



# Harmony of Nature's Pharmacy: Navigating Cultural Traditions and Modern Healthcare through Ethnobotany

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## SUMMARY

Ethno-botany, the study of the relationships between people and plants, serves as a bridge connecting centuries-old cultural traditions with contemporary healthcare. This chapter explores how indigenous knowledge systems have harnessed the therapeutic potential of plants, contributing to a holistic approach to health and well-being. By examining case studies from diverse cultures, the chapter highlights the relevance of traditional medicinal practices in modern healthcare and the importance of preserving this knowledge in the face of rapid globalization. The chapter also discusses the challenges and opportunities in integrating ethno-botanical knowledge with modern medicine, emphasizing the need for a collaborative approach that respects cultural heritage while advancing scientific understanding. Ultimately, this chapter underscores the significance of ethno-botany in fostering a more inclusive, sustainable, and culturally sensitive healthcare paradigm.

## INTRODUCTION

Ethnobotany is a specific area of scientific study in the study of plants, it is a logical investigation of the relationships between people and plants that relies on a multidisciplinary approach involving anthropology, archeology, botany, nature, finance, medicine, strict, social studies, and a few other disciplines (Sharma & Ashwani, 2013). It is viewed as cutting edge European (particularly clinical) ethnobotany is basically founded on old herbals and later advocating books (Leonti, 2011). From the beginning of time, the human species has outfitted the abundance of regular assets to battle illnesses, prompting the advancement of assorted customary restorative societies, each with local attributes (Jia et al., 2015). Around 81% of the people worldwide relies upon plant-based medicines (Sengupta et al., 2018).

### Exploring the Roots of Medicinal Ethnobotany

The first documentation of Indo-Pakistan's medicinal plants dates to Rig-Veda, circa 4500–1600 BC (Ahmed, 2017). These turned into the most seasoned store of human information and depiction of the 67 plants. This framework screens its beginnings in Greek medication, embraced by the people of Arab, and afterward spreads to countries like Europe and India (Rahman, 2019).

As indicated by Plants of the World Online (POWO) information, there are roughly 392,000 medicinal plant species

universally, with Indonesia facilitating around 30,000 species, 33% of which have therapeutic properties. The 2015 Report of Plant-Based Medication and Herbal Research distinguished 1,159 types of medicinal plants across 156 families. Around 500 species are utilized in drug and herbal enterprises (Farooq et al., 2022).

### Traditional Plant Based Medicines

People have been using plants to heal for generations. There are many easily available and traditionally acceptable traditional medicinal plants. 70% of Indians and up to 90% of Africans receive their medical care from traditional medicine. Traditional medicine is not, however, only used in developing nations. In industrialized nations, public interest in natural remedies has grown significantly over the past 21 years, and the use of ethnobotanicals has grown (Ernst et al., 2005; Barnes et al., 2008).

Approximately 25% percent of pharmaceuticals prescribed globally are obtained from plants, with 121 active chemicals being used currently. Of the 252 medications that the World Health Organization (WHO) lists as basic and essential, just 12% are derived solely from plants, and a significant portion are synthetic medications made from natural precursors.

## A GLOBAL OVERVIEW

Traditional plant-based medicines, also known as phytotherapy, have been used for thousands of years across

various cultures worldwide. Here's a global overview of traditional plant-based medicines:

### **Traditional Chinese Medicine (TCM)**

TCM, one of the oldest medical systems globally, uses plant-based medicines like licorice root, ginger, and ginseng. Chinese acupuncture, tai chi, and herbal remedies have been studied for treating heart-related diseases, stroke, mental health issues, and respiratory ailments.

### **Ayurveda**

With roots extending back over 3,000 years to India, Ayurveda promotes a wholistic approach to well-being and therapy. It has been noted that having a balanced metabolism is a prerequisite for good health. In India, it is estimated that around 7500 production facilities produce traditional plant-based formulations and natural health products, requiring over 2000 tons of raw medicinal plant materials (Pandey et al., 2008).

### **Indigenous Healing Traditions**

Native American tribes all around the world have extensive medicinal practices that use plants that are indigenous to their areas. Sage, echinacea, and sweetgrass are among the herbs used in Native American medicine for a variety of illnesses and rituals (Mazid et al., 2012).

### **African Traditional Medicine**

African traditional healing methods rely on indigenous medicinal plants for cultural and economic purposes. The World Health Organization encourages African nations to incorporate conventional medical procedures into their healthcare systems. Africa's abundant biodiversity resources, including 5,000 medicinal plants like hoodia, rooibos, and African potatoes, are utilized (Gurib-Fakim et al., 2006).

### **Amazonian Traditional Medicine**

Native American tribes in the Amazon rainforest possess a vast understanding of the therapeutic plants that grow there. Ayahuasca, cat's claw, and dragon's blood resin are among the plants that are utilized for therapeutic and spiritual purposes (Sanjad et al., 2021).

### **European Herbalism**

Europeans have used herbal treatments for medicinal purposes for ages. Known for their relaxing and healing qualities, plants including valerian, chamomile, and St. John's wort are included in this practice. Chamomile is used throughout Europe to treat wounds and lessen swelling and inflammation. Valerian is used to alleviate anxiety and sleep issues (Kemppainen et al., 2018).

### **Islamic Medicine**

Traditional Arabic and Islamic medicine, a healing system practiced in the Muslim world since ancient times, includes nutritional regimens, mind-body techniques, divine healing,

realistic therapy, and medicinal plants, reflecting ongoing relationships between prophetic and Islamic medicine (Fig. 1), along with an example of how Islamic medical and predictive influences, along with local healing customs, interact to shape the model and its fundamental five aspects.

Horticulture and medicine were closely associated in the Islamic world during the Middle Ages. Although they were perceived to have different qualities than what is currently believed by contemporary medicine, fruits and vegetables were associated with health and wellbeing (Van der Veen, 2014). Islamic medicine, influenced by Greek, Roman, Persian, and Indian traditions, incorporates the use of herbal remedies such as black seed, saffron, and myrrh for various health conditions.

### **Latin American Traditional Medicine**

Latin American nations have abundant herbal customs, frequently fusing native methods with European inspirations. In nations like Peru, Bolivia, and Chile, plants like boldo, muna, and coca leaf are utilized medicinally.

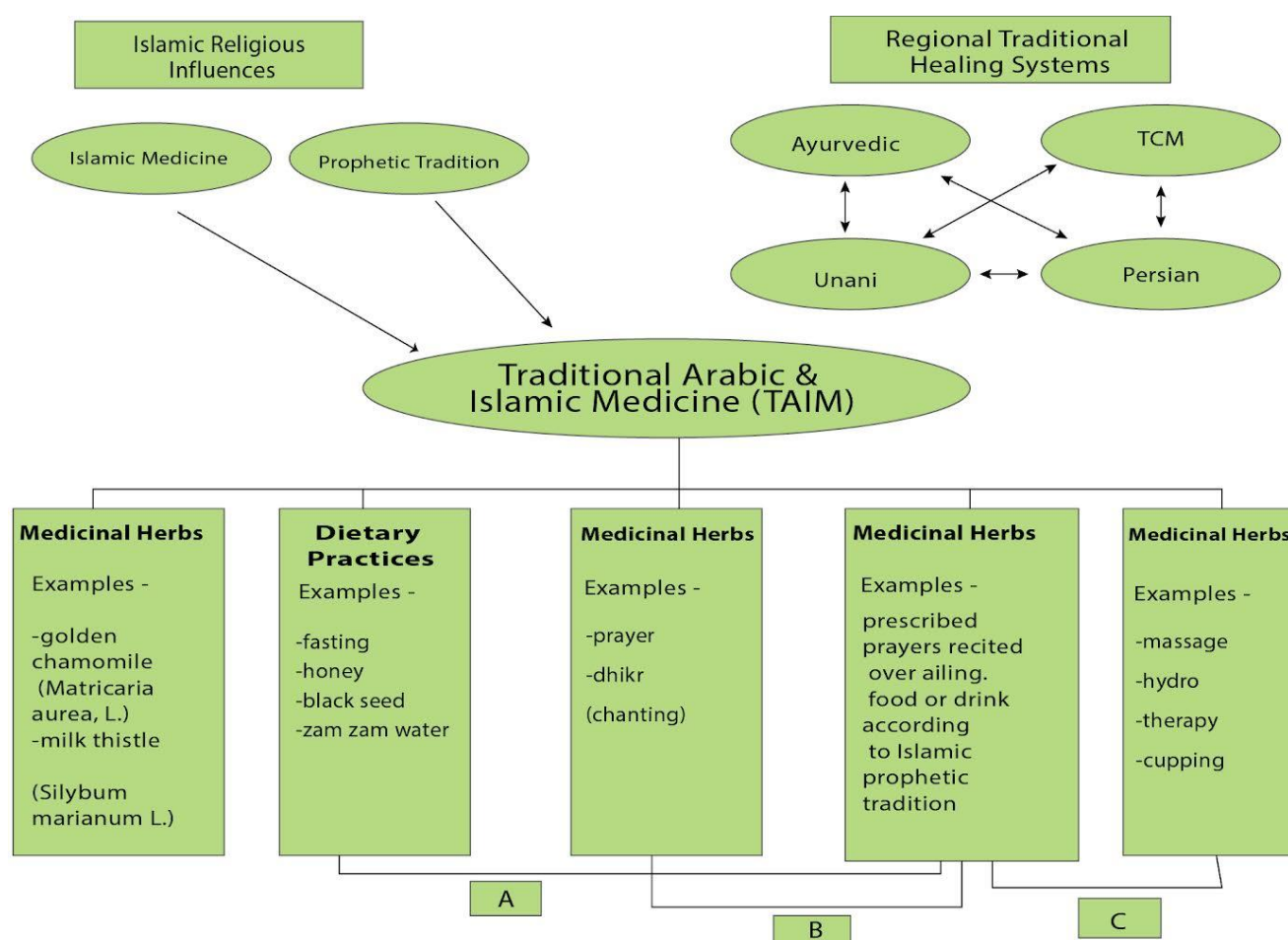
### **Southeast Asian Traditional Medicine**

The history of traditional medicine in South Asia spans more than two millennia. Due to globalization, traditional South Asian medical practices are now commonly used everywhere, even in the West (Sujatha, 2020). Plants like turmeric, ginger, and lemongrass are commonly used for their medicinal properties.

### **Globalization and Modernization**

Overharvesting, habitat damage, and cultural erosion are some of the problems that traditional plant-based medicines are confronting because of rising globalization and industrialization. All things considered, traditional plant-based medicines continue to be extremely important to global healthcare systems since they provide supplementary or alternative therapies for a wide range of illnesses while also protecting biodiversity and cultural legacy.

A single plant or recipe in TM may include several phytochemical components, such as flavonoids, terpenoids, alkaloids, etc (Parasuraman et al., 2014). An ayurvedic remedy known as Samshamani vati (Guduchi ghana vati) is used to treat all sorts of fevers. It has anti-inflammatory and painkilling properties as well. Plants utilized in Dasapushpam, the ten plants are *Curculigo orchioideis*, *Evolvulus alsinoides*, *Eclipta alba*, *Aerva lanata*, *Ipomoea obscura*, *Vernonia cinerea*, *Emilia sonchifolia*, *Cynodon dactylon*, and *Curculigo haliacabum*. It has been used to treat throat problems, bronchitis, and asthma using *leptadenia reticulata*. There are about twenty parts to *Anuthaila* (Aurori et al., 2016; Mohanty et al., 2017). There are the eight medicinal herbs used in *Ashtavarga* (Singh et al., 2018). *Andrographis paniculata*: powdered leaves are used to treat diabetes, and the paste leaves are used to heal poison bites. *Gymnema sylvestre*: powdered leaves are used to cure diabetes, while powdered roots are used to heal poison bites. *Ricinus communis*: the oil extracted from the seeds is used to relieve stomach aches, and the juice taken



**Fig 1.** Traditional Arabic and Islamic Medicine and their uses

from the leaves is used to stimulate milk supply. Young twigs are used as toothbrushes, while *Azadirachta indica* leaf paste is used to cure skin conditions, rheumatism, and smallpox. *Ficus benghalensis*: young twigs are used as teeth brushes, and stem latex is used to cure cracks of heel. *Moringa oleifera*: blossoms are used to cool the eyes and promote sperm production, while boiling leaves are used to alleviate indigestion, lower body temperature, and treat eye conditions. *Zizyphus mauritiana*: the bark powder is used to cure wounds, and the leaf decoction is used to relieve body aches; *Solanum torvum*: unripe fruits are used to fortify the body, while leaf juice is utilized to lower body temperature (Pandey et al., 2013).

### ETHNOBOTANY IN MODERN HEALTHCARE: APPLICATIONS AND IMPACTS

For millennia, ethnobotany has been a significant factor in the discovery of novel medications. Ethnomedical research has led to the development of important medications like reserpine, podophyllotoxin, and vinblastine. These medications, derived from pharmaceutical plants, are used in 25% of prescriptions. Mechanism-based bioassays have led to the discovery of new anti-inflammatory compounds and pharmaceuticals like prostratin. Basil (Tulsi) is used in prescriptions and dark tea. Consumers now plant these plants in their gardens, recognizing their importance as a source of 'Nutraceuticals'. (Kurhekar, 2021).

Dates and their constituents displayed a role in infections anticipation because of their antioxidant and anti-bacterial potential. The protective impact of *P. dactylifera* against poisonous components present in the immediate environment has been affirmed through different examinations (Hammoudi et al., 2022). Garlic has been utilized in the treatment of pulse (Ried et al., 2008) elevated cholesterol, respiratory failure and coronary heart illnesses (Durak et al., 2004).

In the current study *Portulaca oleracea* is used for headache, different types of pain, digestive problems, stomachache, provide relief in snake bite, improves blood circulation, and prevent clotting in the arteries (Amiri & Joharchi, 2013). *Musa paradisiaca* is used to cure constipation and regulate menstruation. Literature says that fruit is also used to treat constipation, burns etc. The fruit that is most advised for women to eat throughout their menstrual cycle is ripe bananas. This is because it's thought to give energy and lessen pain during the cycle (Shubham et al., 2019).

According to Iqbal (1993) & Leaman (2002), the subsequent causes are generally responsible for the desire for medicinal plants and herbal treatments, particularly for their resurrection in affluent countries:

Based on regional and national biodiversity resources, communities and the federal government are interested in small- and large-scale industrial development.

Interest in increased self-sufficiency in health care from individuals, groups, and national authorities; growing achievements in demonstrating the security and effectiveness of herbal treatments.

Improved legal significance for the herbal medicine sector; companies' changed interest in separating valuable compounds from plants.

Ongoing research into novel medications and treatments for severe and drug-resistant illnesses; and marketing tactics employed by herbal medicine companies.

### **Conserving Indigenous Knowledge: The Role of Ethnobotany**

In terms of genetic resources, rangelands are essential places for the conservation of biodiversity (Kideghesho et al., 2013). Weaving Indigenous and Local Knowledge (ILK), customs, and tactics was necessary for sustainable rangeland management (Tengo et al., 2017). According to Saruni (2016), on indigenous traditional lands, where local people use their native and local knowledge to protect natural resources and manage the environment, 80 percent of the world's biodiversity is found.

## **ETHNOBOTANICAL RESEARCH METHODS: TECHNIQUES AND CASE STUDIES**

### **Research Methodology in Ethnobotany**

Ethnobotany, a multidisciplinary field, rapidly expands globally to examine traditional knowledge systems involving human cultures and plants, encompassing more than just therapeutic plant studies and natural product creation.

### **Quantitative Techniques in Ethnobotany**

Quantitative methods are commonly used in ethnobotany to evaluate the cultural significance and functions of plant taxa, a method of great scientific interest due to its potential for biodiversity conservation (Leonti & Weckerle, 2015).

### **Separation Techniques**

Qualitative chromatography: Adsorption, repartition, and ion exchange are the three main principles of chromatography. Different types of chromatographic techniques like TLC, HPLC, and GC are used to know about various phytochemicals.

### **Thin Layer Chromatography (TLC)**

TLC is a simple, fast, and inexpensive technique that allows the researcher to swiftly ascertain the number of components in a combination. TLC is also used to support the identity of a chemical in a mixture by comparing the relative optical density (Rf) of the compound to that of a known compound. A helpful method for identifying bioactive substances with antibacterial activity in plant extract is bio-

autography. TLC bioautographic techniques facilitate the localization and target-directed isolation of active components in mixtures by combining in situ activity assessment with chromatographic separation (Segan et al., 2021).

### **High Pressure Liquid Chromatography (HPLC)**

The HPLC separation of individual chemical entities from a sample mixture relies on their unique affinity for the adsorbent material in the column or the mobile phase. This results in different constituents traveling at different speeds and becoming separated. Previously known as high-pressure liquid chromatography, this technique utilizes high-pressure pumps to facilitate faster separation (Sahu et al., 2018).

### **Participatory ethnobotany and conservation**

Ethnobotanical research utilizes workshops, focus groups, and field excursions to study human-plant relationships, cultural beliefs, and environmental preservation in accordance with local and indigenous communities' knowledge, customs, values, and priorities.

### **Case study (Southern Italy).**

In the Mediterranean region, natural edible plants are a staple of diets because they are high in microelements, vitamins, phenols, flavonoids, antioxidants, and fiber, all of which are helpful to health. This document lists the wild plants that are utilized in the cuisine of the coastal regions of Campania, emphasizing the therapeutic qualities of the most used species. Between April 2017 and September 2019, fieldwork was carried out, and 69 informants in all were questioned. The most frequently cited family was Asteraceae (26.5%), which was followed by Lamiaceae (7.2%) and Brassicaceae. 11 wild species, or 13.5% of the total, have culinary uses that have not yet been documented in Campania's ethnobotanical literature.

The Mediterranean diet is centered on a minimal intake of meat and dairy products and consists primarily of vegetables, fruit, spices, and pasta. Olive oil serves as the diet's primary source of fat (Renna et al., 2021). The Mediterranean diet is good for your health. Through improvements in blood pressure, endothelial function, and lipid profile, the diet guards against the onset of chronic diseases, which are the leading causes of death in the Western world (Asgary et al., 2018; Ranfa et al., 2014). UNESCO has designated the Mediterranean diet as part of the Intangible Cultural Heritage of Humanity (UNESCO, 2013). Nonetheless, in addition to domesticated species, the Mediterranean Diet comprises wild plants. In rural populations, the former has been the primary food ingredient for millennia. Native species that flourish in their natural habitat without being farmed are known as wild food plants (Shelef et al., 2017). Wild plants are often identified as functional foods (foods with biological effects that go beyond their mere nutritional properties) and consumed because they have a clear positive influence on health (Takahashi et al., 2020; Leonti et al., 2009), providing microelements, fiber, antioxidants, phenols, and flavonoids to the body.

### The Ethical Considerations in Medicinal Ethnobotany

Ethical considerations in medicinal ethnobotany are paramount, as they involve the intersection of traditional knowledge, biodiversity conservation, and the rights of indigenous communities. Here are some key ethical considerations:

The worth of traditional information for protecting biodiversity and getting sustainable progress is acknowledged by Western science. Consequently, as he noted, expanding indigenous knowledge is working not only to discover novel medications but also to generate fresh ideas that may help to reconcile empirical accounts. This is the basis for reading about the pursuit and use of indigenous knowledge systems in Africa, South Africa, and Molatedi in the context of an effort to increase knowledge, broaden understanding, and raise awareness of the ecological and therapeutic significance of plants in this region. Evidence-based medicine, or EBM, is incorporated into both traditional and modern medicine. EBM is a crucial component of every nation's official health care system. This method has the potential to be implemented since it has been shown to be useful in numerous nations, including China, Japan, Korea, and India (World Health Organization, 2001).

Many medicinal plants are harvested from wild populations, leading to concerns about overharvesting and habitat destruction. Ethical medicinal ethnobotany promotes sustainable harvesting practices and encourages the conservation of biodiversity to ensure the long-term availability of medicinal plants (WHO, 2013). This is in line with Borges et al., (2020), who contends that to preserve species, their habitats, and ecosystems from uncontrollably high rates of extinction and the degradation of biotic interactions, indigenous conservation efforts also need to manage the natural world and biodiversity of the planet (a concept known as conservation biology).

People see humans as a belief system and as a component of the natural environment. Thus, it is important to emphasize care for the rest of nature to develop sustainable relationships with the source of natural resources. The preservation of natural resources depends critically on human culture and understanding (Jhariya et al., 2022). Community-based techniques are popular for safeguarding traditional knowledge and biocultural heritage, recognizing community ownership and biodiversity conservation. Community-based initiatives also strengthen regional and indigenous people's ability to manage intellectual property rights, promoting mutual respect and understanding between researchers and traditional knowledge holders (Anderson, 2015).

Ethical guidelines for ethnobotanical research and commercialization are crucial to respect indigenous communities' cultural beliefs, practices, and sacredness, safeguard traditional knowledge, and promote responsible engagement and responsible biodiversity use (Hubbell & Ryan, 2021). The guidelines aim to uphold knowledge-

holders' rights and promote equitable benefit-sharing. They require transparent communication, informed consent, and cultural attribution of traditional knowledge. Ethical considerations in ethnobotanical research and commercialization promote trust, inclusivity, and sustainable approaches to biodiversity conservation and traditional knowledge preservation. They also encourage capacity-building and active participation in research design and decision-making processes (Jacob et al., 2024).

Future access to a continuous supply of therapeutic plant components is guaranteed by the conservation of medicinal plants in their natural habitat. But while we eat ethnobotanical plants and add to, or detract from, the sustainability of their environments, what do we give back to the plants that are used to make our medicines? "The idea of actions-in-return that are not founded in voluntary agreements or contracts" and "doing one's part to produce a common good when especially because others are doing theirs" are two definitions of reciprocity given by Leslie Francis (Francis, 2008).

### Cross-Culture Exchange of Medicinal Plant Knowledge

Ethnobotanical study documents the ways in which native people use plants and maintain the environment. It is vital to the preservation of biological integrity worldwide and may yield crucial data for bioprospecting, which aims to develop novel crops and pharmaceuticals (Hoban et al., 2020; Ulian et al., 2020; Atanasov et al., 2021). The protection and sustainable use of these plant species have become an international concern, as both the species itself and the traditional knowledge linked with it are in danger of disappearing. Simultaneously, substantial ethnobotanical knowledge has been documented in recent decades through regional investigations (Borrell et al., 2020; Pei et al., 2020). Nonetheless, systematic data collection is required, as otherwise, such regional records would be dispersed and of little use.

Using the "assembly" strategy, scientists in the field of genomics fuse fragmented sequences (reads) from sequencing technologies into bigger sequences, or even down to the level of a chromosome or genome. This allows scientists to study an organism's genetic makeup in more detail (Nagarajan & Pop, 2013). Taking a cue from genetics, we suggest bringing together the disparate local ethnobotanical knowledge worldwide. Given that plants' chemical makeup and uses are frequently phylogenetically conserved (Gaoue et al., 2017; Garnatje et al., 2017), Assembling ethnobotanical information should ideally start with a fundamental unit of strictly related taxa, such as a genus. As a result, we offer a framework that includes the following steps: 1) a documentation-based taxonomical revision; 2) an assessment of traditional uses; 3) an assessment of the use values of species; and 4) a comparison of ethnobotanical knowledge across cultures. This framework allows for a systematic understanding of any taxon's ethnobotanical knowledge across cultures. An assemblage of this kind provides a useful way to comprehend (ethno-) botanical diversity.

## FUTURE DIRECTIONS IN ETHNO BOTANICAL STUDIES

Ethno botany is, in a nutshell, the study of the relationships between people and plants. All humans rely on plants for survival, but our relationships with plants today are often disconnected and fragmented, especially in urbanized, industrialized societies [Fig. 2 (Lepofsky & Turner, 2013)]. The term "ethno botany" ought to be broadened by ethnobotanists to encompass all relationships between plants and people, not only those in traditional communities (Pandey & Tripathi, 2017). Herbal remedies and associated goods are frequently released onto the market without first undergoing a required toxicological or safety assessment. Cultures continue to evolve, driven by advancements in technology, interdisciplinary collaboration, and shifting societal needs. Technological developments are closely linked to almost all revolutionary discoveries in the biological sciences (Henkhaus et al., 2020).

Here are some possible future directions in ethno-botanical studies, which explore the relationship between people and plants within different studies:

**Biocultural Conservation:** The management of wildlands through the application of indigenous conservation models. The utilization of resources will only be able to contribute to the conservation of biological variety while respecting indigenous rights and practices if ecologically sound management plans based on scientific studies are produced for resource extraction (Walsh et al., 2013).

**Pharmacological Discoveries:** Natural compounds and their semi-synthetic derivatives provide the basis for around half of all known medications. The assortment of plants for drug detection can be done in a variety of ways, but the ethnobotanical method to pharmaceutical lead drug discovery may greatly increase the likelihood of finding a possible therapeutic molecule from medicinal plants (Iwu, 2002).

**Nutrition and Food Security:** To feed future generations, growing populations must consider an increase in the production of crops that are adaptable to climate change and high in nutrients. Traditional food plants (TFPs) are rich in metabolites, vitamins, minerals, and other nutrients that are good for your health. Many communities around the world, particularly those in rural areas, depend on the locally accessible. Future improvements are needed in a number of areas, including enhanced TFP production, appropriate post-

harvesting, transportation, and processing, effective trade and trade, and heightened user demand (Leisner, 2020).

**Ethnobotanical Education and Outreach:** In order to benefit from traditional ethnobotanical knowledge and address issues related to poverty, hunger, healthcare, climate change, and biodiversity conservation, an international collaboration group comprising individuals from different countries and fields can be established (Kumar et al., 2021). The study of ethnobotany in the modern scientific method requires accurate information, statistical backing for data, and quantitative or semi-quantitative analysis of field observations (Pandey & Tripathi, 2017). More ethnobotanists and ethnopharmacologists are desperately needed to record as much information as possible before the plants disappear due to forest degradation and indigenous peoples' acculturation (Pandey & Tripathi, 2017).

## Future Directions: We must focus on issues related to:

- The safety and effectiveness of herbal medicines,
- Taxonomy concerns and DNA barcoding utilizing contemporary technology, Indigenous knowledge validated by science.
- Long-term use of therapeutic herbs, decrease in losses incurred after harvest, adding value to raw materials bringing together various parties involved (university industry), Policy matters with large-scale farming and preservation (Shinwari & Qaiser, 2011).

## REFERENCES

- Ahmed J, 2017. Floristic diversity and ethnobotanical appraisal of Tehsil Oghi, District Mansehra, Pakistan. Doctoral dissertation, GPGC, Mansehra, Pakistan.
- Amiri MS & MR Joharchi, 2013. Ethnobotanical investigation of traditional medicinal plants commercialized in the markets of Mashhad, Iran. *Avicenna Journal of Phytomedicine* 3:254.
- Asgary S, A Rastqar & M Keshvari, 2018. Functional food and cardiovascular disease prevention and treatment: a review. *Journal of the American College of Nutrition* 37:429-55. <https://doi.org/10.1080/07315724.2017.1410867>
- Aurori AC, O Bobiş, DS Dezmirean, 2016. Bay laurel (*Laurus nobilis*) as potential antiviral treatment in naturally BQCV infected honeybees. *Virus research* 222:29-33. <https://doi.org/10.1016/j.virusres.2016.05.024>
- Barnes PM, 2008. Complementary and alternative medicine use among adults and children: United States, 2007. *National Health Statistics Reports* 4:1-23. <https://doi.org/10.1037/e623942009-001>
- Borges PA, R Gabriel & S Fattorini, 2020. Biodiversity erosion: causes and consequences. In *Life on land* (Filho LW, AM Azul, L Brandli, LA Salvia & T Wall, eds). Springer, Cham, USA, pp: 81-90. [https://doi.org/10.1007/978-3-319-95981-8\\_78](https://doi.org/10.1007/978-3-319-95981-8_78)
- Borrell JS, S Dodsworth & F Forest, 2020. The climatic challenge: Which plants will people use in the next century? *Environmental and Experimental Botany* 170:872-85. <https://doi.org/10.1016/j.envexpbot.2019.103872>
- Cox PA, 2020. *Plants, People, and Culture: The science of ethnobotany*. Garland Science, New York, USA, pp: 01-228.
- Durak I, M Kavutcu, M Aytac et al., 2004. Effects of garlic extract consumption on blood lipid and oxidant/antioxidant parameters in humans with high blood cholesterol. *The Journal of Nutritional Biochemistry* 15:373-7. <https://doi.org/10.1016/j.jnutbio.2004.01.005>
- Farooq SA, SM Gulzar, Haq et al., (2022). Millennial traditions-Exploration of ethno-medicinal knowledge among different ethnic groups of Northern part Kashmir Himalaya, India. *Ethnobotany Research and Applications* 23:1-18. <https://doi.org/10.32859/era.23.20.1-18>
- Francis LP, 2008. Reciprocity and Environmental Obligations. *Hofstra Law Review* 37:1007.

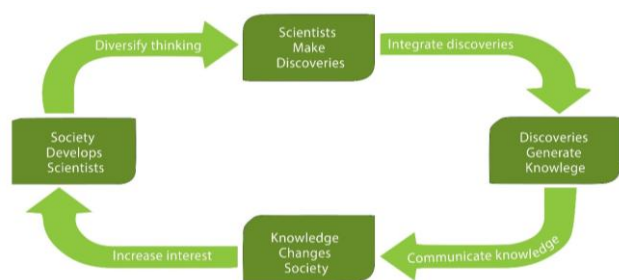


Fig 2. Virtuous cycle of Science and Society

- Gaoue OG, MA Coe, M Bond et al., 2017. Theories and major hypotheses in ethnobotany. *Economic Botany* 71:269-87. <https://doi.org/10.1007/s12231-017-9389-8>
- Garnatje T, J Penuelas & J Valles, 2017. Ethnobotany, phylogeny, and 'omics' for human health and food security. *Trends in Plant Science* 3:187-91. <https://doi.org/10.1016/j.tplants.2017.01.001>
- Gurib-Fakim A, 2006 Medicinal plants: traditions of yesterday and drugs of tomorrow. *Molecular Aspects of Medicine* 27:1-93. <https://doi.org/10.1016/j.mam.2005.07.008>
- Hammoudi HD, M Krayem, S Khaled et al., 2022. A focused insight into thyme: Biological, chemical, and therapeutic properties of an indigenous Mediterranean herb. *Nutrients* 14:2104. <https://doi.org/10.3390/nu14102104>
- Hoban S, M Bruford & JDU Jackson, 2020. Genetic diversity targets and indicators in the CBD post-2020 Global Biodiversity Framework must be improved. *Biological Conservation* 248:108654-67. <https://doi.org/10.1016/j.biocon.2020.108654>
- Hubbell JA & JCRyan, 2021. Introduction to the environmental humanities. In: *Introduction to Environmental Humanities* (Hubbell JA & JC Yyan, eds): Taylor and Francis, Routledge, USA pp: 1-18. <https://doi.org/10.4324/9781351200356>
- Iqbal M, 1993. International trade in non-wood forest products: An overview, FAO, -Rome, Italy.
- Jacob DE, SC Izah, IU Nelson et al., 2024. Indigenous Knowledge and Phytochemistry: Deciphering the Healing Power of Herbal Medicine. In: *Herbal Medicine Phytochemistry* (Izah SC, MC Ogwu & M Akram, eds): Springer, Cham, USA, pp:1953-2005. [https://doi.org/10.1007/978-3-031-43199-9\\_66](https://doi.org/10.1007/978-3-031-43199-9_66)
- Jhariya MK, A Banerjee & RS Meena, 2022. Importance of natural resources conservation: Moving toward the sustainable world. In: *Natural resources conservation and advances for sustainability* (Jhariya MK, RS Meena, A Banerjee & SN Meena, eds): Elsevier, Cambridge, USA, pp: 3-27. <https://doi.org/10.1016/B978-0-12-822976-7.00027-2>
- Jia M, Y Zhang, Z Yan et al., 2015. Species and use of current Chinese minority medicine. *World Science and Technology-Modernization of Traditional Chinese Medicine* 12:1546-50.
- Kemppainen LM, TT Kemppainen & JA Reippainen, 2018. Use of complementary and alternative medicine in Europe: Health-related and sociodemographic determinants. *Scandinavian Journal of Public Health* 46:448-55. <https://doi.org/10.1177/1403494817733869>
- Kideghesho J, A Rija, K Mwamende et al., 2013. Emerging issues and challenges in conservation of biodiversity in the rangelands of Tanzania. *Nature Conservation* 6:1-29. <https://doi.org/10.3897/natureconservation.6.5407>
- Kumar A, S Kumar, Komal et al., 2021. Role of traditional ethnobotanical knowledge and indigenous communities in achieving sustainable development goals. *Sustainability* 6:3062-76. <https://doi.org/10.3390/su13063062>
- Kurhekar JV, 2021. Ancient and modern practices in phytomedicine. In: *Preparation of Phytopharmaceuticals for the Management of Disorders* (Miccon CE, AP Mishra & MR Goyal, eds): Academic Press, London, United Kingdom, pp: 55-75. <https://doi.org/10.1016/B978-0-12-820284-5.00019-8>
- Leaman D, 2002. Medicinal plants. Briefing notes on the impacts of domestication/cultivation on conservation. Paper for the "Commercial captive propagation and wild species conservation" workshop. Jacksonville, 7-9.
- Leisner CP, 2020. Climate change impacts on food security-focus on perennial cropping systems and nutritional value. *Plant Science* 293:110412. <https://doi.org/10.1016/j.plantsci.2020.110412>
- Leonti M, 2011. The future is written impact of scripts on the cognition, selection, knowledge and transmission of medicinal plant use and its implications for ethnobotany and ethnopharmacology. *Journal of Ethnopharmacology* 134:542-55. <https://doi.org/10.1016/j.jep.2011.01.017>
- Leonti M & CS Weckerle, 2015. Quantitative and comparative methods in ethnopharmacology. In: *Ethnopharmacology* (Heinrich M & AK Jäger, eds): John Wiley & Sons, West Sussex, United Kingdom, pp: 29-40. <https://doi.org/10.1002/9781118930717.ch4>
- Lepofsky D & NJ Turner, 2013. Introduction to Ethnobotany in British Columbia: plants and people in a changing world. *BC Studies* 179:9-19.
- Mazid M, TA Khan & F Mohammad, 2012. Medicinal plants of rural India: a review of use by Indian folks. *Indo Global journal of pharmaceutical sciences* 2:286-304. <https://doi.org/10.35652/IGJPS.2012.35>
- Mohanty SK, MK Swamy, UR Sinniah et al., 2017. *Leptadenia reticulata* (Retz.) Wight & Arn. (Jivanti): botanical, agronomical, phytochemical, pharmacological, and biotechnological aspects. *Molecules* 22:1019. <https://doi.org/10.3390/molecules22061019>
- Nagarajan N & M Pop, 2013. Sequence assembly demystified. *Nature Reviews Genetics* 3:157-67. <https://doi.org/10.1038/nrg3367>
- Pandey AK & YC Tripathi, 2017. Ethnobotany and its relevance in contemporary research. *Journal of Medicinal Plants Studies* 3:123-9.
- Pandey MM, S Rastogi & AK Rawat, 2008. Indian herbal drug for general healthcare: An overview. *The Internet Journal of Alternative Medicine* 6:3-15. <https://doi.org/10.5580/1c51>
- Pandey MM, S Rastogi & AKS Rawat, 2013. Indian traditional ayurvedic system of medicine and nutritional supplementation. *Evidence-Based Complementary and Alternative Medicine* 1:376327. <https://doi.org/10.1155/2013/376327>
- Parasuraman S, GS Thing & SA Dhanaraj, 2014. Polyherbal formulation: Concept of ayurveda. *Pharmacognosy Reviews* 8:73. <https://doi.org/10.4103/0973-7847.134229>
- Pei S, H Alan & Y Wang, 2020. Vital roles for ethnobotany in conservation and sustainable development. *Plant Diversity* 6:399-410. <https://doi.org/10.1016/j.pld.2020.12.001>
- Rahman IU, A Afzal, Z Iqbal et al., 2019. Historical perspectives of ethnobotany. *Clinics in Dermatology* 37:382-8. <https://doi.org/10.1016/j.clindermatol.2018.03.018>
- Renna M, FF Montesano & F Serio et al., 2021. The Mediterranean diet between traditional foods and human health through culinary examples. In: *Gastronomy and food science* (Galanakis CM, eds): Academic Press, London, United Kingdom, pp: 75-99. <https://doi.org/10.1016/B978-0-12-820057-5.00005-4>
- Ried K, OR Frank, & NP Stocks et al., 2008. Effect of garlic on blood pressure: A systematic review and meta-analysis. *BMC Cardiovascular Disorders* 8:1-12. <https://doi.org/10.1186/1471-2261-8-13>
- Saruni K, 2016. Indigenous knowledge systems and rangeland governance in Northern Tanzania. *Tanzanian Journal of Population Studies and Development* 1:1-21.
- Sengupta G, A Gaurav & S Tiwari, 2018. Substituting medicinal plants through drug synthesis. In: *Synthesis of Medicinal Agents from Plants* (Tewari A & S Tewari, eds): Elsevier, Oxford, United Kingdom, pp: 47-74. <https://doi.org/10.1016/B978-0-08-102071-5.00003-9>
- Sharma M & K Ashwani, 2013. Ethnobotanical uses of medicinal plants: A review. *Life* 50:52.
- Shelef O, PJ Weisberg & FD Provenza, 2017. The value of native plants and local production in an era of global agriculture. *Frontiers in Plant Science* 8:2069. <https://doi.org/10.3389/fpls.2017.02069>
- Shinwari ZK & M Qaiser, 2011. Efforts on conservation and sustainable use of medicinal plants of Pakistan. *Pakistan Journal of Botany*, 1:5-10.
- Shubham S, S Rupali, S Nayany et al., 2019. Imminent composition of *Musa paradisiaca* blossom of Indian origin: A review. *Journal of Pharmacognosy and Phytochemistry* 8:470-2.
- Singh N, AK Singh, VRS Nilofer-Absar et al., 2018. Importance of endangered/rare, Astavarga medicinal plants in traditional system of medicine in Ayurveda. *International Journal of Agricultural Sciences* 14:258-65. <https://doi.org/10.15740/HAS/IJAS/14.1/258-265>
- Sujatha V, 2020. Globalisation of South Asian medicines: knowledge, power, structure and sustainability. *Society and Culture in South Asia* 6:7-30. <https://doi.org/10.1177/2393861719883063>
- Takahashi JA, FAGG Rezende, MAF Moura et al., (2020). Edible flowers: Bioactive profile and its potential to be used in food development. *Food Research International* 129:108868. <https://doi.org/10.1016/j.foodres.2019.108868>
- Tengo M, R Hill, P Malmer et al., 2017. Weaving knowledge systems in IPBES, CBD and beyond-lessons learned for sustainability. *Current Opinion in Environmental Sustainability* 26:17-25. <https://doi.org/10.1016/j.cosust.2016.12.005>
- Ulian T, M Diazgranados, S Pironon et al., 2020. Unlocking plant resources to support food security and promote sustainable agriculture. *Plants, People, Planet* 5:421-45. <https://doi.org/10.1002/ppp3.10145>
- Walsh FJ, PV Dobson & JC Douglas, 2013. Anperirrentye: a framework for enhanced application of indigenous ecological knowledge in natural resource management. *Ecology and Society* 18:180318. <https://doi.org/10.5751/ES-05501-180318>
- WHO, 2002. Traditional medicine strategy 2002-2005. - Retrieved from WHO website.
- World Health Organization, 2013. WHO traditional medicine strategy: 2014-2023. World Health Organization.
- Yadav US, R Tripathi, GP Yadav et al., 2022. Proposal of a global handicraft index for sustainable development: A visionary approach for small industry and developing strategies for handicraft (rural industry). *European Journal of Sustainable Development Research* 6:0185. <https://doi.org/10.21601/ejosdr/11909>