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Sustainable harvesting and conservation strategies for ethnomedicinal plant biodiversity

¹Jyoti Sen and ²Dr. Hira Lal Sangam

¹Department of Pharmacy, Swami Vivekanand University, Sagar, NH 26, Narsinghpur Road, Sironj, Sagar, Madhya Pradesh, India

²Parashar Ayurvedic Medical College and Hospital, Jamunia, Zirnia, Narsingh Road, Parvalia, Bhopal, Madhya Pradesh, India

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Corresponding Author: Jyoti Sen

Abstract

The collection and use of medicinal plants is one field where eco-friendly methods are crucial. Unfortunately, the indiscriminate harvesting and habitat destruction of these precious botanical resources are threatening their very survival, despite their important role in human healing for ages. Medicinal plants are an invaluable boon to human health and environmental well-being, serving as natural cures for a wide range of diseases. Not all areas have problems with unsustainable harvesting, thus it's important to do evaluations on a local level. One advantage of using local expertise for short-term evaluations is the positive reception it has received. Much research has gone into the topic of medicinal plant conservation and sustainable usage. The future of medicinal plants, ecosystems, and the healing power of nature may be brightened by bringing together scientific understanding, community involvement, and cultural sensitivity.

Keywords: Harvesting, unsustainable, medicinal, cultural and plants

Introduction

Ecosystem health and human well-being are interdependent, making biodiversity and medicinal plant conservation important fields of research. The term "biodiversity" refers to the wide range of living forms found on Earth, whether in a specific habitat, biome, or throughout the planet as a whole. Its vital functions, including pollination, nutrient cycling, and climate control, make it a key component of healthy, stable, and resilient ecosystems. A significant portion of this biodiversity consists of medicinal plants, which have been used in traditional medical systems around the globe for generations and are still an important source for contemporary medicines. The preservation of these plants is about more than simply protecting biodiversity; it's also about defending cultural legacy and making sure that natural resources that are vital to healthcare across the world remain available.

Plants containing bioactive chemicals that have medicinal uses are called medicinal plants. Traditional medicine relies heavily on these herbs for the treatment and prevention of illness. Many contemporary pharmaceuticals have their

roots in traditional knowledge of medicinal plant use that has been handed down over many generations. As an example, the active ingredient in aspirin, salicylic acid, was originally found in willow bark and was used as a traditional medicine to treat inflammation and discomfort. Similarly, indigenous South American tribes have utilized quinine, an anti-malarial medicine, for generations; the bark of the cinchona tree is its source. The vast tradition of medicinal plants highlights their significance throughout history and in the present day.

Medicinal plants are a treasure trove of potential novel pharmaceuticals. In the United States, around 118 of the top 150 prescription medications are derived from natural sources; in Europe, more than 1300 medicinal plants are utilized, with 90% of those species coming from wild resources. In addition, more than 25% of pharmaceuticals in industrialized nations are sourced from wild plant species, while as much as 80% of the population in underdeveloped nations relies only on herbal remedies for their basic healthcare. Worldwide, medical plant use is on the rise to meet rising demand for herbal remedies, natural health

products, and the secondary metabolites found in medicinal plants.

Earth is losing at least one potential big medication every two years, and the present loss of plant species is 100 to 1000 times faster than the projected natural extinction rate, according to a very conservative assessment. The World Wildlife Fund and the International Union for Conservation of Nature estimate that 50,000 to 80,000 kinds of flowering plants are used medicinally around the globe. Twenty percent of their natural resources have been practically depleted due to rising human populations and plant consumption, and over fifteen thousand species are in danger of extinction as a result of overexploitation and habitat degradation.

Much research has gone into the topic of medicinal plant conservation and sustainable usage. The need for integrated conservation measures based on both in situ and ex situ tactics, as well as the creation of mechanisms for species inventorying and status monitoring, are among the many sets of suggestions put out for their preservation. A viable conservation option for medicinal plants with increasingly restricted supply is the sustainable use of natural resources. Due to the enormous needs of vast populations, the situation is especially urgent in South Africa and China. Strategies and approaches for the sustainable use and conservation of medicinal plant resources are reviewed in this article, along with worldwide trends, advancements, and prospects in this area.

Literature Review

Shukla, Sandeep. (2023) ^[1]. People have relied on medicinal plants for ages as a mainstay of their healthcare system. Unfortunately, many species have been wiped off due to factors such as the rising demand for medicinal herbs, the destruction of habitat, and unsustainable harvesting methods. The potential benefits and threats to medicinal plant conservation are discussed in this study report. Various techniques and efforts may be put in place to guarantee the long-term survival of these plants, and the necessity of preserving them is also discussed. The vast variety of medicinal plants and their significant benefits to human health may be preserved by addressing these issues and capitalizing on these possibilities.

Mbelebele, Zusiphe *et al.* (2024) ^[2]. In order to further sustainable development initiatives, such as the protection of indigenous medicinal plants, it is essential that traditional knowledge and environmental preservation work hand in hand. Communities throughout the globe rely on these plants for more than just traditional medicine; they also play a crucial role in economic stability, food security, and nutrition. The sustainability and availability of these essential resources are, however, jeopardized by the fast loss of biodiversity and the deterioration of ecosystems. There is a clear lack of studies that deal with indigenous medicinal plant conservation and sustainable usage, especially those that concentrate on traditional knowledge systems, despite the cultural and economic significance of these plants. Studies documenting traditional knowledge practices connected to medicinal plant conservation are generally lacking in the extant literature.

Khasim, Shaik *et al.* (2020) ^[3]. Medicinal plants and other plant-based products have long been an integral part of

human health care. Plants are still very important in both traditional and contemporary medicine all throughout the world, even though synthetic pharmaceuticals and antibiotics have come a long way. Traditional medicine's efficacy and lack of side effects mean that one-third of the global population continues to rely on it. Medicinal plants, their uses, variety, and biotechnology are all covered in depth in this book. Sections on biodiversity and conservation, ethnobotany and ethnomedicine, biotechnology, and bioactive chemicals derived from plants and microorganisms span the gamut of medical plant study. All parts include the most recent developments. Biotechnology, botany, microbiology, and pharmaceutical science graduate students and researchers will find this book an invaluable resource. Medicinal plants and other plant-based products have long been an integral part of human health care.

Papageorgiou, Dimitrios *et al.* (2020) ^[4]. One of the biggest problems with wild medicinal plant (WMP) sustainability in Europe and the Mediterranean is the harmful harvesting methods and over-exploitation of these plants. Localized evaluations are necessary, however, since unsustainable harvesting is not a problem everywhere. One advantage of using local expertise for short-term evaluations is the positive reception it has received. To better understand the local harvesters' understanding of the ecological sustainability of WMP harvesting and how they perceive changes in WMP availability, as well as to record the known, harvested, and locally used WMP species, this research set out to do just that. The research was place in July and August of 2018 on the Greek island of Lemnos. Using both intentional and snowball sampling, sixteen harvesters were selected who were well-versed in WMP collection and use.

Shafi, Amrina *et al.* (2021) ^[5]. The world's most valuable medicinal plants are in danger of extinction because of human greed, improper harvesting practices, and the misuse of these plants' herbal and bioactive constituents. Added to the list of threats to these priceless floral treasures are the effects of climate change and the exponential growth of the human population. Moreover, there is a lot of room for growth in the newly formed sector of herbal goods business. As a result, tactics for multiplication and culture must be developed and promoted without delay. Managing the biosphere in a way that maximizes value to the current generation while preserving its potential for future generations is what conservation is all about. Supporting the preservation and responsible use of medicinal plants may be achieved via many means. To serve as a trustworthy resource for medicinal plant resource conservation and sustainable usage, this will center on current and future worldwide trends, advancements, and initiatives in this area.

Research Methodology

Many threats endanger medicinal plants and the fragile ecological balance they help to maintain, notwithstanding the plants' critical role in human health. There are a number of major obstacles, including:

Overharvesting: Many plant species have been overharvested due to the rising demand for herbal remedies across the world. This need is fueled by both traditional and

contemporary healthcare systems. Populations may be severely depleted or even wiped off by unsustainable and unregulated harvesting techniques.

Habitat loss: Natural areas where medicinal plants grow have been lost due to deforestation, urbanization, and land change. The local ecosystems and populations that depend on certain therapeutic plant species are badly affected as a result of this, since their growth and availability are disrupted. Less variety and less availability of medicinal plants may result from habitat disruptions caused by climate change.

Lack of regulation: The collecting and sale of medicinal plants is not adequately supervised or regulated in many areas. Vulnerable plant populations are even more at risk because of this lack of regulation, which leads to unsustainable practices and illicit trading.

Data Analysis

Preserving medicinal plants for future generations requires responsible harvesting methods and concerted conservation initiatives. This may be accomplished in a number of ways: Preserving Biodiversity: Recognize and preserve high-biodiversity regions that are vital for medicinal plant survival. In order to preserve these priceless assets, it is necessary to create and oversee protected zones.

Sustainable cultivation: Motivate people to grow therapeutic plants in greenhouses or on farms. By following this method, we can help wild populations thrive and ensure a steady supply of therapeutic plants for the future.

Ethical wild harvesting: Advocate for the use of sustainable wild harvesting methods, including restricted collection quotas, selective harvesting, and seasonal limits. Guidelines that respect traditional traditions must be developed in close collaboration with local communities and those who possess indigenous knowledge.

Education and awareness: Bring attention to the significance of sustainable practices and the possible repercussions of overexploitation among consumers, practitioners, and legislators.

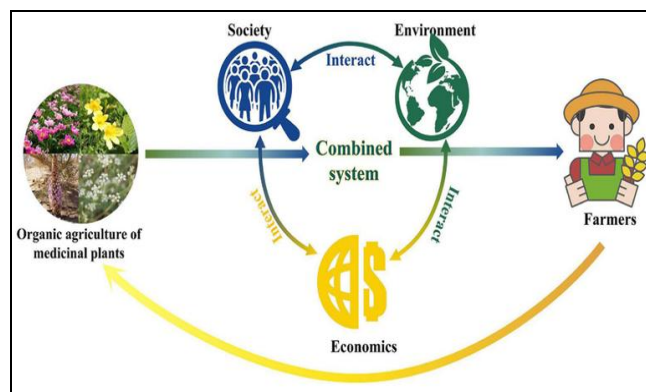


Fig 1: Medicinal plants for a sustainable future.

Many different civilizations have relied on medicinal plants for ages to alleviate a wide range of medical conditions. Their wealth of bioactive chemicals has been essential in the creation of cutting-edge medicines and treatments. A major danger to these priceless resources, however, is the habitat degradation and careless exploitation caused by increasing demand. A comprehensive strategy is necessary for their protection because of the precarious equilibrium between human consumption and environmental preservation. Nature Preserves and Botanical Gardens: Plant nurseries and other protected spaces may act as living archives if they are well-established and well-maintained botanical gardens. These areas facilitate the study, research, and propagation of endangered species for the benefit of the general public, professionals in the field, and academics.

Cultivation and domestication: One way to reduce stress on wild populations is to encourage the growing of medicinal plants in controlled settings. We may develop long-term supplies of herbal treatments by breeding species with comparable chemical characteristics.

Medicinal applications

In the last four years, 341 reports of medicinal usage were received for the 81 plant taxa that were gathered. Harvesters assigned many use reports for most plant taxa; for instance, *M. chamomilla* gives 33 use reports. Of the 341 usage reports, the most common ones concerned the respiratory system (13% of the total) and the digestive system (23%).

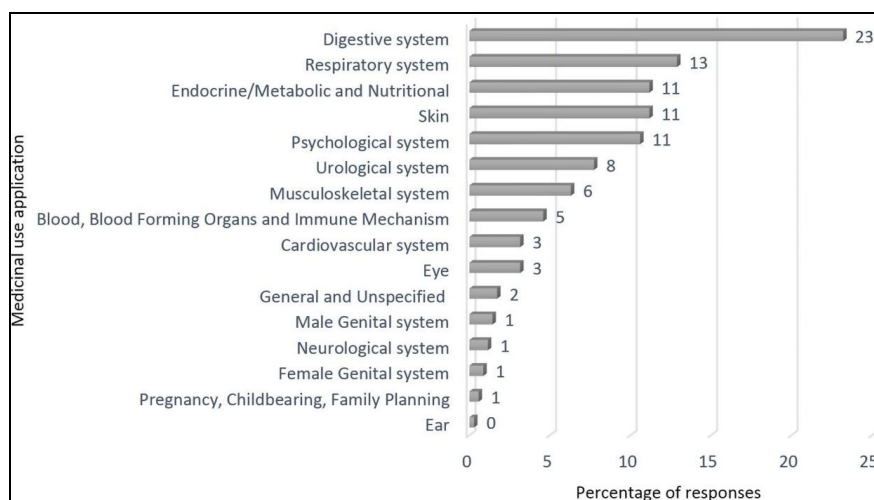


Fig 2: Number of medicinal use applications in the percentage

Traditional knowledge and community involvement

It is essential that indigenous populations and local communities be included in conservation initiatives. Those who have traditional wisdom often have an in-depth familiarity with plant ecology and how to harvest in a sustainable way.

Ethical harvesting practices include taking just what is necessary from plants, such as their leaves, roots, or fruits, and discarding the remainder. This method guarantees the plant's ability to recover and keep on enhancing its natural environment.

Seasonal harvesting

There are ideal periods to harvest several medicinal plants

based on their development cycles. Keeping to the cycles of the seasons enables plants to reproduce in a more organic way and helps to avoid overexploitation.

Sustainable techniques

Reducing habitat disturbance and soil degradation may be achieved by the use of sustainable harvesting practices, such as using hand tools instead of heavy equipment.

Replanting and restoration

Degraded or damaged ecosystems should be restored as soon as possible. Maintaining biodiversity and ecological stability may be achieved by replanting medicinal plants in their native habitat.



Fig 3: Conservation and ethical harvesting.

Preserving cultural traditions

Many cultural customs and traditions revolve on medicinal herbs. Traditional indigenous peoples have deep spiritual and cultural links to these plants, and they often incorporate

them into ceremonial and therapeutic practices. The rich tapestry of human legacy can only be preserved if these cultural practices are respected and supported.

Table 1: Medicinal Plant Conservation Status Ethical Harvesting Practices

Medicinal Plant	Conservation Status	Ethical Harvesting Practices
Ginseng (<i>Panax</i> spp.)	Vulnerable	Harvesting during specific seasons to minimize impact on populations. Limiting the collection of wild plants. Promoting cultivation to reduce pressure on wild populations.
Goldenseal (<i>Hydrastis canadensis</i>)	Endangered	Promoting cultivation and sustainable harvesting practices Certification programs for ethical sourcing. Avoiding harvesting from wild populations.
Echinacea (<i>Echinacea</i> spp.)	Not Evaluated	Promoting cultivation to meet market demands. Sustainable wild harvesting guidelines when necessary. Monitoring populations to assess sustainability.
Yew (<i>Taxus</i> spp.)	Vulnerable to Endangered	Ethical sourcing from cultivated yew trees for Taxol production. Avoiding harvesting from wild populations. Supporting conservation efforts.
Milk Thistle (<i>Silybum marianum</i>)	Not Evaluated	Promoting sustainable cultivation. Monitoring and regulating wild harvesting. Certification for ethical sourcing.
Turmeric (<i>Curcuma longa</i>)	Not Evaluated	Promoting responsible cultivation. Supporting fair trade practices for small-scale farmers. Ensuring sustainable sourcing.
Aloe Vera (<i>Aloe barbadensis</i> miller)	Not Evaluated	Sustainable cultivation practices. Monitoring wild populations. Fair trade initiatives.
Neem (<i>Azadirachta indica</i>)	Not Evaluated	Promoting responsible cultivation. Supporting local communities and small-scale farmers. Ethical sourcing practices.
Valerian (<i>Valeriana officinalis</i>)	Not Evaluated	Promoting cultivation over wild harvesting. Monitoring and regulating wild harvesting when necessary. Ethical sourcing practices.
Lavender (<i>Lavandula</i> spp.)	Not Evaluated	Sustainable cultivation and harvesting. Supporting small-scale farmers. Ethical sourcing initiatives.

Table 2: Medicinal plants for a sustainable future.

Medicinal Plant	Sustainability Score (1-10)
Ginseng (<i>Panax</i> spp.)	6
Goldenseal (<i>Hydrastis canadensis</i>)	4
Echinacea (<i>Echinacea</i> spp.)	7
Yew (<i>Taxus</i> spp.)	5
Milk Thistle (<i>Silybum marianum</i>)	8
Turmeric (<i>Curcuma longa</i>)	9
Aloe Vera (<i>Aloe barbadensis</i> miller)	7
Neem (<i>Azadirachta indica</i>)	8
Valerian (<i>Valeriana officinalis</i>)	6
Lavender (<i>Lavandula</i> spp.)	9

Today, the traditional knowledge of using plants as a form of medicine is seeing a renaissance. The need for ethically gathering medicinal plants and preserving them for future generations is growing in importance as our knowledge of the complex link between the natural world and human health expands. The importance of these activities in protecting ecosystems and cultural traditions, as well as in preserving medicinal plants for future generations, is discussed in this article.

Conclusion

Responsible management is crucial to the survival of medicinal plants, which provide a link between traditional knowledge and contemporary research. Preserving natural resources and practicing responsible harvesting are crucial for the well-being of future generations and the earth itself. The future of medicinal plants, ecosystems, and the healing power of nature may be brightened by bringing together scientific understanding, community involvement, and cultural sensitivity. Ecosystem health and human well-being are interdependent, making biodiversity and medicinal plant conservation important fields of research. Raise awareness and educate the local population about sustainable harvesting techniques that protect WMP and about the external causes that threaten sustainability as a countermeasure to the worsening sustainability of WMP

harvesting. The need for integrated conservation measures based on both in situ and ex situ tactics, as well as the creation of mechanisms for species inventorying and status monitoring, are among the many sets of suggestions put out for their preservation. Unfortunately, the indiscriminate harvesting and habitat destruction of these precious botanical resources are threatening their very survival, despite their important role in human healing for ages.

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