sacred tree into the anthropomorphic in India were observed (Gadgil and Vartak, 1976), (Khan *et al*, 1997).

Sacred groves help to define the cultural identity of the communities that revere and protect them. These are associated with and managed by separate caste groups within a community, some by a village as a whole, and some by neighboring districts within a larger geographical area.

References about SGs have been made in Greek and Sanskrit classics. Many individual species of plants and animals are worshipped by traditional Hindu societies. They are considered to be the symbol of their admiration in some form on the bases of accumulated empirical knowledge. Floristic and ethno-botanical studies on the sacred groves of Maharashtra were studied (Malhotra *et al*, 2001).



Flow Chart 1.1 – Different aspects of biodiversity conservation in sacred groves



Flow Chart 1.2 – Significance of sacred groves in biodiversity conservation

Sacred Groves are;

- Storehouses of rare and endangered plants.
- Services for the maintenance of ecosystem.
- Gene-pool gardens for *ex-situ* conservation.
- Centers of traditional socio-cultural and eco-folklore.

Types of groves

1. Traditional sacred grove – This is the place where the village deity resides.
2. Temple Groves – A grove is created around ancient temple.
3. Burial groves – A grove is created around the burial or cremation grounds (Pandey, 1998).

The present study was carried out in the Nai-Ka-Nath sacred grove, Bassi Jaipur, Rajasthan during the period of 2013 to 2015. Ancient historic sites of Eastern Rajasthan were surveyed by Carlowil (Archaeological Survey of India), including Nai-Ka-Nath. In terms of architecture, the temple is supposed to be about a one and half thousand years old. (Mamodiya, 1987). A historical temple of Bhagwan Shiva is situated in this grove and surrounded by hills. Meena community discovered the temple which is famous for historical interest which is in harmony with the local landscape. Most of the grove is covered with hills and sand dunes. The topography of the grove includes mountains, hillocks, deep gorges, forest regions, rocky terrain, drained rocky plains and rolling sand dunes, barren tracts, nala, rugged, ravines etc. Both Meena and Jogi communities have played a significant role in the protection of this grove. More than 300 floral and faunal species are present in the grove. Lot off medicinal plants are present in the grove, which has significant medicinal values and utilized by local people to meet their primary medicinal requirements.

At present Rajasthan state is facing a serious risk of the existence of biodiversity, due to the loss of natural habitats. Anthropogenic interventions, grazing, deforestation, firewood collection, environmental illiteracy, poverty and degradation of religious beliefs in young generations are the major causes of the degradation of biodiversity of the area. The present study highlighted the floral and faunal species of the area and their conservational status. Many floral and faunal species that have become extinct in neighboring areas are still well conserved in this grove. The study also highlighted the

plant species and their traditional medicinal uses and this attempt shows, that the local people of the area are well aware of the medicinal plants of the area and their uses. The research also highlights the importance of sacred groves for local people. It is observed in the present study that this grove plays a key role in the lifeline of the local tribal population. They used these plants in a sustainable manner to meet their primary medicinal requirements, because of the role of sacredness and religious beliefs of local people in the conservation of the sacred groves. During this study an attempt was also done to educate people about the importance of present floral and faunal species of the area for the healthy environment, their own future generations and the benefits of the sustainable utilization of the natural resources of the grove. Through this study an attempt has also made to form a proposal for Government. In this proposal, all the features of this invaluable area were highlighted and it has been suggested the area has lot of potential for wildlife and deserves the status of a protected area by the government. There is a requirement of preservation, restoration, rehabilitation of degraded landscapes and also urgent need for proper management of dynamic grove.