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Loss of Flora of Ethnobotanical Significance in Indian Thar Desert and its Conservation Strategies

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ABSTRACT

The Indian desert, the Thar Desert, has its own importance and specific characteristics with respect to endemic and medicinal plants. Forty-five plant species are considered to be rare and/or endangered. The desert has a large number of plants of economic importance and medicinal use. The Thar Desert is thickly populated in comparison to other hot deserts of the world. 17.44 million people and 23.33 million livestock are recorded from the region. These populations exert pressure on the biological resources of the Thar Desert causing a lack of sustainability and necessitate conservation of biodiversity actions.

KEYWORDS: *Thar, desert, ethnobotanical, loss, flora, strategies, conservation, significance*

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INTRODUCTION

Plants lose water vapour as transpiration through leaves. To reduce the surface area of leaves, xerophytic plants such as the *kumatiyo (Acacia senegal), ber (Zizyphus mauritiana),* and *googal (Commiphora wightii)* have fewer branches, smaller leaves and thorns/spines. The *kair* bush *(Capparis decidua)* has new leaves for less than a month around March and usually exists as an untidy thicket of leafless twigs. Some plants have fine hair on the surface of leaves to break the airflow or a wax coating on the leaf surface to reflect sunlight. Both these adaptations can be seen in *aak (Caliotropis procera),* a common shrub that also acts as a sand binder on the dunes. Succulents like cactus are able to store water in its tissues. *Thhor* is the most visible cactus of this region that grows in a widening circle, providing, within its stalks, a protected, shady microhabitat for other plants. Species such as the *khejri* tree *(Prosopis cineraria)* and the *kair* shrub *(Capparis decidua)* have a deep root system to tap into ground water reserves.[1,2]

Loss of biodiversity of medicinal plants is commonly occurring in Thar desert areas.

Environmental factors

Caliotropis procera

Rainfall: For the past few years the annual rainfall has decreased to minimum resulting in the health of many herbaceous species during summer months.

Deforestations: Deforestations have been reported over the last two decades. The spread of agriculture, logging, fire wood collection, heavy wood collection, heavy grazing, etc., are the main reasons for reduction. Many valuable wild medicinal plant species are eradicated or minimized every year due to the deforestation activities.

Siltation of water bodies: Siltation of water bodies in Thar has resulted in the reduction of water holding capacity heading to depletion of underground water.[3,4]

Lack of pollinators: Honey bee colonies have declined in numbers to the extent of 50- 60%, in Thar and other areas. Loss of pollinators has resulted in reduced seed set and dispersal of seeds.

Developmental activities

Submersion: Loss of many species of medicinal plants has been noticed in Thar due to submersion.

Infrastructure: Expansion of roads, installation of power lines and construction of buildings has caused extensive damage to Thar desert.[5,6]

Monoculture: There has been a progressive increase in monoculture plantations of economically important indigenous as well as exotic species in Thar. Monoculture plantation totally affects the organic productivity and reduces the natural stability and complexity resulting in loss of medicinal plants. eg., *Eucalyptus* and *Acacia* species in many areas of Thar.

Encroachments: Encroachments have assumed alarming levels. Apart from felling of trees and clearing vegetation, the cultivation practices followed on high sloppy lands has caused soil erosion, and decline of medicinal plant wealth in Thar areas.

Over-exploitation: Gathering of medicinal plants are rampant. The collection was by unorganized collectors, who, in turn sold the product to a contractor at the price fixed by the latter. But now, due to the awareness created by the members of the 'Local Traditional Medicinal Practitioners Association', illegal gathering has been controlled to a certain extent.[7,8]

Discussion

Conservation of medicinal and aromatic plants

Traditionally, the tribal communities of Rajasthan are pastoralists. The varied grasses, shrubs and low branches of trees provide fodder for sheep, camels and cattle. Generations of lore and logic have distilled a bank of knowledge on the medicinal properties of arid plant species, which is now being used for commercial ayurvedic preparations too. In times of crop scarcity, fruit, roots and seeds of wild plants supplement the diet. Listed below a few useful species:

Khejri (Prosopis cineraria): Vital to the ecology with its deep root system penetrating up to 30 metres, it provides both fodder and food. Its pods are gathered when green and cooked as a vegetable. The timber is used for houses, carts and furniture. It offers numerous medical applications to treat asthma, leucoderma and leprosy. Its flowers are pounded, mixed with sugars and eaten by pregnant women to safeguard against miscarriage. The grounded inflorescence mixed with sugar in water is used for prevention of boils and skin diseases. The dried bark and its paste are used to cure rheumatism.[9,10]

Khejri (Prosopis cineraria)

Rohira (Tecomela undulata): Bark paste is applied to cure eczema and syphilis. The powder of root bark is used as a cure for leucorrhoea and diabetes. The timber is highly regarded and used for furniture, printing blocks and implements.

Ber (Ziziphius mauritania): The tangy-sweet fruit is rich in Vitamin C. It is eaten raw, or dried, powdered and mixed with molasses or bajra flour. The flowers yield honey. The leaves provide fodder, and the root, bark and fruit are used in traditional medicine to treat inflammation, rheumatism and digestive ailments. The orange resin deposited on the leaves by the lac insect is used to make shellac. The bark and wood also yield a cinnamon-coloured dye and tanning material. The wood is hardy and used for farm implements and beams. It also makes good charcoal and fuel wood.

Badh (Ficus benghalensis): All parts of this venerable tree have varied medicinal uses. Its latex is used to treat rheumatic pains, the leaves cure abscesses and root fibres are used to treat gonorrhoea. Infusions of the bark serve as a tonic, and bark paste with pepper is used against snakebites. Monkeys, birds and bats relish the fruit, and the leaves are excellent fodder for large animals. Though not native to arid regions, it has been widely naturalised; Hindus worship it as the consort of the pipal.

Kair (Capparis decidua): The fruit and flowers are cooked as a vegetable, usually with khejri pods. Stems and new leaves are ground and the paste is applied to cure boils and swellings. Paste of coal from wood is applied externally to muscular injuries. Powdered root bark is taken with hot water to cure asthma and cough, and as a laxative.[11,12]

Conservation strategy (IUCW, UNEP & WWF, 1980) defines conservation as "the management of human use of the biodiversity so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations".

Strategies & Priorities: The primary goals of biodiversity conservation as envisaged in the World Conservation Strategy can be summarized as follows:

A. Maintenance of essential ecological processes and life support systems on which human survival and economic activities depend.
B. Preservation of species and genetic diversity and sustainable use of species and ecosystems which support millions of rural communities.[13,14]

Strategies for conservation of medicinal plants

Bishnoi tribes in Thar

The conservation of the wild medicinal plants or any other such threatened species can be tackled by scientific techniques as well as social actions. There are basically three scientific techniques of conservation of genetic diversity of these plants.

A. Legislation
B. *In-situ* conservation
C. *Ex-situ* conservation

Legislation: There are no separate policies or regulations for conserving medicinal plants growing in Thar area. There conservation is covered under existing laws pertaining to forestry. Following are the laws formulated by government of India for conservation which directly or indirectly protects the wild herbal flora of Thar.[15,16]

Jodhpur's initiative to conserve Thar desert plants

A. Forest Act, 1927
B. Wildlife (Protection) Act 1972 and Wildlife (Protection) Amendment Act 1991
C. Forest (Conservation) Act, 1980
D. Environment Protection Act, 1986
E. National forest policy, 1988
F. National biodiversity act, 2002

The scheduled tribes and other traditional forest dwellers act, 2006

***In-situ* conservation**

A. Conservation of a given species in its natural habitat or in the area where it grows naturally is known as *in-situ* conservation.
B. It includes Gene bank / Gene sanction, Biosphere reserves, national parks, sacred sites, Sacred grooves etc.
C. It is only in nature that plant diversity at the genetic, species and eco-system level can be conserved on long-term basis[17,18]
D. It is necessary to conserve in distinct, representative biogeographic zones inter and intra-specific genetic variation.

It is cost-effective way of protecting the existing biological and genetic diversity is the 'in-situ' or on the site conservation wherein a wild species or stock of a biological community is protected and preserved in its natural habitat. The prospect of such a 'ecocentric', rather than a species centred approach is that it should prevent species from becoming endangered by human activities and reduce the need for human intervention to prevent premature extinctions. Establishment of biosphere reserves, national parks, wild life sanctuaries, sacred groves and other protected areas forms examples of *'in-situ'* methods of conservation. The idea of establishing protected area network has taken a central place in all policy decision process related to biodiversity conservation at national, international and global level.

The most commonly referred *in situ* conservation methods are highlighted below:

1. Biosphere Reserves: The Ministry of Environment and Forest, Government of India, had identified 14 biosphere reserves based on survey data and 7 of them have already been made operational by now.
2. National Parks: conservation in Rajasthan

In addition to the above wildlife sanctuaries there are Heritage sites, Wetlands (including Ramsagar sites), Mangroves, Coral Reefs, and other areas such as sacred groves, natural monuments, ethno-biological reserves, etc.[19]

Ramsar Wetlands

These will definitely serve in conserving biodiversity in their respective regions. However, experiences have amply demonstrated that in a densely populated area, where a sizeable population is present, ensures conservation on the fast eroding biological diversity. The success of any conservation programme vests solely on the efficient management of protected areas. The involvement of local communities in conservation activities has now been increasingly realised. A people nature-oriented approach thus becomes highly imperative. This will help to generate a sense of responsibility among the local people about the values of biodiversity and the need to use it sustainably for their own prosperity and the maintenance of ecosystem resilience. *In-situ* conservation of medicinal plants in Thar desert can be accomplished through the active support and participation of people who dwell in or near and around the protected areas.

Results

The other complementary methods of *in-situ* conservation are:

A. Preparation of a policy at national level on the conservation and utilization of medicinal plants in protected areas.
B. The policy should include:
C. Identifying which of the protected areas are most important for medicinal plants;
D. Targets and techniques for recording and monitoring medicinal plants in protected areas;
E. Techniques and procedures for collection of medicinal plants within protected areas.
F. Assessment of the extent to which the protected areas system covers the medicinal plants. It should then create new protected areas and extend existing ones to ensure that all the medicinal plants which are conserved. The economic and social incentives for maintaining natural habitats and wild species is essential.
G. Desert managers should ensure that the conservation and exploitation of medicinal plants are incorporated into site management plans.
H. Species that are heavily depleted by over-collection should be re-introduced into areas where they once grew wild.[20]

Ex-Situ Conservation

Conservation of medicinal plants can be accomplished by the ex-situ i.e. outside natural habitat by cultivating and maintaining plants in botanical gardens, parks, other suitable sites, and through long term preservation of plant propagules in gene banks (seed bank, pollen bank, DNA libraries, etc.) and in plant tissue culture repositories and by cryopreservation).

Botanical garden

Seed bank

Gene bank (field repository/clonal repository)

1. (Gene Bank: Storage in the form of seed (Base collection at -20°C; Active collection at +4°C to l0°C). The three national gene banks have been established in India for *ex situ* conservation of medicinal and aromatic plants.
2. National Bureau of Plants Genetic Resources (NBPGR), New Delhi, under ICAR.
3. Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow, Uttar Pradesh, under the Council of Scientific Industrial Research (CSIR), Ministry of Science and Technology, Government of India.
4. (Tropical Botanical Gardens Research Institute, (TBGRI), Palode, Thiruvananthapuram (Kerala).

The conservation of genetic variability of cultivated plants and their wild relatives is the sole responsibility of the National Bureau of Plant Genetic Resources (NBPGR) that operates under the Indian Council of Agricultural Research (ICAR), Department of Agricultural Research and Education (DARE).

Seed gene bank

Germplasm conservation in Seed Gene Bank is more economical. The NBPGR, New Delhi, houses National Gene Bank (NGB) which is primarily responsible for conservation of germplasm of floral diversity and their wild relatives for long-term seed storage for posterity. These are referred to as "Base Collection" stored in modules maintained at -20°C. The seeds are dried to attain 4-6 per cent moisture content and hermetically sealed in moisture proof aluminium foil packets. These stored seeds remain viable for 50 to 100 years. In most crops, seeds samples with more than 85 per cent seed viability are only processed. The seeds in gene bank are stored preferably as per the gene bank standards recommended by FAO/IPGRI.[21]

National active germplasm sites

The national active germplasm sites (NAGS) are the integral component of the network. There are presently 40 NAGS, which are based at ICAR institutes, (crop-based institutes for a specific crop or a group of crops) and SAUs. These are integral part of national plant biodiversity conservation network. The NAGS are entrusted with the responsibility of multiplication, evaluation, maintenance and the conservation of active collection and their distribution to bonafide users both at the national and international levels. These active/working collections are stored in modules maintained at +4°C and 35-40 per cent relative humidity (RH). Under these temperatures, seeds are expected to remain viable for 15 to 50 years. For medium term storage, seed moisture content is brought down to 8 to 10 per cent. The NBPGR has a network of II regional stations located in different agroclimatic zones of the country to support the active germplasm conservation activities of the regions.

Cryopreservation (in liquid nitrogen at-165°C to-196°C)

Cyropreservation or freeze preservation under liquid nitrogen.

A. Seed Preservation: The seeds have been grouped broadly into two categories, based on their response to dehydration.[3] A majority of them are desiccation tolerant, called 'Orthodox' and hence can be stored for longer durations. The second group of plant species are called 'Recalcitrant', whose seeds suffer injury on their drying and therefore cannot be stored at subzero temperatures.

B. Pollen Preservation: Pollen storage was mainly developed as a tool for controlled pollination of synchronous flowering in plants, especially in fruit tree species. In addition, pollen storage has also been considered as an emerging technology for genetic conservation. Pollen can easily be

collected and cryo-preserved in large quantities in relatively small spaces.

C. Exchange of germplasm through pollen poses fewer plant quarantine problems. In recent years, cryo-preservation techniques have been developed for pollen in a large number of species and cryo-bank of pollen has been established for fruit-tree species in several countries.

Cryopreservation

Conclusions

Thar desert is one of the ecosystem possessing low biodiversity due to loss of flora among the desert ecosystems of the world. *P. cineraria* wood is reported to contain high calorific value and provide high-quality fuel wood. The lopped branches are good as fencing material. Its roots also encourage nitrogen fixation, which produces higher crop yields. The Thar is one of the most heavily populated desert areas in the world with the main occupations of its inhabitants being agriculture and animal husbandry.

Agricultural production is mainly from kharif crops, which are grown in the summer season and seeded in June and July. These are then harvested in September and October and include bajra, pulses such as guar, jowar (*Sorghum vulgare*), maize (*zea mays*), sesame and groundnuts.[22]

The Thar region of Rajasthan is a major opium production and consumption area

The floristic survey of Thar desert was carried out recently. A total of 62 families, 157 genera and 206species were documented from the area. Three most dominant families of plants in the study area were Fabaceae (29species), followed by Poaceae (26 species) and Asteraceae (15 species. The habit wise analysis of the results depicted that herbaceous vegetation (60.10%) were highest prevailing vegetation in Thar desert followed by shrubs (16.26%), trees (14.29%) and climber (9.36%). The results of the study will be helpful for conservation and sustainable utilization and management of the plant resources of the Thar desert [22]

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