Preliminary Study on Rare and Threatened Plants in the Chirawa Region of Jhunjhunu District, Rajasthan

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Abstract

The Chirawa region in Jhunjhunu District of Rajasthan lies within India's arid and semi-arid zone, known for its unique ecological diversity and adaptive flora. Despite its harsh climatic conditions and resource limitations, this region harbors several rare and threatened plant species of environmental, cultural, and medicinal importance. However, increasing anthropogenic pressures such as agricultural expansion, urbanization, overgrazing, and unsustainable harvesting practices have contributed significantly to habitat degradation and species decline.

This preliminary study aims to document and analyze the current status of rare and threatened plant species in Chirawa through systematic field surveys and a thorough review of relevant literature and herbarium records. Field investigations conducted during the monsoon and post-monsoon seasons of 2018 covered varied habitats including scrublands, fallow lands, and semi-cultivated fields. A total of XX rare and threatened plant species were recorded, with many facing imminent risk due to their restricted distribution, ecological specificity, and economic exploitation.

Among the key species identified were Ceropegia bulbosa, Tecomella undulata, Sarcostemma viminale, and Ephedra foliata—each recognized for their ecological and/or ethnobotanical value. The study also highlights the contributing threats, including land-use changes, climate variability, invasive species proliferation, and a lack of effective conservation frameworks.

The findings underscore the urgent need for conservation strategies focused on in-situ and ex-situ preservation, policy-level interventions, and community-based stewardship. Public awareness, local participation, and integration of indigenous knowledge systems are essential to preserve the region's botanical heritage. This research serves as a foundational step toward the long-term goal of ecological restoration and sustainable management of Chirawa's native plant diversity.

Keywords: Chirawa, Jhunjhunu, rare plants, threatened species, Rajasthan, biodiversity conservation

1. Introduction

Biodiversity, particularly plant diversity, plays a pivotal role in sustaining ecological balance, providing ecosystem services, and supporting human livelihoods. Rajasthan, one of India's most ecologically diverse states, encompasses a wide range of habitats including deserts, dry deciduous forests, grasslands, and scrublands. The Jhunjhunu District, situated in the northeastern part of the state, forms part of the transitional zone between the Aravalli hills and the Thar Desert. Within this district lies the Chirawa region, which, despite being relatively understudied, is home to a variety of plant species adapted to survive in harsh, arid conditions.

The Chirawa region experiences a semi-arid climate characterized by low and erratic rainfall, high temperatures, and sandy, nutrient-poor soils. These environmental constraints have led to the evolution of a unique flora consisting of drought-tolerant trees, shrubs, herbs, and climbers. However, this delicate ecological balance is increasingly threatened by anthropogenic factors such as urban expansion, land conversion for agriculture, overgrazing, deforestation, and the unsustainable collection of plant resources for fuel, fodder, and traditional medicine.

Over the past few decades, numerous plant species in this region have shown signs of decline in population and distribution. Some have even reached a stage where they are considered rare, endangered, or locally extinct. Despite the urgency, there has been limited scientific documentation and conservation planning in the Chirawa region compared to other parts of Rajasthan. Previous studies such as those by Shetty & Singh (1987–1993) and recent surveys by the Rajasthan Biodiversity Board have highlighted the presence of rare and threatened species in broader areas of the state, but a focused study on Chirawa's unique flora is lacking.

This research aims to bridge that gap by conducting a preliminary assessment of rare and threatened plant species in Chirawa. The objectives of this study include:

- To identify and document rare and threatened plant species in the region.
- To understand the ecological and anthropogenic factors contributing to their declining populations.
- To provide baseline data for future conservation planning and ecological research.

By generating a localized inventory and analyzing threats to plant diversity in the Chirawa region, this study intends to raise awareness among policymakers, conservationists, and local communities. The results may also inform regional conservation policies and support the implementation of sustainable land-use practices to protect and restore native vegetation.

2. Materials and Methods

Study Area

The study was conducted in the Chirawa region, located in the Jhunjhunu District of Rajasthan, India, between latitudes 28.2°N and 28.4°N and longitudes 75.6°E and 75.8°E. Chirawa lies within the semi-arid transitional zone between the Aravalli hill ranges and the Thar Desert, with an average elevation of about 294 meters above sea level. The region experiences a hot and dry climate, with summer temperatures reaching up to 48°C, and average annual rainfall ranging between 300–500 mm, most of which is received during the monsoon months (July–September).

The vegetation is primarily xerophytic, dominated by thorny shrubs, scattered trees, ephemeral herbs, and grasses adapted to water scarcity. Land use in the area includes agricultural fields, scrublands, pasture lands, roadside vegetation, and wastelands each providing diverse microhabitats for native flora. Human settlements and expanding agricultural activity have resulted in significant habitat fragmentation, making the region ideal for studying the pressures on rare and threatened plant species. The combination of ecological uniqueness and anthropogenic stressors makes Chirawa an important site for studying rare and threatened plant species in the arid landscapes of Rajasthan.

Methodology

The methodology for this study was designed to ensure a comprehensive and systematic assessment of rare and threatened plant species in the Chirawa region. It combined field-based ecological surveys, community knowledge, herbarium consultation, and literature review to gather both qualitative and quantitative data. The methods were structured around four key components: field data collection, species identification, threat assessment, and data analysis.

During the field survey, various criteria of IUCN f-or categorizing threatened plants, viz. extent of occurrence, area of occurrence, number of individuals, probability of extinction etc. were measured. Rarity of species was determined by field study, ocular estimation, literature and herbaria and from discussions with the traditional healers, tribals, and the elderly citizens. The recorded plants are enumerated in alphabetical order with local name, family, habit, conservation status, major threats, and present status in the study area (Table 1). Using current international union for conservation of nature (IUCN) and natural resources red list criteria plants are categorized as Extinct (EX), Extinct in the Wild (EW), Critically endangered (CR), Endangered (EN), Vulnerable (VU), Rare (R), Near threatened (NT) and Least concern (LC) threatened at regional and global levels. The threatened status of the plant species was determined according to IUCN Red List Category Strategies and Criteria and also with the help of using available Red Data book and standard publications. The medicinal value was determined using scientific literature and discussion with traditional healers.

Observation and Results

The present study reveals that the Chirawa Conservation Reserve, located in Jhunjhunu District of Rajasthan, is notably rich in both floristic and faunal diversity. This ecologically significant region supports a wide array of rare, endangered, and medicinal plant species, emphasizing its importance as a biodiversity hotspot in the semi-arid zone of India. Table-1 provides comprehensive data on the endangered medicinal plant species recorded during field surveys. The table includes critical information such as scientific names, family affiliations, vernacular names, ethnomedicinal uses traditionally practiced by local communities, and the various threats faced by these species. Predominant threats identified include habitat destruction due to agricultural expansion, overgrazing by livestock, illegal harvesting for commercial medicinal

use, and the overarching impacts of climate change. Taxonomical classification highlights the dominance of species from families such as Fabaceae, Asclepiadaceae, and Asteraceae, known for their rich medicinal properties. Ethnomedicinally, many of these plants are used to treat ailments like fever, digestive disorders, respiratory issues, skin infections, and joint pains, reflecting the deep-rooted traditional knowledge of the indigenous people. The documentation of these plants is crucial for strategizing conservation efforts and sustainable management of the Chirawa Reserve's botanical wealth.

1. Ceropegia bulbosa Roxb., a member of the family Apocynaceae, holds significant medicinal value in traditional systems of medicine, especially among tribal and rural communities in Rajasthan and western India. The plant is primarily known for its underground tuber, which is rich in medicinal properties. Traditionally, the tuber is consumed raw or cooked to treat a variety of ailments such as digestive disorders, ulcers, and skin diseases. Decoctions prepared from the tuber are commonly used as a natural remedy for wound healing, inflammation, and to reduce body swelling. Tribal healers also use extracts of the tuber to alleviate joint pain and enhance general stamina and immunity. In periods of food scarcity, the tubers serve as an emergency food source, providing vital nutrition. Besides its anti-inflammatory and antimicrobial potential, modern studies suggest that Ceropegia bulbosa may possess bioactive compounds beneficial for managing oxidative stress and supporting skin health. However, due to excessive harvesting for medicinal use and habitat destruction, the species faces a serious threat in its natural range, highlighting the urgent need for conservation and sustainable utilization efforts.

2. Tecomella undulata (Sm.) Seem., commonly known as Rohida, is a medicinally valuable tree species belonging to the family Bignoniaceae and is native to the arid regions of Rajasthan and adjoining areas. Traditionally, various parts of the plant, especially the bark and flowers, have been widely used in indigenous medicine. The bark is known for its strong antimicrobial, anti-inflammatory, and hepatoprotective properties. In traditional practices, a decoction of the bark is used to treat liver disorders, jaundice, and urinary tract infections. It is also applied externally to heal wounds, boils, and skin infections. Moreover, bark extracts are used as a remedy for diabetes**,** fevers**,** and digestive problems, demonstrating the plant's versatility in folk medicine. The flowers are sometimes used for their cooling effect in herbal formulations. Modern pharmacological studies have indicated that Tecomella undulata contains bioactive compounds like flavonoids and phenolic acids, which contribute to its medicinal efficacy. Given its multipurpose value and declining population due to overexploitation and habitat loss, Tecomella undulata is now considered a threatened species, necessitating conservation and sustainable utilization strategies.

3. Sarcostemma acidum, commonly known as the Indian trumpet vine or Acid Sarcostemma, is a medicinal plant native to India and other parts of Asia. It is recognized for its various therapeutic properties in traditional medicine, particularly in Ayurvedic and folk practices. The plant is known to possess several medicinal benefits, primarily attributed to its alkaloid, saponin, and flavonoid content. It is used in the treatment of a variety of conditions such as respiratory disorders, including asthma and bronchitis, due to its potential to act as an expectorant, helping to clear mucus from the respiratory tract. It is also known for its anti-inflammatory properties, which can aid in the reduction of swelling and pain. Additionally, it has been used to treat digestive issues, like constipation, by acting as a mild laxative. In some traditional practices, it is also employed for its purported anti-fungal and anti-bacterial effects. However, it is important to note that while Sarcostemma acidum has a long history of use in traditional medicine, scientific studies on its efficacy and safety are still limited, and caution should be exercised when using it medicinally.

4. Commiphora wightii, commonly known as Indian guggul or guggul, is a medicinal plant widely used in traditional Ayurvedic medicine for its numerous therapeutic benefits. The gum resin derived from this plant, known as guggul gum, is particularly valued for its anti-inflammatory, analgesic, and lipid-lowering properties. It is traditionally used to treat a variety of conditions, including arthritis, high cholesterol, and obesity. The active compounds in guggul, particularly guggulsterones, are believed to help reduce cholesterol levels by

promoting the breakdown of fats and improving circulation, which supports heart health. Additionally, Commiphora wightii has been utilized for its detoxifying effects, aiding in the treatment of skin conditions, such as acne and eczema, as well as for improving overall metabolic function. It is also used in managing conditions like hypothyroidism, as guggul may help stimulate thyroid function. Despite its widespread use in herbal medicine, modern research on guggul's efficacy is still ongoing, and it should be used with caution, especially when combined with other medications, due to potential interactions.

5. Indigofera cordifolia, commonly known as heart-leaved indigo or Indian indigo, is a plant used in traditional medicine, particularly in Ayurvedic and folk healing practices. This herb is primarily valued for its anti-inflammatory, antimicrobial, and antioxidant properties. It has been employed in treating various skin conditions, such as eczema, rashes, and wounds, due to its ability to promote healing and reduce irritation. Additionally, Indigofera cordifolia is known for its potential in supporting liver health, and it is sometimes used as a detoxifying agent to cleanse the body of toxins. The plant's leaves and roots are utilized in herbal preparations to treat respiratory issues, including coughs, colds, and asthma, as it is believed to have expectorant properties that help clear mucus from the airways. In some traditional practices, it is also used as a mild laxative and to treat digestive disorders. While the plant has a long history of medicinal use, scientific studies confirming its full range of therapeutic effects are still limited, and caution should be exercised when using it medicinally.

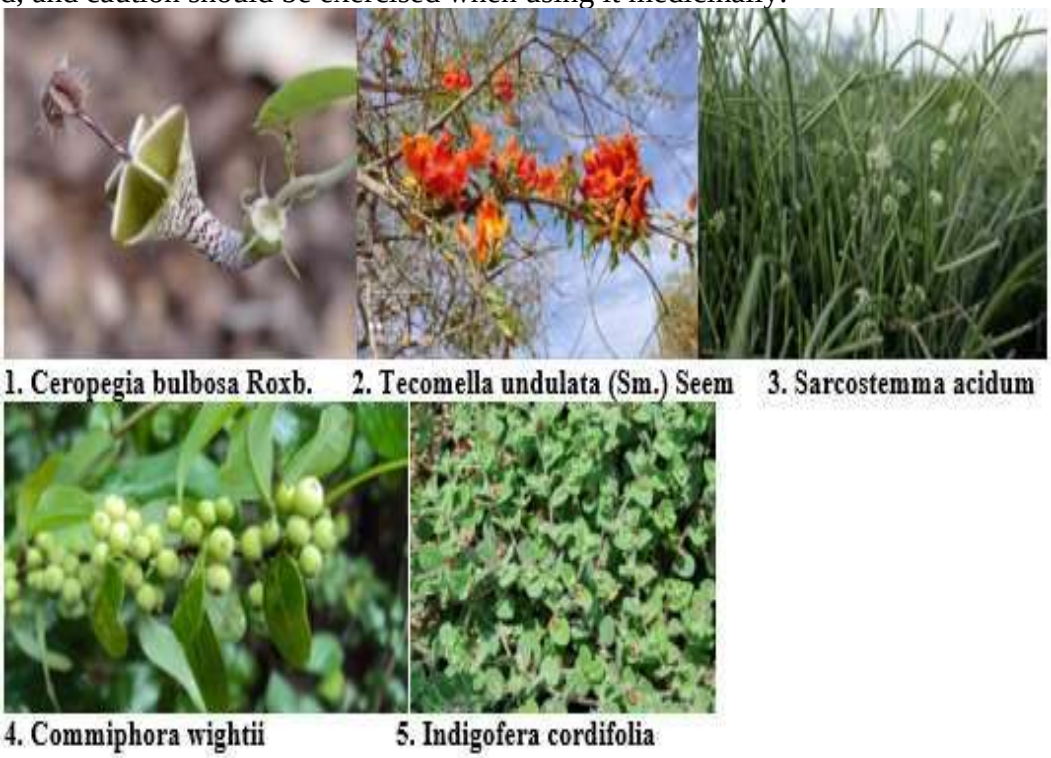

Figure 1: Threatened Medicinal Plant Species of the Study Area

6. Aerva javanica, commonly known as desert knotweed or Javanese knotweed, is a medicinal plant found in arid regions of Asia, Africa, and the Middle East. In traditional medicine, it has been used for its various therapeutic properties, particularly in treating urinary and kidney-related ailments. The plant is often employed as a diuretic to promote urination and help alleviate conditions like kidney stones, urinary tract infections, and fluid retention. It is also valued for its anti-inflammatory and analgesic effects, making it useful in managing conditions such as arthritis and joint pain. Additionally, Aerva javanica is sometimes used to treat digestive issues like dysentery and diarrhea due to its mild astringent properties. The plant is also believed to have antimicrobial effects, which can help in fighting infections. Although Aerva javanica is widely used in traditional systems of medicine, scientific research on its medicinal efficacy and safety is still limited, so it should be used with caution and under proper guidance.

7. Capparis decidua, commonly known as kerda or dryland caper, is a medicinal plant native to arid regions of India, Africa, and the Middle East. It is widely used in traditional medicine

for its numerous therapeutic properties. The plant, including its roots, leaves, and fruits, is known for its anti-inflammatory, antimicrobial, and antioxidant effects. It is commonly used to treat various ailments, such as digestive disorders, including constipation, dyspepsia, and gastric ulcers, as it is believed to have mild laxative and digestive-stimulant properties. Capparis decidua is also used for its wound-healing properties, as it can promote the healing of cuts, bruises, and ulcers when applied topically. In traditional medicine, it is also used to treat respiratory conditions, including coughs and asthma, due to its ability to act as an expectorant. Additionally, the plant is thought to support liver health and may have anti-diabetic effects, helping in the management of blood sugar levels. While its traditional uses are widespread, scientific studies on the full scope of its medicinal benefits are still ongoing, and caution should be taken when using it in large quantities or without proper guidance.

8. Leptadenia pyrotechnica, commonly known as fire-stem or desert thorn, is a medicinal plant found in the arid regions of Africa, the Middle East, and parts of India. In traditional medicine, it is highly valued for its numerous therapeutic properties, particularly in treating various ailments related to the digestive, respiratory, and urinary systems. The plant has a reputation for its anti-inflammatory, antimicrobial, and analgesic effects. It is often used to manage digestive issues such as indigestion, constipation, and bloating, as it is believed to help improve digestion and relieve discomfort. Additionally, Leptadenia pyrotechnica is used to treat respiratory conditions like cough, bronchitis, and asthma due to its expectorant and anti-inflammatory properties that help clear mucus and ease breathing. The plant's roots and stems are also used in traditional remedies for urinary tract infections and kidney-related disorders, as it is thought to have mild diuretic properties. Furthermore, Leptadenia pyrotechnica is used for its potential to strengthen the immune system and combat infections, making it a valuable plant in folk medicine. While it has a rich history of use, scientific research on its medicinal efficacy is still in the early stages, so it should be used with caution and under proper guidance.

9. Calligonum polygonoides, locally known as Phog, is a xerophytic shrub of high ethnomedicinal significance in the arid and semi-arid regions of Rajasthan, including the Chirawa area of Jhunjhunu district. Traditionally, it has been utilized by local communities for its cooling, digestive, and anti-inflammatory properties. The young twigs are often consumed raw or boiled during extreme summer months to alleviate heat stress and dehydration, acting as natural coolants and mild diuretics. An infusion of the flowers is employed in the treatment of sunstroke, diarrhea, and urinary tract disorders, especially in traditional Rajasthani and tribal medicine. The ash obtained from burnt stems is applied to swollen gums or used as a natural toothbrush due to its astringent and antiseptic qualities. In addition, decoctions made from the root and stem are applied externally for treating rheumatic pains and skin inflammation. Its medicinal value, combined with its ecological role in stabilizing sand dunes and controlling erosion, underscores its importance in desert ecosystems. However, unsustainable harvesting and grazing pressure have led to a decline in its natural population, making it a species of conservation concern in the region.

10. Ziziphus nummularia (Burm.f.) Wight & Arn., commonly known as Jharber or Wild Jujube, is a hardy, spiny shrub native to the arid and semi-arid zones of Rajasthan, including the Chirawa region of Jhunjhunu district. Renowned for its resilience in drought-prone habitats, this species holds considerable ethnomedicinal value in traditional Indian systems of medicine. Its leaves are used as an astringent in the treatment of skin infections**,** boils, and wounds, while decoctions of the bark are administered to manage diarrhea**,** dysentery, and feve**r**. The fruits are rich in vitamin C and are eaten both fresh and dried; they are traditionally employed to improve digestion, treat cough, and enhance general immunity. In folk remedies, the powdered root and bark are used to treat mouth ulcers, and its leaves are sometimes used in herbal shampoos for their anti-dandruff properties. Due to its high adaptive capacity and nutritional potential, Z. nummularia also serves as a valuable source of fodder and fuelwood, but this multifunctionality has also led to localized overuse, especially in marginal habitats. While not globally threatened, the species is under pressure in some regions due to intensive land-use practices and grazing stress, making its sustainable use critical for both ecological and medicinal purposes.

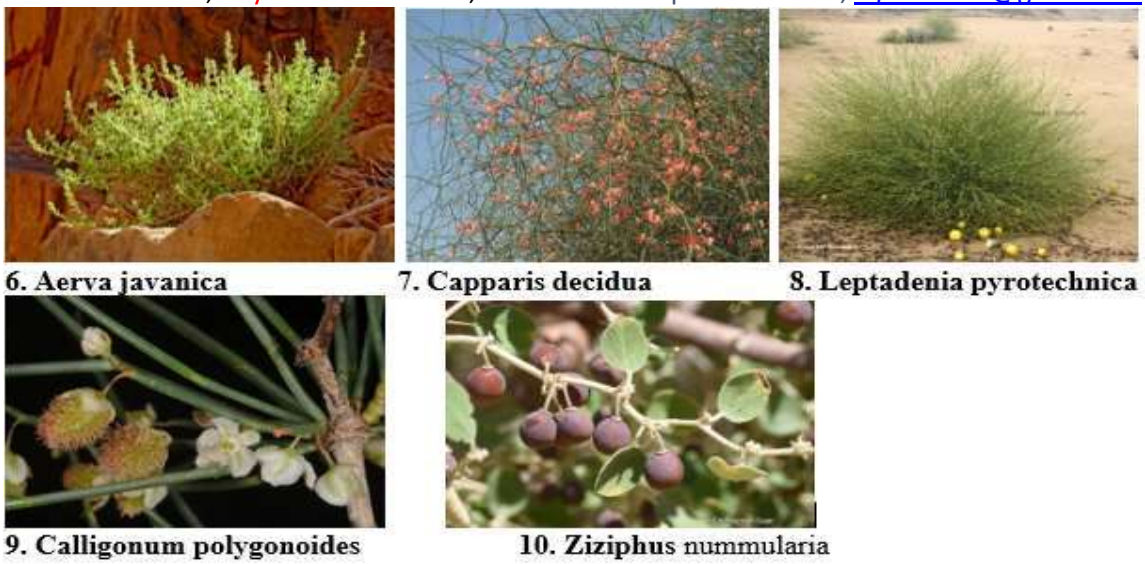

Figure 2: Threatened Medicinal Plant Species of the Study Area

11. Withania somnifera, commonly known as Ashwagandha or Indian ginseng, is a highly regarded medicinal plant in Ayurvedic medicine, known for its adaptogenic, anti-inflammatory, and rejuvenating properties. The root of the plant is primarily used in herbal remedies to combat stress, fatigue, and anxiety, as it is believed to help the body adapt to physical and emotional stressors by regulating the endocrine system and balancing cortisol levels. Withania somnifera is also widely used for its potential to enhance energy, improve stamina, and promote overall vitality. It is known to have anti-inflammatory effects, making it helpful in treating conditions such as arthritis, muscle pain, and joint discomfort. Additionally, it has been shown to support cognitive function, improve memory, and help in the treatment of neurodegenerative disorders like Alzheimer's disease. Ashwagandha is also used for its immune-boosting properties, helping to strengthen the body's resistance to infections. Furthermore, it is believed to have a role in improving sexual health and fertility, particularly in men, by enhancing sperm count and motility. While Withania somnifera has a long history of use with a wide range of health benefits, ongoing research continues to explore and validate its therapeutic effects. However, it should be used cautiously, particularly by pregnant or breastfeeding women, as well as individuals on certain medications.

12. Tribulus terrestris, commonly known as puncture vine, is a medicinal plant widely used in traditional medicine systems, including Ayurveda, Traditional Chinese Medicine, and folk medicine in various cultures. It is known for its adaptogenic, aphrodisiac, and anti-inflammatory properties. The plant's fruit, root, and seeds are primarily used to treat a range of health conditions, with particular emphasis on improving sexual health and enhancing athletic performance. Tribulus terrestris is believed to boost libido and fertility, particularly in men, by increasing testosterone levels and improving sperm quality. It is often used as a natural remedy for erectile dysfunction and other sexual health issues. Additionally, the plant is recognized for its potential to improve physical endurance, muscle strength, and recovery in athletes, making it a popular supplement for those engaging in strenuous physical activity. Beyond its effects on sexual and physical health, Tribulus terrestris is also valued for its ability to support heart health by reducing blood pressure and cholesterol levels. It is also thought to have mild diuretic and anti-inflammatory properties, helping in the treatment of urinary tract infections and inflammatory conditions. While Tribulus terrestris has shown promising benefits in traditional uses and some studies, further research is needed to confirm its full range of medicinal effects and safety.

13. Boerhavia diffusa, commonly known as punarnava, is a medicinal plant widely used in Ayurvedic and traditional medicine systems for its diverse therapeutic properties. The plant is particularly valued for its ability to support kidney and liver health, earning it the name punarnava, which means "renewal" or "revitalization" in Sanskrit. It is known for its diuretic, anti-inflammatory, and antioxidant effects, making it effective in treating conditions such as urinary tract infections, kidney stones, and fluid retention. Boerhavia diffusa is often used to

promote detoxification by helping the body eliminate waste products and excess fluids, which can be beneficial for people with kidney or liver disorders. It is also recognized for its ability to improve digestion and alleviate symptoms of gastrointestinal distress, such as constipation and bloating. In addition, the plant is used for its potential to enhance immune function, reduce inflammation, and support overall vitality. Traditional uses of Boerhavia diffusa also include its application for respiratory conditions like asthma, cough, and bronchitis, due to its expectorant properties. While it has a long history of use in herbal medicine, more scientific research is needed to fully understand its mechanisms and confirm its therapeutic benefits. As with all medicinal plants, caution should be taken when using it, especially in combination with other medications.

14. Asparagus racemosus, commonly known as Shatavari, is a highly regarded medicinal plant in Ayurvedic medicine, known for its adaptogenic, rejuvenating, and nourishing properties. It is particularly celebrated for its benefits to women's health, often referred to as a "female tonic." Asparagus racemosu**s** is widely used to support reproductive health by balancing hormones, regulating the menstrual cycle, and enhancing fertility. It is also believed to be beneficial during pregnancy and postpartum, as it is thought to strengthen the uterus, promote lactation, and support overall maternal health. In addition to its benefits for women's health, Shatavari is also known for its ability to support digestive health, improving appetite, digestion, and reducing symptoms of gastrointestinal disorders like ulcers and acid reflux. The plant has adaptogenic properties, helping the body cope with stress and promoting overall vitality. It is also known for its immune-boosting effects, helping to strengthen the body's defenses against infections. Additionally, Asparagus racemosus is sometimes used to treat respiratory conditions, such as cough and asthma, due to its soothing and anti-inflammatory effects on the respiratory tract. While Shatavari has been used for centuries in traditional healing systems, ongoing research continues to explore its full range of health benefits.

15. Heliotropium marifolium, commonly known as sea heliotrope, is a medicinal plant found in coastal regions of Africa and Asia. In traditional medicine, this plant is known for its anti-inflammatory, analgesic, and antimicrobial properties. It is often used to treat various skin conditions, including wounds, ulcers, and rashes, due to its healing and soothing effects. The leaves and roots of Heliotropium marifolium are sometimes applied topically or used in poultices to reduce swelling and pain, particularly in cases of inflammation or injury. The plant is also believed to have mild diuretic properties, helping to alleviate conditions such as fluid retention and urinary tract infections. Additionally, it is used in some traditional remedies to treat digestive issues, such as dysentery and diarrhea, due to its astringent and anti-bacterial qualities. While Heliotropium marifolium has a history of use in folk medicine, there is limited scientific research available to fully validate its medicinal efficacy, so caution should be exercised when using it for therapeutic purposes.

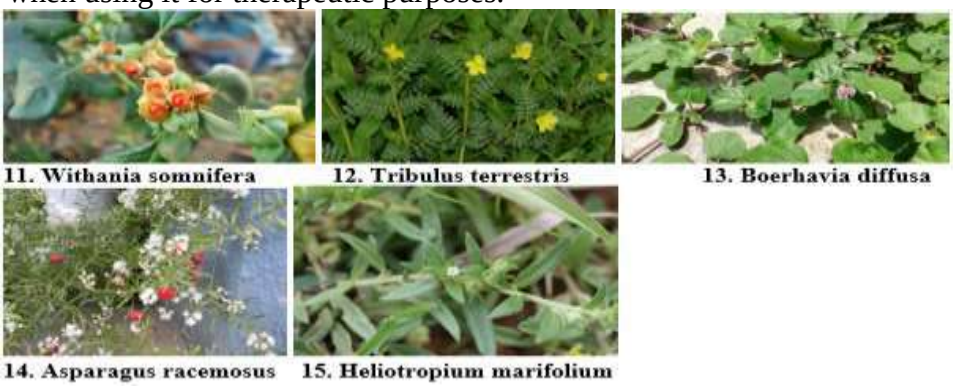

Figure 3: Threatened Medicinal Plant Species of the Study Area

16. Pergularia daemia, commonly known as Devil's vine or Balloon plant, is a medicinal plant found in tropical and subtropical regions of Asia, Africa, and Australia. In traditional medicine, this plant is known for its wide range of therapeutic uses, particularly in treating respiratory, digestive, and skin ailments. The leaves, stems, and roots of Pergularia daemia are used to prepare herbal remedies that are believed to have anti-inflammatory, antimicrobial, and expectorant properties. It is commonly used to treat respiratory conditions like asthma, cough,

and bronchitis, as it helps to clear mucus from the airways and reduce inflammation in the lungs. The plant is also valued for its ability to promote digestion, alleviate constipation, and manage gastrointestinal discomfort, thanks to its mild laxative and digestive-stimulant effects. Pergularia daemia has been used traditionally to treat skin conditions such as ulcers, wounds, and fungal infections due to its antibacterial and healing properties. In some cultures, it is also used for its mild diuretic effects to promote urine flow and support kidney health. While Pergularia daemia has a history of medicinal use, scientific research on its full range of benefits and safety is still limited, so it should be used with caution under professional guidance.

17. Momordica balsamina L., commonly known as Balsam Apple or Kakrol, is a medicinal climbing plant from the family Cucurbitaceae**,** widely distributed in arid and semi-arid regions of Rajasthan, including the Chirawa region of Jhunjhunu District. Traditionally used in various indigenous healing systems, this plant is prized for its bitter fruits**,** leaves, and roots, which are rich in bioactive compounds like cucurbitacins, glycosides, and flavonoids. The fruits are often used to treat diabetes, malaria, and digestive disorders due to their potent hypoglycemic and antimicrobial properties. The leaf paste is applied externally for eczema**,** boils, and wound healing, while decoctions made from the plant are ingested to combat liver ailments**,** parasitic infections, and rheumatic pain. In some traditional practices, the plant is also used as a vermifuge and anti-inflammatory agent. Despite its medicinal importance, Momordica balsamina is becoming increasingly rare in parts of Rajasthan due to habitat disturbance**,** overgrazing, and lack of awareness regarding its conservation. It remains underutilized in formal herbal pharmacopoeias, highlighting the need for scientific validation and conservation-focused cultivation strategies.

18 Acacia senegal, commonly known as gum acacia or senegal gum, is a medicinal plant native to Africa and parts of the Middle East. It is most famous for its gum, gum arabic, which has been used for centuries in both traditional medicine and various industries. In traditional medicine, Acacia senegal is valued for its anti-inflammatory, antimicrobial, and astringent properties. The gum is widely used to treat digestive issues, particularly for conditions such as diarrhea, dysentery, and other gastrointestinal disturbances. It is believed to help soothe the digestive tract, reduce inflammation, and promote healing of intestinal ulcers. Additionally, Acacia senegal is used in traditional remedies for respiratory conditions like coughs, asthma, and bronchitis, due to its soothing and expectorant effects. The plant is also applied topically to treat wounds, ulcers, and skin infections, as it has antimicrobial properties that help prevent infection and promote healing. Beyond its medicinal uses, Acacia senegal is also known for its potential to support oral health, as it is often used in tooth powders and mouthwashes to help with gum disease and toothaches. While Acacia senegal has a long history of use in herbal medicine, more scientific research is needed to fully understand its medicinal properties and therapeutic potential.

19. Salvadora oleoides, commonly known as oleander or Indian mustard tree, is a medicinal plant found in arid regions of Africa and Asia. Traditionally, it has been used for its various therapeutic properties, especially in the treatment of gastrointestinal, skin, and respiratory conditions. The leaves, bark, and roots of Salvadora oleoides are often used in herbal remedies due to their anti-inflammatory, antimicrobial, and analgesic effects. It is commonly used to treat digestive issues, including indigestion, constipation, and gastric ulcers, as it is believed to possess mild laxative and soothing properties. The plant is also utilized in treating respiratory conditions like coughs, asthma, and bronchitis due to its potential to act as an expectorant and reduce airway inflammation. In some cultures, Salvadora oleoides is applied topically to wounds and skin infections, as it is believed to have antimicrobial and healing properties. Additionally, the plant has been used in traditional medicine to treat conditions such as headaches, fever, and pain relief. However, caution is advised when using Salvadora oleoides medicinally, as certain parts of the plant can be toxic in large quantities, and its safety and efficacy require further scientific validation.

20. Cordia dichotoma G. Forst., commonly known as Lasora or Indian Cherry, is a medium-sized deciduous tree belonging to the family Boraginaceae, and is widely found in arid and semi-arid regions of India, including the Chirawa region of Jhunjhunu District, Rajasthan. This

species holds significant value in traditional medicine due to its wide therapeutic applications and nutritional properties. The fruits are mucilaginous and are widely used as a demulcent, expectorant, and digestive tonic. Consumed raw, pickled, or cooked, they are believed to help relieve coughs, asthma, and constipation. The leaves are applied topically to skin infections**,** ulcers, and inflammatory conditions, while bark decoctions are used internally to treat diarrhea**,** dysentery, and fever. In Ayurvedic and Unani systems, various parts of the plant are used for their cooling, antipyretic, and anti-inflammatory properties. Additionally, Cordia dichotoma plays a nutritional role as a famine food in drought-prone areas, offering both sustenance and medicinal support. Although the species is classified as Least Concern globally by the IUCN, unsustainable fruit collection**,** overharvesting, and grazing pressures in some regions have led to its localized decline, warranting conservation attention in areas like Chirawa.

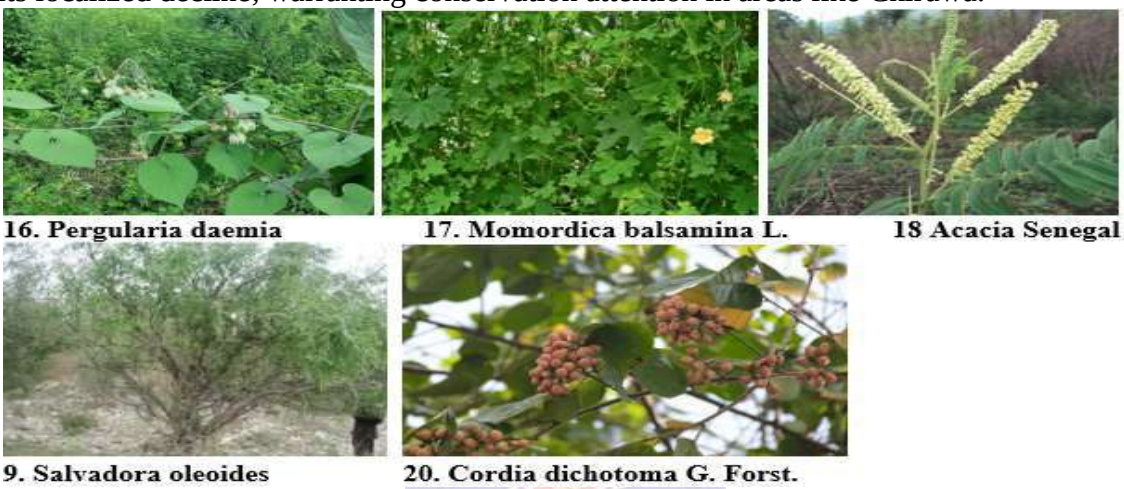

Figure 4: Threatened Medicinal Plant Species of the Study Area

Discussion

Forests serve as vital islands of biodiversity, sheltering a wide variety of plant and animal species, including many that are rare, endemic, or threatened. However, over the past fifteen years, widespread developmental activities, overexploitation of natural resources, and changing climatic conditions have led to significant depletion of forest ecosystems, particularly impacting medicinal plants. Through extensive field surveys and plant exploration efforts, the present study has identified 20 threatened medicinal plant species, representing 20 genera across 12 families. Among these, Ephedra foliata was the sole gymnosperm recorded, while the remaining species were angiosperms.

Table 1. Endangered Medicinal Plant Species of Chirawa Region, Jhunjhunu District, Rajasthan

S. No.	Scientific Name	Family	Vernacular Name	Ethnomedicinal Use	Threats	IUCN Status / Regional Status
1	Ceropegia bulbosa	Apocynaceae	Khar Kudi	Treats ulcers, skin wounds	Overgrazing, habitat destruction	Rare (Regional); Not Evaluated (NE)
2	Tecomella undulata	Bignoniaceae	Rohida	Bark used for liver disorders	Logging, agricultural expansion	Endangered (Regional); Near Threatened
3	Sarcostemma acidum	Apocynaceae	Somlata	Antidiabetic, used in rituals	Overharvesting, habitat loss	Endangered" Near Threatened
4	Commiphora wightii	Burseraceae	Guggal	Resin for arthritis, weight loss	Overexploitation, illegal trade	Critically Endangered
5	Indigofera cordifolia	Fabaceae	Neel	Skin infection treatments	Grazing, soil erosion	Rare (Regional); Not Evaluated (NE)
6	Aerva javanica	Amaranthaceae	Bui	Urinary tract infections	Habitat degradation	Least Concern Rare Regionally

7	Capparis decidua	Capparaceae	Kair	Fruit for digestive problems	Land clearing for farming	Least Concern (IUCN); Locally Threatened
8	Leptadenia pyrotechnica	Apocynaceae	Khimp	Root tonic for strength and stamina	Overgrazing, sand mining	Least Concern (IUCN); Vulnerable Regionally
9	Calligonum polygonoides	Polygonaceae	Phog	Latex for joint and muscle pains	Habitat disturbance	Not Evaluated (NE)
10	Ziziphus nummularia (Burm.f.) Wight & Arn.	Simaroubaceae	Jharber	Antidiabetic, antimicrobial	Fruits, Leaves	Least Concern (IUCN); Vulnerable Locally
11	Withania somnifera	Solanaceae	Ashwagandha	General health tonic, stress relief	Overharvesting, habitat loss	Least Concern (IUCN); Threatened Locally
12	Tribulus terrestris	Zygophyllaceae	Gokhru	Diuretic, used for kidney problems	Soil erosion, grazing	Least Concern (IUCN); Declining Wild Populations
13	Boerhavia diffusa	Nyctaginaceae	Punarnava	Treats edema, urinary disorders	Agricultural encroachment	Least Concern (IUCN); Locally Threatened
14	Asparagus racemosus	Asparagaceae	Shatavari	Women's health tonic	Overharvesting, land conversion	Endangered" Near Threatened
15	Heliotropium marifolium	Boraginaceae	Hiran Chhoti	Remedy for respiratory infections	Drought, grazing pressure	Endangered" Near Threatened
16	Pergularia daemia	Apocynaceae	Utaran	Used for fever and constipation	Grazing, habitat degradation	Least Concern (IUCN); Threatened Locally
17	Momordica balsamina L.	Cucurbitaceae	Balsam Apple, Kakrol	Root extract for skin diseases, blood sugar levels	Habitat destruction	**IUCN Status**: Not Evaluated (NE)
18	Acacia senegal	Fabaceae	Kumbhat	Gum (Gum Arabic) for digestive issues	Overexploitation, climate change	Least Concern (IUCN); Vulnerable Regionally
19	Salvadora oleoides	Salvadoraceae	Meethi Jal	Used for dental care (toothbrush tree)	Urbanization, drought	Near Threatened (IUCN); Threatened Locally
20	Cordia dichotoma G. Forst.	Boraginaceae	Lasora, Indian Cherry, Sebesten	**ulcers**, **insect bites**, and **skin infections**	**Habitat fragmentation** and **overgrazing**	**Least Concern** globally

The study documented the presence of rare plant species such as Ceropegia bulbosa Calligonum polygonoides and Tecomella undulata at several locations. Nevertheless, local residents have indicated that these plants were previously abundant in the region. This situation is concerning, as endangered plants necessitate increased efforts to preserve their genetic diversity. It is crucial to implement specific protective measures to guarantee their long-term survival in the area. Medicinal plants are currently facing significant threats due to

overexploitation. Major risks include unregulated harvesting, habitat destruction, heightened exploitation, unsustainable collection practices, excessive grazing, deforestation, and pathogen attacks. Species such as Salvadora oleoides, Ceropegia bulbosa, Tecomella undulata, and Salvadora oleoides are commonly utilized in traditional medicine by the rural and tribal communities in the study region. Unsustainable harvesting practices have led to the depletion and scarcity of these medicinal plants; for instance, the roots of Salvadora persica have been extensively harvested for commercial purposes as miswak. The loss of habitat due to the export of medicinal plants sourced from the wild has ultimately resulted in a severe and irreversible decline in the genetic diversity of many of these species.

The study identified climbers such as Leptadenia reticulata, Salvadora oleoides, Ceropegia bulbosa var. bulbosa, and C. bulbosa var. lushii as critically endangered within the research area. Notably, Ceropegia bulbosa is especially at risk due to its edible tubers, which are frequently consumed by herders and local communities, as well as its significant medicinal properties. The research also observed a substantial decline in the populations of plant species like Withania somnifera and Tephrosia falciformis in the region. The analysis of plant species collected from the Chirawa Jhunjhunu Conservation Reserve suggests that many threatened plants are regularly utilized by the local rural population for medicinal purposes and daily necessities. Over the past few decades, the natural resources in this area have been rapidly diminishing due to habitat destruction. Species such as Tephrosia falciformis, Tecomella undulata, and Ceropegia bulbosa, which are recognized as threatened in the sandy habitats of the Thar desert, were found to be struggling for survival in the study area. It is imperative to commence systematic cultivation of medicinal plants to conserve biodiversity and safeguard endangered species.

Conclusion

Medicinal plants are acknowledged as a crucial yet increasingly endangered global asset. Current observations indicate that numerous plant species, such as Ceropegia bulbosa, Enicostemma hyssopifolium, Sarcostemma viminale, and Salvadora persica, are extensively utilized in the local area for medicinal purposes. It is imperative to conserve these species along with their natural habitats. Effective conservation initiatives in these regions require the active participation of local communities, who rely on these resources for their livelihoods. There is an immediate necessity to formulate strategic conservation programs for rare and endangered medicinal plants in the Chirawa, Jhunjhunu region, which could facilitate their protection. Additionally, documenting the traditional knowledge of local communities is being prioritized to support in-situ conservation of medicinal plants through community engagement and conservation actions. The government should promote traditional forest conservation practices. Preserving species in their natural habitats and implementing artificial regeneration are optimal strategies for recovering species from the brink of extinction. Establishing national parks, botanical gardens, wildlife sanctuaries, and conservation reserves is vital for the protection of rare and threatened species, as they significantly contribute to both ex-situ and in-situ conservation efforts for these vulnerable plants.

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